Museum Learning,
The Museum Visitor,
The Museum Visit

An Investigation into their Understanding and its Implications for the Effective Exhibition Development in Indian Science Museums

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TO

Professor Arthur Lucas

for his excruciating and guileless critiques

&

Dr. Eilean Hooper-Greenhill

for her compassionate and unstinted supports

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INTRODUCTION

At the turn of the century, and more particularly the millennium, our society faces tremendous changes that affect the nature and function of everything from people to institutions and nations. One of the many forces that cause these changes is the information age. The marriage of communication technology with computer technology in this age brings in a sea of changes in the way people perceive and live in the world. For example, the information network provides opportunities to communicate instantly and to work at home. These and other changes affect the way people deal with their family and leisure pursuits and a range of other aspects of life.

Generally, the past years can be divided into three ages: the classical age, the industrial age, and finally the information age. It is also generally agreed that these three ages correspond to three revolutions, namely the agricultural revolution, the industrial revolution and the information revolution respectively. The current changes in our society, particularly due to the information explosion and technological innovation, are explained by the theory of postmodernism. Although the term postmodernism has many inflationary and contradictory meanings (Kuspit 1990), it is still possible to simplify the core concept of it for our discussion without loosing sight of the complexity of the topic. Basically, postmodernism brings the modernist hegemony to a closure; it examines the ends, goals, hopes of modern activity, situating it in its context of pre modernist frameworks. So, postmodernism recognises the importance of many things or persons on their own merits but not from the viewpoints of the majority, Europeans, or whites.

I will illustrate this aspect with an example. Communication was traditionally achieved by post. In postal communication, the letter is addressed, enveloped and transported by various means of traffic — by land, sea, or air. The advent of the telephone gave rise to more effective, more efficient and faster communication through wire or wireless. In spite of its many advantages, the telephonic line cannot carry more than one message at a time, but the postal traffic route can take as many letters as possible at any time. The recent information network (i.e. Internet) makes use of the postal metaphor by creating a packet for each message with an address but using the telephonic line to transport the message for its speed and efficiency. The information network is therefore a postmodern concept for it combines aspects from both the traditional (the postal metaphor) and modern (telephonic line) world.

This aspect of post-modern thinking also effects our value system. In modern times, we tend to value things in a vertical dimension: for example, good or bad; ability or disability; and powerful or weak. The theory of postmodernism introduces a rupture in the vertical structure and makes it into a horizontal dimension. In other words, post-modernists deconstruct the modern framework, which tends to value one more than the other, into the postmodern framework that tends to value all equally on a different level. This rupture in the value system sets the individuals free and sovereign.

Davidson and Rees-Mogg (1997) argue that the information revolution has both good and bad sides. On the good side, it liberates individuals as never before. The genius of individuals will be unleashed, freed from both the oppression of government and the drags of racial and ethnic prejudice. On the bad side, the new organisation of society based on information economy will leave individuals far more responsible than they have been accustomed to during the industrial period. Clearly, market forces, not the political majorities, will influence the society more than ever before. The liberation of responsible individuals coupled with market forces has already changed the nature of education, the museum situation and the Indian situation.

In education, intelligence tests and other standardised tests were originally devised to measure the logical and mathematical ability along a vertical axis. During the 1960s and after, there emerged a widespread dissatisfaction with this approach of placing people in the vertical dimension in a limited sense, as many well developed intelligences in areas such as music, craft or dance were going unnoticed and unrecognised. The intelligence scale therefore became a discredited concept. Demolishing the hegemony of this limited view of the 'modern' concept of intelligence, Gardner (1983) proposed a theory of multiple intelligences and identified seven distinct and equally important intelligences.

At the same time, but independently, a field of learning style theory emerged which recognises that people have different styles in approaching a learning situation and that one style is not necessarily better than or superior to others, as the styles are merely different and are equally appropriate ways of dealing with a learning situation. This recognition of multiple ways and values to a learning situation reflects the concept of postmodernism. By addressing learning styles as horizontal dimensions rather than vertical abilities as IQ tests do, the theory of learning styles is a fitting concept to understand the museum visitor, especially during this information age.

In museums, a number of authors introduced dichotomies (in the words of Watkins, 1994). The concept of dichotomies places things or persons in a vertical order with one being superior to another or vice versa. Some of the dichotomies are play or learning, object-oriented or people-oriented, science museum or science centre, conservation or education, collection or education, and them or us. These dichotomies indicate that one excludes another and assume that they cannot go together. This situation is excellently captured as an Either/Or situation in museum learning by Mintz (1994) or as an Us/Other situation in museum interpretation by Pearce (1994). Along with Mintz and Pearce, Gurian (1992) also argues that this situation is an artificial one and suggests that the 'or' in the dichotomies should be replaced by the 'and'.

Recognising these false dichotomies, museums have already started to combine both parts of the dichotomies, for example, education and entertainment. These museums are called by Hooper-Greenhill (1994) postmodern museums, or science centrums as Orchistron and Bhathal (1984) would prefer to call them, that take advantage of the good aspects from both the traditional and the modern age.

What do these changes in thinking and values, due to information revolution, mean to India? India has been of late exposed to a plethora of media such as cable TVs and Internets. Even multinationals have set up their branches in India for the cheap English speaking labour. Many international food chains such as Macdonalds and KFCs have already encroached many parts of India. All these mean that the experience of the Indian population is not very much different from that of the western population. There is also strong evidence that it is possible not just to learn but also internalise a culture or a concept through media. People can learn vicariously not only in museum exhibits as proved by Tulley and Lucas (1991), but also in all walks of life. For example, Jenn Crowell, the author of the novel 'Necessary Madness', not only learnt about England by watching TV serials but also wrote the whole novel describing the life in England without ever been there (Roberts, 1997). The influence of media, the advantage of information technology and the possibility of vicarious learning have already been exploited by many multinationals. For example, Bangalore in India has become a major centre for writing computer software. Many western companies have branches there and value the highly skilled programmers. In another case, doctors in Washington can dictate memos by phone to Bangalore, and receive typed versions on a computer seconds later. So, the world can be reached at the cost of a local call, thanks to telephonic technology (Bowen, 1997).

As Indians have already been exposed to international media and work climate, they will obviously expect a high standard out of a museum experience. It is therefore essential on the part of Indian museums to provide the best exhibitions and programmes. In order to develop effective exhibitions, the nature of museum learning, the museum visitor and the museum visit itself should be thoroughly understood. This research therefore aims to capture the changing and broad-based nature of these three concepts using theories of learning, published research in museum studies and three empirical studies with Indian museum visitors and directors. Also, by case-studying the exhibition developmental processes in Indian science museums, and comparing them with some of the best practices in American and British museums, the improvable areas for the development of effective exhibitions, programmes and provisions will be identified and described.

The first chapter attempts to set the world scene and fit this research within a framework of museum education, science museums and the Indian science museum situation. A way forward for Indian science museums is sought by identifying the challenges currently faced by them. The thesis, it is hoped, will contribute toward meeting some of those challenges.

After defining and classifying the exhibition and describing the changing nature of museums, particularly science museum exhibitions, Chapter II looks at the exhibition development process from the historical perspective. Four approaches are identified in the developmental processes of museum exhibition. They are the 'open storage' approach, the Bauhaus's contribution of design elements to exhibitions, Neurath's contribution of the ISOTYPE method of presenting information, and finally the contemporary approach. Having traced the traditional and project-team approaches to exhibition development in museums across the world in terms of their advantages and disadvantages, I will compare and contrast them with the exhibition development approaches in Indian science museums. After having identified the missing inputs of visitors and educators to the exhibition development in Indian science museums, the thesis sets out to shed light on the nature of museum learning, the museum visitor and the museum visit.

In Chapter III, learning theories from behaviouristic, cognitive, and humanistic traditions are presented and discussed in relation to museum learning. Some comprehensive models of learning that integrate principles from these three schools are also discussed in terms of their usefulness to describe museum learning. Finally, a 'spiral' approach to museum learning is synthesised to explicate what is going on inside the museum.

Chapter IV weaves together Jung's psychological types, Gardner's multiple intelligences, and one-, two- and multi-dimensional learning styles into a framework to explain the fabric of the museum visitor.

A survey and an observation of museum visitors to an Indian science centre were conducted to explore the nature of the museum visitor and the museum visit. An interview was conducted with Indian museum directors to shed light on four learning-related issues. The four issues are learning in museums, evaluation and visitor studies, criteria in exhibition development, and finally interest in science and the nature of the scientific temper. The analyses and results of the survey, the observation and the interview are presented in Chapter V, VI and VII respectively.

This thesis culminates in Chapter VIII, which pulls together the findings from this research. After summarising the broad-based approach to museum learning, the museum visitor, and the museum visit, I will suggest how effective exhibitions and programmes can be developed incorporating various best practices followed in museums around the world, including some in India. This thesis ends with a conclusion that each and every museum must strive to follow universal design and access to provide something for every museum visitor.

CHAPTER I

SCIENCE MUSEUMS AND MUSEUM EDUCATION WITH SPECIAL REFERENCE TO INDIA

INTRODUCTION

This chapter systematically presents three areas of background from which this thesis emerges. First, a scheme for the evolution of science museums is deduced by pulling together research and published evidence. As will be shown in more detail, the evolution revolved around the educational roles of the museum. Second, the educational function of museums is traced historically and discussed in terms of its potential and offerings to informal learning. Third, the science museum situation of India is captured by tracing how modern museums, including science museums, were set up in India. Finally, by critically analysing how Indian science museums responded to global developments in two areas, namely *the science museum* and *museum education*, the challenges faced by them are identified and presented. In what follows, I will present how science museums evolved.

EVOLUTION OF SCIENCE MUSEUMS

Science museums, during the 200 years or so since the inception of the first science museum, the Musée de National des Techniques at the Consevatoire National des Arts et Métiers in Paris in 1802, have evolved through a number of stages (Baird 1986; Hudson 1987; and Danilov 1976). The number of stages ranges from three to five (Table 1.1). Consolidating these without loosing any information and watershed events, a four-stage theory of evolution of science museums is proposed. According to this theory, all science museums began in any one of the four stages; some museums remain at that stage for ever, whereas other museums evolve during time and travel through the stages. For example, the London Science Museum began as a second-stage museum and travelled to the fourth stage, for it now has both object-oriented and idea-based exhibitions. The discussions on the four-stage theory are restricted only to the 'museums of influence' though it is possible to apply these stages to any science museum.

First stage

There are two important characteristics that differentiate first-stage museums from other museums: first, the exhibitions are object-based; and second, the roles of museums are primarily to care and collect objects. This stage is based on and coincides with Danilov's first, Hudson's first, and both Baird's first and second stages.

Undoubtedly, the first stage therefore marks the establishment of the first science museum in Paris, an object-oriented museum that has changed very little since then and remained at this stage in its own right. In addition, the London Science Museum, although it began as an object-based science museum in this stage, has changed and adapted itself in response to time, the changing needs of society, and the changing philosophy of the museum. For example, the Science Museum in London has many characteristics of the second, third and even fourth stages by having exhibitions such as Launch Pad, a hands-on exhibition, and Flight Gallery, an exhibition having both objects and interactives. In sum, museums at this stage are primarily object-based and entirely collection-oriented.

HUDSON (1987)	DANILOV (1976)	BAIRD (1986)
1. Musée de National des Techniques at the Consevatoire National des Arts et Métiers in Paris, 1802; London Science Museum, 1852	1. Musée de National des Techniques at the Consevatoire National des Arts et Métiers in Paris, 1802; London Science Museum, 1852	1. Musée de National des Techniques at the Consevatoire National des Arts et Métiers in Paris, 1802
		2. London Science Museum, 1852
2. Deutsches Museum in Munich, 1903; The Technical Museum in Vienna still remains at this stage.	2. Deutsches Museum in Munich, 1903; Palais de la Decouverte in Paris, 1937	3. Deutsches Museum, 1903
3. Palais de la Decouverte in Paris, 1937; but not the MSI in Chicago for it began as the second stage.	3. The Museum of Science and Industry in Chicago, 1933	4. Palais de la Decouverte in Paris, 1937 or Evoluon in Eindhoven, 1966.
4. The Municipal Museum at Russelheim, near Frankfurt in Germany.		5. National Museum of Science and Technology in Ottawa, 1967.

Table 1.1: Comparison of stages of science museums' development from different perspectives.

Second stage

Museums at this stage introduced idea- or phenomena-based exhibits along with object-based exhibits: for example, working-type exhibits are placed side by side with artefacts. Visitors had opportunities not just to see and appreciate original objects, but also to understand the working of the objects. The roles of the museum at this stage are mainly collections, and to some extent, education. The second stage is based on and coincides with Danilov's second, Hudson's second, but Baird's third stages. Therefore, the establishment of the German Museum for the Masterworks of Natural Science and Engineering (Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik), commonly known as the Deutsches Museum, in Munich in 1903, marked the second stage. This museum owes its existence to Oscar Von Miller. It is the first museum to introduce the industrial machinery that are actually kept in working condition so that visitors not just wonder but also understand. It has been an inspirational source for many science museums throughout the world, especially in North America and India. For example, Julian Rosenwald established the Museum of Science and Industry in Chicago, after his son's fascination with exhibits in the Deutsches Museum (Danilov 1982). Also, the visit to the Deutsches Museum by Dr B.C. Roy, the then Chief Minister of West Bengal, and the expertise of Dr Karl Bessemer, the then Director of the Deutsches Museum, contributed to the creation of the first Indian science museum, Birla Industrial and Technological Museum in Calcutta. The Technical Museum in Vienna, among others, falls into this stage, but still remains at this stage (Hudson, 1987).

In sum, museums at this stage began to introduce, or started with, some components within exhibitions that help visitors' learning. So the dictum 'objects for its own sake' is slowly replaced by 'objects for understanding'. Thus, the educational role of the museum is recognised as an important function and is introduced at this stage but not to its fullest extent.

Third stage

Once the importance of the museum education was understood, some inchoate institutions went so far that they completely forgot the need to have the objects and avoided them altogether. The result is therefore the establishing of museums with mostly idea-based exhibits without objects, which characterises this stage; the role of collection is diminishing as the role of education is flourishing. Hudson's third, and Baird's fourth stages resemble this stage.

Palais de la Decouverte in Paris in 1937 marks the beginning of this stage. Hudson (1987) supported this view, and argued that the true representative of the third stage museum is Palais de la Decouverte but not the Museum of Science and Industry in Chicago as suggested by Danilov (1976). The Chicago Museum, according to Hudson, became a third stage museum well after the second world war.

The Palais de la Decouverte is the first museum that started almost without artefacts and was highly didactic in intent as it was designed originally for students. It was built with public funds from the International Exposition of 1837, in the Grand Palais of Paris. It was attached to the University of Paris and governed and supported by the French Ministry of Education. The exhibits in it used models to demonstrate concepts in the fields of physics, chemistry, biology, medicine, mathematics, and astronomy.

The Palais' emphasis on models that teach rather than collections that illustrate or exemplify drew the attention of Frank Oppenheimer. The explainer programme of the Exploratorium in San Francisco is the outcome of Oppenheimer's visit to the Palais de la Decouverte in Paris (Hein H, 1990). The Palais, besides the Deutsches museum, the London Science Museum and the Chicago Museum of Science and Industry, tremendously inspired Oppenheimer so that he incorporated many of its features in the Exploratorium, which later became a trend-setter for many science centres across the world. Although there existed a number of hands-on contemporary scientific exhibits before its inception, the Exploratorium has nonetheless pioneered didactic exhibits in limited areas such as perception and physics, and nowadays even biology and chemistry. For this reason, the Palais de la Decouverte is seen as the forerunner of the science centre and was indirectly responsible for the mushrooming of science centres across the world.

The Evoluon in Eindhoven, Holland, also falls into this stage, according to Baird. It was founded in 1966. The original idea for it came from J. F. Schouten, director of the Institute of Perception Research and scientific advisor to the Physical Research Laboratory in the N.V. Philips electronic company. The Evoluon is an industrial exhibition that deals with people and technology, communication devices and computers, and the company's history, people, organisation and products.

Like the Palais, the Evoluon also influenced one of the earliest science centres, the Ontario Science Centre, Canada. It adopted many ideas of the Evoluon and was founded in 1969 as a contemporary science and technology centre. Though it started in the third stage, the Ontario Science Centre has recently begun to make use of objects in their exhibitions after realising the difficulty of showing the latest changes without reference to the past (Baird, 1986). It, like the Exploratorium, also stands as a model for the development of similar centres across the world.

In sum, these two led to two types of science centres: the first type having phenomena-based and stand-alone exhibitions, modelled by the Exploratorium; and the second type housing object-based exhibitions with interactives to explain the phenomena, modelled by the Ontario Science Centre. The Exploratorium approach is however viewed sometimes with reservations: the displays are often disjointed and oriented toward limited sciences (Wymer, 1991; and Shortland 1987). The approach of the Ontario Science Centre is generally appreciated for the fact that it has advantages of both science centres and science museums. While British science centres still narrowly follow the Exploratorium approach, many museums across the world, let alone science museums, have adapted the mixed approach that leads to the next stage. So science museums at this stage tended to shift their emphasis entirely towards their educational role, at times even at the cost of their collection role.

Fourth stage

Many science museums at the third stage cannot last for ever as these were frowned upon as being 'the ugly ducklings' in the museum world. Obviously, many museum personnel had difficulty thinking of museums devoid of objects, which are the *sine quo non* of any museum. These deficiencies of the third stage science museums lead to the fourth stage: first, exhibitions are more likely than ever to strike a balance between object-oriented and idea-oriented exhibits, to tell a story or to give a context; second, the roles of collection and education are viewed as being different but equal and one is not necessarily better or worse than the other. Hudson's fourth and Baird's fifth stages signify this stage.

The National Museum of Science and Technology in Ottawa in 1967 and the Municipal Museum at Russelheim, near Frankfurt, were created at this stage. While the former attempted to combine the advantages of science museums and science centres in a single place the latter was organised, through the concept of process (industrialisation) rather than product (industry), to give social historical context to its exhibitions.

Recently, many science museums, including science centres, have mixed the science centre's interactives and the science museum's objects: for example, Snibston Discovery Park in England and many American and Indian science centres. Many museums, such as Gallery 33 at Birmingham Museum and Art Gallery, are also exploiting the capability of new technologies, particularly multimedia technology, to express ideas in many levels and issues from many perspectives, and to give social historical context to scientific exhibitions (Anon., 1990; and Yahya, 1994).

To conclude, during the four stages of evolution of science museums, the primal importance shifted to and fro between the object-oriented exhibitions that give people the opportunity to see and appreciate, i.e. *collection*, and the idea-based exhibitions that help people to learn, i.e. *education*. That is, it can be said that *collection* was the primary objective for the first stage museums, *collection with education* for the second, *entirely education* for the third, and *collection and education* for the fourth. Therefore, there is no wonder that much of the research studies on museum learning were conducted in science museums (McManus, 1987 and 1989; Serrell, 1990b; Raymond 1993; and Heltne and Marquardt, 1988). Having shown how science museums and science centres adapted to the changing needs of society by borrowing techniques from each other, I will present the educational role of science museums in general.

EDUCATION IN MUSEUMS

Until the beginning of the 20th century, the attitude of the museum remained that the object speaks in an arcane language only to the few privileged enough to understand it. The public policy of the British Museum in the words of Burcaw (1983) is as follows: 'The British Museum was said to be open to the public, but received 30 visitors daily. These visitors had to apply for admission well in advance and present their credentials at the office. If acceptable, they had to wait two weeks for an admission ticket.' This was the situation in the so called public museums then. Nathaniel Burt is of the opinion that European museums were originally collection and semi-exclusive curiosities, but American museums, on the other hand, began with a deliberate appeal to the public; they emphasised education and interpretation while European museums gave importance to historical truth and original objects.

Many famous American museum curators and directors advocated the educational role of museums: for example, George Browne Goode, the Director of the National Museum at Washington DC, recommended that the exhibition should be a collection of instructive labels rather than objects, each illustrated by a well-selected specimen (Goode, 1889); Benjamin Ives Gilman invented the principle of gallery instruction at the Museum of Fine Arts, Boston, in the first part of this century; Henry Watson Kent, who worked at the Metropolitan Museum of Art in New York, championed the idea that museums must serve a variety of people through, among other things, the establishment of branches and the principle of museum outreach; and John Cotton Dana, the Director of the Newark Museum from 1909 to 1929, was one of the promulgators of museums as institutions of learning and believed education was a museum's social responsibility and should be its primary mission.(Commission on Museums for New Century, 1984). Museum education is thus often considered an American phenomenon. However, it cannot be said that the educational roles of museums were completely absent in the past.

Providing a fuller picture on the educational role of museums in her book ***Museum and Gallery Education***, Hooper-Greenhill could trace the educational roles of museums well back to the Victorian age and before. When the first public museum in Paris, the Louvre, was opened in 1792, the intent was purely educational. The methods developed and used to educate the public were thematic and included labelled displays, inexpensive catalogues and gallery teaching. The museum thus became a place to learn, to browse, to meet friends, to talk, to paint, to enjoy exhibitions and events (Hooper-Greenhill, 1988a).

Pittman (1991) also found that the great Victorian museums had a clear vision of their purpose; it was to increase public understanding. Possibly, collections were not gathered together for the sake of collecting but they were collected and displayed for the 'improvement' of the masses. In spite of this 'vision', he however admitted that the Victorian museums followed the 'open storage' approach in which all the items in a collection were generally put on display to the public. This approach obviously lacked interpretation as the displays were densely packed and labels were fairly brief and rudimentary, so much so that a large proportion of the visitors probably could not read them. Altogether, though there were visions for the educational role for museums in the Victorian age, little was done in the exhibition space for learning to occur. Lewis (1980) supports this view by pointing out that the Victorian establishment had a somewhat elitist view of education and it was definitely not for everyone.

The Victorian emphasis, in spite of its elitist nature, on the educational role of museums, started fading after the World War II. Hooper-Greenhill (1991) identified two reasons for this: firstly, the shift in emphasis towards the care and collection of objects and the curatorial hegemony over establishing museums as places for caring of objects rather than for learning about objects; and secondly, by the end of the nineteenth century, the day school code was modified to allow visits of school children to museums and galleries to count as valid school attendance (Smythe 1966:11 quoted in Hooper-Greenhill, 1991). Although the second reason gave rise to an increase of attendance of school students in museums, museum education was soon understood to mean children's activities and provision for schools, rather than a whole responsibility for all audiences.

In sum, education in museums had been given importance during and before the Victorian period. However, the importance started declining sometime after the second world war mainly due to the hegemony of the curators. Since then, the educational role of museums began to be revived and museums were found to have great potential for informal learning.

Museums as learning environments

During the 1970s and after, a number of studies assumed museums to be learning environments and many museum personnel advocated and emphasised the learning potential of museums (Chase, 1976; Screven, 1974; Fazzini, 1971; Hilke and Balling, 1984; Gurian, 1990; and Hein, 1991; Oppenheimer, 1968).

Learning in museums is different from what happens in school. The former director of Boston Children's Museum, Michael Spock, describes what happens in museums as 'landmark learning' (cited in Commission on museums for New Century 1984). Although every part of a museum will not have a profound effect on every one, each visitor is likely to be moved in a special way by something he or she sees. That becomes a 'landmark' in the visitor's lifelong learning experience.

Learning in museums is a spontaneous, individualised process; it cannot be imposed on the visitor. When museum education emphasises teaching and verbal communication, it does a disservice to the museum as a learning environment. Arguing that the development of research tools, both theoretically and empirically, for investigating museum learning is in its infancy, and that it is often difficult to translate research findings into information that can be used by museum professionals, the Commission recommended as follows:

> Recommendation 6: We urge a high priority for research into the ways people learn in museums. Continuing, systematic research into these unique processes and mechanisms is the key to the success of the museums as an environment for learning. Research is also needed to guide the introduction of computers and other electronic technology into museum learning. Universities linked with consortiums of museums in particular fields might provide a mechanism for implementing these studies (Commission on Museums for New Century, 1984).

In all, only by making a strong policy to conduct various research studies to understand the mechanism of museum learning, can the gap between the reality and the potential of museum education be narrowed. Science museums are already well on their way towards achieving this as many research studies have been undertaken in science museums to understand their visitors.

Museum's educational potential

During the 1980's, a great deal of attention was centred on the educational potential of museums. Museums were then at a watershed with clamouring from both inside and outside the profession to reach out to the public in creative new ways and to offer exciting and enriching learning opportunities. Lewis (1980) favoured the museum setting as educational institution not in spite of, but because of, its informal and volitional nature. He argued that the fact that visitors are free to come and go should be seen not as an obstacle, but as a facilitator of learning. He was convinced that the absence of control might actually facilitate learning provided that a right sort of environment could be contrived. Hooper-Greenhill (1983), supporting Lewis's argument, provided five basic principles that can be adhered to when making choices from the range of options available for museum education: museum education should be relevant to the museum; it should be relevant to the audience; it should be based on objects; it should make the learner feel confident and competent; and it must be of the highest quality.

Museums are currently experiencing 'upheaval in education' or 'expanded roles for museum education'. The Commission on Museums for New Century (1984) recommended that in order to integrate the educational role into all the activities of the museum the internal structure of museum would have to be thoroughly examined. As the Commission put it:

> Recommendation 5: Education is a primary purpose of American museums. To assure that the educational function is integrated into all museum activities, museums need to look carefully at their internal operational structures. Collaborative approaches to public programmes that include educational as well as scholarly and exhibition components facilitate achieving the full educational mission of museums (Commission on the Museums for new Century, 1984).

So the internal structure of the museum should have to be changed to accommodate educational staff at the top management levels.

Again, over the last ten years or so, Dr. E. Hooper-Greenhill, with the help of the department of museum studies and various other related organisations, has produced three documents, namely 'Initiatives in Museum Education', 'Writing a

Museum Educational Policy', and 'Ten Career Experiences.' These documents have influenced and informed the British museum communities about the importance of museum education in general and education policy in particular. Hooper-Greenhill (1991) observed that the museum education policy should go hand in hand with the broad communication policy and mission of the museum as shown in Figure 1.1. This view has also been expressed by the Commission on Museums for New Century that the educational function should be integrated into all museum activities. Pittman (1991) is also of the same opinion:

> Museum education is too important to left to the educators. It needs to imbue everyone who work in museums... the policy of any museum should be an education policy... education is a key component in every museum's *raison d'être* (Pittman, 1991: 43, cited in Hooper-Greenhill, 1994: 8)

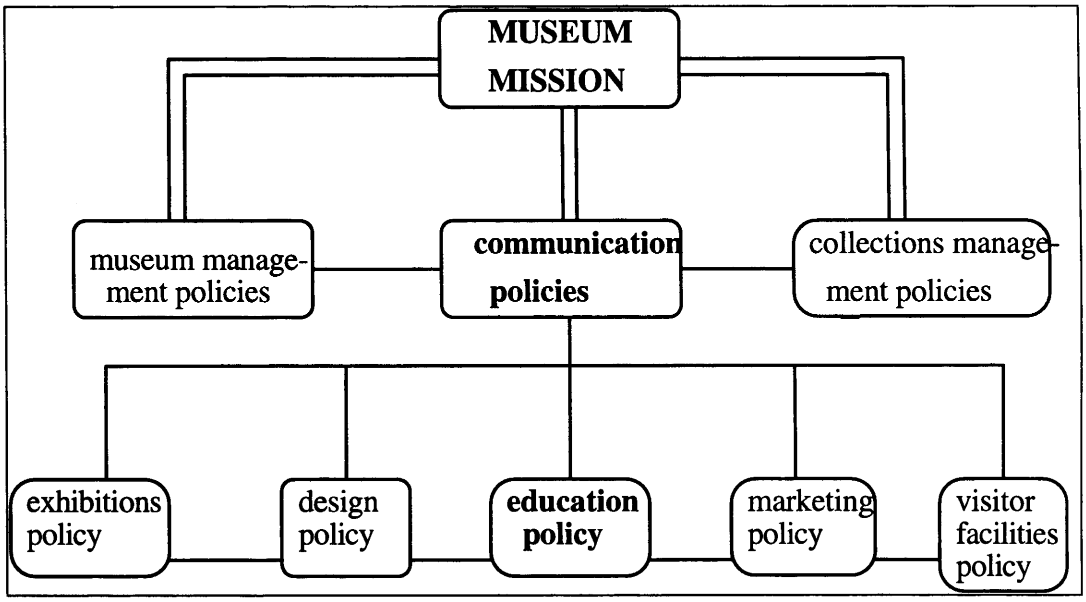


Figure 1.1: A museum education policy is one of the communication policies. (After Hooper-Greenhill, 1991)

On the one hand, the educational function is extended beyond the educators. On the other, the educators in British museums who were once asked to develop only educational programmes (Hooper-Greenhill, 1988b), have already been involved not only in the educational programming of the museum but also in the development of museum exhibitions and other core activities of museums (Hooper-Greenhill, 1994). As Hooper-Greenhill comments:

> In a great many museums in Britain at the present time, the staff responsible for education are part of the senior management team, contribute to scheduling and

planning of exhibitions and other events, and take responsibility for the management of buildings and staff (Hooper-Greenhill, 1994: 9).

The above expanding role for the educators and for the educational function leads to a new concept of audience advocate. Hooper-Greenhill (1994) explained the concept of the audience advocate role for the educator based on a development that occurred in the National Museum of American History, Washington DC.

According to Hooper-Greenhill, the educators as audience advocate have the following responsibilities: he or she acts as a person responsible for considering the needs of all sectors of the audience as new projects are developed; researches the actual and potential museum audience, makes links with appropriate experts in order to develop knowledge and understanding of specific target groups (such as those with a particular disability); monitors new exhibitions and other projects; supplies audience-related information to other staff as appropriate; and evaluates all aspects of the museum, its exhibitions and educational programmes in relation to visitor requirements. This new staff role has been introduced in Britain within education or marketing departments of museums, or placed within a new interpretation unit, as at the Science Museum, London, which is responsible for researching the needs of audiences.

The audience advocate should also have knowledge in two areas: firstly, in theories of learning to understand how people learn, and secondly in evaluation or visitor studies to understand the audience needs. Although Indian science museums have achieved a great deal in the techniques of exhibition or programming, they are still lacking in these two fields, namely visitor studies and learning research. The challenge before them is to understand the developments in these areas, and to develop exhibitions and events that are suitable to the visiting public by asking and studying them.

In sum, the field of museum education has undergone upheavals in two directions: the first is that the responsibility of education is to be imbued in all museum personnel not just the educators; and the second is that educators are to be involved in the design of the whole museum experience including exhibitions. I will now present the Indian museum situation to identify the challenges faced by the Indian science museums.

A BRIEF HISTORY OF MUSEUMS IN INDIA

The existence of museums and picture galleries in India can be traced back to ancient times. The temple in ancient India was a miniature museum of arts and crafts that contained sculptures and paintings and created a taste for music and dance among the public. The epics had a mention of '*chitrasalas*' that were centres of recreation, education and culture. In the modern sense of the term 'museum', the first museum collection was founded as early as 1796, just forty years after the inception of the British Museum (Markham and Hargreaves 1936: 5). However, it was only in 1814 that the first proper museum was set up in the Asiatic Society of West Bengal at Calcutta. This museum later grew into the Indian Museum, Calcutta, in 1875.

After the independence of India in 1947, grand efforts were made to ameliorate the status of the existing museums, and the patriotism of Indian leaders fuelled the formation of many new museums. Some of them are the National Museum in New Delhi, and a few science museums. By 1958, there were already 174 museums as recorded in the *Directory of Museums in India* (Sivaramamoorthy 1959). After this, there is no clear account of museums in India except two sources. The first is the *Directory of Museums in the World* (Hudson and Nicholls 1975), according to which there are about 190 museums in India. The second is a study (De la Torre M and Monreal L, 1982) conducted by the International Council of Museums (ICOM), according to which there are about 360 museums in India. At the present time there might be approximately 400 museums, which means that there has been a five fold increase in the number of museums during the last 60 years.

During the 200 year-old history of Indian museums, meanings and philosophies have undergone many changes. The definition and relevancy of museums have affected and influenced Indians in many walks of life. Museums have played many dominant roles amongst the people of India, so much so that even some shops that sell goods are named museums, implying the meaning of 'collections'. Some examples are the *Jewellery Museum* and the *Indian Silk Museum* at Calcutta, and the *Saree Museum* and the *Shoe Museum* at Madras (see Plates 1.1 - 4.1). Museums have thus become part of the Indian life in many ways. Having outlined a brief history of Indian museums and their influence over the people of India, I will now consider the science museum movement of India.

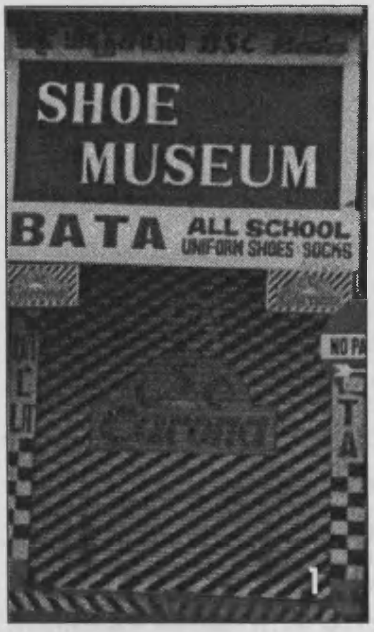
THE SCIENCE MUSEUM MOVEMENT OF INDIA

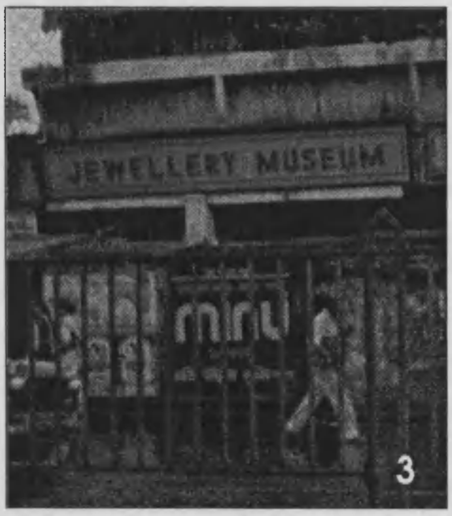
Early attempts

Although museums already existed in India, science museums were not set up until India became independent in 1947. So the phenomenon of the science museum movement is wholly an attempt of the independent India. Jawaharlal Nehru, the first prime minister, expressed a vision for science to be used in solving the problems facing the country. Subsequently a great deal of significance was attached to scientific research as could be evidenced by the creation of a separate Ministry of Scientific Research and Cultural Affairs in the mid 1960s. In the early post-independent period, the emphasis was on industrialisation, technological innovations and industrial research. The leaders of India then had a strong feeling that it was the development of science and technology that gave confidence to humans so that they can control and alter their environment purposefully. And, this development had enabled western countries to introduce many welfare measures within their national boundaries during the last hundred years or so. The government's emphasis on, and Nehru's vision for, the development of science and technology were the forces behind the creation of a number of science museums and ultimately the formation of a task force to identify potentials and guidelines for the science museums' network.

The earliest attempt to set up a science museum was initiated in 1956 by Dr Krishnan, the Director General of the National Physical Laboratory (NPL), a unit under the Council of Scientific and Industrial Research (CSIR), New Delhi. This museum was opened in 1956 and became known as the Science Museum, New Delhi. Mr. R. Subramanian, the then appointed curator of this first science museum project and currently the Director of the Birla Planetarium at Calcutta, described how the 'nucleus' Science Museum at the NPL was set up with the help of a Unesco expert Dr W. T. O'Dea, then keeper of the Science Museum, London (Subramanian 1973). He called it 'nucleus' for it would eventually emerge as the National Science Museum in another permanent location. Unfortunately, the NPL, in 1967, decided to close down the Museum due to a lack of vision, caused by the sudden demise of Dr.Krishnan, a vital inspirational source behind the project and Mr.R.Subramanian's subsequent migration to set up the India's first planetarium at Calcutta (Personal communication from Subramanian, 1994).

Mr.R.Subramanian may be called the father of the Indian science museum movement for he is the earliest Indian to work in a science museum establishment of India. He has since then actively involved and dedicated himself to the development of the Indian science museums by chairing many committees of the National Council of Science Museums (NCSM) on its various stages of development and by directing the oldest planetarium at Calcutta.





Plates 1.1 - 1.4: The Shoe Museum and the Saree Museum at Madras; the Jewellery Museum and the Indian Silk Museum at Calcutta.

Although the Birla Educational Trust appointed a curator to set up the Birla Museum in the form of a few models and charts in 1954, the museum did not become a proper science museum until the late 1960's. The Birla Museum started as, and remains, an encyclopaedic museum. It adapted itself only later to include scientific exhibitions as a result of the curator's visit to the Science Museum of New Delhi and his subsequent exposure to and benefit from the expertise of Mr.R.Subramanian. The Birla Museum was finally housed in a new purpose-built building in 1968 (see Plate 1.5).

In 1956, the Government of India (again through the CSIR, which could not find a suitable building to house the 'nucleus' Science Museum at New Delhi) decided to plan and set up a large science museum at Calcutta, which became the Birla Industrial and Technological Museum (BITM). The Birla family at Calcutta played a crucial role in creating the BITM by donating a palatial house with a plot of land. While the 'nucleus' Science Museum at New Delhi was still searching for a building and site, a lack of which ultimately led to its closure, the BITM was finally opened in 1959 (see Plate 1.6). The name *Industrial* and *Technological* in its title might have originated possibly from two sources: this may be an Indian adaptation of the then American *Industrial* museums and the European *Techn*(olog)*ical* museums. Or this might have derived from its parent organisation, the Council of Scientific and Industrial Research (CSIR).

Another museum in Bangalore, called Visvesvaraya Industrial and Technological Museum (VITM, see Plate 1.7), was handed over to the CSIR by the Visvesvaraya Industrial Society in 1962 to facilitate co-ordination between two museums at Calcutta and Bangalore. This is the beginning of the chain of science museums in India.

Council of Scientific and Industrial Research (CSIR)

Six types of institutions were developed to conduct scientific and technological research in India (Rahman, 1984). They are as follows: *Autonomous organisations*, *Special department/commissions*, *Institutions under ministries*, *Industrial Research & Development establishments*, *Co-operative research associations*, and *Private institutions*.

The most relevant for our purpose is the first category. Autonomous organisations were created as societies for two reasons: firstly, to provide them with functional autonomy so as to free them from bureaucratic control and enable them to undertake imaginative and bold programmes of research; and secondly, to make them accountable both with regard to the utilisation of resources made available and the fulfilment of their scientific and technical programmes.

CSIR is one such autonomous body that was constituted in 1942 by a resolution of the then Central Legislative Assembly and has since been under the aegis of the Ministry of Scientific Research and Cultural Affairs, the Ministry of Education, and currently under the Ministry of Science and Technology. The interesting fact is that both the CSIR and Indian museums were under the same Ministry of Scientific Research and Cultural Affairs, when the science museum movement started during 1956-60.

During the 1970's, there were growing concerns over the inability of scientific organisations like the CSIR to manage the mushrooming of newly formed institutions under a single organisation. A science policy decision was reached by the Government of India to decentralise many scientific organisations and attach them to its relevant ministries or to newly created organisations. This decision caused the science museums leaving the CSIR and forming the National Council of Science Museums (NCSM).

NCSM — a national network of Indian science museums

A network of museums as such is not a new concept; many museum networks, or 'museum systems', exist in America at local, state, federal and university levels. Also in the UK, the National Museum of Science and Industry is responsible for three museums: the National Railway Museum in York, the National Museum of Photography, Film, and Television in Bradford; and the Science Museum in London. But, there are about thirty British science centres that are individually managed (Johnson 1992). Naturally it emerges that the NCSM differs from other museum networks in the world for the following reasons: all constituting units of the NCSM are *government funded*; they are at *different levels* and at *different capacity*; they are all of the *same type*; they are a relatively *small network* compared to a 'system'.

In 1973, the Government of India, through its planning commission, had foreseen the tremendous potential of science museums in community development. It set up a task force to stipulate guidelines, area and scope of activities for four major science museums in four zones of the country which would support a chain of six regional and twenty district science centres so as to reach the deep interior of the country. The task force recommendations also included an addition of 30 or so mobile science exhibitions to the existing few to supplement the regional and district science centres. The entire idea was to disseminate and diffuse the benefits and uses of science in the day to day life of the community.

The task force on science museums also recommended the creation of a *central co-ordinating agency* for the planning and management of science museums. This central agency would pull together specialisation and expertise from its staff and the national advisory committee to reach decisions on the major aspects of policies and programmes. It would also be responsible for the following tasks: the planning of a network of science museums in India, ensuring effective co-ordination between individual science museums, and pooling of the available resources in order to prevent duplicating the expenditure on the design and fabrication of exhibits.

In 1978, the NCSM was formed as an autonomous body under the aegis of the Ministry of Education and Culture. The NCSM headquarters is situated in Calcutta (see Plate 1.8). The then existing three science museums in Calcutta, Bangalore and Bombay were separated from the CSIR and affiliated to the NCSM. Ever since, the NCSM has been entrusted with planning to establish new museums or centres, providing guidance from time to time to all its units, creating exhibits and activities for all new set-ups, and mobilising of expertise and funds for its constituent units.

The NCSM is organised into two components: *advisory committees* and *implementing authorities* (see Figure 1.2). A *society* and a *governing body* would be formed to act as the National Advisory Committees as the task force recommended. The members of the committees would be chosen from amongst the eminent persons in the country in the field of science and technology, education, commerce and industry, art and culture, and museology.

The individual national level units of the NCSM are governed by their respective executive committees constituted by the governing body of the NCSM from amongst worthy local persons in the field of science, industry, education, culture, and museums. The executive committee would further create and constitute sub-committees like finance committees, scientific and programme committees, buildings and works committees, local advisory committees to assist the executive committee in taking policy decisions in respective aspects.

The organisation is therefore a highly centralised one as the NCSM (Director General) fixes the priorities in accordance with the national requirements and provides funds, even though the constituent units of NCSM (Directors) may enjoy autonomy in planning, programming and execution of their activities within the framework laid down by the Governing Body of the NCSM. A Central Research and Training Laboratory (CRTL), created in the late 1980s, shares responsibilities with the NCSM in developing exhibitions for new units and in training personnel for all units. The

NCSM currently administers 22 science centres of four types (see Figure 1.3): *national, regional, sub-regional,* and *district science centres.* The national level museums or centres are at Calcutta (see Plate 1.6), Bangalore (see Plate 1.7), Bombay (see Plate 1.9) and New Delhi (see Plate 1.10). Each is responsible for its regional, sub-regional and district science centres.

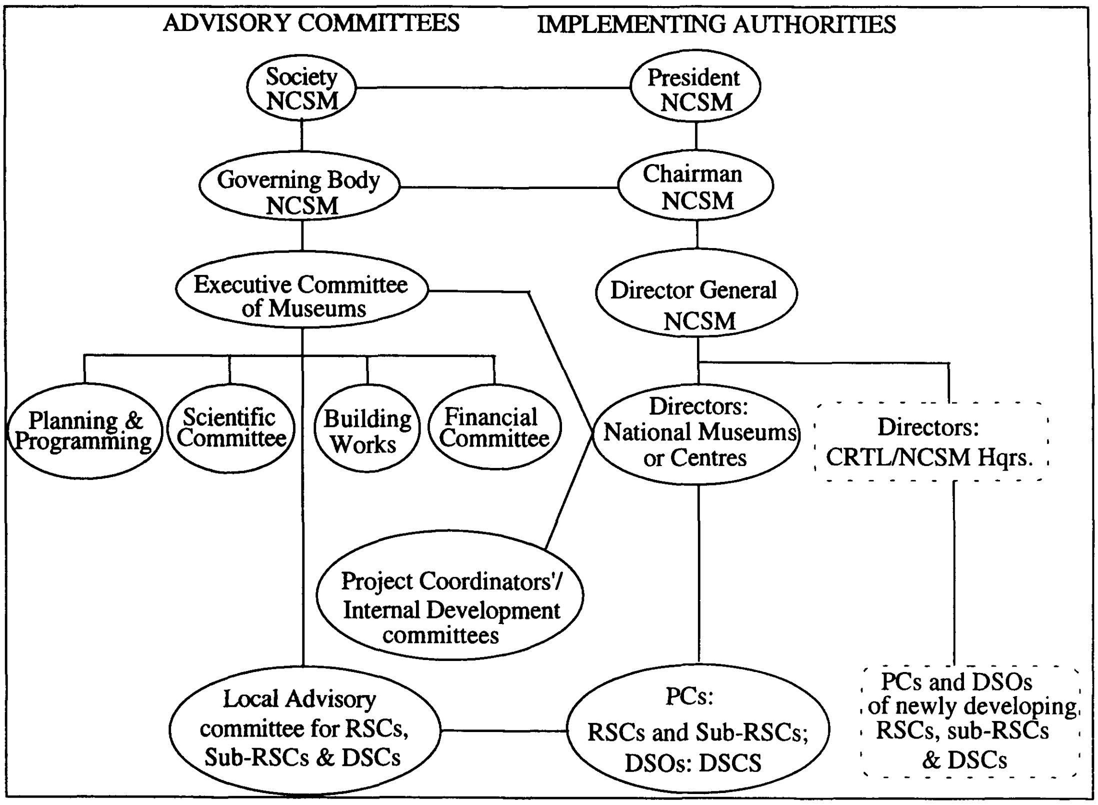


Figure 1.2: Organisation chart of NCSM. Abbreviations: RSCs—Regional Science Centres; Sub-RSCs—Sub-Regional Science Centre; DSCs—District Science Centres; PCs—Project co-ordinators; DSOs—District Science Officers; CRTL—Central Research and Training Laboratory; and NCSM—National Council of Science Museums.

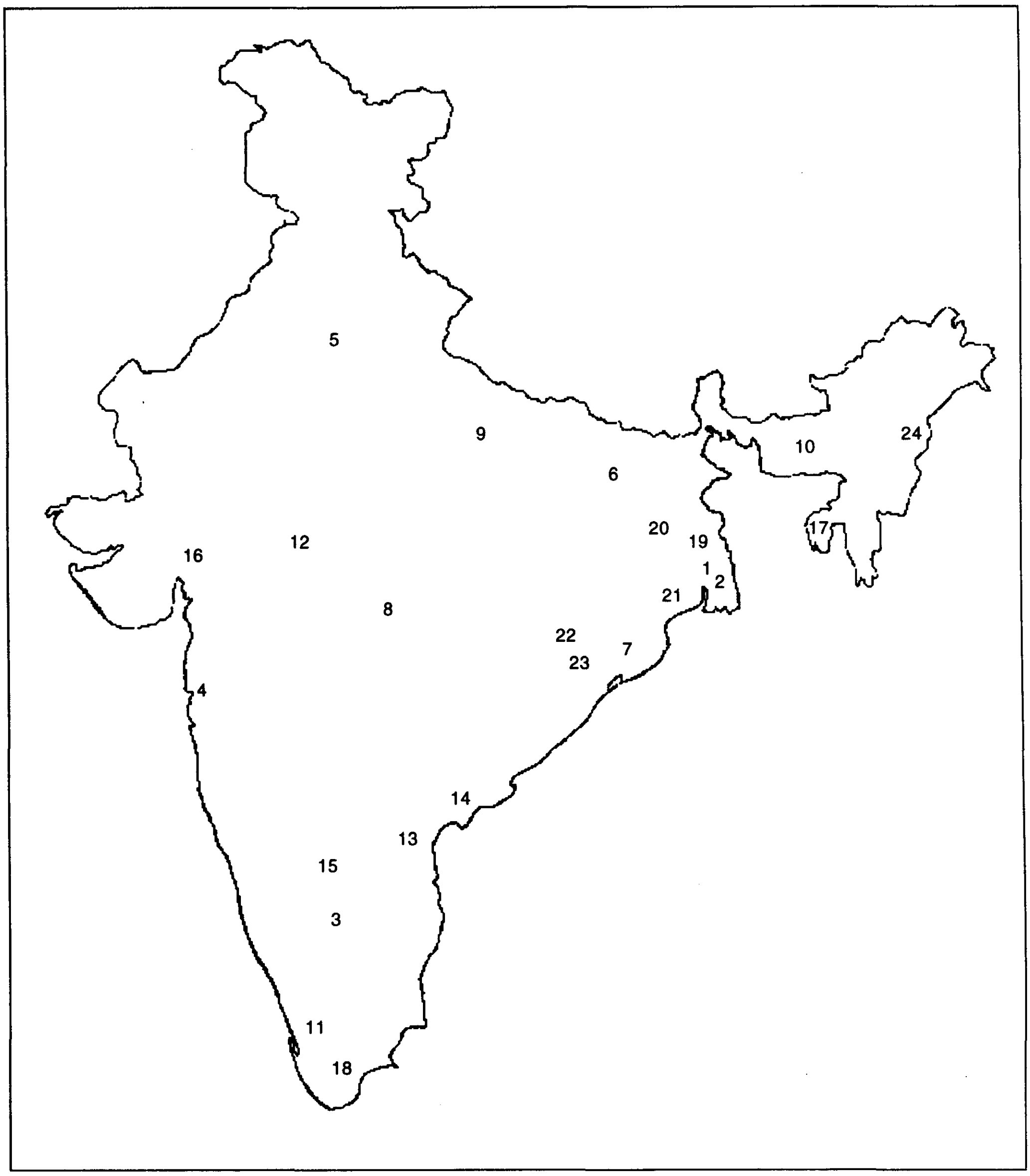


Figure 1.3: Geographical distribution of NCSM units: 1. National Council of Science Museums Headquarters and Central Research and Training Laboratory, Calcutta. 2. Birla Industrial and Technological Museum, Calcutta. 3. Visvesvaraya Industrial and Technological Museum, Calcutta. 4. Nehru Science Centre, Bombay. 5. National Science Centre, New Delhi. 6. Srikrishna Science Centre, Patna. 7. Regional Science Centre, Bhubaneshwar. 8. Raman Science Centre, Nagpur. 9. Regional Science Centre, Lucknow. 10. Regional Science Centre, Guwahati. 11. Regional Science Centre, Calicut. 12. Regional Science Centre, Bhopal. 13. Regional Science Centre, Tirupati. 14. Sub-regional Science Centre, Vijayawada. 15. District Science Centre, Gulbarga. 16. District Science Centre, Dharampur. 17. Tripura Science Centre, Agartala. 18. District Science Centre, Tirunelveli. 19. Sub-regional Science Centre, Burdwan. 20. District Science Centre, Purulia. 21. District Science Centre, Digha. 22. Science Park, Kapilash. 23. Sub-regional Science Centre, Dhenkanal. 24. Sub-regional Science Centre, Imphal.

Other science museums or centres in India

Science museums or centres that do not come under the NCSM fall into two categories: those run by *private trusts* and those run by the *state governments*. First, The Birla Museum in Pilani (Plate 1.5), B. M. Birla Science Museum and Planetarium both in Hyderabad (Plate 1.11) and in Jaipur, and Vikram A Sarabhai Community Science Centre in Ahamedabad are some science museums which were set up and are maintained by private trusts.

Second, Kerala, Andhra Pradesh and Tamilnadu are three Indian state governments which set up and maintain their own science museums or centres: The Kerala State Science and Technology Museum (KSSTM) in Trivandrum (Plate 1.12); The Andhra Pradesh Science Centre in Hyderabad; and The Tamil Nadu Science and Technology Centres (TNSTC) in Madras. Unlike the other two, the TNSTC is an autonomous body under the Ministry of Education of the Government of Tamilnadu. It is not a single museum, but a state-owned network of science centres along the line of the NCSM. The TNSTC consists of the Periyar Science and Technology centre (PSTC), Madras (Plate 1.13); and four District Science Centres in Coimbatore, Tiruchi, Salem and Madurai. The PSTC was opened in 1988 and others are only in the planning stages. Many science centres are also at the planning stage under various state governments namely—Orissa, Madhya Pradesh, Karnataka, and so on.

To sum up, there are in all about 30 science museums or centres in India under the three different categories: national-funded, state-funded and private-funded. The Indian science museums have also undergone developments and changes during these thirty years or so. The first three science museums of India are the Birla Industrial and Technological Museum in Calcutta, the Visvesvaraya Industrial and Technological Museum in Bangalore, and the Nehru Science Centre in Bombay. As their names imply, the first two are museums with mainly object-oriented exhibits whereas the science centre at Bombay has more idea-oriented exhibits. At the present time, all units of NCSM irrespective of being a centre or a museum, would have both object-oriented and idea-oriented exhibits. For example, the Nehru Science Centre at Bombay does have a number of objects in its exhibition galleries. We can therefore say that Indian science centres began in the second stage and travelled through to the fourth stage. There are however some science centres that have only idea-based exhibits without any objects and therefore remain in the third stage only. The galleries that take advantages of both objects and idea-based exhibits are, for example, the Information Revolution Gallery at the National Science Centre in New Delhi; and the Sun Gallery at the Regional Science Centre in Bhubaneshwar.

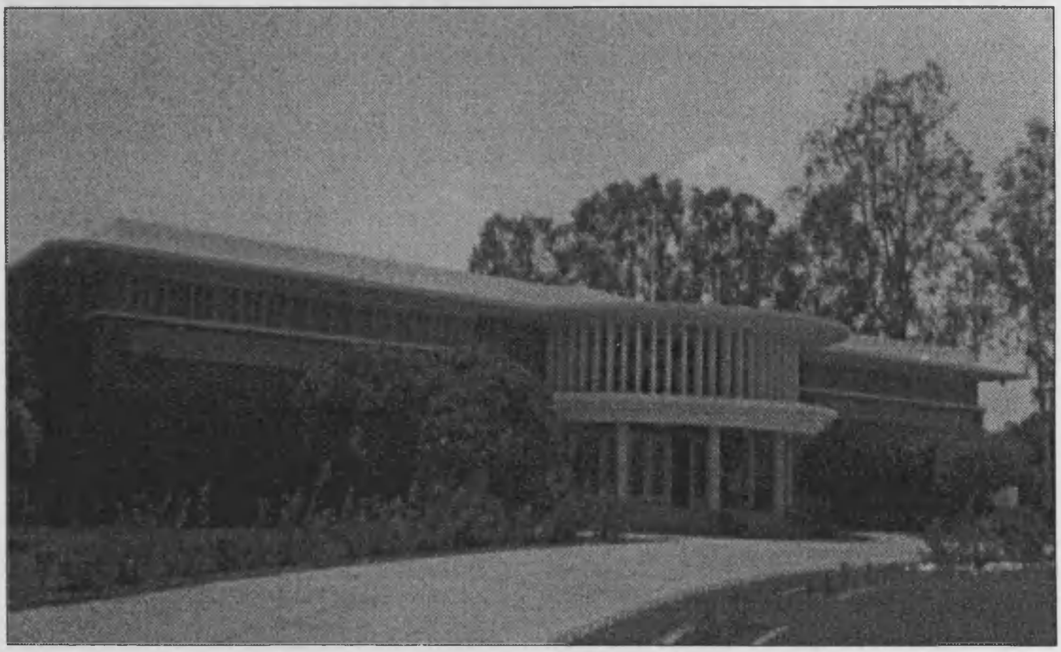


Plate 1.5: The Birla Museum in Pilani was not housed in this new building until 1968.

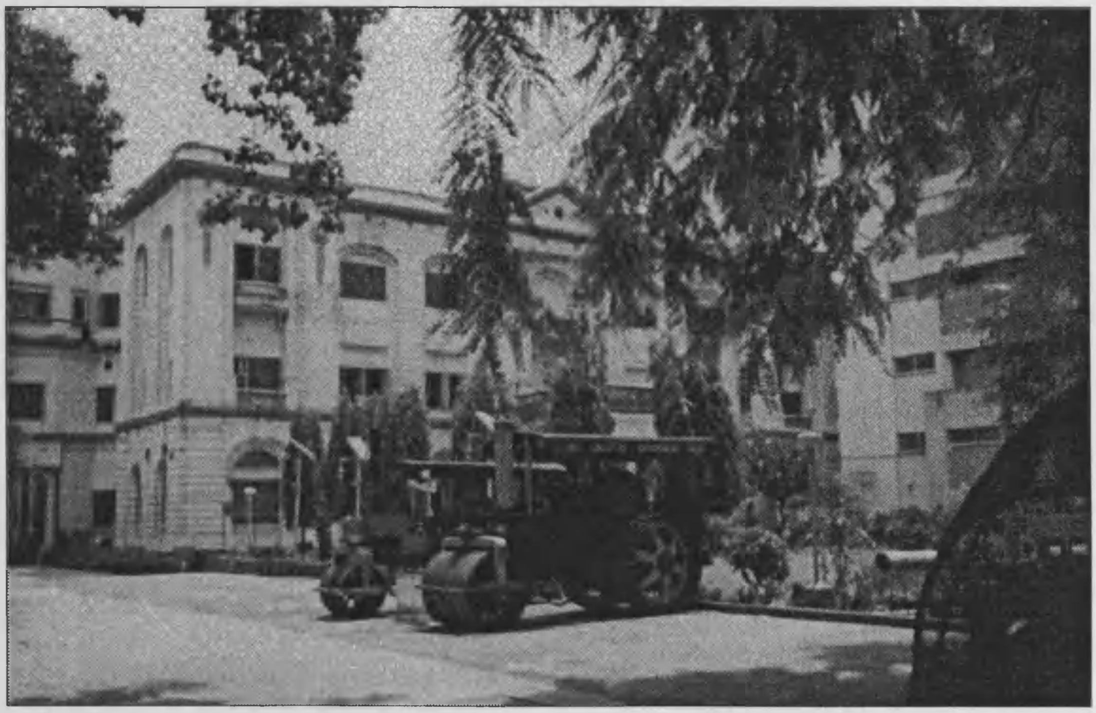


Plate 1.6: The Birla Industrial and Technological Museum at Calcutta established in 1959

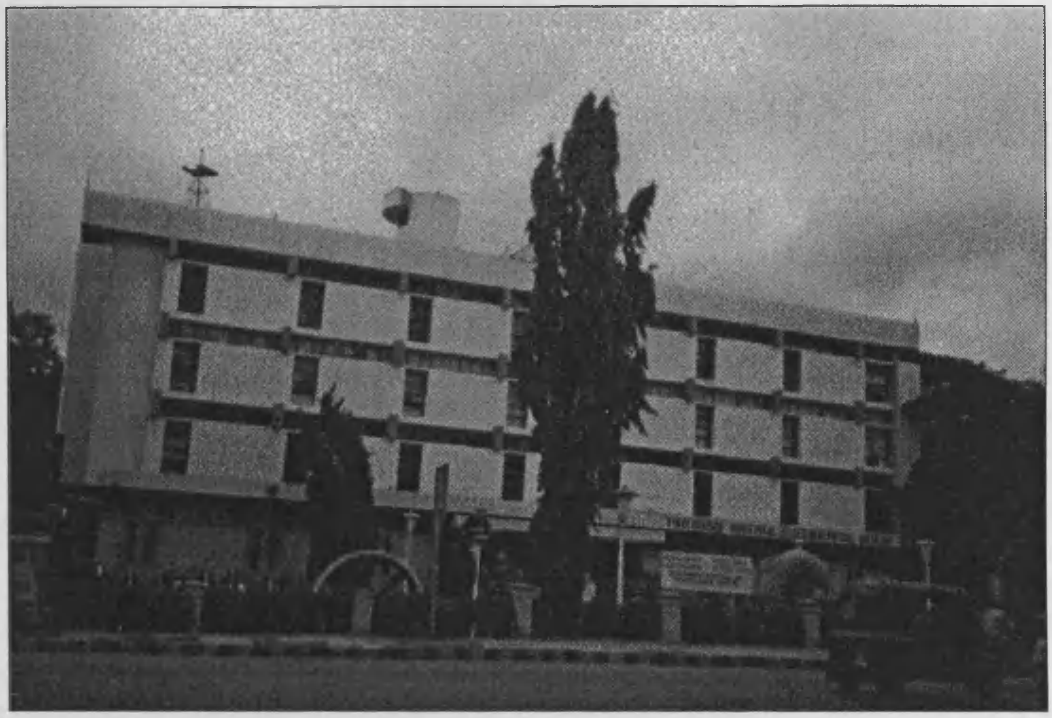


Plate 1.7: The Visvesvaraya Industrial and Technological Museum at Bangalore established in 1965.

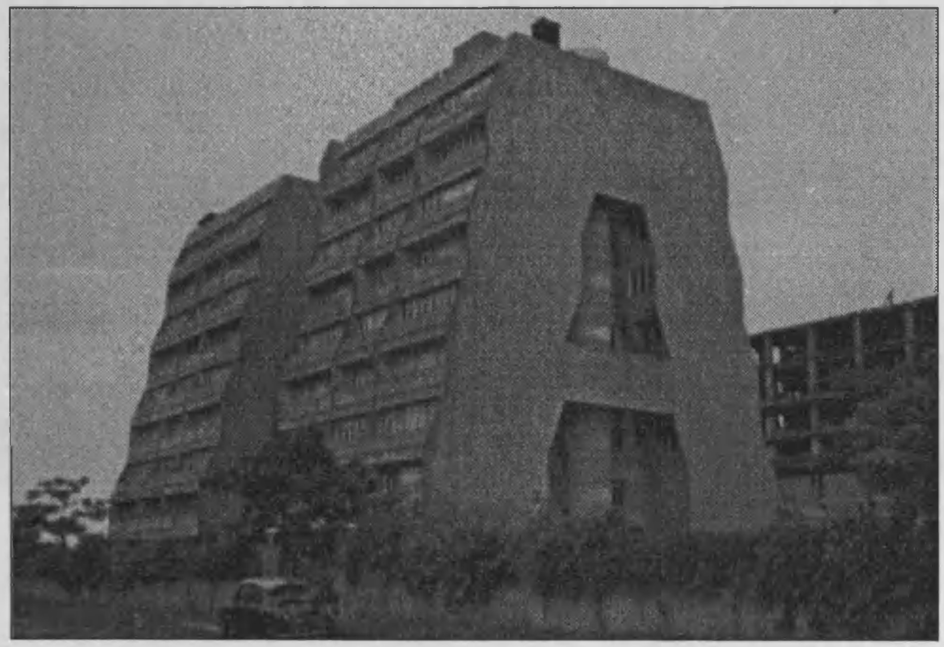


Plate 1.8: The National Council of Science Museums headquarters at Calcutta, though created in 1978, was housed in this building only in 1988.

Plate 1.9: The Nehru Science Centre at Bombay, though its science park was opened in 1979, was completed only in 1988.

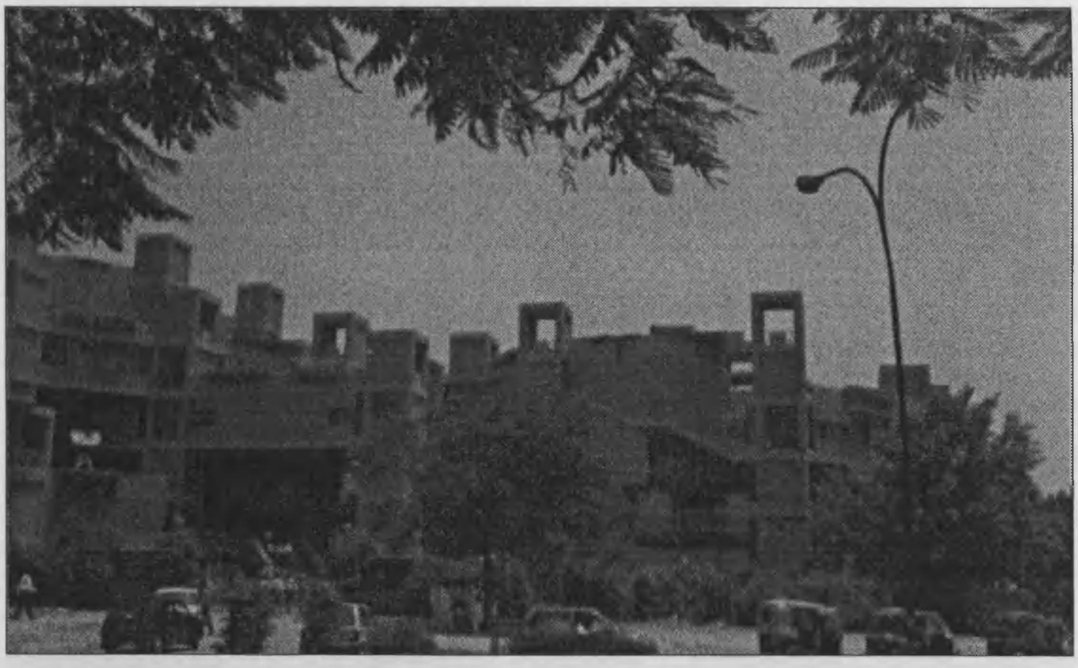


Plate 1.10: The National Science Centre at New Delhi.

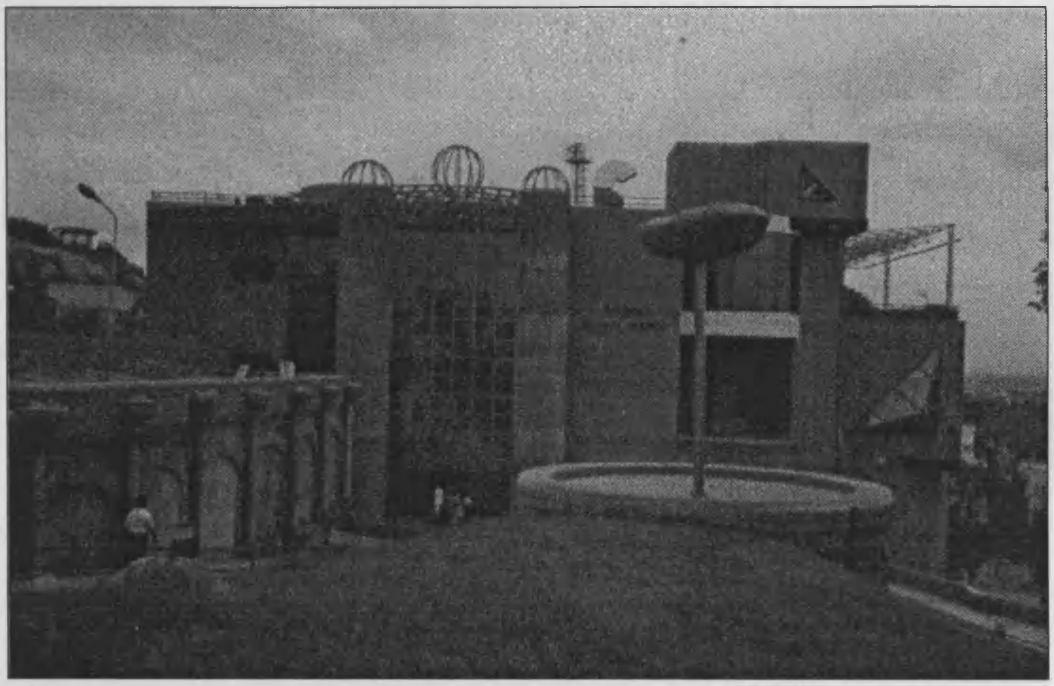


Plate 1.11: The B.M.Birla Science Centre and Planetarium at Hyderabad.

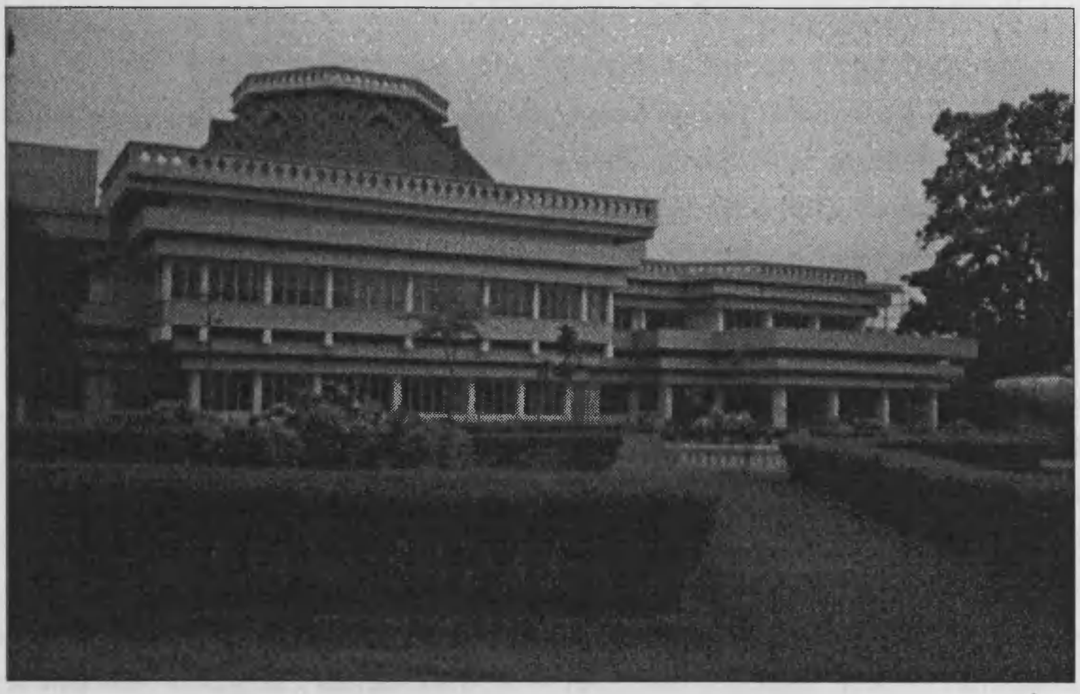


Plate 1.12: The Kerala State Science and Technology Museum at Trivandrum.

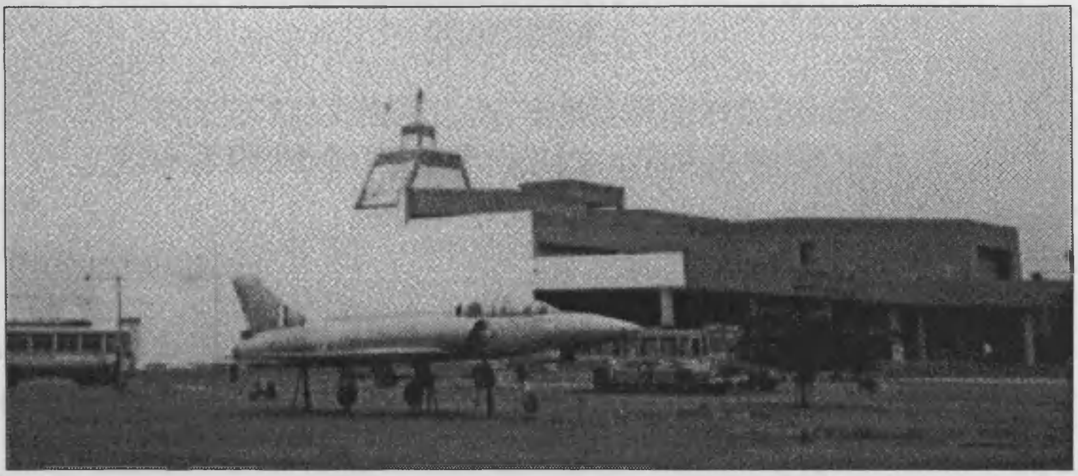


Plate 1.13: The Periyar Science and Technology Centre at Madras.

A WAY FORWARD: CHALLENGES FOR INDIAN SCIENCE MUSEUMS

As I have shown earlier, although a few began in the second stage, all Indian science museums quickly responded to new developments in the science museum field by reaching the fourth stage, but remained stagnant in responding to the developments in the field of museum education.

Indian science museums have not responded to the expanded role for museum education as they all too often view education as an adjunct function and educators do not, even now, have any say in the exhibition development. None of the Indian science museums has introduced so far the concept of Hooper-Greenhill's audience advocate or evaluator. Even the National Council of Science Museums is not the exception. Indian science museums should therefore seriously think of reforming the internal institutional structures so that the education staff are involved in exhibition developmental processes and are appointed at senior management level. Unless this serious challenge is faced with courage and conviction by museums, their educational potential cannot be realised. Understanding museum learning and the museum visitor are the primary responsibilities of audience advocates or evaluators. After having conceptualised usable approaches to exemplify the nature of museum learning and the museum visitor from published research evidence, the present study will also attempt to find and identify their usefulness to the development of science museum exhibitions, which will be considered in the next chapter.

CHAPTER II

THE DEVELOPMENT OF MUSEUM EXHIBITIONS WITH A CASE STUDY OF INDIAN SCIENCE MUSEUMS

INTRODUCTION

The exhibition is the museum's primary medium of communication. It is also a main instrument for museum learning. For these two reasons, exhibitions in museums are so powerful that they have become the most prominent aspect of any museum's public face. As the public perceive the museum more closely as institutions of authority and social responsibility, museum exhibitions are particularly effective in conveying the message. Given their potential for museum learning, exhibitions occupy almost 80% of the museum space. So, it is necessary to understand the process involved in the development of museum exhibitions, particularly in Indian science museums, so that better methods and approaches can be identified to design and develop effective exhibitions.

In this chapter, after having briefly defined the terms 'exhibition' and 'exhibit' and discussed their different usage, I will present and discuss various types, styles and approaches of exhibitions as to how museums gradually involved designers, educators, evaluators and others in the process of exhibition development. The project team approach is also presented and discussed in terms of its advantages over the traditional methods of developing exhibitions. Similarly, how exhibitions are developed in Indian science museums will be discussed. Finally, after identifying the missing inputs to the development of museum exhibitions in India, I will set out the problem for the thesis.

EXHIBITIONS, WHAT ARE THEY?

The term 'exhibition' generally evokes an image of trade fairs, public exhibitions, agriculture shows, propaganda exhibitions, and international exhibitions; but not usually museum exhibitions. Misha Black (1950) assigned a very important task for every exhibition as 'to sell something'. The same view was also held by one of the earliest museum designers, James Gardner, when he and his associate (Gardner and Heller, 1960) mentioned that at least 80% of exhibitions are concerned with the business of selling goods. Although the objective of exhibitions was originally to attract attention to goods for sale, things began to change so much so that museums started to make use of the commercial exhibition techniques for educational purposes. As Gardner and Heller state:

> Like the oil industry, exhibitions have become big business in barely one hundred years. Governments today are prepared to spend millions on temporary cities for international fairs. Organisations and associations of every conceivable kind exhibit themselves enthusiastically. The smallest firms make budget allocations for exhibitions. Even museums have started to dust down their shelves and consider display as something more adventurous than storage in glass cases (Gardner and Heller, 1960:7).

On the other hand, although exhibitions have an overall purpose of attracting the attention of the public who visit them, their meanings are different depending on many factors such as where they are situated, and what their objectives are. The difficulty in getting the right meaning for the exhibition is expressed by Velarde as follows:

> Exhibitions come in all shapes and sizes and resultantly they mean different things to different people. 'Exhibition' is one of the words which have several public meanings and even more 'professional' ones. 'Exhibitions,' 'shows,' 'displays,' 'fairs' are all words that used to mean the same sort of thing when exhibition professionals communicate with each other. The exhibition therefore ranges from display of goods on market stalls, motor show, trade fairs, world fairs, eco-centres, heritage centres, contemporary museum galleries and exhibitions, science centres and travelling exhibitions of one sort or another (Velarde 1988: 13).

Definitions

In museums, the term 'exhibition' is always used to represent a collection of individual exhibits, which is also called 'Hall', 'Gallery', or simply 'Room'.

On the other hand the term 'exhibit' is used in two ways. First, it stands for a physically independent unit that may consist of an object or a group of objects with or without labels; or it may be a collection of everyday functional objects or of specially constructed gadgets to explain phenomena or ideas. Second, it stands for the exhibition. This second meaning of the exhibit is mostly, or only, used by American authors. However, when they use the term 'exhibit' to mean the exhibition, Americans use a term 'unit' to represent the first meaning of the exhibit. In sum, Americans use the term 'exhibit' to mean both the exhibit and the exhibition at different times: the exhibit as a group of units or the exhibition as a group of exhibits.

There are two kinds of exhibits: the object-based exhibits that are generally more prevalent in the arts, archaeological and history museums, and the idea-based exhibits that are more common in science museums. In terms of its access to visitors, an exhibit may be kept for just viewing only or also for manipulation. When it invites touching or handling, the exhibit is called 'please touch'; but when it prohibits touching or handling, the exhibit is called 'no touch'. In addition, there are three different types of 'please touch' exhibits namely a simple hands-on type, a participatory type, or a complete interactive type. The definitions, extents and impacts of these three types are given in Table 2.1.

Classifications

Exhibitions are classified on the basis of different criteria by different authors (Hall 1987, Velarde 1988, Nicks 1991, and Burcaw 1983); the criteria are life, mode, strategies, style and purpose of the exhibition.

<u>Life</u>

Exhibitions are set up and kept for viewing visitors for a specific period. On the basis of how long they last, exhibitions can be classified into permanent and temporary exhibitions. For example, the permanent exhibition typically lasts up to about 15 years whereas the temporary exhibition is to last from a few weeks up to a few months. But it is also possible that many temporary exhibitions have been extended for a considerable time and many permanent displays have been altered much sooner than it was originally planned.

<u>Mode</u>

The exhibition is not always made for and set up in a single location or museum. Sometimes, it is designed and developed for many museums and is circulated around them. Exhibitions of such type are called travelling exhibitions. They are further divided into two kinds namely portable and mobile exhibitions. They are portable because they are transported and set up at different locations; but mobile when they are moved around by bus or train.

<u>Strategies</u>

Irrespective of the life and mode of the exhibition, there are mainly two alternative strategies adapted for the organisation and subsequent design of the exhibition materials (for example, Hall 1987).

Table 2.1: Three types of 'please touch' exhibits according to Bitgood (1991c: 5)

TYPE OF EXHIBITS	*EXAMPLES*	*INTENDED IMPACTS*
SIMPLE HANDS-ON (The exhibit of this type prompts the visitor to touch, climb, etc.)	1. Touching the animal fur. 2. Climbing on a statue of an animal. 3. Dressing up in fire-man's clothing.	1. Produce sensory and/ or perceptual learning. 2. Focus visitor's atten-tion on the object. 3. Create an increase in interest, and/or a change in attitudes (affective learning).
PARTICIPATORY (The exhibit of this type prompts a response and the out-come is used to teach a point by comparing it with some other response or standard; it goes beyond simple hands-on.)	1. Comparing jumping distance (or some other visitor response) with other animals. 2. Feeling several objects and comparing them on characteristics such as coolness, rough-ness, etc. 3. Assembling a turtle skeleton and com-paring with a correct assembly.	1. Teach similarities and differences between two objects or events. 2. Focus visitor's atten-tion on the object. 3. Produce an increase in interest, and/or a change in attitudes, (affective learning).
INTERACTIVE (The exhibit of this type prompts a response which changes the state of the exhibit; the change is under the control of the visitor.) LEVEL 1: Simple engage-ment (e.g., press a button.) LEVEL 2: Prolonged en-gagement (e.g., interactive computer game.)	1. A label with a flip panel. 2. Devices with controls (buttons, levers, cranks, etc.) in which a response on the control makes a change in the exhibit (lighting, sound, ob-ject's position, etc.) 3. Interactive computer tutorials, self-testing devices, games, etc. 4. Magnifiers that when used correctly reveal what was previously unseen.	1. Teaching of cause-effect relationships (using either dis-covery learning or guided learning.) 2. Teach similarities and differences between two objects or events. 3. Focus attention of visitors on objects or events. 4. Affective learning (increase in interest, attitude change, etc.). 5. Self-testing of visitors. 6. Conceptual orientation of visitors.

The first is taxonomic or systematic in which materials are presented in terms of classification alone to provide the opportunity for visitors merely to discriminate between objects, probably drawing their own conclusions. This approach assumes an informed public.

The second approach is thematic, in which a story or theme is told to guide the visitor to make connections and to follow the development of the thesis as it evolves in the exhibition. Also, this approach can further entail a simpler linear technique or a tricky mosaic technique. In the linear technique, visitors are compelled to go through a one-way flow and because of this fact it is also called a tunnel show. On the other hand, in the mosaic technique, many separate displays, within a major theme, provide random information from which the visitor can piece together his or her own selection of information on the main theme, pursuing his or her own route and following no particular order.

Occasionally, very occasionally, a third approach is followed, particularly in natural history exhibitions, by organising exhibition materials according to their habitat or living relationship to each other. This approach is called ecologic (Burcaw 1983). It resembles more or less the thematic approach but diagonally opposite to the taxonomic approach.

Style

Exhibitions can be presented in different styles. For example, they can be aesthetic, evocative, didactic or a combination of some or all of them (Jones, 1987; and Shettel, 1973). In an *aesthetic* exhibition each object 'speaks for itself'. Supporting texts and display mechanisms complement but are subordinate to the aesthetic and visual experience. In an *evocative* exhibition on the other hand an atmosphere of an era, a country, a particular art style or a scene is created in a theatrical way. This scene-setting aids the understanding of visitors by evocation and association, and not necessarily by the display of informative texts. However, the *didactic* type of exhibition presents information like 'a book on the walls'. The primary intent is to impart information through printed text, panels, or interactive exhibits.

Similarly, exhibitions can be classified according to the planning and design process of exhibition. They can be open storage, object approach, idea approach and combined approach. In open storage approach, all objects are placed on display as acquired. In object approach, the objects are selected, arranged, researched and labelled to produce an educational exhibition. In idea approach, an idea or story will be given so much importance that it is possible to develop an 'idea' exhibit without objects. But, according to Burcaw, it was an extreme approach and a bad practice. In the combined approach, the curator selects both objects and ideas at the same time. This classification is very useful to science museums, as they evolved through these approaches(see Chapter I).

<u>Purpose</u>

Exhibitions vary in their purpose: for example, some have explicit didactic intents while others have mainly entertaining features. Based on their purpose or intent exhibitions can be classified into three types namely aesthetic, factual and conceptual (Burcaw 1983). When the aesthetic exhibitions are mainly entertaining in nature, the factual and conceptual types are didactic. When the intent is for people to enjoy viewing the exhibits and be entertained by it and the emphasis is on pleasing the visitor, the exhibition is aesthetic. However, factual exhibits convey useful and interesting information to visitors. Conceptual exhibits, on the other hand, intend to present ideas or broad principles which the visitor will hopefully grasp, internalise (make a part of his or her thinking), and thereafter act upon. So factual and conceptual exhibits meet the primary goal of education by enhancing visitors' understanding.

In all, exhibitions generally incorporate various combinations of the types discussed above. For example, exhibitions at contemporary science and technology centres are normally entertaining, factual or conceptual; but in traditional natural history museums, the exhibitions would generally follow the systematic and ecological approaches. Altogether, it is possible for exhibitions to be both entertaining and systematic, factual and ecological, or any other combinations (Danilov 1982).

APPROACHES TO THE DEVELOPMENT OF MUSEUM EXHIBITIONS: A HISTORICAL PERSPECTIVE

As their purpose and philosophy underwent a great many changes during the past six hundred years or so, museums, including science museums, have changed their approaches to exhibition development by taking inputs from designers, educators, evaluators and finally, visitors. In this section I will look at how museums slowly involved many experts besides curators, by highlighting some epoch-made contributions. It is however very difficult to analyse these changes in this way as they are not always straight forward and linear. Nevertheless, a simplified scheme will give an idea about various approaches adopted during the development of museum exhibitions. From the evidence gathered so far, it appears that there are five stages during which the approaches to museum exhibitions dramatically changed.

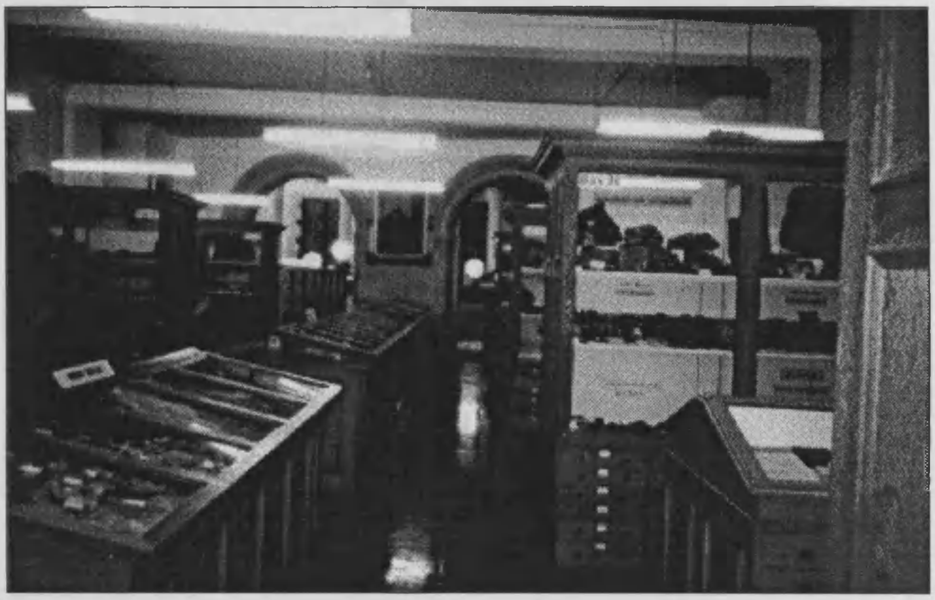


Plate 2.1: Segwick Museum, Cambridge, an example of 'open storage' display of exhibition.

Plate 2.2: Another example of 'open storage' type of exhibition in the British Museum (Natural History).

Plate 2.3: The Gallery 33 of the Birmingham Museum and Art Gallery, Birmingham. A display with labels illustrated by well-selected specimens or objects.

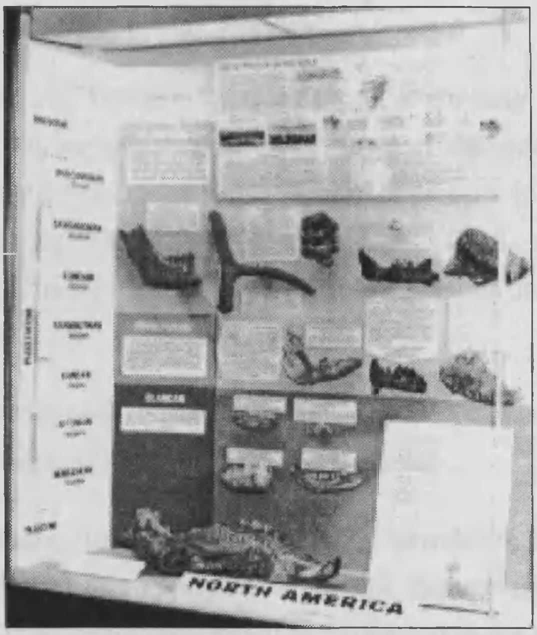


Plate 2.4: A natural history exhibition in the British Museum (Natural History), London, illustrated by George Brown Goode's 'well-selected specimens.'

First, museums were traditionally grand houses of impersonal display. Although there was evidence that the working class visited museums during the Victorian times, the education during this era was of an elite nature and the public were privileged to enter the museum as they were often checked for their credentials (Lewis 1980 and Burcaw 1983). In this situation, museums were mainly employing Victorian methods of exhibition; endless rooms were filled with endless specimens specifically for the benefit of scholars and mostly people of very upper-class social standing (Guthrie 1983).

This style of complete collection display without incorporating any exhibition design apart from constructing cases for exhibits is generally called 'open storage'. In this approach, the whole exhibition development was under the reign of curators, who often tend to group objects and specimens according to a classification that is visible and decipherable only to the experts. This approach of display (see Plates 2.1 and 2.2), in which dozens of objects are crowded together with little or no explanation, has survived in all sorts of museums, more particularly in British museums, down to the present day.

Second, slowly but steadily there emerged a growing dissatisfaction of the 'open storage' approach as museums became more of democratic institutions. One reaction to the dissatisfaction is the introduction of design in museum exhibitions, which has been originally, although in a rudimentary form, advocated by George Browne Goode, then Director of the US National Museum, in his oft-quoted paper (cited in Burcaw, 1983: 12):

> An efficient educational museum may be described as a collection of instructive labels, each illustrated by a well selected specimen.

Many museums responding to this and similar calls introduced labels and instructions to their objects. Even now this approach is perhaps the commonest type of display, despite covered under a contemporary finish as evidenced in the displays of the Gallery 33 and the Geology gallery of the Natural History Museum, London (see Plates 2.3 and 2.4). In both cases, a theme is narrated with a number of well-written labels, each of them is supported by specimens, objects or simply photos as shown. This type of exhibition tends to incorporate such designs as ergonomics and size of labels and objects and to present information on how the objects or specimens are important and how they fit into the overall theme of the presentation. However, this approach to exhibition is not free from criticisms. The most important one is that visitors often tend to be overpowered by information and formidable length of labels; resultantly they often go unnoticed by visitors due to the information overload.

Third, the creation of the 1930 Deutcher Werkbund Exhibition in Paris and the 1931 Building Workers' Union Exhibition in Berlin marks another approach to exhibition development (Miles et al. 1988). The design team of the exhibitions were led by Walter Gropius, the founder director of the Bauhaus. The team members divided the exhibitions up into areas of different character and arranged the displays so that they followed a logical sequence from room to room. Also, they paid special attention to circulation, promoting a smooth flow of visitors by introducing curved walls. In addition, drama was achieved by the use of a bridge or raised viewing gallery which overlooked the space.

These exhibitions in effect adopted what is called 'gallery-downward', or simply the top down approach for they were essentially concerned with firstly the space to be filled in and secondly the message to be communicated. This approach was also popularised and incorporated by Herbert Bayer, an Austrian and the ex-Bauhaus, in many exhibitions including those in Berlin and later in the US. A few words about the Bauhaus are included here.

The Bauhaus is the most celebrated art school of modern times and was founded by Walter Gropius in 1919 and was closed by Nazi on 11 April 1933. The movement precipitated a revolution in art education whose influence is still felt today. Every student now pursuing a 'foundation course' at an art school should thank the Bauhaus for it. Every art school, which offers studies of materials, colour theory and three-dimensional design, is indebted in some degree to the educational experiments carried out in Germany between 1919 and 1933. Everyone sitting on a chair with a tubular steel frame, using an adjustable reading lamp or living in a house partly or entirely constructed from pre-fabricated elements is benefiting (or suffering) from a revolution in design largely brought about by the Bauhaus. In the words of Wolf von Eckardt, (cited in Whitford 1984), the Bauhaus 'created the patterns and set the standards of present day industrial design; it helped to invent modern architecture; it altered the look of everything from the chair you are sitting in to the page you are reading now'.

To be brief, the Bauhaus (1919-1933) introduced the concept of a designed environment that meets the requirements of not just the collections, but also visitors in terms of their appreciation and comfort. Its innovations influenced exhibition design all over the world, and are still strongly felt at the present day. It might have even been responsible for the introduction of full-time professional designers in the museum world. For example, the British Museum (Natural History) in London appointed its first professionally trained three-dimensional designer only in 1965 (Miles et al. 1988:5-6).

The fourth approach to exhibition development was introduced by Otto Neurath, the spirit behind the Social and Economic Museum in Vienna. His approach centred on the act of communication and the difficulties likely to be faced by the receiver in understanding the message. Basically a graphic designer, Neurath was concerned with helping common people to understand social change. He sought a method of presenting statistics in a way that was both correct and interesting. His method, originally called the Vienna method, later developed into ISOTYPE, an acronym which stands for International System of Typographic Picture Education (Neurath M 1973). Emphasising the importance of the Vienna method, Miles et al. (1988) acknowledge Neurath's contribution to an approach to exhibition development:

> Although Neurath's innovations in exhibition design have been less influential than those of Gropius, in our view both approaches are needed and we suggest that the successful exhibition designer is the person who can work from the gallery downwards and from the message upwards at the same time (Miles et al. 1988: 8).

Finally, between Neurath and the present day there are a number of developments in the process of exhibition making. The most important ones are the appointment of evaluators and audience advocates in many museums and the establishment of a separate department of public services for conducting visitor studies, as in the Natural History Museum in London. The current approach to exhibition development tries to incorporate as many factors as the 'gallery-downward' approach popularised by the Bauhaus; and the 'message-upward' approach popularised by Neurath. It also responds to multiculturalism by presenting the alternative and multiple perspectives rather than the old and dominant ones (Porter G 1993). It also incorporates a number of findings from visitor studies and learning theories of how people learn in museums and make meaning.

To illustrate with an example, the writer has selected Seeds of Change, an exhibition held in the National Museum of Natural History in Washington DC. This exhibition attempted to interpret the true meanings and events that followed Columbus's voyages of discovery 500 years ago and their implications not only for those of Americans alive in 1992, but for generations to come. It employed the new museological approach by telling the story not only from the western or European perspectives but also from the native American or multicultural perspectives.

For example, a display showing a native American, while landing in an Italian airport, proclaims that he had discovered the land of Italy and therefore the people of Italy are his slaves; the display gives the native American a chance to argue implicitly on what grounds can Columbus discover America when people have already been living there (Viola and Margolis, 1992).

To conclude, there has been a strong preference for thematic displays in many museums including science centres in recent years. By making the title evocative and inviting, they help fire and sustain the visitor's imagination. However, the two methods (systematic and thematic) can easily be mixed so that a thematic exhibition, built around a theme or story, can be chronologically ordered (Velarde 1988:94-95). At the same time, it must be borne in mind that the thematic and educational approaches cannot be uncritically applied to all museums and collecting institutions, irrespective of the specific nature and purpose of an exhibition that should be considered in determining the appropriate method for a project. The skills required would also vary depending upon the method of exhibition: for example, an art exhibit or systematic specimen exhibition would primarily be a curatorial project; a science centre display or extensive dioramic environment might be the main concern of the designer; and a heavily scripted presentation using extensive interactive menus would need the information structuring and editorial skills of an interpreter.

So far, I have discussed different approaches to the development of museum exhibitions in general; I will now restrict my discussions to science museum exhibitions in particular.

The changing nature of science museums and its influence over the design approaches to the development of exhibitions

Exhibitions in science museums in general have undergone tremendous changes over time. They were, originally, mainly object-based. The Musée de National des Techniques at the Consevatoire National des Arts et Métiers in Paris, opened in 1802, and was the first science museum with object-based exhibitions; it remained as such even now. Slowly and steadily a new breed of exhibits started appearing without the so called objects. The Deutsches Museum in Munich and Palai de la Decouverte in Paris are two museums representing the second and third stages in the evolution of science museums. These two museums mostly made use of the so called idea- or phenomena-based exhibits. How this transition occurred in science museums in India and other countries has been discussed in the previous chapter.

As can be seen, the spin-off from the transition from the second stage to the third stage is a new species, the science centre, with mostly idea exhibits without objects. Recently the science centre began to follow an integrated approach, that is using both idea-based and object-based exhibits. By fortuitous coincidence, it has become the Hooper-Greenhill's postmodern museum, which, according to her, is 'one that has thrown off the constraining yoke of outdated practices, and which has successfully used the best elements [*objects*] of the past and the most useful *ideas* of the present to forge a way towards the future' (Hooper-Greenhill 1994: 143-4, emphasis mine).

So the integrated approach has more advantages than others. How the integrated approach could be achieved in practical terms was exemplified for a theme, 'sun', by Orchistran and Bhathal (1984: 46):

> The science centrum display would aim to integrate ideas derived from the science and humanities. We would start with a definition of the sun that would include not only our current scientific interpretation (the sun as a star) but also the mythical and mystical perceptions of earlier people. Woven into this account would be a discussion of eclipses, some of the non-European interpretations which are more entertaining! We would also examine the sun's influence on clothing, lifestyles (particularly sporting activities), architecture, and the like, as depicted in contemporary and past civilisations.

The definition of the sun from the scientific, mythical and mystical perspectives, amongst others, has been practically executed during the late 1980s in the Sun Gallery of the Regional Science Centre, Bhubaneswar, India, a unit of the National Council of Science Museums.

Therefore, many science museums or centres recently recognised the advantages of SCIENCE CENTRe and science museUM and combined the advantages of both types to make a new breed. Orchistron and Bhathal (1984) discovered and gave the new breed a name 'science centrum' by combining only the capitals. But Baird (1986) thinks of this concept as something that the modern science museum has undergone during its evolution and confirms that one such new breed is the National Museum of Science and Technology in Ottawa, which has operated successfully in Canada since 1967. In all, the most recent approach to science museum exhibitions is a balanced mix of object- and idea-oriented exhibits.

HOW EXHIBITIONS ARE DEVELOPED IN MUSEUMS

Exhibition development undergoes many different stages depending upon the type of museums, the approaches to organising the materials, and many other factors. Besides the 'open storage' approach, there are two other approaches to develop museum exhibitions. They are traditional and project team approaches.

Traditional approach

Traditionally, museum exhibitions were developed in three stages. The curator selects the objects and writes labels; he or she selects the theme and outlines the individual exhibits and writes up labels for them. The designer makes things look good by selecting colour schemes and other things, primarily to limit damages. The teacher, that is the museum teacher (sometimes called the guide lecturer, educator or explainer), makes the best of things after the opening to explain or interpret to visitors (see Figure 2.1).

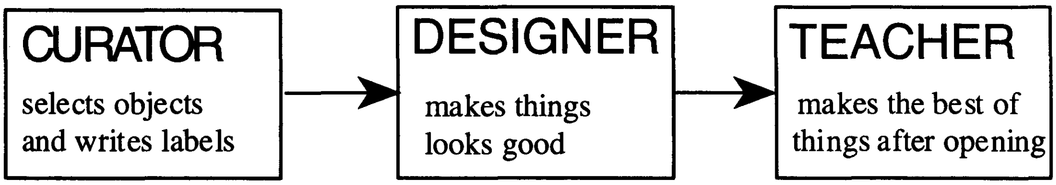


Figure 2.1: The traditional approach to development of exhibition (Miles 1993:27).

This traditional exhibition making process, as Miles (1993) argues, has many limitations especially in the post-industrial or information society that is dominated by technology with media, advertising, communication networks and multiculturalism. The problems with the traditional approach, according to him, include:

- People work in uncoordinated compartments.
- Curators' hegemony overtakes the visitor's interests.
- Design is reduced to window display.
- Educationalists are brought in too late to contribute

Similarly, the last problem of the traditional approach, that the educator was brought in too late in the process of teaching the exhibition rather than developing the exhibition, was also expressed by Hooper-Greenhill (1983). She also observed that the educational function of the museum is rarely seen to be as important as the curatorial function. Educators were often left on their own to develop educational programmes in British museums, as Hooper-Greenhill states:

> Education officers have been known (often as a result of difficult relationships in the museums or lack of resources) to buy in their own 'museum objects' and design educational programmes around these while ignoring the museum's existing collections (Hooper-Greenhill, 1983: 127).

This prevailing situation in the UK museums reflects the current situation of the development of exhibitions in Indian science museums; the Indian situation is rather worse as educators were not brought in at all and they often develop educational programmes which are unrelated to the exhibition topics. After having realised and understood a number of problems in the traditional approach, many museums, particularly the Chicago Field Museum of Natural History and the London Natural History Museum, have adopted the project team approach for developing museum exhibitions.

Project team approach

In 1982, the Field Museum of Natural History in Chicago organised a series of seminars as part of the Kellogg Project to explore an alternative method of exhibition development. Based on her experience as co-ordinator of the seminar, Gaiber (1984) described the team approach and discussed its merits and demerits. According to her, a team may contain from at least two to several people depending upon the institution. Mostly, museums have three members in a team, that is a curator, designer and educator. She emphasised the importance of the role of the educator in a team by bringing in the knowledge base of the audience. The team approach, as she argued, can minimise the costly mistakes and maximise the use of skills and talents.

More recently, Miles (1993) presented the Natural History Museum's approach that, according to him, aimed to solve the problems of the traditional approach. This new approach suggests that exhibition development should involve, in addition to curators and designers, evaluators, editors, educators, and various other people who have a stake in the exhibition. This new team approach is rather a two way process unlike the traditional approach. As shown in Figure 2.2, the crucial factor is the brief that has been made after involving not only curators and designers, but also educators, editors, evaluators and others. The exhibition will therefore be an outcome of the team play between professionals from disparate disciplines.

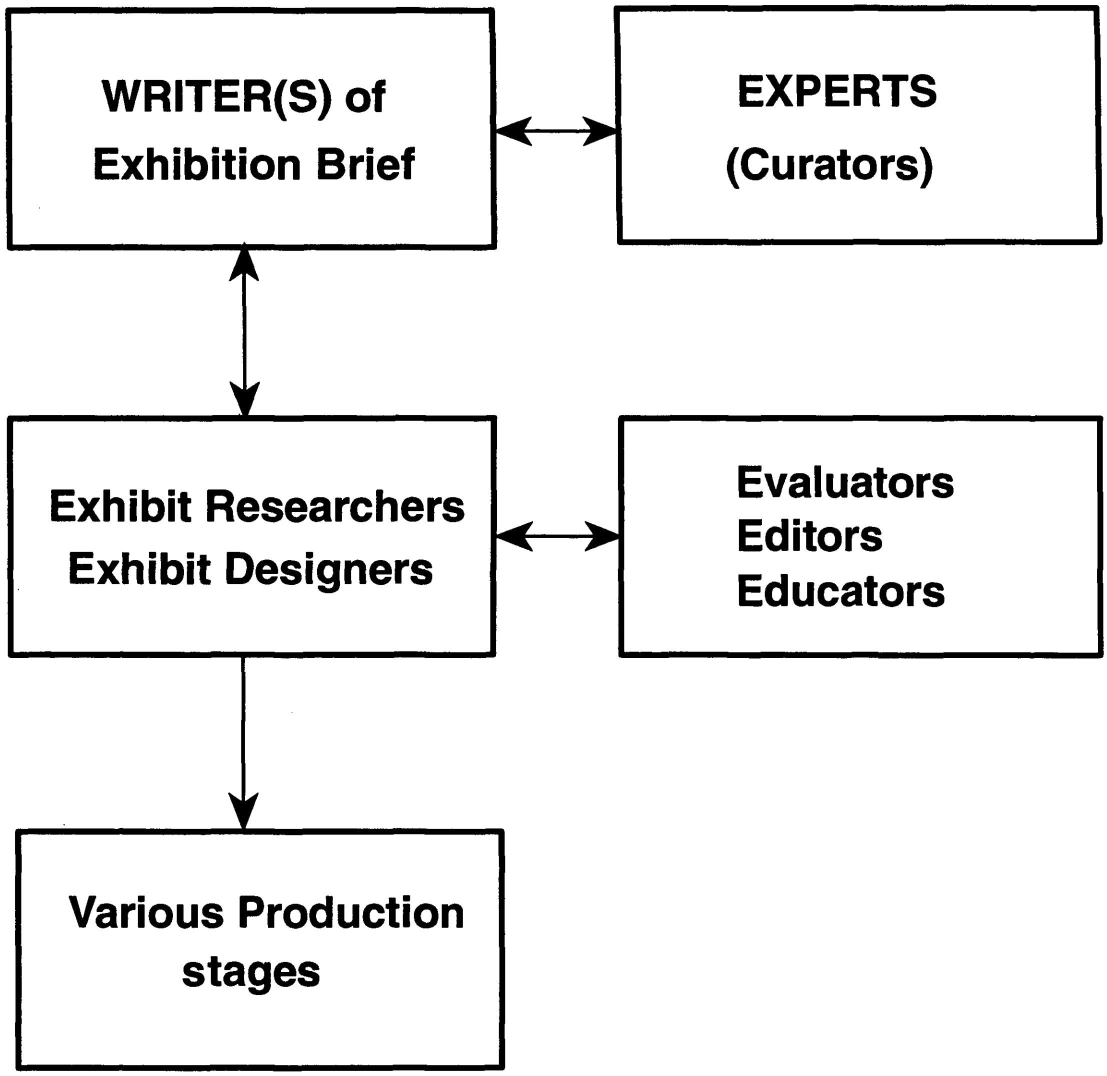


Figure 2.2: The London Natural History Museum's approach to designing educational exhibits aims to solve many of the problems of the traditional system (From Miles 1993: 27).

As well as the Chicago Field Museum of Natural History, there are two other museums that have made watershed contributions to the process of exhibition development: the Royal Ontario Museum in Canada and the Natural History Museum in London. The offshoots of the research efforts in these two museums are the two important publications that played many critical roles in shaping the process of exhibition development in the museum world.

The first is the ***Royal Ontario Museum Communicating with the Museum visitor: Guide-lines for Planning*** authored by the Communication Design Team of the Royal Ontario Museum in 1976. This book discussed the nature of a project team for developing a gallery. Based on the literature and experiences of several museums, it proposed that the development of a gallery requires an interdisciplinary team. The team in a small museum may be an individual who will require a series of resources in order to carry out the function. The team should basically include a curator, a designer, and an educator. The others may include conservators, media experts, preparators, artists, carpenters, maintenance staff, etc. The designers may be in-house or outside consultants.

The experiments and researches conducted at the British Museum (Natural History) resulted in another book ***The design of educational exhibitions*** by Miles and his associates (1988). This is the first book ever published on exhibition design and it attempted to integrate and involve as varied fields as evaluation, and visitor studies. Miles et al (1988) suggested that the team approach to exhibition development proved to be more effective than the traditional approach. According to them, the team should include curators, designers, evaluators, editors and educators.

The project team approach was also described with many variations by many others including Spencer (1991), Hall (1987), Belcher(1991), Klein (1986), and Miles et al. (1988). In what follows I will describe them synthetically and individually.

Spencer (1991) described a three-function approach to exhibition development that was utilised by the large museums with multi-disciplinary collections and staff with a range of specialist knowledge and experience. However, this is not to be confused with Miles's traditional approach, for the former is just a team approach with three main functions. First, the curatorial expertise provides a framework for collections and defines and delineates the subject areas and contents for the exhibition. By providing the intellectual content and thesis of the exhibition, the curator becomes a bridge with the institution's collections. Second, the designer gives an exhibition project a visual and three-dimensional form. He or she must create an environment firstly for objects to be displayed and secondly for the exhibition thesis to be communicated. Third, the interpretation, unlike Miles' teaching function, serves an editorial and advocacy function on behalf of museum visitors in the ongoing planning of the exhibition. Interpretation skills are needed to structure complex curatorial or scientific information into public messages that are comprehensible for the lay visitors as well as to help refine gallery layouts and displays into 'user-friendly' experiences for appropriate audiences.

Apart from the three distinct functions of curation, design, and interpretation, Spencer (1991) also advocated the involvement of other museum staff members such as educators, public relations officers, fund-raisers, financial and personal administrators, security staff, the registrar, and the conservators, in a broadly based exhibition committee for major exhibition projects. Both senior staff and less experienced officers may be able to contribute to the exhibition planning process. The chair person of the exhibition committee, to be chosen by the museum director, should be responsible for co-ordinating the efforts of all museum staff to achieve a major exhibition project.

Margaret Hall (1987), while offering a design grammar for museum exhibitions, was of the opinion that a team should be made to oversee the conception, design, production, and management of an exhibition. The size of the team will, of course, vary from one or two participants in a local museum to a large interdisciplinary team in a national museum, or a team of specialists brought together under a commercial sponsor. She further expressed the need for 'additional expertise' in the team, firstly an editor or script writer, followed by other experts on conservation, security, education, evaluation, publicity and technical advisers on the more specialised aspects of the lighting, use of computers and audio-visual presentation. She, however, admitted that many museums prefer to build exhibitions 'in-house' with experts appointed or hired for a specific project, rather than placing works with outside specialists. This is true in India, as almost all the science museums do develop exhibitions in-house.

Belcher (1991) suggested that the exhibition team in the medium-sized museums should include: the museum director to initiate and get necessary approval and monitor the project; the curator to provide specialist information, to prepare a list of exhibits, to select specimens or objects, and to provide a draft of labels; the designer to produce design solutions; the designer (graphics) to work with the designer on graphic elements of the exhibition, and to design catalogues and brochures; the conservator; the security officer; the education officer to contribute specialist knowledge on educational aspects of both the subject and exhibition to the brief and to advise on aspects on educational psychology and technology; editor; production staff; maintenance staff; marketing officer; and consultants preferably to review the exhibition proposal or for any of the above specialist jobs.

In sum, according to the above researchers and writers, the project team should consist of a number of experts as varied as evaluators, editors, educators and a range of others to make the exhibition benefit from the expertise of all of them so that it can really be effective to museum visitors with different levels of maturation, interests, learning styles, concentration and existing knowledge. The importance and advantages of the team approach over the traditional approach are many, as revealed from the experiences of the two authors for two different museums.

Recently there was a vigorous exchange centring around the team approach in the cyberspace (Museum discussion list in the Internet) between Paul Apodoca of Bowers Museum at Santa Ana, California and Kevin Coffee of the American Museum of Natural History, New York. While Paul Apodoca attributed the failure of an exhibition 'Travelling the Pacific' at the Chicago Field Museum of Natural History to the team approach, Kevin Coffee counter-argued that Apodoca's attribution is unsubstantiated. Later, John Terrell, the curator in-charge of developing the exhibition, came in to clarify 'what went wrong with our pacific galleries wasn't the fault of the team approach; things went wrong because we didn't follow the team approach (Terrell, 1994). Terrell (1993) elsewhere described how the wonderful *Maori meeting house* was reconstructed using the team approach including the full participation of the 'native community'. The team should therefore not only include the experts from inside the museum but also non-experts from outside the museum.

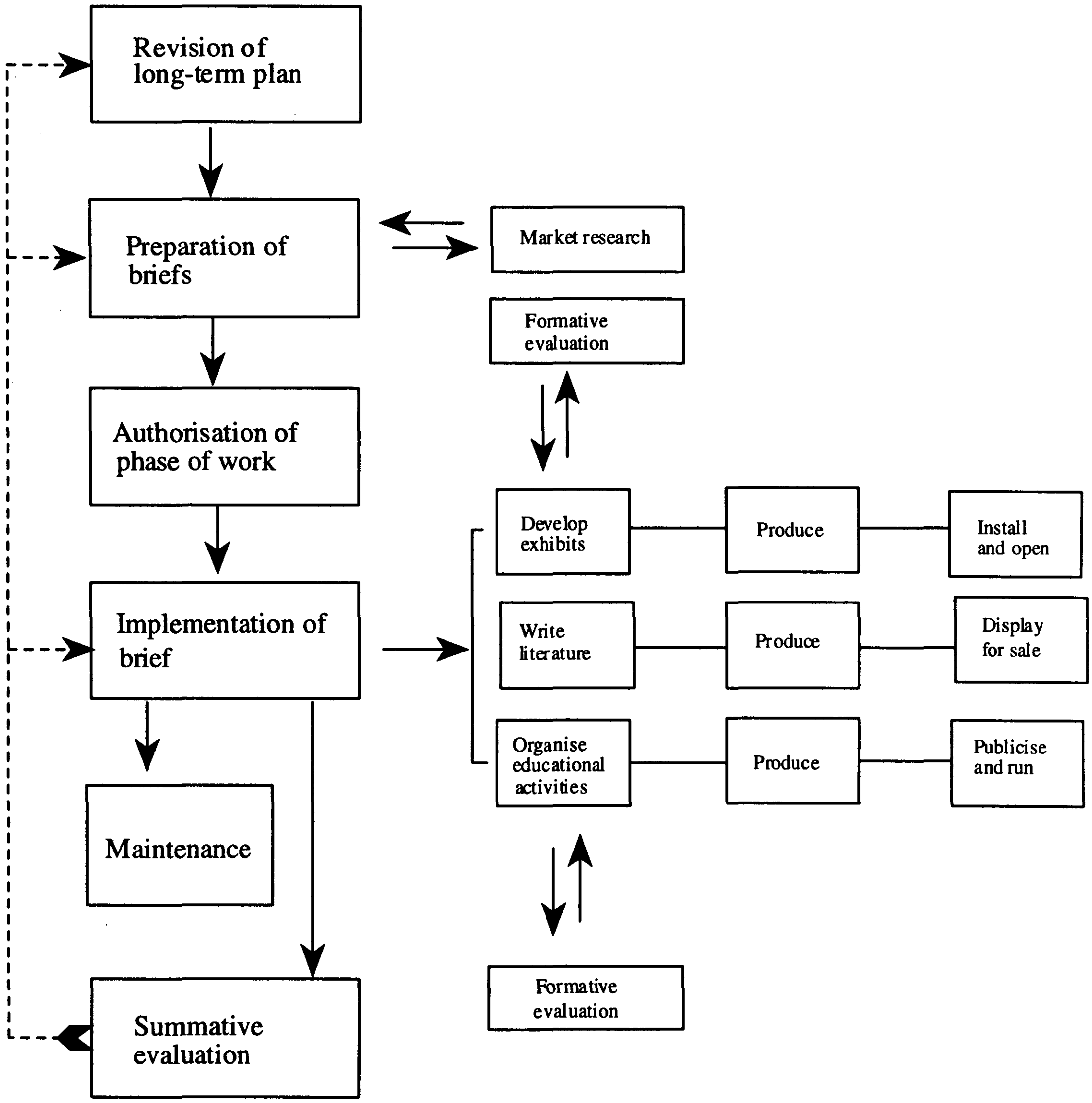


Figure 2.3: Activities involved in planning, designing, and producing exhibitions, from Miles (1985)

The development and importance of the team approach to art museum exhibitions were expressed recently by Hallowell as follows:

> Some art museums today use a team approach that involves curators, educators and designers as equals in planning both special exhibitions and reinstallations; many museums conduct audience research. Such 'shared ownership' of museum exhibitions is necessary if museums are to be viable players in the quest for public funds, capable of answering Weil's 'So what?' questions. The process surely must involve input from more players than the curator, however enlightened. Museumgoers, museum educators, museum guards, museum exhibition designers, as well as museum curators, actually do ask 'fruitful questions', and they provide valuable information about how and why art museums are used. The collaborative process, although often painful because it requires serious connecting and negotiating (and for curators, what may feel like a critical loss of status and independence), may have the most beneficial results for museum visitors and the future of museums (Hallowell, 1994: 230).

Stages in the development of museum exhibitions

Underlying the project team approach, there are a number of stages through which the development of exhibition undergoes (Spencer 1991, Hall 1987, Belcher 1991, Klein 1986, and Miles et al. 1988). The main stages of exhibition development are excellently captured by Miles (1985) in his all embracing model in Figure 2.3. These stages are partly or fully followed whether the development of exhibitions is done in-house or contracted outside.

EXHIBITION DEVELOPMENT IN INDIAN SCIENCE MUSEUMS — A CASE STUDY

Generally, science and technology centres in North America and India conceive, design, construct, and install their own exhibitions. The majority of them belief that they can do better jobs than any outside consultants. As some of them feel that it is more economical, they generally have an exhibition development department.

In North America, for example, the Ontario Science Centre in Toronto has a total of about 60 or more staff; they are scientists and scientific assistants, exhibit designers, and craftsmen in the wood, electrical and metal workshops. Similarly, the Exploratorium also has an exhibition department with a number of staff responsible for creating exhibits.

In India, of the total of about 30 science museums or centres, the majority are centrally administrated by the National Council of Science Museums. Among the rest, four are administrated and funded by private trusts (equivalent to independent museums in the UK) and another four are administrated by the local governments. A discussion of them is presented in Chapter I. As I have already shown, the NCSM units are in four levels namely national, regional, sub-regional and district levels. The national level science museums of the NCSM have their own exhibition department and will be administering its regional, sub-regional and district level museums or centres. The regional level museums will have a small workshop mainly to maintain the existing exhibitions and to fabricate exhibitions in a very limited way. The sub-regional and district level science centres have their exhibits fabricated in the corresponding national museums. The exhibition department in a national level museum, including the Central Research and Training Laboratory, typically has three sections. They are a workshop section with a mechanical engineer who is often called Curator (Mechanical) or Technical Officer, an arts section with an Exhibition Officer(s), and an electronics section with an electronic engineer, called Curator (Electronics) or Technical Officer. In these museums, centres, or laboratories, the director initiates and the curator most often co-ordinates the whole exhibition.

The typical exhibition development department in the national level museums has approximately fifty staff. The Birla Industrial and Technological Museum has a workshop section with 35 members, an art (design) section with 11 members, and an electrical and electronic section with 12 members of staff. In Visvesvaraya Industrial and Technological Museum at Bangalore, there are about 28 staff in the workshop section, 5 in the arts section, and 16 in the electrical and electronics section. In the National Science Centre at Bombay, there are 21 personnel with the workshop section, 6 with the arts section, and 12 with the electrical and electronics section.

Therefore, the exhibition development draws inputs mainly from curators, designers (Exhibition Officers as the NCSM calls them) and in-house fabricators. Fabrication of the exhibit is mainly carried out by two equally important sections namely, the mechanical workshop section and the electrical and electronic section. The heads of these sections, usually mechanical or electronic engineers respectively, are also curators and therefore they may sometimes co-ordinate an exhibition project in addition to their fabricator's role. Curators other than mechanical and electronic engineers are mostly specialised in one of the physics-related, chemistry-related, or life science-related subjects. It is a pity that graduates in mathematics or museum studies are not even eligible to become curators in the NCSM.

Besides the inputs from fabricators, the approach in Indian science museums is almost traditional and very much resembles Mile's traditional approach shown in Figure 2.1 for the following three reasons: first, the educators in the form of guide lecturers or explainers are used to teach exhibits only in a later stage, that is after installation of the exhibition; second, they and the education officers have so far not been involved in the process of exhibition development, though the education officers are sometimes directed to co-ordinate an exhibition (usually temporary) project; and last, the designers transform the curator's idea into three dimensional shape by only suggesting the colours and shapes, but suggesting the educational design only to a limited extent.

The activities for developing an exhibition in a national level museum or centre under the NCSM are as follows: the director of the museum will initiate the exhibition by selecting a theme and a responsible curator or an officer; the curator or the officer will be co-ordinating the project; the conception of exhibit ideas and story-line will be developed by the co-ordinator and his or her director. On a few occasions, a presentation of the core ideas of the exhibition or sketches of exhibits are presented for brainstorming purposes in the internal meetings of staff members. After feedback from the designers, education officers and other staff members, a final list of exhibits would be prepared. The exhibition officer (designer) would translate the ideas into scale models with layout and scheme of colour. After this preliminary design is approved by the director and the co-ordinator, the fabricator, usually a mechanical engineer responsible for the workshop, will start wood works, sheet metal works and case building. The electronic section would be responsible for any electronic circuits that go into the exhibits. The arts section would be responsible for the layout and screen printing of labels and finally mounting them on the exhibits.

The local government types of Indian science museums usually follow the same pattern as the units of the NCSM, except that the construction of exhibits is more often contracted outside. In this case, a curator, scientific officer or technical officer is made responsible for co-ordinating the project; the exhibition officer, or more often an artist, would work under the guidance of the co-ordinator to translate the ideas into three dimensional form; the fabricator, most of the time, is an outside contractor. In case the fabrication is undertaken in-house, there is a provision of an electrical and electronic section that would design and make electronic circuits if needed, and a mechanical workshop to make carpentry and sheet-metal works of exhibits.

The independent science centres have very few staff members responsible for fabricating an exhibition. The Birla Museum in Pilani has a curator with an artist assistant and 12 craftsmen of various skills. If the workload is more than these members could manage, additional craftsmen, especially carpenters, would be appointed on a temporary basis. The Birla Science Centre in Hyderabad also has only one technical officer with his team of an electronic assistant, artist assistant and a few craftsmen to develop the exhibition. In this type of private-run science centres, a curator or technical officer is responsible for the entire development of the exhibition; he or she often uses only subordinates, not equals, — assistants and craftsmen — to carry out his (yes, only males) ideas into exhibits or exhibitions.

Underlying these activities, there are six stages of development of the exhibition in Indian science museums: identification, planning, design, fabrication, and installation and maintenance. In the identification stage, the theme or topic of the exhibition and the curator who will be the co-ordinator are identified by the director; the topic is sometimes suggested and usually approved by members of various committees responsible for running the museum. The planning stage would see the preparation of the list of individual exhibits, labels of each exhibit and a curator's sketch for each exhibit. In the design stage, the designer would translate the curator's sketches into three dimensional scale models within the lay-out of the exhibition. In the fabrication stage, the engineers design the mechanisms or circuits, and finally make them. In the installation and maintenance stage, work includes the placement and setting up of exhibits, lighting and final touches, and maintenance of exhibits during the life of the exhibition. The NCSM model is shown in Figure 2.4.

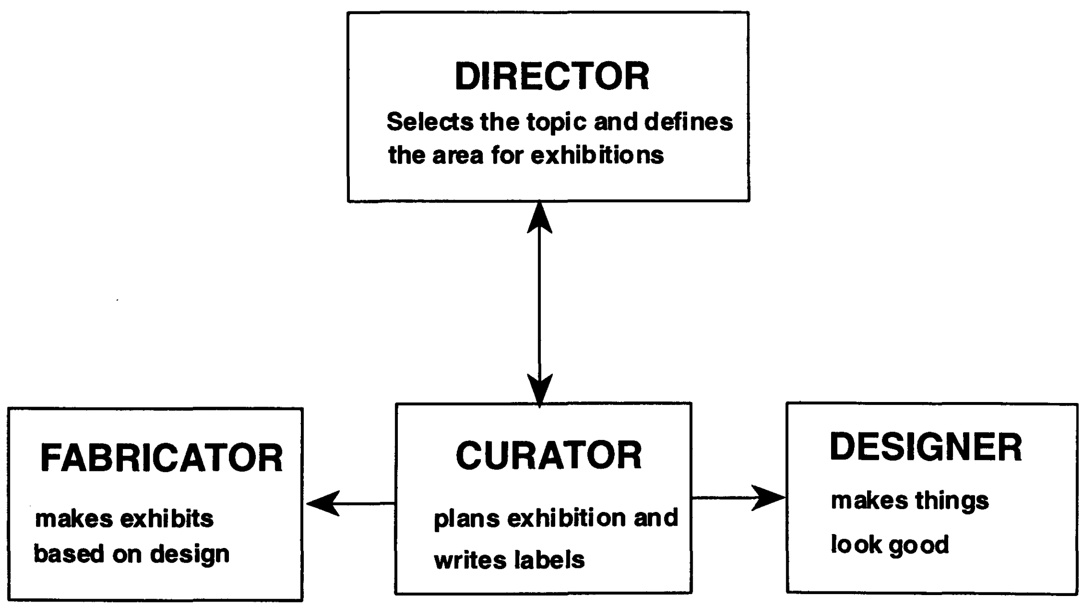


Figure 2.4: The NCSM's approach for development of exhibitions in India.

Overall, the science museums in India more or less follow a single pathway in exhibition development with its director's and curator's captaincy as evidenced by the arrowheads in Figure 2.4. The contribution from evaluators and educators in addition to editors, for the planning and development of the exhibition is totally absent. The educators, in the sense of Miles's teacher, are the guide lecturers or explainers that are available in the gallery but the education officers are left to develop stand-alone programmes and activities outside the exhibition-related topics. The design of the exhibition was always done in-house, never by consultant staff, in any of the science museums in India.

CONCLUSIONS

This chapter intended to pull together literature evidence on exhibition development in the UK and US museums and science centres and to analyse the situation of exhibition development in Indian science museums. The team approach is mostly preferred to develop successful exhibitions in the UK and USA as many exponents in the museum field, design field, and marketing field advocate involvement of all those who have a stake' in the process of exhibition development. While stressing the importance of educational and behavioural research in public learning, Guthrie suggested that educators can contribute expertise on learning theory to the exhibition development, while the curator can supply information pertinent to the collection and aspects of purely museological concern (Guthrie 1983:20). Gurian (1990) also advocated the role of the educator as an audience advocate. The concept of audience advocate has already been discussed more elaborately in Chapter I.

Many advocate the understanding of museum visitors through conducting various visitor studies or collecting evidence from a mass of published visitor studies literature. Though the team approach — incorporating inputs from visitor studies and learning theories and styles — has been successfully attempted to develop exhibitions in a few museums in the UK and the USA, there is still a lack of a solid body of evidence and findings that could guide museum or exhibition planners to develop exhibitions to accommodate visitors with varied expectations, levels of intelligence, learning styles, and so on.

Generally in museums, the exhibition is developed using the traditional uni-directional approach or using the team approach with the help of curators, designers, and educators. Exhibitions are usually fabricated either in-house or contracted outside. Though inputs from the evaluators, editors, and educators are nonetheless sought and fed into the exhibition development of some of the UK and the US museums, they are completely absent in Indian museums including science museums. In this thesis, I have decided therefore to restrict and contribute only to two areas of expertise: the educator's expertise in applying learning theories and learning styles to understand the nature of museum learning and the museum visitor; and the evaluator's expertise in conducting visitor studies to understand the nature of the museum visit and applying them in the process of exhibition development.

In the next two chapters I will investigate the nature of museum learning (Chapter III) and the nature of the museum visitor in terms of their learning styles (Chapter IV). These two concepts and the nature of the museum visit are explored particularly in the Indian context using three different empirical studies namely a survey, an observation, and an interview (Chapter V to VII). In the following chapter, I will present and review various learning theories and visitor studies conducted in museums in order to identify a conceptual framework to explicate museum learning.

CHAPTER III

THEORIES OF LEARNING AND A 'SPIRAL' APPROACH TO MUSEUM LEARNING

INTRODUCTION

A few decades ago, researchers were trying to measure cognitive outcomes in the museum exhibition environment using the instruments developed for classroom settings. They found no meaningful outcomes in this area (for example, Shettel, 1973). It was felt that in order to understand the dimensions of museum learning, new procedures and instruments are needed that go beyond those developed for the classroom. More recently, many researchers (McManus, 1987; Hilke, 1984; and Borun, 1977) found that visitors do learn inside the museum and some researchers (for example, Tulley and Lucas 1991) even supported this with empirical evidence that cognitive gain occurs after the encounter with a museum exhibit. Over the years, museum learning has been regarded not just as information transfer and cognitive engagement but also as a whole range of experiences including attitudinal, contemplative, emotional, social and recreational aspects. In this chapter, I will look at various learning theories and museum studies in order to propose a new approach to museum learning, which does justice to the unique learning environment of museums.

LEARNING THEORIES

Before discussing learning theories I will present two associations which people often mistakenly attach to them.

First, theories of learning normally bring to mind psychological theories in a limited sense because 'learning theory', strictly speaking, used to be a distinct area within theoretical psychology and a product of the 'arm-chair' method of introspection. In recent times, mainly during the 20th century, many psychologists have involved themselves with the study of learning theory and have concentrated upon developing systematic theories supported by experimentation. Still more recently, theories of learning have included many areas as diverse as cognitive development, theory of knowledge, and learning styles. For example, any major work on learning theories could not exclude Piaget's contribution to learning although he is not originally a learning theorist. Thus it appears that the differences between the subject areas from which a theory originated are ignored. Learning theories therefore include anything that provides explanations about learning.

Second, many may respond to theory negatively, more particularly non-academic museum personnel, who may associate theory with impracticability and unrealism. Yet they often have and believe their own theory of learning, even though they may not have stated it in so many words. They may use different theories in different times or situations or conflicting theories for different decisions in the same situation. There is a cliché, often attributed to Kurt Lewin, that nothing is so practical as a good theory to enable people to make choices confidently and consistently, and to explain or defend why they are making the choices they make. The better they understand various theories, therefore, the better decisions they would be able to make regarding learning experiences that will achieve ends they would wish to achieve. Theories are therefore very useful in providing both explanations of phenomena and guidelines for action.

Learning is a word that has many meanings and is said to occur everywhere and all of the time — from school to the supermarket. Though there may be a basic agreement about the definition of learning amongst theorists, there are many controversies about its fact and interpretation. To put it simply, learning is essentially a change due to experience. This may be a 'product' when the emphasis is on the end result or outcome of the learning experience; a 'process' when the emphasis is on what happens during the course of a learning experience in attaining a given learning product or outcome; or a 'function' when emphasis is on certain critical aspects of learning, such as motivation, retention and transfer, which presumably make behavioural changes in human learning possible. Learning can be a planned (nurtured) change in behaviour and also a natural growth. Some theories treat learning as process whereas others emphasise growth such as cognitive development; still others, called third force psychologists like Carl Rogers and Abraham Maslow, argue that learning is self-initiated and self-actualisation.

So, learning theories basically fall into one of three major schools, namely the stimulus-response or behaviouristic school, the cognitive school and the humanistic school. There are, however, a number of theories that assume views of more than one school. For example, Gagnes' conditions of learning, Bruner's cognitive psychology, Kolb's experiential learning, and many theories of learning styles which assume views from more than one school. In what follows, I will present a number of theories and concepts from the stimulus-response school (hereinafter the S-R school) that are relevant to museum learning.

Stimulus-Response or Behaviouristic school

Theories from the S-R school suggest that learning evolves out of the development of associations between stimuli and responses. This means that learning can be programmed to take control of the learner's environment by continuously reinforcing the correct responses while punishing the wrong ones. For this theorist, learning is therefore a change in behaviour. It involves the formation of relations of some sort between a series of stimuli and responses. Stimuli, the causes of learning, are environmental agents that act upon an organism either to cause it to respond or to increase the probability of a response of a certain class or kind. Responses, the effects of learning, are the physical reactions of an organism to either external or internal stimulation (Bigge 1976).

While the S-R school has made an invaluable contribution to psychology and to the developing information-processing field, there are only a few psychologists today who adhere to this position as the sole explanation for learning. It is, however, important to understand these theories as some aspects of museum learning can be understood from these perspectives. The major exponents in the S-R school are Edward Lee Thorndike (1874-1949), Burrhus Frederic Skinner (1904-1990), Clark Leonard Hull (1884-1952), Ivan Petrovich Pavlov (1849-1936), Edwin Ray Guthrie (1849-1936), Edwar Chace Tolman (1886-1959) and John Broadus Watson (1878-1958).

Ivan Pavlov, a Russian physiologist, not a psychologist, accidentally discovered 'classical conditioning' while he was working with dogs in his laboratory. He found that the dog can be conditioned to salivate at the sound of a bell without the food, if the connection was reinforced repeatedly between the bell and the food. He also found that the dog would also salivate at other similar sounds like that of siren.

The first American psychologist who made use of Pavlov's research findings is John B. Watson; he is therefore called the father of behaviourism. According to him, humans are born with a few reflexes and the emotional reactions of fear, love and rage, and all other behaviours are established by building new S-R connections through conditioning.

Similarly, Edward Thorndike, another American psychologist, posited that learning is a process of 'stamping in', or forming connections between a stimulus and a response. His theory is known as connectionism and it dominated educational practice in the US during the 1950s. According to him, the main factor influencing all learning is reward, and connections were strengthened by rewarded practice; practice without reward will be ineffective. This idea of learning suggests the importance of repetition, practice, and drill.

In this school, the most important contemporary psychologist is B. F. Skinner. Like Thorndike, Skinner viewed reward, or reinforcement, as the most important element in the learning process. Skinner preferred reinforcement to reward. He identified two types of response in the learning process: *respondents* and *operants*. *Respondents* are elicited by specific stimuli such as Pavlov's bell, corresponding to classical conditioning. On the other hand, according to Skinner, an individual's responses are initially random, but after some time, due to selective reinforcements some responses are dominant. These dominant responses are called *operants*. Skinner's operant conditioning differs from Thorndike's explanation of learning as follows: what is strengthened by conditioning is the S-R bond according to Thorndike; but according to Skinner, what is strengthened is the probability that the same response will occur again.

Since the 1940s, behavioural psychologists have been interested in how children acquire social behaviours. These behaviours include co-operative, competitive, affiliative, assertive, aggressive, moral-ethical, and other social responses. The operant conditioning suggests that the individual must perform and be reinforced by his or her responses for learning to occur. Realising this is not always true, Bandura and Walters (1963) proposed a social learning theory. According to this theory, children learn social behaviours by observing the actions of important people in their lives—their parents, siblings, teachers, peers, and television heroes. It is therefore not necessary to experience everything and learn, but it is possible to observe others and learn. Therefore, social responses are primarily inferred from observing behaviours and this is referred to as modelling or observational learning.

Observations, according to Bandura and his followers, are stored in the form of mental images and other symbolic representations that sometimes help people to imitate behaviour. Social learning theorists differ from behaviourists, for the former think that imitation does not always occur in the observational learning. For example, a person observing a car in front that hits a pit on the road would avoid the action, i.e. by not imitating it. So, it is not the action that one learns but the information. In social learning theory, both behaviour and the environment are changeable. Bandura and others believe that we can learn as much from vicarious experiences as from observing the consequences of our behaviour. This idea has implications in museum learning as a pre-recorded video which demonstrates the working of an exhibit, or watching others using the exhibit, enables museum visitors to learn vicariously before they interact directly. Therefore, the museum is a place where visitors interact with other members of society and learn through observing others.

The above point was supported by an empirical study in a science centre. From studying visitors at the Lock and Key exhibit at Launch Pad in the London Science Museum, Tulley and Lucas (1991) found that people gained cognitive gain not just by participating themselves but also by watching others: that is, people who watched others before having a go tended to take significantly less time to both assemble and reassemble the exhibit than those who did not watch others. This result suggests that vicarious experience is possibly an important method of learning in interactive science centres and that perhaps physical engagement is not always necessary to learn from such exhibits.

Skinner also designed also a procedure called 'shaping', a method to develop new behaviour or learning. In this case, reinforcement is applied to responses that successively approximate or are increasingly closer to the desired behaviour. This means that the level of the task is reduced or approximated so that the subject is successful (reinforcement), and the level is increased stepwise until it reaches the desired level (Skinner, 1972).

On the other hand, dialectically opposed to the idea of shaping, 'scaffolding', according to Vygotsky, is another approach to develop new learning. In this approach, the level of the task is kept unchanged but the learner is supported or is helped with assistance from teachers or experts (scaffolds), until they master the learning to reach the level without any help from others. Both shaping and scaffolding might be useful in museum learning. For example, many exhibits explain simplified concepts and these are made simple so that they are decipherable to any visitor; similarly, some exhibits are manned so that everyone approaches them operates that exhibit correctly and understand the concepts.

In sum, many of the principles from the behaviouristic school have been applied in programmed instruction, Computer-Assisted Instruction (CAI) and museums. For example, the quiz games within a museum exhibition provide feedback; the design elements of exhibits to attract and hold visitors assume behaviouristic principles.

Cognitive School

The cognitive psychologists theorise that learning is a process of gaining or changing insights, outlooks, expectations or thought patterns. Reasoning involves the development of symbolic images of reality and the use of these mental images.

Reasoning stimulates a search for relationships and solutions from what is already known; familiar elements are combined in different ways to create novel or original answers. Knowledge is the result of the rearrangement of ideas and experiences into concepts. These theorists prefer the terms *person* to *organism, psychological environment* to *physical or biological environment,* and *interaction* to either *action or reaction* (Bigge 1976).

Within this school there can be identified three major areas, namely the gestalt theory, developmental psychologists, and information-processing psychologists. They all have a number of similarities and differences. The major proponents of this school are Max Wertheimer (1880-1943), Wolfgang Köhler (1887-1967) and Kurt Kofka (1886-1941), the founders of the Gestalt theory; Jean Piaget, a representative from the developmental psychologists; and Donald Norman, a representative from the information-processing psychologists.

The Gestalt theory

According to Gestaltists, the organism adds something to experience that is not contained in the sensory data and that something is called organisation, to which the German word is gestalt. For example, let me arrange or draw three straight lines in a triangular form without touching each other on a sheet of paper. No one will find it difficult to identify the drawing as a triangle even though its corners are not joined. People tend not just to perceive the sensual stimuli — in this case, they are just three lines arranged in a triangular form — but they add to those sensuous stimuli some information and perceive it as a triangle without any difficulty. Having recognised this holistic perception of people, Gestaltists argue that people experience the world in meaningful wholes and that these should be therefore the subject matter of psychology. Their oft-quoted slogans are 'the whole is different from the sum of its parts' and 'to dissect is to distort'.

Developmental psychologists

Piaget is a major exponent in this area of the cognitive school and is basically a biologist-turned-epistemologist. For him, 'to know or to understand is to transform reality and to assimilate it to schemes of transformations'. This is the basis for all learning through hands-on activities that is happening in science museums and recently also in other museums. His theory of cognitive and intellectual development proposes that children undergo developmentally four stages that are genetically determined: sensory motor, pre-operational, concrete operational and formal operational. The stages are very much related to the physiological age of children: 0-2 years for the sensory motor; 2-7 years for the pre-operational stage; 7-11 years for the concrete operational stage; and 11-15 years and onwards for the formal operational stage. Though there are research findings that do not support the exactness of the years, there is a general consensus of agreement for his stages.

For Piaget, a fundamental concept underlying all the stages is adaptation. It consists of two very important processes through which every child or adult undergoes simultaneously, *accommodation* and *assimilation*. *Accommodation* is the process by which a child or adult accepts that external conflict in ideas is due to a deficiency of his or her own internal mental structure (which Piaget called schemata) and changes it. *Assimilation* is the process by which a child internalises external observations and fits them into his or her schemata. It is the dynamic equilibrium between the two fundamental processes that keeps the organism (the child or adult) developing (Bagchi, Yahya and Cole, 1992).

The Piagetians have a number of similarities with the Gestaltists. Both agree that experiences are organised; and both believe that there is an innate need for a psychological balance. But they differ on the matter of innate organisational abilities. For example, those who tend to emphasise the Gestalt at all levels would prefer to see the total picture. Such teachers in schools would prefer group discussions or the lecture system. On the other hand, Piagetian teachers would be concerned about the individual student. By the same token, in museums, gallery instruction or lecturing is undertaken in two different ways. First, guide lecturers or museum docents would walk museum visitors along various exhibits to give a whole picture of the museum or its gallery. Second, the explainer interacts with visitors on an individual basis, facilitates learning in an individual exhibit, and meets the demand of the individual learner who passes by the exhibit.

Information-processing psychologists

Donald Norman is a representative for the information-processing area of this school. His model resembles that of Piaget to a certain extent (Hergenhahn and Olson, 1994). According to his theory of complex learning, there are three different processes which essentially link a learner's present knowledge with new experiences to acquire new learning; they are *accretion*, *restructuring*, and *tuning*. *Accretion* is the process by which an individual acquires information to fill in the mental structure. This, more or less, resembles Piaget's *assimilation*. *Restructuring* is the process by which the learner enhances his or her mental structure to understand the acquired knowledge, in short making new concepts and understanding. It resembles Piaget's *accommodation*. *Tuning* is the process by which the learner begins to master the performance or learning with continued use. Ultimately, he or she reaches a stage of automation in the domain through practice and problem solving.

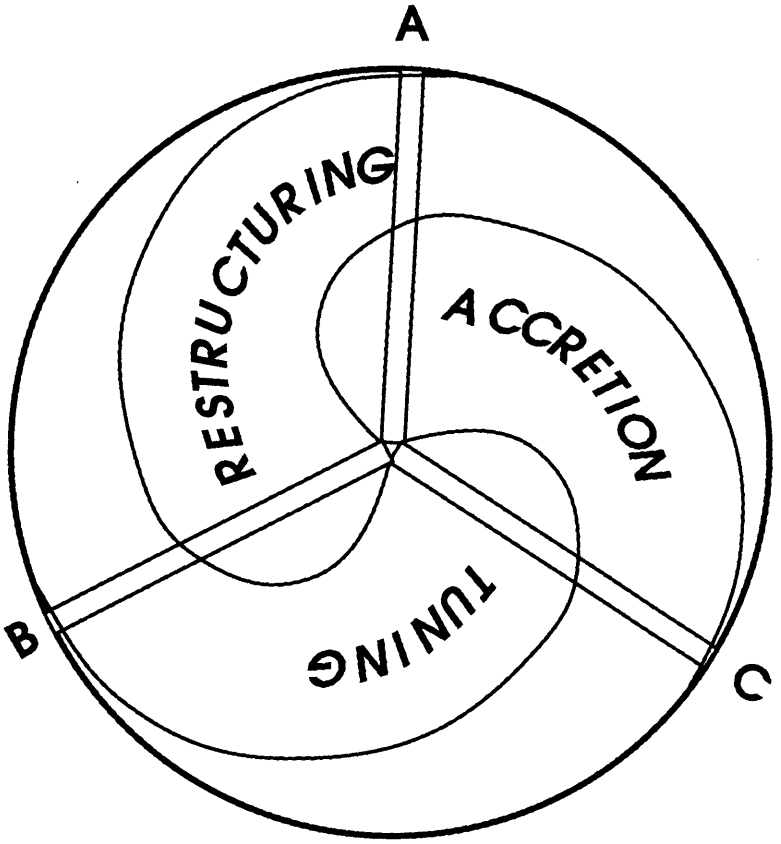


Figure 3.1: Nature of action of three modes of complex learning. A. The radius represents a situation when more of accretion followed by restructuring and less of tuning takes place. B. The radius represents a situation when more of restructuring followed by tuning and less of accretion takes place. C. The radius represents a situation when more of tuning followed by accretion and less of restructuring takes place. The circle symbolises that there can be any one of the situations (A, B, C, or any other) to start with and that an individual can move in either direction (clockwise or anticlockwise) depending upon one's past experiences.

This theory accounts very well for what is going on in the science centre. For example, young children, through exploratory play, spend a great deal of time in the process of *accretion*. They accumulate a set of discrete notions about a particular material or activity but, once this becomes familiar, the child will increasingly be able to perceive underlying patterns or concepts and begin the process of restructuring, sometimes with help from parents or explainers. This process is then likely to be followed by a new period of *accretion*. The cycle is likely to be repeated until a period of *tuning* emerges in which a new learning experience has been thoroughly acquired and becomes '*automatic*'. This period is characterised by a fluency or mastery of these recently acquired concepts or skills.

The modes of learning — accretion, restructuring and tuning — do not necessarily occur in sequence but they are always present, as represented in Figure 3.1. The sweep of the radius of the circle represents the nature of learning that has neither a definite starting point nor a definite ending point. The start always builds upon previously acquired material. Learning is therefore not a unitary process and there are different modes of learning, each with different behavioural and instructional assumptions.

In sum, for cognitive psychologists the process involved in learning is much more important than the outcome. The three sub-areas in this school explicate different aspects of museum learning: for example, the Gestaltists and Piagetians suggest different approaches to gallery instruction while the information psychologists throws light on different modes of learning that takes places in museums.

Humanistic school or third force psychologists

During the late 1940s, a new psychological perspective emerged from the work of clinical psychologists, social workers and counsellors. This movement became known as humanistic, existential, perceptual or phenomenological psychology and attempted to understand behaviour from the point of view of the behaver rather than the observer. The exponents in this school are Arthur Combs (1974), Abraham Maslow (1970) and Carl Rogers (1967). They are often called third force psychologists and they are concerned with studying the development of fully functional persons, to use Roger's term, or self-actualising persons, to use Maslow's. They are critical of the atomistic approach, common in physical science and among behaviourists, of breaking things down into their component parts and studying them separately. According to this school, learners are influenced and guided by the personal meanings and feelings they attach to their learning experiences. The goals of humanistic education have been incorporated into a number of alternative approaches; they include open education, moral education, and co-operative learning (Dembo 1991).

Carl Rogers' student-centred teaching has derived from his client-centred therapy, which he developed from the study of adults in therapy. To him, therapy is a learning process. Rogers believes that individuals have a desire to learn and are more likely to learn when they perceive that the learning is relevant to their own needs and purposes and when it is self-initiated. He also pointed out that threat can diminish learning. He sees the role of the teacher as a facilitator of learning (Rogers 1967).

Abraham Maslow (1970) proposes a learning hierarchy, according to which higher level human needs such as learning can proceed only when the lower level needs such as hunger are met. Before any meaningful learning may occur in museums, visitors should feel safe and secure. Only if such needs as hunger and tiredness are under control, will visitors be able to look for new information, aesthetic sensations or new knowledge.

The belief of this school that the students will learn if they are freed from teacher-directed or other forms of pressure and are allowed to decide what they want to do in the class room, came under much criticism. Having felt that students are not free simply because their teacher chooses not to exert control over their behaviour, Skinner (1973) argued that they then come under the control of other conditions and their effects.

Humanistic psychologists are more closely aligned with cognitive psychologists in their view of the teacher as a facilitator or mediator of learning than they are with behavioural psychologists, who view the teacher as a director or manager of learning. Unstructured teaching methods can be effective in helping students to attain many educational objectives. For example, Peterson (1979, cited in Dembo 1991) found that open teaching was somewhat more effective in developing independence and curiosity among students than was structured teaching. This does not mean that unstructured methods are the only way to attain affective goals. The research on mastery learning and other forms of individualised instruction indicates that positive affective outcomes can also be achieved through structured methods of teaching.

It is important to note that there is more than one theory in a particular school and they differ to a certain extent. The educational methods, like open class-rooms and co-operative learning, and functions like motivation and personality, are not wedded to one theory, or one school. According to Dembo (1991), the open classroom makes use of Piaget's cognitive-developmental theory and of humanistic theory. Co-operative learning uses ideas from all three traditions. Though interpersonal relations and positive communication (humanistic goals) are given high priority in co-operative learning, group rewards provide incentive for group members to help each other (behavioural principles) and group members must identify the task and select appropriate learning strategies to achieve their objectives (cognitive principles). Dembo therefore makes a very important point that some teaching methods can be used simultaneously for different objectives and can be claimed by more than one theoretical position.

So far in this section we have seen a number of theories from the three schools and discussed a number of concepts. Although behaviourist theories are viewed in a negative fashion, they are widely used in our society, for example, in much of advertising in general and to an extent in museums. The concepts of attracting and holding power of exhibits are behaviouristic notions for they assume the exhibit as stimulus (Dierking, 1992). Cognitive theories, on the other hand, contradict behaviouristic notions and emphasise the process of learning. Cognitive theorists had tremendous influence over hands-on learning in museums and other educational institutions. Humanistic theories, especially Maslow's hierarchical learning, influenced the whole museum experience that emphasises not only good exhibits but also good restaurants and other facilities. From the above discussions, we can conclude that theories from all three schools of thought, though they have deficiencies in some respects, are useful and applicable in a learning situation including the museum setting.

SOME COMPREHENSIVE MODELS OF LEARNING

Realising the importance of the three different schools in defining different aspects of learning, many researchers attempted to develop comprehensive models containing elements of theories from more than one school. I will present some of them in this section. They are the theory of experiential learning, Knowle's theory of andragogy and motivational learning theories.

Theory of Experiential Learning

Kolb (1984) offers a theory of experiential learning, which, he claims, synthesises mainly three traditions: Dewey's experiential learning in higher education, Lewin's experiential learning in training and organisational development, and Piaget's cognitive developmental experiential learning. He also opines that in addition to these three, a contribution to experiential learning also comes from Carl Jung's therapeutic psychology, Carl Rogers' client-centred therapy, Maslow's self-actualisation, and also from radical educators Paulo Friere and Ivan Illich.

There are seven themes that offer guidance and direction for programmes for experiential learning. They are T-groups, action research, democratic values, pragmatism, development, dialectic learning process and epistemology. From Lewin and his followers come the theory and technology of *T-groups* and *action research.* The articulation of *democratic values* guiding experiential learning is found both in

Lewin's work and the educational philosophy of John Dewey. Dewey's *pragmatism* forms the philosophical rationale for the primary role of personal experience in experiential learning. Common to all three traditions of Dewey, Lewin and Piaget is the emphasis on *development* toward a life of purpose and self-direction as the organising principle for education. Piaget's contribution is his description of the *learning process as a dialectic* between assimilating experience into concepts and accommodating concepts to experience and his work on *epistemology* that defines the relationship between the structure of knowledge and how it is learned.

Kolb called the learning 'experiential' for two reasons. The first is to tie it to the intellectual origins of Dewey, Lewin and Piaget. The second is to emphasise the central role of experience in the learning process. Kolb also claims that his theory differs from rationalist and cognitive theories of learning that tend to primarily emphasise acquisition, manipulation, and recall of abstract symbols, and from behavioural learning theories that deny any role for consciousness and subjective experience in the learning process. He however acknowledged that his work is not a third alternative to behavioural and cognitive theories, but a holistic integrative perspective on learning that combines experience, perception, cognition and behaviour.

Converging the evidence from the fields of philosophy, psychology, and physiology, Kolb describes two basic structural dimensions of experiential learning.

The first is the prehension (*perception*) dimension that includes two dialectically opposed modes of grasping experience: one through direct apprehension of immediate *concrete experience*; and the other through indirect comprehension of symbolic representation of (*abstract*) *experience*.

The second is a *transformation* dimension, which includes two dialectically opposed modes of transforming experience: one through intentional *reflection*; and the other through extensional *action*. Experiential learning therefore suggests that people perceive information though concrete or abstract experiences and transform those experiences into learning using reflective observation or active experimentation.

Knowle's Andragogy

Knowles (1981), while introducing the concept of androgogy, compares the assumption of two models of education namely pedagogy and androgogy and concludes that both models have plus and minus points (see Table 3.1). They are equally good in different learning situations. Some subjects are learnt better in one model than the other.

On the one hand, the pedagogical approach suggests that learning is teacher-directed, that the learner is a dependent personality, that readiness to learn is dictated by curriculum, that the orientation to learning is subject-centred, and that the motivations are external rewards and punishments. This approach mostly resembles learning facts in museums.

On the other, the andragogical approach suggests that learning is self-directed, that the learner is a self-directed organism, that the readiness to learn develops from life tasks and problems, that the orientation to learning is task- or problem-centred, that the motivation derives from internal incentives and curiosity. This approach mostly resembles play in museums.

Table 3.1: Assumptions of two methods of teaching - andragogy and pedagogy (After Knowles, 1981).

Subject of Assumption	Pedagogy	Androgogy
Direction of the learning process	Teacher-directed	Self-directed
Concept of the learner	Dependent personality	Self-directed organism
Role of learner's experience	To be built on more than used	A rich resource learning
Readiness to learn	Dictated by curriculum	Develops from life tasks and problems
Orientation to learning	Subject-centred	Task- or problem-centred
Motivation	External rewards and punishments	Internal incentives and curiosity

These two different approaches to learning explain the dichotomy between play and learning in museums in general and science museums in particular (Yahya, 1995). Both approaches are good and effective at different times and with different visitors.

Motivational theories of learning

Motivation is a very important factor in the learning situation. Motivation generally derives from two sources. If motivation is influenced by internal factors such as satisfaction or enjoyment, then it is called intrinsic motivation. If it is influenced by external factors such as grades, points, recognition of status, or money, then it is called extrinsic motivation. Behavioural psychologists tend to emphasise the importance of extrinsic motivation, whereas cognitive and humanistic psychologists tend to emphasise the intrinsic motivation. In reality, both motivations are applicable in any learning situation, but one form may be more appropriate in a particular situation. There are a number of theories that have attempted to find out the importance of motivation in learning, of which two theories are particularly interesting and have influenced museum learning.

The first motivational theory of learning is due to the work of Csikszentmihalyi and Robinson (1975). They used questionnaires and interviews to identify intrinsic rewards, using a group of people — chess players, surgeons, rock climbers, dancers, music composers, and basket ball players— who were deeply involved in activities which required much time and effort and skill yet produced little or no financial status. They found out that people who enjoy what they are doing, enter a state of 'flow': they concentrate their attention on a limited field of stimulus, forget personal problems, lose their sense of time and of themselves, feel competent and in control, and have a sense of harmony and union with their surroundings.

The analysis of the data from the questionnaires and interviews revealed a theoretical model of enjoyment as shown in Figure 3.2. According to this model, a person has action capabilities, that is, *skills,* and the activity poses opportunities, that is, *challenges*. On the one hand, when a person believes that the challenges are too demanding for his or her skills, the resulting stress is experienced as *anxiety*; this anxiety reduces to *worry* if the level of challenges is reduced but is still higher than the existing skills of the person. On the other hand, when the skills are greater than the challenges posed, a state of *boredom* results; this state again fades into *anxiety* when the skills are considerably greater than the challenges. So, the state of flow is felt only when the challenges are in balance with the person's skills; the experience is hence autotelic.

An important outcome from the above model is a clear understanding of the dichotomy between play and work. Generally, rather traditionally, work and play are considered to be diametrically opposite activities. The evidence from the study of Csikszentmihalyi and Robinson (1975) suggests that the essential difference is not between play and work as culturally defined activities but between the flow experience — which typically occurs in play activities but occurs in work as well — and the experience of worry or boredom, which may occur anytime and at any place but is more likely to happen in activities that provide either too few or too many opportunities for action. They conclude that flow experience is the only important factor and where it happens does not matter:

> Work is not necessarily more important than play and play is not necessarily more enjoyable than work. What is both important and enjoyable is that a person acts with the fullness of his or her abilities in a setting where the challenges stimulate growth of new abilities. Whether the setting is work or play, productive or recreational, does not matter. Both are equally productive if they make a person experience flow (Csikszentmihalyi and Robinson, 1975: 202).

Applying the theory of flow into the museum situation recently, Csikszentmihalyi and Robinson (1990) attempted to find out the components of aesthetic experience by interviewing a number of curators, educators and directors from different art museums of the USA.

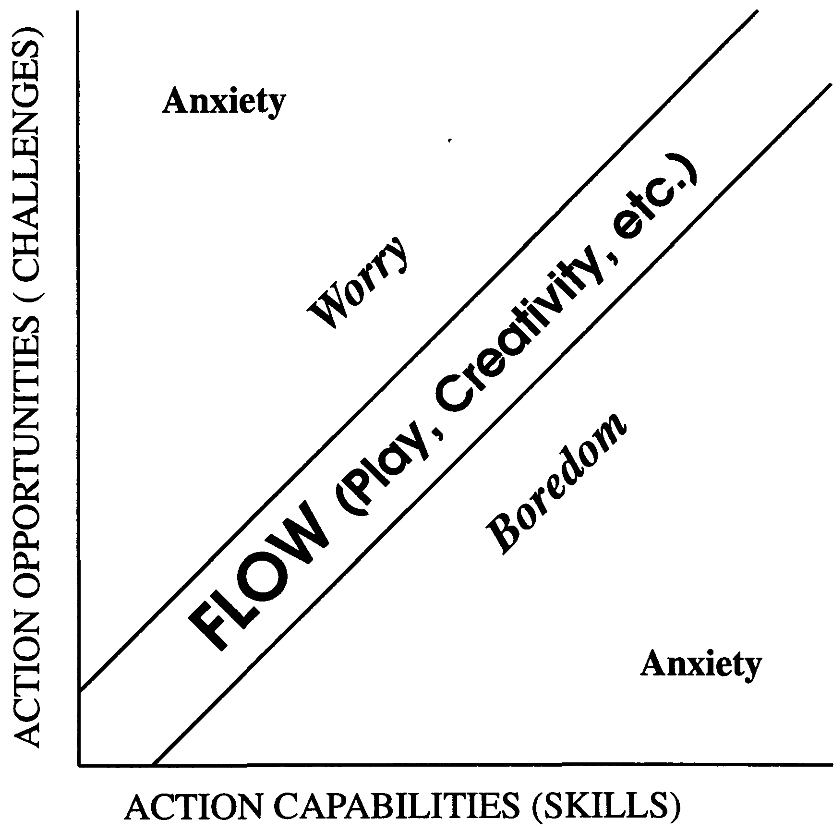


Figure 3.2: A theoretical model for enjoyment (From Csikszentmihalyi and Robinson 1975).

The second motivational theory is that of Thomas W. Malone (1980). He conducted a controlled experimental study to find out the factors that make learning fun using one out of 25 popular computer games. With assistance from the developers of the software, he developed eight versions of the game with various features deleted from the original version for the experimental study. Eighty fifth-graders were assigned to one of the eight versions. From the results, he found out that there are three factors that affect learning and make it fun: challenge, fantasy, and curiosity. Later, he and Lepper (1987), presented a taxonomy of intrinsic motivations for learning. To Malone's original 'individual' motivations (i.e. challenge, fantasy, and curiosity), were added a fourth class of 'individual' motivations (i.e. control), and three 'interpersonal' motivations (i.e. co-operation, competition, and recognition). In all, challenge, fantasy, curiosity, control, co-operation, competition and recognition constitute intrinsic motivations for learning.

This taxonomy was adapted by Deborah Lee Perry (1989) to a museum setting. A particularly popular exhibit, 'The Colour Connection: Mixing Coloured Lights', was used. She identified six components of an intrinsically motivating museum experience: *curiosity, confidence, challenge, control, play, communication.* The research was intended to develop a model for designing educational museum exhibits by increasing both visitors' interaction with the exhibit and their social interaction. She set up an interrupted time-series quasi-experiment designed to verify the educational effectiveness of the exhibit and the usefulness of the model with an *existing exhibit* and a newly constructed exhibit *(revised exhibit)* which incorporated the guidelines of the model.

The result of this study has indicated that visitors enjoyed both exhibits (the *existing* and *revised exhibit*) equally, but they stayed at the *revised* exhibit for longer periods of time; the amount and quality of interaction with the revised exhibit were increased; the amount and quality of the social interaction were increased in the revised exhibit; and teaching and learning behaviour occurrences were more at the revised exhibit.

Having further tested this model at SciTrek in Atlanta, Perry (1993b) most recently proposed an 'anatomy of the museum visit', which I will present in the following section. The anatomy of the museum visit attempts to explain thoroughly the entire process involved in the museum visit.

In sum, the comprehensive models of learning make use of ideas and concepts from various traditions and attempt to explain the learning process. Kolb's theory of experiential learning offers an explanation that the learner first perceives the information and then transforms it to make meaningful learning. Similarly, Knowle's theory of andragogy and pedagogy differentiate two types of learning, which resemble what constitutes learning and play in museums. Motivational theories identified various intrinsic motivations that affect museum learning and the museum visit.

HOLISTIC APPROACHES TO UNDERSTAND THE MUSEUM EXPERIENCE

As our understanding of museum learning began to broaden and to include a large variety of intelligences, skills and attitudes, museum researchers were forced to rethink their research questions. Instead of asking how much people learned during the museum visit, museum researchers recently asked what constitutes the museum visit to piece together the complexities of the visitor experiences. In this section, I will selectively present four studies that attempted to look at the museum experience from holistic perspectives. They are Hooper-Greenhill's 'The experience of the museum,' Falk and Dierking's 'Interactive museum experience,' Annis's 'Symbolic museum experience,' and finally Perry's 'An anatomy of the museum visit.'

Hooper-Greenhill's 'The Experience of the Museum'

Hooper-Greenhill (1988b) argued that the museum experience is made up of many different aspects that relate to each other. They are the role, status, and perceptions of not only visitors but also of every one including security staff, administrators, academic staff, user groups, voluntary workers, trustees and councillors, involved in the museum; the institutional and architectural site; and the material collected, stored and displayed.

Having given a shape to the museum experience in her recent book, Hooper-Greenhill (1994) diagnoses the limitation of the simple communication models as they often have been used to reduce discussion of museum communication to discussion of exhibitions. The notion of museum communication often very easily becomes subsumed into the development of exhibitions, which is of course an important method of making connections with people, but museums are fortunate enough to have a whole battery of other methods.

These other and most often ignored aspects of museums need to be considered, in addition to the traditional methods of communication. They are the museum's buildings, both internal and external features; the attitudes and activities of the museum staff; the general atmosphere in the institution, which will owe much to management styles and staff morale; and the attention given to comfort, orientation and the general guiding of visitors through the experience of the museum.

The museum experience model (see Figure 3.3) not only includes displays, artefacts, specimens, and publications, but also a whole gamut of outside-exhibition experiences including shops, cafes, socialising and so on.

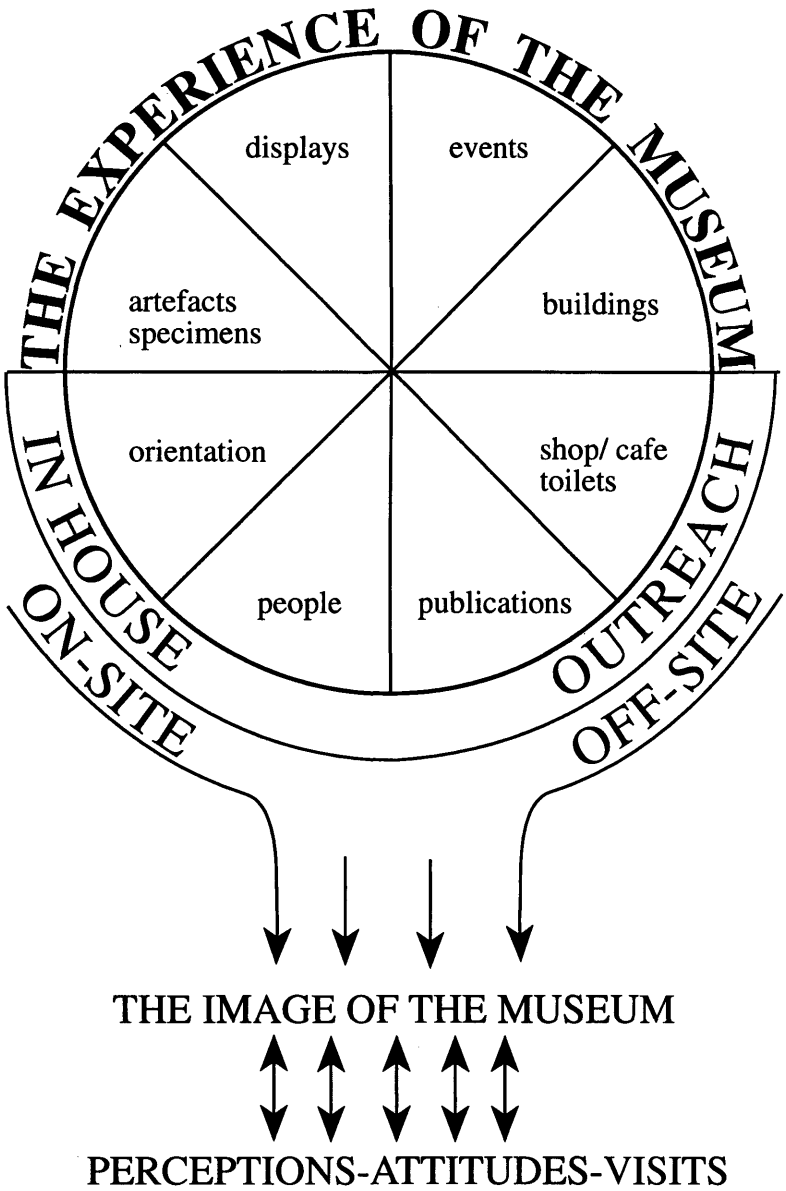


Figure 3.3: The entire experience of the museum contributes to the image of the museum. The image of the museum affects the perceptions and attitudes of people, and will affect whether or not they decide to visit the museum (From Hooper-Greenhill, 1994: 51).

Hooper-Greenhill further argued convincingly that people would visit in greater numbers and with greater interest if only genuine links were made with visitors and only if the experiences made available were comfortable and valuable as in places like 'Cadbury World'; a commercial exhibition put on at the Cadbury factory at Bourneville, near Birmingham. She demonstrates that these have already been taking place in museums, though not in a level they ought to be, with two illustrative examples of exhibitions. They both are in the Midlands in the UK: 'Who are the

Coventry Kids' at the Herbert Museum and Art Gallery, Coventry and the 'People Show' at the Walsall Museum and Art Gallery, Walsall.

Both of the exhibitions have many similarities, such as: the social span was broader than we have come to expect of museum visitors; a huge amount of work had been done prior to the opening to develop the audience, in contrast to many museum exhibitions which are developed with no contact with the intended audience. In Coventry, for example, the curator organising the exhibition 'Who are the Coventry Kids?' conducted informal dialogues with over seventy city groups to explore the concept and meaning of this local expression, 'Coventry Kid', and used a thousand questionnaires to encourage people to take part in the exhibition process and to feel that the exhibition was of importance to them.

Falk and Dierking's 'Interactive Museum Experience'

Falk and Dierking (1992) presented a three dimensional 'interactive museum experience' model as shown in Figure 3.4. According to this model, the interactive experience is dictated by three contexts interacting with each other.

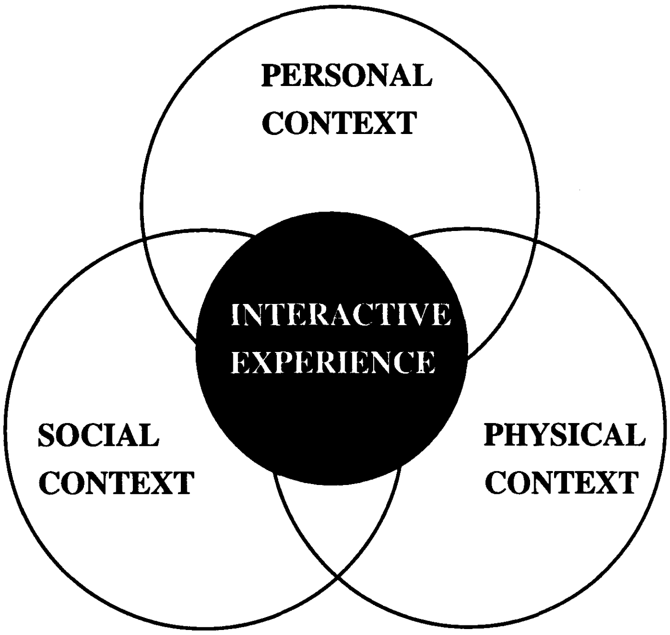


Figure 3.4: The interactive experience model can be visualised as a three dimensional set of three intersecting spheres, each representing one of the three contexts— ***personal contexts***, ***social contexts***, and ***physical contexts*** (From Falk and Dierking, 1992).

First, the personal context is what the visitor brings to the visit. This includes their psychological make-up such as prior knowledge, experience, attitudes, motivation and interests.

Second, the physical context is what the visitors encounter inside the museum. They include objects and artifacts, as well as the architecture, 'feel' and ambience of the building.

Third, the social context of the experience is how the visitors interact socially with whom they attend, as well as those encountered during the experience, such as museum staff and other visitors.

The model can be visualised as a set of three intersecting spheres, with each sphere representing one of the three contexts. At the heart of the model is a shaded area created by the intersection of the three contexts: the interactive experience. The interactive museum experience occurs within the physical context that we call 'museum', and includes not just objects and artifacts, but physical structures as well. Within this museum is the visitor, who perceives the world through his or her own personal context. Sharing this experience with other people constitutes the social contexts for the visitor.

At any given moment, any one of the three contexts could assume major importance in influencing the visitor. The visitor's experience can be thought of as a continually shifting interchange between personal, physical and social contexts. The model predicts that a visitor's experience can be understood by analysing, over time, the series of critical intersections of the three contexts. According to the authors, the model has the potential for providing a framework for understanding the totality of the museum experience — a socially, cognitively, kinaesthetically and aesthetically rich experience.

Annis's 'Symbolic Museum Experience'

Annis (1986) considered the museum as a staging ground for symbolic actions or simply as the symbolic experience. He argued that visitors interact in museums symbolically in various levels, what he called 'spaces', as illustrated in Figure 3.5. Three such spaces amongst others are dream space; pragmatic space; and cognitive space.

In the museum dream space, visitors are making meanings and using their imagination in a highly personal level like 'I know this', 'I don't like this', 'I like this', etc. It is in this space that the visitor relates museum exhibits or objects to his own personal interest and knowledge. The visitor's mind and eye sub-rationally seize upon certain objects that jolt the memory or recognition and provide an internal association of fantasy, desire and anxiety.

In pragmatic space, the mere physical presence of the visitors and their companions matters rather than the objects. In this space, visiting the museum is usually a happy event. Being there in some particular social union is both a purpose and a product. It does not really matter whether the coins are Roman or Chinese.

In cognitive space, visitors interact with and make use of the designed order of the museum exhibition. It is in this space that the visitor is on the same wave-length as the curator. Museumgoers enter this space selectively because entering this space requires complete understanding of the curatorial message, which in turn requires patience and concentration in a quiet atmosphere. Annis concluded that 'the magic that makes the museums so attractive may lie in the flexibility with which people create their own spaces' (Annis 1986).

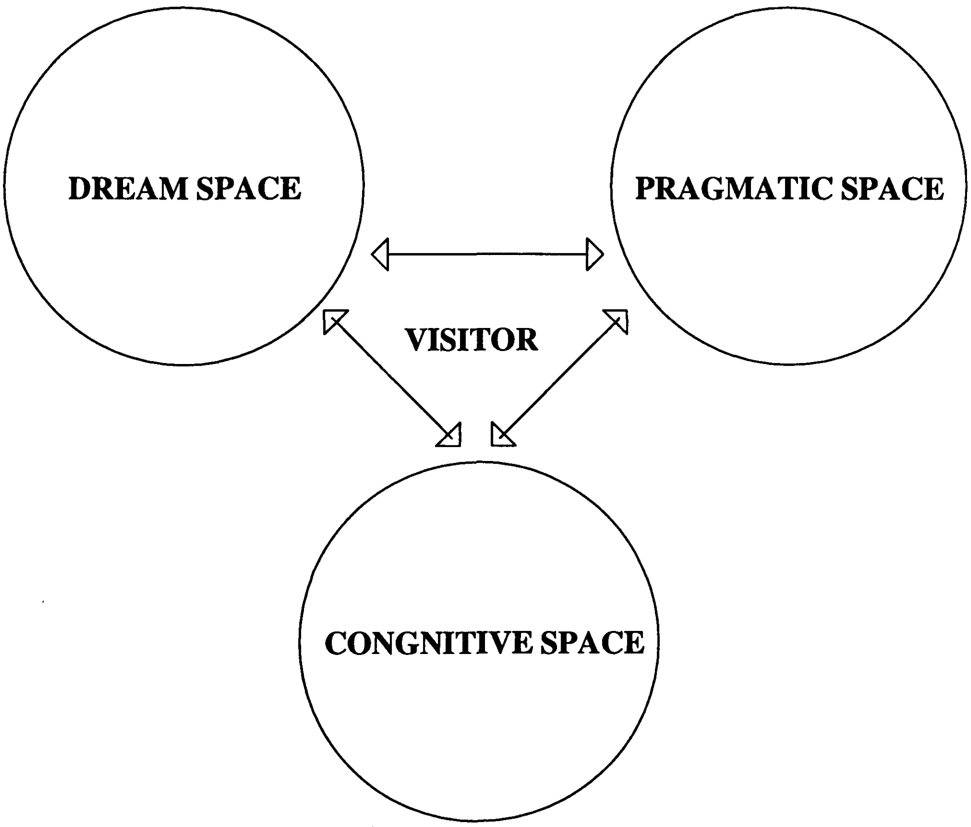


Figure 3.5: Museum visitors' symbolic interaction occurring simultaneously at three levels of spaces: ***dream space***; ***pragmatic space***; and ***cognitive space*** (Ideas from Annis, 1986).

Graburn (1977), Korn (1992) and Kavanagh (1992) applied Annis's model to the museum situation and emphasised the importance of visitors.

Perry's Anatomy of the Museum Visit

Perry (1993b) proposed a twelve-component model on the anatomy of the museum visit (see Figure 3.6). According to her, there are twelve components that constitute the museum visit. These twelve components fall into three factors that affect visitors' learning or experience in museums: they are *interactions* between the visitor and the museum; *needs* of the visitor; and *outcomes* of the museum visit.

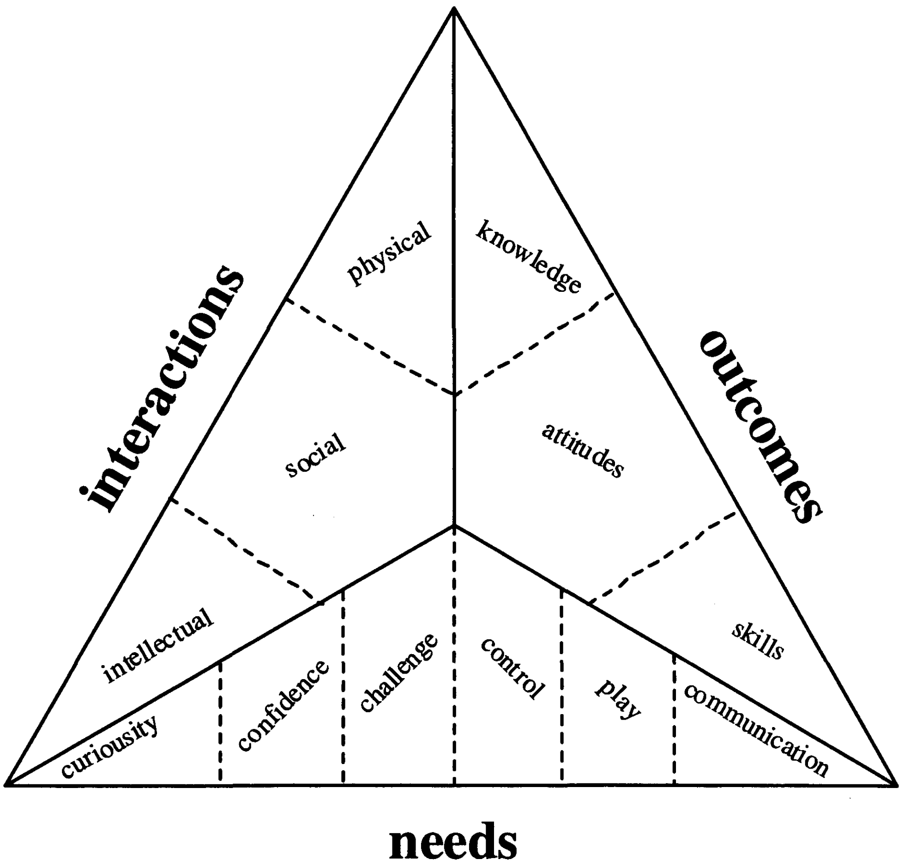


Figure 3.6: The twelve components model of Anatomy of the Museum Visit. (After Perry, 1993b)

The *interactions* between the visitors and museums can take place in three different levels. They are in a *physical level* such as pushing buttons, walking into galleries, reading labels and so on; they can be in a *social level* such as explaining and discussing with group members; in an *intellectual level*, they include such things as thinking and finding new information. So, the *interactions* reasonably resemble Falk and Dierking's 'contexts' or Annis's 'spaces'.

Similarly, Perry identifies six psychological *needs* of the museum visitor and argues that they have to be met for meaningful learning to occur in a museum environment. They are *curiosity*, *confidence*, *challenge*, *control*, *play*, and *communication*.

Arguing that visitors must be changed in some way in order for a museum visit to be successful, she presents three *outcomes* namely *knowledge*, *attitudes*, and *skills*. These *outcomes* resemble the cognitive, affective and psychomotor domains of learning (Bloom et al, 1956).

In sum, the holistic approach studies may generally fall into two categories: those which attempt to conceptually understand the whole museum experience; and those which attempt to evaluate what the visitors gain from the museum experience or in other words what impact the museum makes on the visitor usually in the long-term. What we have discussed so far in this section falls in the first category. The studies in the second category usually deal with the mechanism of memory and how much people could recall, and recognise not only the cognitive, but also the affective and social aspects of learning. Some of them are the much spoken about Museum Impact and Evaluations Study (MIES) conducted in the Chicago's Museum of Science and Industry (Perry 1992b and 1993a); a PhD research in the Launch Pad of the London Science Museum (Stevenson 1991); and a long-term impact study at Gallery 33: A Meeting Ground of Culture in the Birmingham Museum and Art Gallery (McManus 1993).

Cutting across all these holistic studies, it is found that they are all making use of many diverse fields and multiple aspects of the museum visit; that they all are placing emphasis on the visitor; and that they all are trying to capture the whole rather than the specific aspect of the museum visit. I will attempt to synthesise various aspects of the museum visit and try to develop a new 'spiral' approach to museum leaning.

TOWARDS A 'SPIRAL' APPROACH TO MUSEUM LEARNING

Incorporating the findings of Perry's anatomy of the museum visit, and Bloom's taxonomy of educational objectives, I have constructed a knowledge tetrahedron which forms the basis for the spiral approach to museum learning (Figure 3.7). The spiral approach also borrows important concepts from Piaget's theory of adaptation (for accommodation and assimilation), Norman's theory of complex learning (for accretion, restructuring and tuning), Csikszentmihalyi and Robinson's theory of flow (for providing a multiple range of opportunities and challenges), and Malone's taxonomy of intrinsic motivation (for curiosity and other factors).

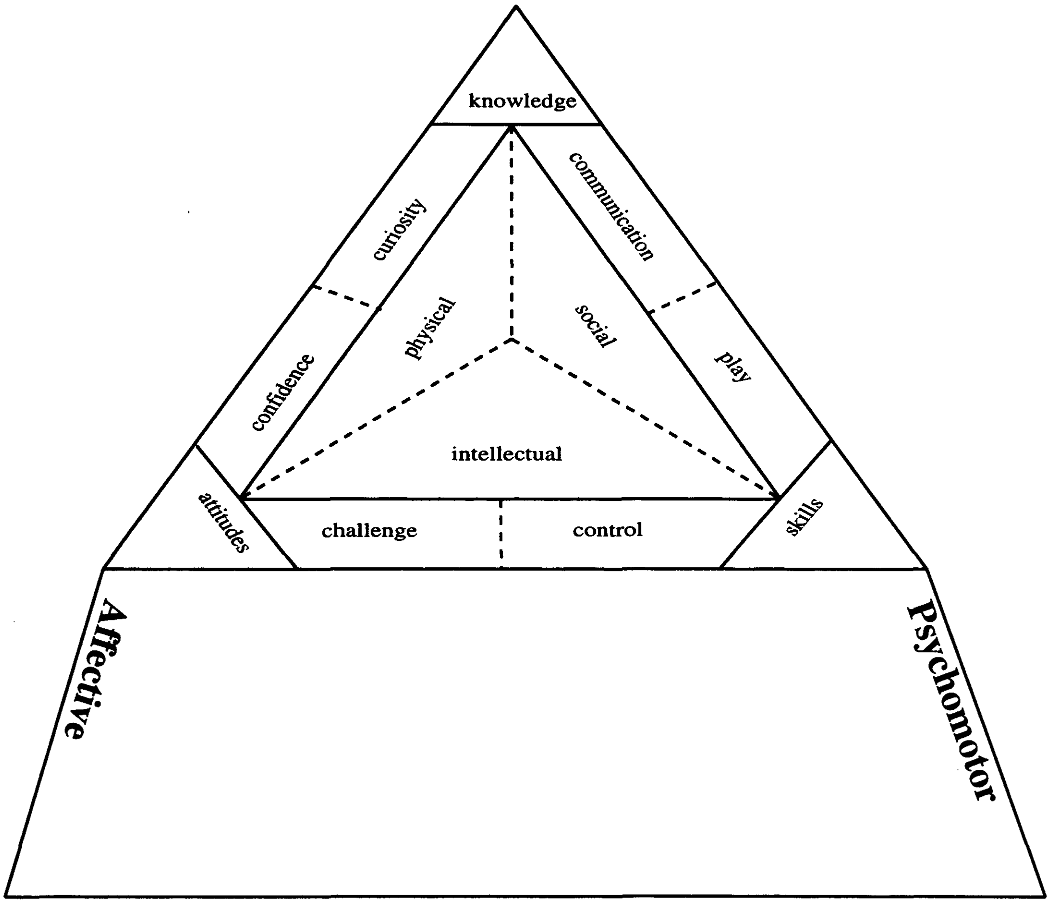


Figure 3.7: A cross-section of the knowledge tetrahedron is generated by rearranging the form of the anatomy of the museum visit originally proposed by Perry (1993b). The inner triangle represents *interactions* of visitors in three different levels. They resemble Falk and Dierking's contexts or Annis's spaces of the museum visit. The corners of the outer triangle represent the three *outcomes* from the museum visit. These are the representatives for what goes on in the three knowledge domains or areas in the 'spiral' model. Between the interactions and outcomes, there are six *needs* of the visitors. The entire form in its triangular shape can be viewed as a cross section of the knowledge tetrahedron in the 'spiral' model for the exploration of science in museums.

The tetrahedron represents what the science centre or museum can offer in all three domains of knowledge (including science knowledge). Visitors are expected to climb metaphorically on any or all sides of the tetrahedron. The sides implicitly represent the capabilities and skills each visitor brings with him or her. For example, a science teacher would find it easier to climb up on the side between the vertices 'affective' and 'psychomotor'; an experimental scientist would find it easier to climb up on the side between the vertices 'psychomotor' and 'cognitive'; or a scientific philosopher or a theoretical scientist will find it easier to climb up on the side between the vertices 'affective' and 'intellectual'.

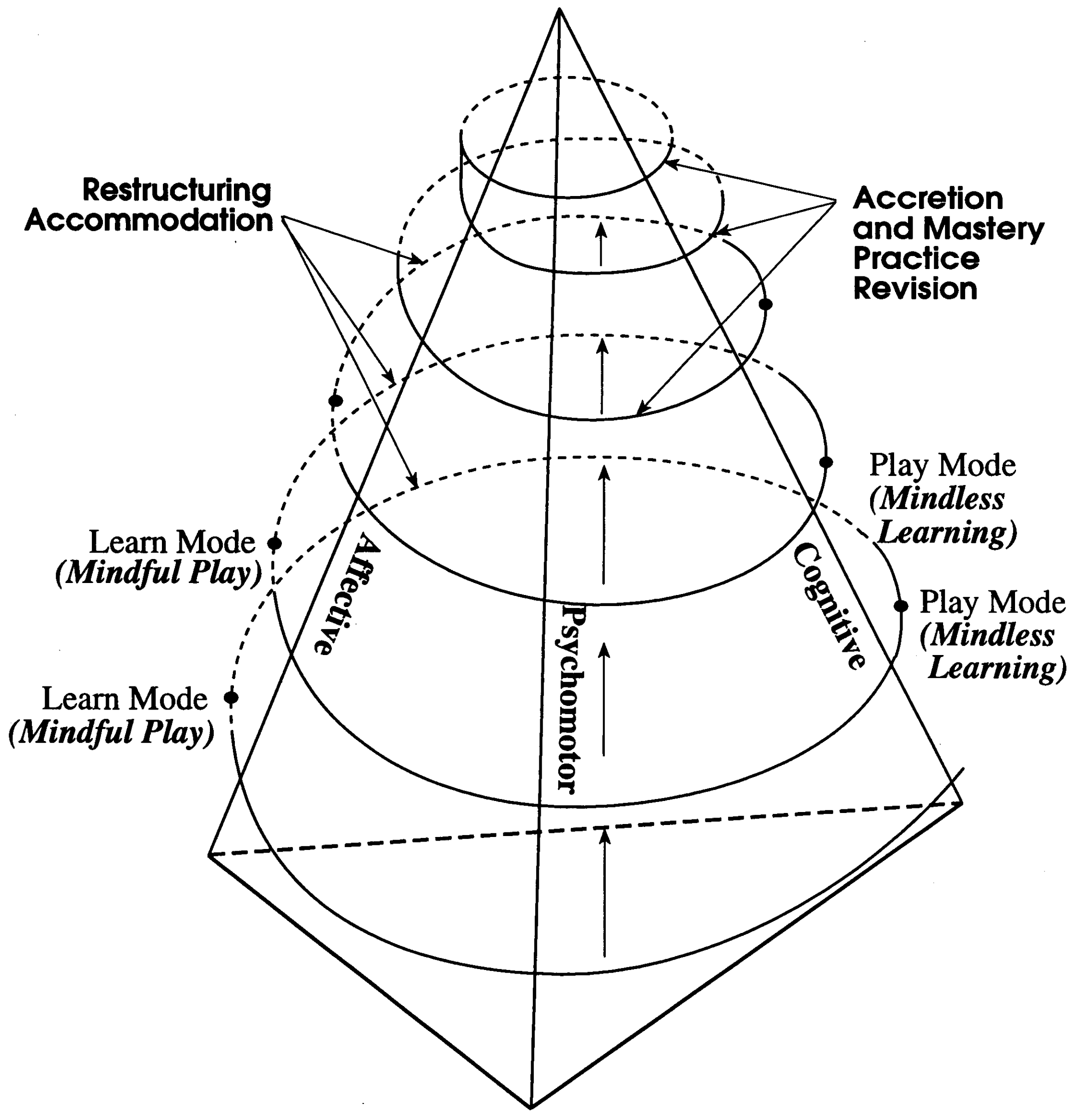


Figure 3.8: A 'spiral' approach to museum learning. The learning in museums starts from one of the two modes — affective and emotional play, (also learning in its broadest sense) and cognitive learning (traditionally considered learning) modes. It switches between them in a spiral fashion embracing the three domains of knowledge of the metaphorical tetrahedron. The play mode represents a phase in which an individual is involved in accretion or assimilation and mastering skills through practice and problem solving. The learn mode represents a phase in which the individual is restructuring and accommodating the pattern and developing concepts with direction from social group members or facilitators. It is the choice of modes at will by the individual that signifies the informal nature of the museum.

The spiral represents how an individual explores the museum or the science centre, switching between the two different modes, play and learning, covering all three domains. The slope of the spiral will be more or less steep depending upon the individual and the offerings in each domain.

According to the spiral model (see Figure 3.8), visitors enter science museums or science centres with or without their family and during their visit they explore and spend a portion of their two-hour visit in a museum exhibition or an interactive-type exhibition. They are, mostly, on the move, actively exploring to get a sense of the whole museum or centre; they pause casually at most of the exhibits but they give time and pay attention only to a few that they find interesting. The exploration ranges from play to learning, or learning to play, in a cyclical fashion.

This approach therefore attempts to accommodate all that goes on inside the museum, particularly the interactive-type institution. By arguing that the difference between play and learning is narrow, this approach does not entirely reject the traditional concept of play and learning. It is argued that the traditional concepts are indeed needed and that they should be treated as classification schemes. At the same time, as Roberts (1992) observed, the traditional meaning of play or learning should not prevent the museum staff from broadening their notions of what constitutes 'education' and 'learning' to include other non-cognitive experiences like social interaction, private reverie and play. Underlying the play and learning modes, as Norman (1978) conceptualised, each visitor undergoes the process of accretion, restructuring and tuning in a simultaneous cyclical fashion. These processes occur in different levels of the visitor depending upon his or her individual capabilities, skills, curiosities, and a range of other styles. Providing a multiple range of opportunities or challenges at different levels in the museum would facilitate every visitor to explore and learn in different modes and to match their skills to experience the 'flow'.

CONCLUSIONS

Many learning theories from three different schools of thought, namely, behaviouristic, cognitive and humanistic schools were reviewed. No single theory was found to explain learning satisfactorily. In recognition of the fact that different theories explain different aspects of learning, many researchers attempted to develop comprehensive models of learning. Some of them are found to have many implications to museum learning.

Many behaviouristic principles are found to be useful in museums. Skinner's operant conditioning and Bandura's observational learning explain how people often learn vicariously inside the museum. Skinner's shaping provides a strong evidence to the fact that people need reinforcement while learning new and difficult information even at the cost of full understanding of the concept in question. The notion of exhibits as stimuli gave rise to the entire field of museum design which incorporated many elements within exhibits to attract and hold visitors. The popularity of quiz games within museum exhibitions demonstrate the success of feedback elements within museum exhibits.

Theories from the cognitive school fall further into three areas: the gestalt theory, developmental psychologists and information processing psychologists. Emphasising the total picture of experience, the Gestaltists give credence to the gallery instruction. On the contrary, developmental psychologists support the concept of the museum explainer who interacts with museum visitors on an individual basis. Information processing psychologists explain what is going on in museums by offering different modes of learning such as accretion, restructuring and tuning, or assimilation and accommodation, or play and learning.

The third force psychologists emphasise the freedom and the flexibility of museum learning. Maslow in particular influences the whole museum experience that gives importance not only to good and effective exhibits but also to good and comfortable restaurants and other facilities.

Kolb's theory of experiential learning, Knowle's andragogy and two motivational theories are reviewed for their usefulness to museum learning. While Kolb's theory suggests different ways people perceive information and transform it to a meaningful learning, Knowle captures two ways of acquiring knowledge through play and learning. The motivational theories suggest and identify various extrinsic and intrinsic motivations. Some of the intrinsic motivations are flow experience (Csikszentmihalyi and Robinson, 1975), challenge, fantasy, curiosity, control, confidence, play, co-operation, competition, recognition and communication (Malone and Lepper, 1987).

Museum researchers started to ask different questions and diverted their attention from merely cognitive learning to the whole museum experience including affective learning and beyond. Hooper-Greenhill's 'The experience of the museum', Falk and Dierking's 'Interactive museum experience', Annis's 'Symbolic museum experience' and Perry's 'Anatomy of the museum visit', are reviewed.

Finally, by pulling together findings and evidence from the theories of learning and the holistic museum studies, a 'spiral' approach was conceptualised to explain what is going on in museums. Visitors explore museums using two modes, namely play and learning and switch between them in a spiral fashion embracing three domains of knowledge, namely cognitive, affective and psychomotor domains. Having suggested a useful approach to museum learning, the following chapter will consider theories of learning styles to further our understanding of the museum visitor.

CHAPTER IV

THEORIES OF LEARNING STYLES AND A 'WEAVE' APPROACH TO MUSEUM LEARNING STYLES

INTRODUCTION

Museum visitors can be anybody: the old or the young; the rich or the poor; males or females; experts or novices; scientists or non-scientists; singletons or groups; and so on. They are a highly heterogeneous group. Although it is very difficult to meet the individual needs of every visitor, it is sensible to concentrate on those needs and aspects that affect learning in museums, as museums are primarily learning institutions. Do museum visitors, or adults in general, vary in their level of cognitive, affective, perceptual and social intelligences? Do different people prefer to process the information cognitively in different ways? Do environmental factors such as light, temperature and design influence different people in different ways? Do museum visitors, or people in general, have different expectations depending upon whom they are with and where they are?

These questions are very important as they may influence people the way that people learn. To answer these questions, theories of multiple intelligences, Jung's personality types and theories of learning styles are found useful as they are based on a mass of research evidence, and attempt to explain how people learn in different ways, depending on their intelligence, personalities and styles. Therefore, in this chapter, I will first present Gardner's theory of multiple intelligences and its implications in the museum setting. Second, I will present Jung's personality types and their relevance to museum visitors and their learning. Third, I will review and discuss a number of theories of learning styles in terms of their theoretical underpinning, types, usefulness and application to the museum setting. Finally, I will suggest and discuss a 'weave' approach to museum learning styles by consolidating evidence from these theories and some museum studies based on these theories.

THEORY OF MULTIPLE INTELLIGENCES

Howard Gardner and his colleagues in the Graduate School of Education of Harvard University have taken up a project on human potential. From this and other experiences, Gardner (1983) demolished the long held theory that there exists a single measurable intelligence scale, along which each individual can be assessed by means of paper-and-pencil 'IQ' test. He convincingly argued that the test can never measure all the intelligences common to all cultures, as each with its own patterns of development and brain activity is different from others. After finding persuasive evidence for the existence of several relatively autonomous human intellectual competencies or human intelligences, he concluded that it is increasingly difficult to deny that the intelligences are relatively independent of one another and called them 'frames of mind'. Although he is not very specific about their numbers, Gardner identified mainly seven intelligences, which can be further broken down into about 237 sub-intelligences.

Gardner's argument mainly rests on findings from two branches of research that he had been pursuing during the 1970s and early 1980s. One branch is from the Harvard Project Zero in which he looked at the development of normal and gifted children. The other branch is the breakdown of cognitive capacities of individuals suffering from brain damage, which he had been pursuing at the Boston Veterans Administration Medical Centre and at the Boston University School of Medicine. Collecting evidence from a large and hitherto unrelated group of sources such as studies of prodigies, gifted individuals, brain-damaged patients, idiots savants, normal children, normal adults, experts in different lines of work and individuals from different cultures, he performed what he called a subjective factor analysis on the data to bolster a preliminary list of intelligences.

The seven intelligences, according to the theory of multiple intelligences, are *linguistic*, *logico-mathematical*, *spatial*, *musical*, *bodily-kinaesthetic*, *intrapersonal* and *interpersonal* intelligences. That none of them has an epistemological and biological priority over the others is the whole point of the theory. The seven intelligences can be further regrouped into three. First, the spatial, logico-mathematical and bodily-kinaesthetic intelligences can be further regrouped into the *object-related intelligences* for they are subjected to controls exerted by the structure and the function of the particular objects with which individuals come into contact. Were our physical universe structured differently, these intelligences would presumably assume different forms. Second, the language and music intelligences can be collectively called *object-free forms of intelligence* for they are not fashioned or channelled by the physical world but, instead, reflect the structures of particular languages and music. Third, the intrapersonal and inter personal intelligences constitute together *personal forms of intelligence* for they reflect three powerful and competing constraints: the existence of one's own person, the existence of other persons, and the culture's presentation and interpretation of the self. There will be not only universal features of any sense of person or self, but also considerable cultural nuances reflecting a host of historical and individual factors. Next I will discuss and elaborate, in detail, the seven intelligences one by one.

First, linguistic intelligence includes things like writing poems, essays and novels. These activities involve a sensitivity to the meaning of words, the order among words, and the sound, rhythm, inflection and meter of words. There are four aspects of linguistic knowledge that have proved of striking importance in human society are *rhetorical*, *mnemonic*, *explanatory* and *meta cognitive analysis*. The rhetorical analysis is the ability to use the knowledge to convince other individuals of a course of action. Mostly political leaders and legal experts tend to have this aspect of the intelligence. The mnemonic analysis is the capacity to use mnemonic tools to remember information, ranging from lists of possessions to rules of a game, from directions for finding one's way to procedures for operating a new machine. The explanatory analysis is the capacity to give oral instructions, generally employing verse, collection of adages, simple explanation and written words. It is also necessary to generate metaphors that are crucial for launching and for explaining a new scientific development. The meta-cognitive analysis is the potential of language to explain its own activities.

Second, musical intelligence is the earliest to emerge in an individual as demonstrated by nursery rhymes. Gardner takes note of three children. The first is a Japanese youngster who has participated since the age of two in the Suzuki Talent Education Programme and has, like thousands of her peers, mastered the essentials of a stringed instrument by the time she enters school. The second child is a victim of autism who can barely communicate with anyone else and who is severely disturbed in several affective and cognitive spheres. However, he can sing back flawlessly any piece he hears and thereby exhibits an isolated sparing of musical intelligence. The third is a young child raised in a musical family who has begun to pick up tunes on his own, a throw-back to the young Mozart, Mendelssohn or Saint-saens.

The aspects of this intelligence range from the composing of music to the reproduction of music. The elements of this intelligence are pitch, rhythm and timbre. They are basically dependent on the auditory and oral domain similar to the linguistic intelligence. Just as one could tease apart a series of levels of language from the basic phonological level, through a sensitivity to word order and word meaning, to the ability to appreciate larger entities like stories, so too, in the realm of music, it is possible to examine sensitivity to individual tones or phrases, and also to look at how these fit together into larger musical structures exhibiting their own rules of organisation. For example, when Stravinsky was two years old, he heard some nearby country-women singing an attractive and restful song on their way home from the fields in the evening. When his parents asked him what he had heard, he recited what they had sung, to everyone's astonishment. His father remarked that he had a wonderful ear. (Gardner 1983)

Third, logico-mathematical intelligence is what we have traditionally believed to be the intelligence, which is just one of the multiple intelligences according to Gardner. In contrast to linguistic and musical intelligences, the logico-mathematical intelligence does not have its origins in the auditory-oral sphere, but can be traced to a confrontation with the world of objects. Over the course of development in this area of intelligence, one proceeds from the realm of sensory-motor to the realm of pure abstraction, and ultimately to the heights of logic and science. The chain is long and complex, but it need not be mysterious as the roots of the highest regions of logical, mathematical and scientific thought can be found in the simple actions of young children upon the physical objects in their worlds. Piaget brilliantly portrayed the development in this domain but wrongly considered that it pertains to other areas of intelligences (Gardner 1983: 134).

This intelligence therefore includes only works of mathematicians and scientists. It is often said that there is after all only one logic and only those with developed logico-mathematical intelligences can exercise it. However, Gardner, to his way of thinking, argues that it is far more plausible to think of the logico-mathematical skill as one among a set of intelligences, and as a skill powerfully equipped to handle certain kinds of problems. But this intelligence is in no sense superior to, or in danger of overwhelming, the others. For example, Einstein's universal laws that harbour the secrets of the universe do not reflect the core operations of the other form of intelligences namely music, linguistic, or bodily intellects. Indeed, there are even different logics with contrasting strengths and limitations.

Fourth, spatial intelligence includes abilities, even in the absence of relevant physical stimuli, to perceive the visual world accurately, to perform transformations and modifications upon one's initial perceptions, and to be able to recreate aspects of one's visual experience. The abilities are found in the following people: artists, architects, engineers, surgeons, and certain kind of scientists. If a person has a high degree of spatial intelligence, he or she is much more likely to become a sculptor than a musician or to become an architect than a mathematician. Some examples of the outcome of spatial intelligence are John Dalton's view of the atom as a tiny solar system in science, Lewis Thomas's description of the sky as membrane in poetry, Kekule's open structure of the benzene ring, Watson's structure of the DNA molecule.

Fifth, bodily-kinaesthetic intelligence is a form of intelligence that helps people, for example, to unscrew the medicine bottle, to dance, and to mime. This form of intelligence is often needed when using tools in such activities as fishing, embroidering, making and repairing. The common forms of this intelligence are found, amongst others, in jugglers and typists. The mature forms of bodily expressions are the dance and other performing roles like actors, musicians, athletes, inventors and a whole range of professions that need skills relating to the efficient use of bodily movements and co-ordination.

In this domain, the focus is on the body as an object. Dancers, actors and athletes use their whole body, whereas inventors and other workers use parts of their bodies, particularly hands, in order to manipulate, arrange and transform objects in the world. Gardner found this intelligence relating to spatial and logico-mathematical intelligences as follows:

> ...described in this vein, bodily intelligence completes a trio of object-related intelligences: logico-mathematical intelligence, which grows out of the patterning of objects into numerical arrays; spatial intelligence, which focuses on the individual's ability to transform objects within his environment and to make his way amidst a world of objects in space; and bodily-kinaesthetic intelligence, which, focusing inward, is limited to the exercise of one's own body and hands, facing outward, entails physical actions on the objects in the world (Gardner 1983: 235).

Sixth, the intrapersonal intelligence allows one to detect and to symbolise complex and highly differentiated sets of feelings. This is a capacity to know and understand your strengths, weakness, desires and even your intelligences, and be able to use that knowledge effectively to solve problems or fashion a product, including a product known as yourself. This form of intelligence can be found in the *novelist* who can write introspectively about feelings, in the *patient* who comes to attain a deep knowledge of his or her own feeling in life, and in the *wise elder* who draws upon his or her own wealth of inner experiences in order to advise members of the community. This and interpersonal intelligences are called personal intelligences.

Seventh, the other personal intelligence, that is, interpersonal intelligence, turns outward, to other individuals. The core capacity here is the ability to notice and make distinctions among other individuals and in particular, among their moods, temperaments, motivations and intentions. In the most elementary form, the interpersonal intelligence entails the capacity of the young child to discriminate among the individuals around him and to detect their various moods. In the advance form, interpersonal knowledge permits a skilled adult to read the intentions and desires, even when these may have been hidden, of many other individuals and, potentially, to act upon this knowledge. There are highly developed form of interpersonal intelligence in *political and religious leaders* (for example Mahatma Gandhi), in skilled *parents and teachers*, and in individuals in the helping professions, be they *therapists* or *counsellors*. The development of personal knowledge can take place naturally as well as through explicit instruction.

As the seven intelligences are considered seven different ways of knowing the world, people learn, remember, perform and understand in different ways. For this reason, Dierking (1991) called these intelligences 'learning styles' in museum studies. Museums can accommodate people with these seven different learning styles by including labels, strategy games, maps, charts, slides, photographs, melodies of songs, physical activities, playing alone and with social groups, and opportunities to be alone or with people.

Hooper-Greenhill (1994) gives a thorough account of how museums can accommodate these various multiple intelligences by giving a number of examples and suggestions. For example, asking museum visitors to write a poem about a specific subject would accommodate linguistic intelligence as demonstrated by the two museums in England: *This fitz me fine*, a book of poetry produced by the Fitzwilliam Museum at Cambridge; and poem written by Emma, a very young child visitor to the Ironbridge Gorge Museum at Telford.

'Maths at the Geffrye' and 'Science at the Geffrye' which are the teacher's hand books are examples of one way to accommodate logical-mathematical intelligence, at the Geffrye Museum at London.

The opportunities to handle and play the Ugandan lyre, at the Horniman Museum in South London, would accommodate musical intelligence.

The opportunities for visiting children to adopt the postures of some of the sculptured gods and goddesses at the Indian galleries of the Victoria & Albert Museum in London would accommodate bodily-kinaesthetic intelligence.

Hooper-Greenhill further stated that museums have potential to accommodate all the seven intelligences so that the museum experience can be broadened to people with many different skills and abilities.

In the following section, I will discuss Jung's personality types and their relevance to museum studies.

JUNGIAN PERSONALITY TYPES

The attempt to classify humans into types dates back to fifth century BC when Hippocrates attempted to classify the people into four types: the sanguine, the phlegmatic, the choleric and the melancholic. They are compared to body fluids (Greek versions are given in the bracket) namely blood (sanguis), phlegm (flegma), bile (coln), and black bile (melan coln) respectively. These body fluids were attributed to the decisive factors for their corresponding temperament namely optimistic, apathetic, depressed and irascible.

Carl Jung attempted to classify people into psychological types (Jung 1921). According to him, people can be classified into two types namely extraverts and introverts. The extraverted attitude is characterised by an outward flowing of libido, an interest in events, in people and things, a relationship with them. They are motivated by outside factors and greatly influenced by the environment. The introvert type is characterised by withdrawal; the libido flows inward and is concentrated upon subjective factors, and the predominant influence is inner necessity. They lack confidence in relation to people and things.

In addition to these two main types, Jung identified four functions, which people use to orient themselves in the world and also to our inner world: *sensation*, which is perception through our senses; *thinking*, which gives meaning and understanding; *feeling*, which weighs and values; *intuition*, which gives us information of the atmosphere which surrounds all experience.

By combining, the two types and four functions, Jung finally arrives at eight different types namely the extraverted thinking type, extraverted feeling type, extraverted sensation type, extraverted intuitive type, introverted thinking type, introverted feeling type, introverted sensation type and introverted intuition type. The thinking and sensation types are called rational types whereas the feeling and intuitive types are called the irrational types. The characteristics of the individual types are elaborately discussed by Jung (1921).

Vernon (1973) observed that Jung did not try to build a vast empire, by claiming associations with physique and other characteristics, but it has been enormously extended by subsequent investigators such as Eysenck. Vernon, based on Stricker and Ross's findings, asserts that the four functions Jung superimposed— intuition, sensation, feeling, and thinking, have never achieved the same recognition as the extraversion-introversion, nor have been subjected to any empirical study until they were taken up in the Myers-Briggs Type Indicator (MBTI), to which I will turn my attention shortly. It is also very important to note here that it is Eysenck who has transformed Jung's extraverted and introverted types into a continuous dimension of Extraversion-Introversion (Weckowicz 1973:143).

Myers-Briggs Type Indicator, known as the MBTI indicator, can identify 16 types of people using four preference scales based on 1) their attitudes toward the world, 2) their ways of taking in information, 3) their ways of making decision, and 4) their life styles. Each scale can have two extremes: 1) Extraversion or Introversion, 2) Sensing or Intuition, 3) Thinking or Feeling and 4) Judgement or Perception. The sixteen types are obtained by combining the two extremes and four preference scales. All except the fourth scale or dimension are based on Jung's types.

Extraversion and introversion are complimentary *attitudes* toward the world. Both attitudes are used by everyone, but one is usually preferred and better developed. Active, outward, sociable, people, many, expressive and breadth are the key words for extraversion; Reflective, inward, reserved, privacy, few, quiet and depth are the key words for introversion.

Sensing and intuition are ways of *taking in information*. The sensing function perceive information by way of the five senses whereas the intuition function discerns information by way of a 'sixth sense' or hunch; both ways of perceiving and taking in information are adapted by everyone, but one is usually more dominant than the other. Details, present, practical, facts, sequential, directions, repetition, enjoyment, perspiration and conserve are some of the key words for sensing; patterns, future, imaginative, innovations, random, hunches, variety, anticipation, inspiration and change are some of the key words for intuition.

Thinking and feeling are ways of *making decisions*. The thinking function reaches decisions on the basis of logic and objective considerations, whereas the feeling function reaches decisions on the basis of personal and subjective values. Every one decides and evaluates situations using both ways, but some prefer thinking for feeling or vice versa. Thinking, head, objective, justice, cool, impersonal, criticise, analyse, precise and principles are some of the key words for thinking; feeling, heart, subjective, harmony, caring, personal, appreciate, empathise, persuasive and values are some of the key words for feeling.

Judgement and perception are complementary *life styles*. A judging life style is decisive, planned and orderly, whereas a perceptive lifestyle is flexible, adaptable and spontaneous. Both attitudes are part of everyone's life style, but again one of them is more favoured than the other. Judgement, organised, structure, control, decisive, deliberate, closure, plan, deadlines and productive are some of the key words for judgement; perception, flexible, flow, experience, curious, spontaneous, openness, wait, discoveries and receptive are some of the key word for perception (Page, 1983).

There are a number of studies which attempted to relate these types to learning styles (for example, Provost and Anchors 1987). More complete descriptions of each of the 16 types are given by Isabel Myers in her book *Introduction to Type*. Though Jung did not directly contribute to the study of cognitive or learning styles, his basic idea gave impetus and was widely quoted in many of the studies of learning styles or cognitive styles.

In museums, a few studies have been undertaken to identify learning styles (in sensing-intuition dimension) amongst museum visitors using the administration of the MBTI indicator (Vance and Schroeder, 1992).

Vance and Schroeder (1992) studied four hundred visitors to the 'Rain forest: Exploring the life on earth' exhibition at the Milwaukee Public Museum, under four conditions: control, baseline and two experimental conditions. The studies include a questionnaire to measure the knowledge of the visitors and a MBTI indicator to identify and categorise the visitors into two types — sensing and intuitive. The control group was administered the questionnaire and the MBTI before entering the gallery, whereas the baseline group was administered after the visit; the two experimental conditions are the exhibition with additional sensing labels and with additional intuitive labels. In addition to the questionnaire study, the groups were tracked to find out the duration of time in the exhibition.

Vance and Schroeder found that there are individual differences in the ways museum visitors process information. About one-third of the visitors were found to be sensing types and the remaining two-thirds were intuitive types. Matching visitor styles with exhibit types enhanced learning. They also found that the intuitive visitors took more time when the intuitive labels or sensing labels are added to the exhibition, whereas the sensing types took more time when the sensing labels were added but less time when the intuitive labels were added to the exhibition. They finally concluded that purely sensing or intuitive exhibits may not be the best strategy and a better approach would be to incorporate both sensing and intuitive types of exhibits.

THEORIES OF LEARNING STYLES

Learning style is how an individual prefers to approach a learning situation. This area of study originates from its fore-runners 'Jungian Personality types' and 'Cognitive style'. Drawing inputs from cultural influences, personality types, left/right brain researches and a whole range of other subject areas, the learning style theory developed into a multidisciplinary area of its own.

The connotation of the word 'style' varies. It refers to a pervasive psychological characteristic that cuts across intellectual, perceptual, and interpersonal functioning as in Witkin's field independent/dependent style. Sometimes it is considered to be the usual or preferred manner of learning. At other times, it is treated as the best or the most effective manner of learning. People prefer different learning styles at different times and in different situations and for different tasks. Learning styles should therefore be considered as a classification scheme rather than as labelling people with a particular style. This means that learning styles are malleable and different depending upon the situation and need.

Collecting evidence from published research, theories of learning styles can be classified into three categories: one-dimensional, two-dimensional and multi-dimensional theories. The first type treats learning styles as cognitive- or personality-oriented. The second type treats learning styles as ways of information-processing. The multi-dimensional theories treat learning styles as the individual's choice of environmental, cognitive, motivational, personal, sociological and physiological factors that tend to affect learning. The research did not proceed linearly from one-dimensional to two-dimensional and finally to multi-dimensional. This classification is therefore based on merely conceptual and not chronological order. Underlying all these theories, each dimension is bipolar in nature. This means that each dimension has two extremes: for example, field dependent at one end and field independent at the other end, or concrete at one end and abstract at the other end. Individuals are found to fall between the two extremes in a continuum as none can be absolutely one or the other.

In museums, only very few studies have so far been conducted on learning styles. They mainly fall into again three groups: emphatic, overview and applied. The *emphatic* ones are mainly articles and books that emphasise the importance of the accommodation of learning styles of museum visitors (for example, Chase, 1976; and Falk and Dierking, 1992). There are a number of *overview* studies that attempt to discuss the meaning and scope of learning styles and various theories of learning styles and their implications for museums (for example, Serrel 1990a). Very few studies are in the *applied* category in which they often attempt to measure the museum visitors' learning styles and match or suggest their accommodation in museum exhibitions or programmes, (for example, Ames, 1993; and Vance and Schroeder, 1992).

Museum studies have so far concentrated only on the first two types of learning styles. McCarthy's four learning styles, a sensing-intuition dimension of MBTI and Gardner's theory of intelligences are the only three theories that have so far been applied to museum situations. None of the museum studies on learning styles reflects the existence of multi-dimensional learning styles and their applications to museums. In what follows, I will present the one-, two-, and multi-dimensional learning style theories.

One-dimensional learning styles

Since the late 1940s, Herman A Witkin and his co-workers have been conducting studies on the perceptions of the upright by changing the *visual fields* and *forces acting on the body*, the two cues that help us to determine the upright. During this period, he and his colleagues have constructed various instruments: the 'tilting-luminous-frame-tilting-luminous-rod' apparatus (Witkin and Asch 1948), the 'tilting-room-tilting-chair' apparatus (Witkin 1949) and the 'embedded figure test' (Educational Testing Service 1975).

The first apparatus is shown in Figure 4.1. This consists of a luminous frame and a luminous rod, which are pivoted coaxially in the middle so that each can be rotated independently of each other. Subjects are asked to sit down on a chair and can see only the luminous frame and rod in the dark room. The task for the subjects is to either adjust the rod or the frame to the upright in different experimental conditions. The result of this experiment showed that there were some subjects who could make the rod vertical or upright irrespective of the tilting of the frame. Some others found it difficult to make the rod upright, but rather aligned the rod along the frame even when the frame was tilted up to 30 degrees.

In the second apparatus (Figure 4.2), a room and a chair is pivoted coaxially at the middle and can be rotated independently of each other using the worm gear mechanism. Subjects are brought to the room blind-folded and asked to adjust the chair or the room to the upright in different experimental conditions. Also in this experiment, subjects were behaving similarly as in the previous case. Some could adjust their chair upright irrespective of the tilt of the room or the room upright irrespective of the tilting of chair. Some others could not make it upright but rather aligned the chair with the room or vice versa even when the room or the chair was tilted as far as 30 degrees.

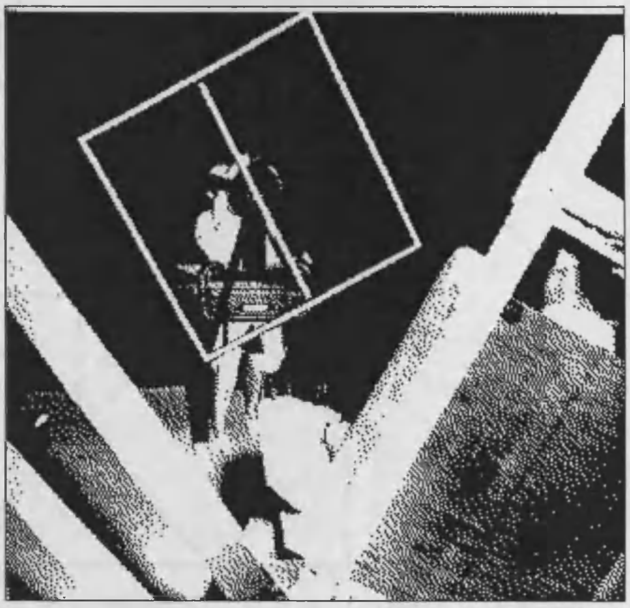


Figure 4.1: Witkin's tilting 'luminous rod' and 'tilting luminous frame' test (After Witkin and Asch 1948).

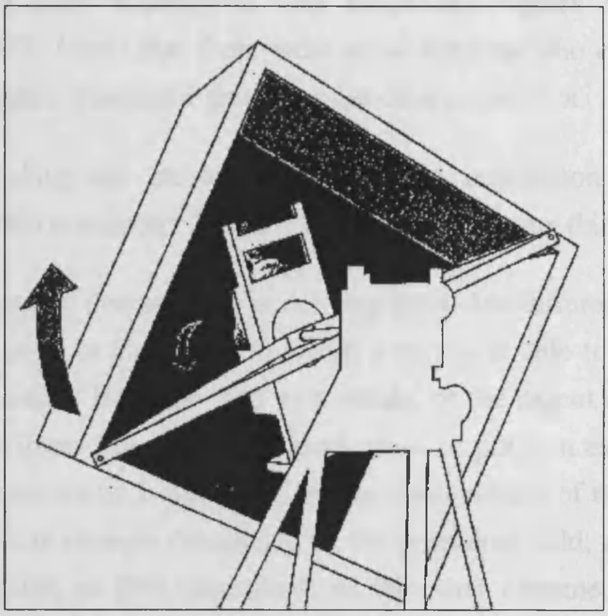


Figure 4.2: Witkin's room and chair apparatus (From Witkin 1949)

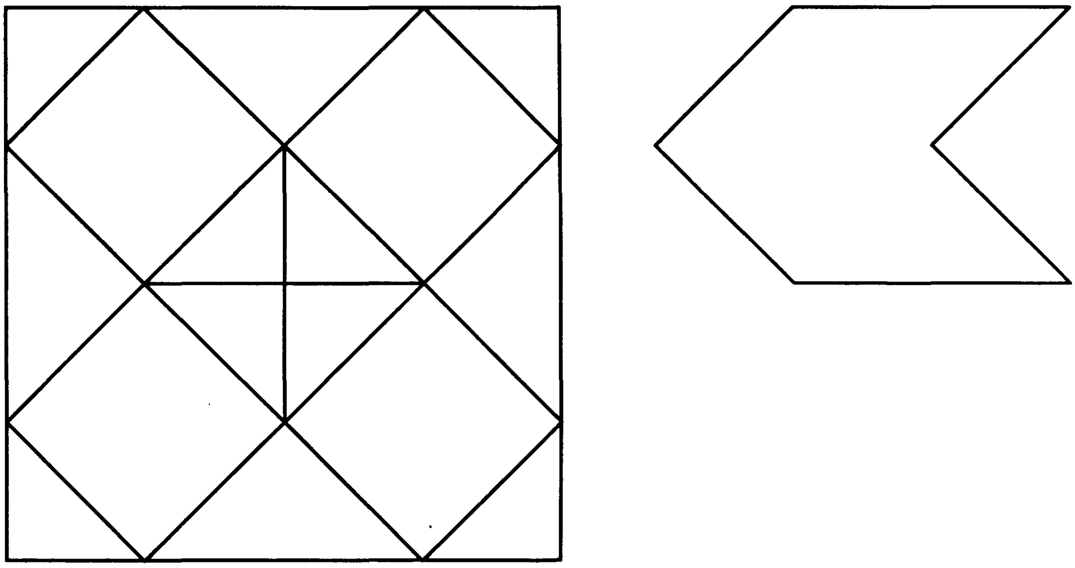


Figure 4.3: Witkin's embedded figure test. (From Witkin et al. 1977)

The third experiment is the simplest one among three and makes use of the embedded figures in a complex pattern (Figure 4.3). The task here is to locate or find out the shape or figure (shown right side) in the complex pattern (shown left side). After conducting many experiments with Embedded Figures Test in earlier works, Witkin et al (1977) found that there were some subjects who could locate the shape immediately within a reasonable time whereas others could not.

After finding the existence of a good correlation among these three instruments, Witkin concluded that they all measure the same thing, as follows:

> ...the common denominator underlying individual differences in performance in all these tasks is the extent to which a person is able to deal with a part of a field separately from the field as a whole, or the extent to which he is able to disembed items from organised context — to put it in every day language, the extent to which he is analytical. At the one extreme of the performance range, perception is strongly dominated by the prevailing field; we speak of this mode of perception as field dependent. At the other extreme, the perception of an item is relatively independent of the surrounding field and we refer to this mode of perception as field independent (Witkin 1976:42).

Witkin therefore called the set of people 'field independent', who can adjust the chair or the rod to the upright irrespective of the tilt of the room or frame respectively and therefore they are working independent of surroundings or context. The 'field dependent' subjects, on the other hand, act by taking cues from the surroundings and therefore their activities are affected by the surroundings or context, and because of this reason they tend to align, rather than making upright, the rod or chair along with the frame or room respectively.

One of the most important factors in which the learning style approach differs from the ability dimension like intelligence, is in its bipolar dimension. One style is not better or worse than the other, or good or bad:

> ...with regard to value judgements, cognitive styles are bipolar. This characteristic is of particular importance in distinguishing cognitive styles from intelligence and other ability dimensions. To have more of an ability is better than to have less of it. With cognitive styles, on the other hand, each pole has adaptive value under special circumstances, and so may be judged positively in relation to those circumstances (Witkin et al. 1977:16).

Though the above argument warns us that the 'cognitive styles' are not to be read as different ways of acquiring the same kind of knowledge, Tennant (1991) argues that the research indicates that different types of knowledge are more or less accessible with different cognitive styles.

Witkin et al (1977) gave, for the first time, a comprehensive analysis of the educational implications of cognitive styles. On the one hand, the field dependants, according to him consider external reinforcement more salient; they rely on externally provided structure and therefore need assistance with unorganised material; they tend to focus on salient cues only; and they are better at reading and remembering social material. On the other hand, the field independents learn more under the condition of intrinsic motivation; they are more likely to structure ambiguous material; they tend to sample the entire array of cues; and they need assistance in focusing on social material.

Cognitive styles are malleable. Wapner argues that a person in one context could be field independent and in another context he or she can become field dependent:

> I maintain that (cognitive styles) are not independent of the context in which they operate and should not be defined as such... for example, there may be students who are more field independent in the presence of an aggressive teacher and relatively less field dependent in the presence of a submissive teacher (Wapner 1976:75).

There are numerous studies (for example, Kirby 1979; Squires 1981; Grimsø 1985) that attempted to give a detailed account of cognitive and learning styles. These studies brought together a range of learning style theories and mainly observed that they are diverse in nature as well as having some interesting similarity; that cognitive styles are typically represented as polar opposites of a single dimension so that a person is described as field independent or field dependent, reflective or impulsive, serialist or holist, a converger or a diverger and so on.

Recognising similarities between theories of cognitive styles, Grimsø attempted to synthesise many theories, namely Hudson's convergent-divergent thinking, McKenney and Keen's systematic/intuitive-receptive/perceptive, Kable's qualitative-quantitative, Kolb's accommodators/assimilators-convergers/divergers, and Kirton's adaptation-innovation styles, into a single dimension: *rational thinking style/ intuitive thinking style*.

In museums, Greenglass (1986) conducted an experimental study in which sixty subjects were measured for their conceptual level (CL) in a continuum of information processing ability from low to high using Hunt's Paragraph Completion Method (Hunt, Butler, Noy and Rosser, 1977). Greenglass classified a person low CL if the score lies between 1.0 and 1.5, and high CL if the score is in the range 1.7-2.8. Their performance of learning from museum objects was scored in two experimental conditions, namely high structure and low structure. The high structure of an educational environment was created by stating explicitly the rule and principle before the examples. An environment with low structure, on the other hand, provides little organisation; the responsibility of structuring, clarifying and organising is placed on the learner.

The results of this study supported the hypothesis that low CL adults would demonstrate higher performances in high structure museum learning environments; however, the data did not support the hypothesis that high CL adults would demonstrate higher performances in low structure environments. A 2X2 factorial ANOVA revealed a significant interaction between CL and structure. Greenglass has thus shown that there is a relatively wide range of CL among adult museum visitors and that all museum exhibits should be highly structured so that the exhibits would accommodate the needs of both low and high CL visitors.

Two-dimensional learning styles

The two-dimensional learning styles attempt to fit people into four different learning styles. The pioneer in this line is Kolb's (1978) learning style inventory based on his experiential learning model (Kolb and Fry 1975; Kolb 1984). There are a number of other researchers who have devoted and developed models in this two-dimensional learning styles. Two of them are Bernice McCarthy and Anthony Gregorc.

David A Kolb

According to Kolb (1978 and 1984), learning occurs through two bipolar modes. In one mode, the information is perceived through concrete experience at one end or abstract conceptualisation at the other end of the continuous spectrum. In another mode, the perceived information is transformed or processed through reflective observation at one end or active experimentation at the other end of the continuous spectrum.

Kolb classified people with four learning styles depending upon the ways they perceive and transform information. First, a diverger prefers to perceive information through concrete experience and process them through reflective observation. Second, an assimilator perceives information through abstract conceptualisation and processes it through reflective observation. Third, a converger perceives information through abstract conceptualisation and processes it through active experimentation. Fourth, an accommodator perceives information through concrete experience and processes it through active experimentation. This is illustrated in Figure 4.4.

Kolb developed a learning style inventory that claimed to identify these four learning styles. The final form of the test is a *nine-item* self description questionnaire. Each item asks the respondent to rank in order four adjectives by assigning a score of 4 to the one that best characterises his or her learning style, a score of 3 to the next best word, 2 to the next best, and 1 to the word that least characterises his or her learning style. One word out of four in each item corresponds to each one of the four modes.

In other words, each mode will therefore be reflected by nine adjectives as follows. To characterise concrete experience (CE), people would chose *feeling, discriminating, receptive, accepting, intuitive, concrete, present-oriented, experience and intense*. Reflective observation (RO) is reflected by *watching, tentative, relevant, aware, questioning, observing, reflecting, observation* and *reserved.* For abstract conceptualisation (AC) the key adjectives are *thinking, involved, analytical, evaluative, logical, abstract, future-oriented, conceptualisation* and *rational.* Active experimentation (AE) is reflected by *doing, practical, impartial, risk-taker, productive, active, pragmatic, experimentation,* and *responsible.*

By adding up the individual scores of nine adjectives, four main scores will be obtained for four modes namely CE, AC, RO and AE. From these would be computed two more scores namely (RO-AE) and (CE-AC), which give the values of the x and y co-ordinates respectively. Depending upon the negative or positive values of the co-ordinates, the individual will be placed in the respective quadrant.

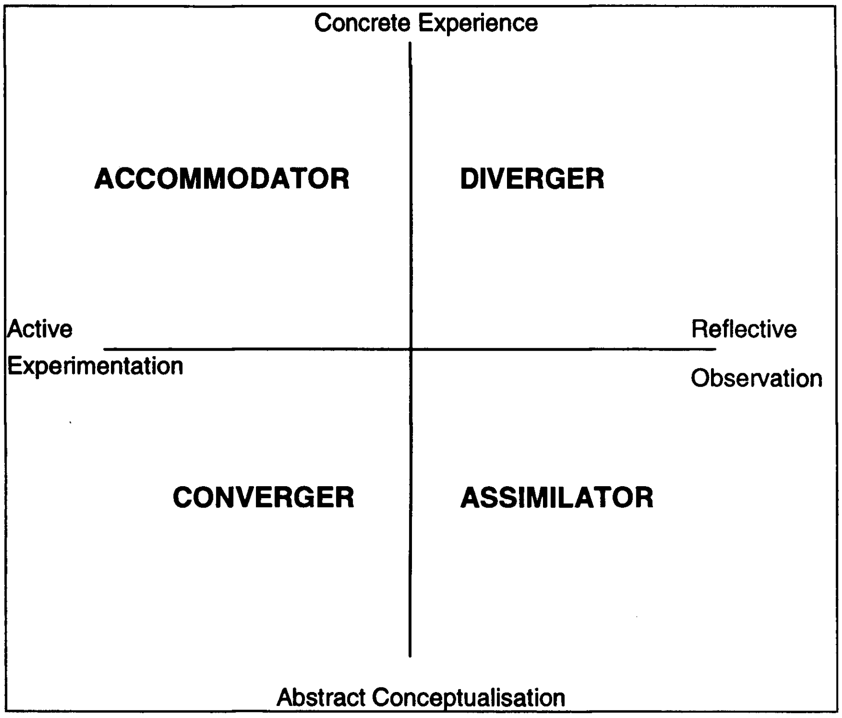


Figure 4.4: Kolb's model on learning style dimensions (After Kolb 1978)

I will present briefly the characteristics of people with these four learning styles. First, the divergers' dominant strength lies in their imaginative ability. They excel in the ability to view concrete situations from many perspectives and to organise many relationships into a meaningful gestalt. Kolb called these learners divergers because they perform better in situations such as brainstorming sessions, that call for generation of ideas. They are interested in people and tend to be imaginative and emotional. They have broad cultural interests and tend to specialise in the arts and social sciences as supported by Kolb's research.

Second, the assimilators have greater strength in their ability to understand and generate concrete theoretical models. They excel in inductive reasoning, in assimilating disparate observations into an integrated explanation. They are usually less interested in people and more concerned with abstract concepts, but are less concerned with the practical use of theories. For them, it is more important that the theory be logically more sound and precise. As a result, this learning style is more characteristic of the basic sciences and mathematics rather than applied sciences. In organisations, this learning style is found most often in the research and planning departments.

Third, the covergers have strengths in the practical application of ideas. They are called convergers because they do well in conventional intelligence tests where there is a single correct answer. They are relatively unemotional, preferring to deal with things rather than people, they tend to have narrow interests and choose to specialise in the physical sciences. This style is the characteristic of many engineers, according to the research.

Fourth, the accommodators have strengths opposite to those of the assimilator. They have strengths in doing things, in carrying out plans and experiments and being involved in new experiences. They tend to be more of a risk-taker than the others. They are called accommodator as they tend to excel in those situations where they must adapt themselves to specific immediate circumstances. In situations where the theory or plans do not fit the facts they will most likely discard the plan or theory. They tend to solve problems in an intuitive trial and error manner relying heavily on other people for information rather than on their own analytical ability. They are at ease with people but sometimes are seen as impatient and pushy, and their educational background is often in technical or practical fields such as business. In organisations, this style is found in action-oriented jobs, often in marketing or sales.

Having identified these four learning styles, Kolb (1984) developed them into a cycle of experiential learning. This cycle starts with a concrete experience and passes on further through reflective observation, abstract conceptualisation and finally to active experimentation. Kolb's cycle of experiential learning has been widely applied in school settings not only by McCarthy, whose work I will discuss later in this chapter, but also a number of researchers in the UK (Dennison and Kirk, 1990; and Gibbs, 1988). The four cycles are equated to *doing* (concrete experience), *reviewing* (reflective observation), *learning* (abstract conceptualisation), and *applying* (active experimentation).

Anthony Gregorc

Gregorc (1982) proposed a self-analysis tool, 'Style Delineator' as he called it, to identify two types of mediation abilities, *perception* and *ordering*, of adults.

The style delineator is based on a Mediation Ability Theory, which states that the human mind has channels through which it receives and expresses information most efficiently and effectively. The power, capacity, and dexterity to utilise these channels are collectively termed mediation abilities. The outward appearance of an individual's mediation abilities is what is popularly termed 'style'. According to him, there are two channels where people perceive and order information.

On the one hand, the *perception* abilities are the means through which an individual grasps information. There are two qualities in this dimension: abstractness and concreteness. This is similar to Kolb's perception dimension, concrete experience and abstract conceptualisation.

On the other, the *ordering* dimension has two qualities, namely sequence and random. First, the sequence ordering mode enables our mind to grasp and organise information in a linear, step-by-step, methodical and predetermined order. Second, the random ordering mode enables our mind to grasp and organise information in a non-linear, galloping, leaping and multifarious manner.

The coupling of these four qualities form four distinct transaction ability channels as follows: Concrete- Sequential (CS); Abstract-Sequential (AS); Abstract-Random (AR); and Concrete-Random (CR). These four channels, more or less, resemble Kolb's learning styles.

The style delineator instrument again follows the method of analysis used by Kolb. Unlike Kolb's, Gregorc's has ten items. Each item has a set of four words and the respondents are asked to rank them in order by putting a 4 against the word that is the best and most powerful descriptor of themselves, putting a 3 to the next best descriptor, 2 to the next and 1 to the word that is the least powerful descriptor of themselves.

The words that describe the concrete/sequential channel are objective, perfectionist, solid, practical, careful with detail, thorough, realistic, ordered, persistent, product-oriented. The words that describe the abstract/sequential are evaluative, research, quality, rational, ideas, logical, referential, proof, analytical, and judge. The words that describe the abstract/random are sensitive, colourful, non-judgmental, lively, aware, spontaneous, empathy, attuned, aesthetic, and person-oriented. The words that describe the concrete/random channel are intuitive, risk-taker, insightful, perceptive, creative, trouble-shooter, innovative, multi-solutions, experimenting, and practical-dreamer.

After adding individual scores of the corresponding style, one can find out scores for each style. If the score is between 25-40, then the corresponding style is the dominant one; if the score is between 16-26, then the corresponding style is the intermediate one; if the score is between 10-15, then the corresponding style is the low style. Gregorc provides the characteristics of persons with the four styles in terms of how they approach a number of learning-related categories (Table 4.1).

Table 4.1: The style characteristics of the Gregorc's style delineator (after Gregorc 1982)

Category	Concrete/ Sequential	Abstract/ Sequential	Abstract/ Random	Concrete/ Random
WORLD OF REALITY	Concrete world of the physical senses.	Abstract world of the intellect based upon concrete world.	Abstract world of feeling and emotion.	Concrete world of activity and abstract world of intuition.
ORDERING ABILITY	Sequential step-by-step linear progression.	Sequential and two dimensional; tree-like.	Random non-linear and multi-dimensional.	Random three dimensional patterns.
VIEW OF TIME	Discrete units of past, present, future.	The present, historical past, and projected future.	The moment: time is artificial and restrictive.	Now: total of the past, interactive present, and seed for the future.
THINKING PROCESS	Instinctive, methodical, deliberate, structured.	Intellectual, logical, analytical, rational.	Emotional, psychic, perceptive, critical.	Intuitive, instinctive, impulsive, independent.
VALIDATION PROCESS	Personal proof via the senses; accredited experts.	Personal intellectual formulae; conventionally accredited experts.	Inner guidance system.	Practical demonstration; personal proof; rarely accepting of outside authority.
FOCUS OF ATTENTION	Material reality; objects of value.	Knowledge facts, documentation.	Emotional attachments, relationships, and memories.	Applications, methods, processes and ideals.
CREATIVITY	Product, prototype, refinement, duplication.	Synthesis, theories, models and matrices.	Imagination, the arts, refinement, relationships.	Intuition, originality, inventive, and futuristic.
APPROACH TO CHANGE	Slightly adverse; speculative, hesitant and slow.	Notoriously indecisive, cross-checks, deliberation, fence-straddler.	Subject to emotions, level of interest; critical or impressionable/	Open and amenable, often instigator— 'rolling stone' 'trouble shooter'
APPROACH TO LIFE	Realist, patient, conservative, and perfection-oriented.	Realist; serious, determined, logical, and intellectual.	Idealist; emotion-al, exuberant, transcendent, and intense.	Realist/idealist; telescopic attitudinal, inquisitive, and independent.
ENVIRON-MENTAL PREFERENCE	Ordered, practical, quiet, stable.	Mentally stimulating, ordered and quiet, non authoritative.	Emotional and physical freedom; rich; active and colourful.	Stimulus-rich, competitive, free from restriction, amenable.
USE OF LANGUAGE	Literal meaning and labels; succinct, logical.	Polysyllabic words; precise, rational; highly verbal.	Metaphoric, uses gestures and body language; colourful.	Informative, lively, colourful; 'words do not convey true meaning'.
PRIMARY EVALUATIVE WORDS	Good	Excellent	Super, fantastic, out-of-sight, dynamite.	Superior, great.

Bernice McCarthy

Bernice McCarthy is one of the exponents in this field who actively applied her theory of learning styles in a school setting. Having pursued research in this area for a number of years, McCarthy (1979) initially proved that 1) students do have four major, identifiable learning styles, 2) teaching formats can be designed to accommodate learning style preferences, and 3) matched students were doing significantly better cognitively but not affectively. McCarthy's instrument that was used to identify the learning styles of the students of the St. Viator school consists of descriptive sentences rather than items with mere adjectives. Students were asked to underline those sentences that most fitted their characteristics, and to delete those that did not at all fit.

Mostly drawing from Kolb's learning styles, McCarthy (1980) later attempted to synthesise a group of learning styles (based on Kolb, Gregorc and others), Jung's personality types and researches of left/right brain into four neat styles namely *innovative learner*, *analytic learner*, *commonsense learner*, and *dynamic learner*. The learning styles are almost similar to Kolb's diverger, assimilator, converger and accommodator respectively. McCarthy further developed these ideas and planned different lessons in four different ways to accommodate four different learning styles in a cyclical fashion based on her 'The complete 4MAT system model', which was adapted and improved from Kolb's experiential learning theory of growth and development and Piaget's theory of intellectual development stages (McCarthy 1985).

McCarthy's innovative learners tend to seek meaning; need to be involved personally; learn by listening and sharing ideas; absorb reality; perceive information concretely and process it reflectively; are interested in people and culture; are divergent thinkers who believe in their own experience; excel in viewing concrete situations from many perspectives; model themselves on those they respect; and function through social interaction. Their main goals are self-assessment in important issues, and bringing unity to diversity. They tend to ask 'why or why not'. Their careers are found to be in counselling, personnel, the humanities, or in organisational development.

McCarthy's analytic learners tend to seek facts; need to know what the experts think; learn by thinking through their ideas; form reality; perceive information abstractively; are less interested in people than in ideas and concepts; are critics to information; are data collectors; are thorough and industrious; re-examine facts if situations perplex them; enjoy traditional classrooms; and function by adapting to experts. Their strengths are in creating concepts and models. Their goals are self-satisfaction and intellectual recognition. They always ask 'what?'. They are found in the following careers—basic sciences, maths, research, and planning departments.

McCarthy's commonsense learners tend to seek usability; need to know how things work; learn by testing theories in ways that seem sensible; edit reality; perceive information abstractly and process it actively; use factual data to build designed concepts; need hands-on experiences; enjoy solving problems; resent being given answers; restrict judgements to concrete things; have limited tolerance to fuzzy ideas; need to know how the things they are asked to do will help in real life; and function through inferences drawn from sensory experience. Their strength lies in the practical application of ideas. Their goal is to bring their view of the present into line with future security. They prefer to ask 'how does this work?'. They are often found in engineering, physical sciences, nursing, and as technicians.

McCarthy's dynamic learners tend to seek hidden possibilities; need to know what can be done with things; learn by trial and error and self-discovery; enrich reality; perceive information concretely and process it actively; are adaptive to change and relish it; like variety and excel in situations calling for flexibility; tend to take risks; are at ease with people but are sometimes seen as pushy; often reach accurate conclusions in the absence of logical justification; and function by acting and testing experiences. Their strengths are in action and carrying out plans. Their goals are to make things happen, and to bring action to concepts. The tend to ask 'what can this become?'. They are found in the following careers—marketing, sales, action-oriented managerial jobs.

McCarthy claimed in her book *4MAT System in Action* (McCarthy, 1985) that each learner will shine 25% of the time as the lesson is delivered in four different ways to accommodate four different styles. Critics, however, argued that in effect every student will be at learning difficulty at 75% of the time (Weinstein 1988). Although the criticism may outwardly suggest a weakness of '4MAT' lessons, it actually does not. Some students will otherwise be in a learning difficulty situation for 100% of their time and others will be at a learning advantage situation for 100% of the time when the lesson is delivered in the traditional way, which is suitable for the analytic learner. It is better in a way to let all students experience learning difficulty for 75% of the time — a politically correct way. However, it can also be argued that students would not at all be in a difficult learning situation for 75% of the time, instead, they are given the opportunity to stretch out to other learning styles, as learning styles are malleable and different styles are effective at different times and for different situations.

In museums, Ames (1993) shows how museum programming such as orientation, interpretation, visitor sensitivity, tours or classes can be developed to suit

McCarthey's four learners. The imaginative learner will prefer people on the floor to answer questions, to encourage social interaction, to articulate the reasons and to facilitate group discussion. The analytic learner will prefer a floor plan, facts and ideas, to get some specific questions answered by museum staff, a museum tour with a lot of discussion and analysis, and plenty of information. The common sense learner will like to find his or her own way, to discover things independently, and to give their feedback on exhibits. The dynamic learner will prefer to explore the museum innovatively, to share some of their imaginative thinking with others, and to share their ideas and opinions with staff.

There are a number of limitations with these one- and two-dimensional learning styles. First of all, they are too narrow as they include only cognitive factors and processes. The instruments measuring these styles do not actually measure the individual's abilities; rather, they only measure the individual's preferences for the words. This may inevitably lead to the fact that the measured diverger may in fact be a converger. Concentrating only on the internal cognitive structures and processes, the one- and two-dimensional cognitive and learning styles miss out affective, physical, personal, cultural and environmental influences. These types of styles are furthermore limited in numbers as the factors influencing learning goes beyond four, as evidenced in the multi-dimensional learning styles, to which I will now turn my attention.

Multi-dimensional Learning Styles

Concurrently, the inadequacy of learning styles with their preoccupation with cognitive structures and processes, leads to another type of learning styles (for example, French, 1975; Canfield, 1983; Dunn and Dunn, 1978 and 1992) that incorporates many factors - personal, social, environmental and others.

Russell French

The theory of learning styles developed by Russell French (1975) act as a bridge between the two-dimensional and multi-dimensional learning styles. French proposed 35 learning styles in a matrix form. The matrix constitutes seven columns of *sensory intake (perception)* and five rows of *concept formation*. The seven sources of sensory intake are *print-oriented*, *aural*, *oral*, *visual*, *tactile*, *motor* and *olfactory*. The five ways of concept formation are *sequential*, *logical*, *intuitive*, *spontaneous* and *open*. The various combinations of five rows and seven columns lead to 35 learning styles.

French's learning styles, in effect, have only two dimensions, but they are merely extended each into five by seven matrix form. Therefore, it is somewhat like an extended version of the Gregorc style delineator.

The *print-oriented* person is dependent on reading and writing; the *aural person* is a listener and does not say much; the *oral person* is a talker and learns through discussion; the *visual person* has many visual stimuli and visual representations; the *tactile person* has to touch everything and everyone; the *motor person* has to move about while learning something; and the *olfactory person* learns through taste and smell.

The *sequential person* must perceive orderly relationships; the *logical person* uses the processes of reasoning to reach conclusions; the *intuitive person* perceives truths and facts directly without the benefit of extensive reasoning; the *spontaneous* person relies on impulse; the *open person* uses combinations of the above or different ones of the above at different times.

Though the number of styles in this case increased beyond four, this theory does not extend beyond the cognitive and physiological processes and factors.

Albert A Canfield

Canfield (1983) originally developed his learning style inventory in 1972 and subsequently revised it many times. He recognised the inadequacy of the current learning style theories' preoccupation with cognitive structures and processes and the importance of the affective factors that influence learning:

> The research is beginning to confirm what has been largely evident to the experienced and concerned teacher—people do differ in the way they learn and not all aspects of that difference are related to mental ability or intelligence as we customarily measure it. Certain personality or attitudinal values impinge upon the teaching-learning situation and those have gone comparatively unnoted, unresearched and unverified (Canfield 1983:1).

Accordingly, Canfield devised a learning style inventory to measure some of those affective variables that seem to effect learning. He therefore proposed that a learning style inventory should have four major elements namely *conditions*, *contents, modes* and *expectations*.

The first element, *conditions,* was based on the conviction that an individual is most responsive to the relationship between the individual's motivation and environmental influences. Therefore, there should be more than one way of meeting the relationship. The conditions are therefore devised to consist of four major motivational areas namely: *affiliation, structure, achievement,* and *eminence*.

Affiliation is the way in which an individual prefers a friendly, warm and supportive relationship with peers and instructors. Some examples are working with another student; and knowing the instructor personally.

Structure is the way in which an individual prefers logical, orderly, well-defined and clear instructional procedures in terms of organisation and in terms of detail. For example, course work logically and clearly organised and meaningful assignments and sequences of activities.

Achievement is the way in which an individual prefers independence of action, pursuit of own interest, self-test objectives in relation to self-perceived capabilities and interests in terms of goal-setting and independence. For example, setting one's own objectives, making one's own decisions about objectives, and working alone and independently.

Eminence is the way in which individuals compare themselves to others in competing for recognition, having situations controlled, and having friendly, warm and supporting relationships with others. For example, needing to know how one is doing in relation to others, desiring classroom discipline and maintenance of order, and having informed and knowledgeable instructors.

The second element, *contents,* is based on a practical point of view that students perform best when engaged in a subject matter of personal interest and they have preferences in subject areas. Therefore, four major fields or domains of interest were identified to measure the student's level of interests: first, a *numeric* or mathematical area that includes working with numbers, computing and solving mathematical problems; second, a *qualitative* or verbal area that includes working with words or language, writing, editing and talking; third, an *inanimate* or manipulative area that includes working with things, building, repairing, designing and operating; four, *people* or interactive area that includes working with people, interviewing, counselling, selling and helping. These four areas give an indication of the popular topics in museum exhibitions and the particular efforts that can be made to interest and attract more museum visitors.

The third element, *modes,* is based on the research evidence that there exist individual differences among adults in channel utilisation efficiency. In this element, four different kinds of learning modes have been included. First, the *listening* or auditory mode includes hearing information from lectures, tapes, and speeches. Second, the *reading* mode involves examining written words by reading texts, and pamphlets. Third, the *iconics* mode includes viewing illustrations, movies, slides, pictures and graphs. Fourth, the *direct experience* mode involves a range of manipulative and touching activities, handling and performing.

The last element, *expectation*, is based on the research of Sperry's Learning Performance and Individual Differences that discusses theories supporting the correlation between expectancy and success and assumes that the expectancy influences learning in a significant way. Quantifying the level of expectation for performance provides invaluable clues to student treatment. This element includes four levels of performance namely *outstanding*, *above average*, *average* and *unsatisfactory*. In museums, visitors' expectations are often shaped by the reason of their visit. People visit the museum for various reasons, so their expectations will be different.

<u>Rita Dunn and Kenneth Dunn</u>

Dr Rita Dunn and Dr Kenneth Dunn joined the group of researchers in the field of learning styles who often think that the current learning styles are not adequate as they are often restricted to only one dimension or two. The Dunns argued that learning style is a combination of many biologically and experientially imposed characteristics that contribute to learning, each in its own way and together as a unit. Unlike Canfield, the Dunns had a further step by including not just the affective and physiological variables but also cognitive variables:

> Learning style is more than merely whether a child remembers new and difficult information most easily by hearing, seeing, reading, writing, verbalising, or actively experimenting; perceptual modality strength is only one part of learning style. It also is more than whether a person processes information sequentially, analytically, or in a 'left-brain' mode rather than in a holistic, simultaneous, global 'right-brain' fashion; that too, is only one important component of learning style. It is more than how someone responds to the environment in which learning must occur or whether information is absorbed concretely or abstractly; those variables contribute to style but again, are only part of the total construct. We must look only at the apparent symptoms; we need to examine the whole of each person's inclinations toward learning (Dunn and Dunn, 1992: 2).

Initially, the Dunns identified 12 variables that significantly differentiated students (Dunn and Dunn 1972). They later added five more components to the learning styles (Dunn and Dunn 1978). By 1992, they had incorporated hemispheric preferences and global-analytical inclinations into their framework and finally the Dunn and Dunn model of learning styles included 21 elements as in Figure 4.5.

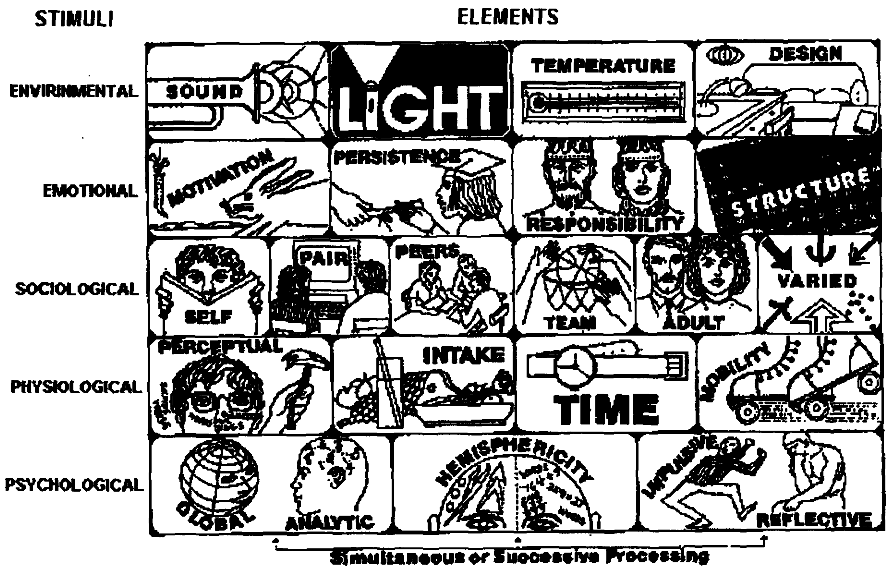


Figure 4.5: A most recent version of the Learning Styles Model proposed by Dunn and Dunn (1992).

This classification revealed that learners are simultaneously affected by their immediate environments, their own emotionality, their sociological preferences, their physiological characteristics and their psychological characteristics. So, the final model of Dunn and Dunn (1992) diagnoses learning styles using five stimuli and their elements. The stimuli are *environmental, emotional, sociological, physical* and *psychological*. First, sound, light, temperature, and design are the elements of the *environmental stimuli*. Second, the elements of the *emotional stimuli* are motivation, persistence, responsibility and structure. Third, the elements of the *sociological stimuli* are peers, self, pair, team, adult, and varied. Fourth, the elements of the *physiological stimuli* are perceptual (seeing, hearing, smelling, touch and kinaesthetic), intake, time and mobility. Fifth, the elements of the *psychological stimuli* are global/analytic, hemisphericity, and impulsive/reflective. This model attempts to include many factors that influence learning without trying to fit the factors into the neat numbers.

An adult version of this model, called Productivity Environmental Preference Survey (PEPS), was later designed to identify comprehensively an adult's productivity and learning styles. About 100 items have been designed to elicit individual preference to learning situations in a five-point Likert-type scale. The correlation matrix of these items was inputted to factor analysis procedure to reveal about 20 factors which constitute the elements of learning styles. Raw score and standard score were computed for these twenty areas. Having a mean of 50 with standard deviation of 10, the standard score ranges from 20 to 80. Individuals having a standard score of 40 or less, or 60 or more find that variable important. I will present the areas individually.

Affected-Unaffected by sound:- Although many children require a quiet place while concentrating on difficult information, others literally learn better with sound than without (Pizzo, 1981). Most of the interactive-type galleries generate sufficient ambient noise to accommodate the people who are unaffected by sound; but having static and silent galleries would accommodate the people who are affected by sound.

Natural/Low-Artificial/Bright light:- Although many people concentrate better in brightly illuminated rooms, others think better in soft light than in bright light. Indeed fluorescent light often over stimulates certain learners and causes hyperactivity and restlessness (Dunn, Krimsky, Murry and Quinn, 1985). Recognising this dimension, some European and North American museums have already been taking advantage of architectural designs to diffuse the natural lights inside the gallery space.

Cool-Warm temperature:- Temperature variations affect individuals differently. Some achieve more in warm environments and others in cool environments (Murrain 1983). More research is needed to suggest how people in this dimension can be accommodated in addition to having both cool and warm rooms within the same museum.

Formal-Informal design:- Some youngsters achieve more in an informal physical environment where as others learn more easily in a formal setting (Dunn and Dunn 1992). The informal physical environment would include, for example, carpeting, lounge chairs, couch or bed. The formal setting on the other hand would have desks, library tables and hard chairs.

In museums, thematic exhibitions often tend to concentrate on providing a highly formal and designed environment whereas the 'tutti-fruity' disjointed exhibitions more often strive to contrive a very informal designed space. The Exploratorium in San Francisco is an example of an informal design whereas the Human Body Gallery of 'Eureka: The Children's Museum' in Halifax, England, is an example of formal design. People who prefer formal design would think the Exploratorium is a barren land and not at all attractive; at the same time, people who prefer informal and subdued designs would see the Human Body at the Children's Museum in Halifax as over stimulating. In reality, both are needed inside the same museum to cater to the different needs of the visitors.

Intrinsic-Extrinsic motivation:- People generally are motivated by both internal and external factors (Dunn and Dunn 1992). Intrinsic motivation may include such things as self interest and recognition of achievement; extrinsic motivations are things like parents or partners' expectations and rewards. Museum visitors are more likely to be motivated through intrinsic factors, though they are also motivated by external factors to a certain extent. Providing a range of opportunities at different levels within a museum exhibition would make visitors experience the 'flow', thereby motivating them intrinsically. Things like tokens, prized competitions, would accommodate people with extrinsic motivations.

Continuous-Irregular concentration or persistent - not persistent:- This recognises that there are people who start many things simultaneously; and there are also others who prefer to complete things before taking up another (Dunn and Dunn 1992).In museums, the visitors with continuous concentration can learn in any situation whereas the visitors with irregular or intermittent concentration need to be accommodated by enhancing the attractiveness of the exhibits and making exhibits very simple and quick in communicating their intents, probably within two minutes.

High-Low responsibility:- People with high responsibility scores would feel best when they do things they know they should do and they are more conforming. On the other hand, people with low responsibility scores like to do things most other people do not like to do; they, being a non-conformist, do not respond well to authority (Dunn and Dunn 1992). Though museums cater very well to people with low responsibility by allowing them freely to do whatever they like, some attempts are also to be taken to provide clear and explicit instructions as to how to approach the museum learning situation so that people with high responsibility are guided to conform to the informal nature of learning.

Flexible-Strict structure:- Some people prefer to be told exactly what to do in a learning situation whereas other people like to be left to decide on their own (Dunn and Dunn 1992). This tendency amongst people has implication for the necessity of structuring the learning materials (exhibitions in the case of museums) for those who prefer structure. Structuring exhibitions can be done in a number of ways (see Chapter VIII). A research study conducted by Canizalles de Andrade (1989) provides evidence that the use of a worksheet to structure visits to museum exhibits can be a valid method to help ensure the achievement of the objectives proposed for the visit.

Alone-Many in the group :- People in this dimension prefer to learn in a group that consists of many to one. Some really like to be the leader of the working groups and learn while interacting with them, whereas others, at the opposite pole, prefer to learn alone, for many reasons. There is research evidence that suggests that students prefer to concentrate on a difficult topic alone rather than in a group (Dunn and Dunn 1992). Besides providing opportunities for interaction with exhibits and between people, science centres must create more opportunities for independent and secluded learning stations amidst the lively (noisy as critics would put it) halls. By extending access to the reference library within the museum, it would accommodate serious learners. The library itself would then also be treated as another gallery.

Strongly-Weakly kinaesthetic:- Some people are found to have strong preferences to kinaesthetic activities whereas others have weak preferences to those activities that need running, acting and moving and so on (Dunn and Dunn 1992). Gardner (1983) also identifies this dimension as bodily-kinaesthetic intelligence. Science centres have already been providing opportunities to accommodate these strongly kinaesthetic people by introducing hands-on exhibits. More and more interactive exhibits need to be created to meet the needs of more people.

Strongly-Weakly auditory:- Biologically some people are well developed to be strongly auditory whereas others are weakly auditory. Some people's hearing sense is much more dominant than other senses (Dunn and Dunn 1992). Gardner (1983) found that this modality is responsible for the two of his seven intelligences, linguistic and musical intelligences. Use of such things as good quality audio guides and guide lecturers or explainers would accommodate people who prefer to listen.

Strongly-Weakly visual:- A learner whose primary perceptual strength is visual can recall what has been read or observed more easily than others whose visual perceptions are weak. In museums, the strongly visual learners are accommodated mostly in museums through dioramic and immersion exhibits that attempt to provide contexts; visual learners can understand holistically without needing any further explanation for they have highly developed spatial intelligence (to use Gardner's expression).

Strongly-Weakly tactile:- In this dimension children more often tend to be strongly tactile than adults; this does not preclude the interest and involvement adults attach to learning by touching. For example, learners with strong tactile strengths need to underline as they read, or take notes when they listen (Dunn and Dunn 1992). So, strongly tactile people like to touch everything and they can think only in action. In museums, most of the interactive exhibits and touching specimens accommodate these people.

Intake a Must-Unnecessary:- For some people, it is a necessity to eat or drink something while learning, whereas others do not need to take anything (Dunn and Dunn 1992). Those people who always use some kind of intake while learning more often tend to be global thinkers and often find it difficult to concentrate for a long time. The analytics tend not to prefer any intake and generally have a high level of concentration. But to accommodate people of this dimension in a museum setting, provision of eating facilities inside a museum has to be made without any danger to the environment.

Morning-Evening time of day:- Amongst junior high school students, one-third of them are found to have high energy levels in the morning; and only 13 percent of them are found have high energy levels in the evening (Dunn and Dunn 1992). By keeping the museum open in early morning and late evening hours, more people can be accommodated.

Active-Passive mobility:- Della Valle (1984) documented evidence that almost 50 per cent of students from a large urban junior high school could not sit still for any appreciable amount of time. Twenty-five percent could remain immobile if interested in the lesson, and the remaining 25 per cent preferred passivity. Della Valle clearly demonstrated the importance of this dimension of learning style. Students who required mobility moved from one part of the room to another in order to master all the information in the lesson and performed better than when they sat for the period. On the other hand, students who disliked moving performed worse when required to learn while walking and significantly better when permitted to sit quietly and read. In a museum, apart from active exhibition spaces, the provision of quiet places with chairs within a more flexible exhibition space would accommodate people in this dimension.

Global-Analytic:- In this dimension, analytic thinkers learn more easily when information is presented step by step in a cumulative sequential pattern that builds toward a conceptual understanding. Global thinkers learn more easily when they either understand the concept first and then can concentrate on the details, or when they are introduced to the information with preferably a humorous story replete with examples and graphics.

Global and Analytic thinkers appear to have different environmental and physiological needs. Many analytics tend to prefer learning in a quiet, well illuminated, formal setting; they often have a strong emotional need to complete the tasks they are working on; and they rarely eat or drink while learning. Conversely, globals appear to work with what teachers describe as distracters; they concentrate better with sound (music or background talking), soft lighting, an informal setting arrangement, and some form of intake. Globals frequently break while studying and often prefer to work on several tasks simultaneously. They begin a task, stay with it for a short amount of time, stop, do something else, and eventually return to the original assignment. This is what happens with most of the children inside the science centre. The informal nature of the science centre will mostly cater for global thinkers. However, the science centre should also attempt to provide more opportunities to accommodate the analytic thinkers; this can be achieved by providing secluded classroom-type places with resource books and personnel.

Left-Right brain dominant people:- This dimension is based on the brain lateralisation theory of the French neurologist Paul Braco (Dunn and Dunn 1992). According to him, the two hemispheres of the human brain have different functions. Subsequent research in the field provided evidence for the view that the left hemisphere is responsible for verbal and sequential abilities whereas the right hemisphere is responsible for emotions and spatial and holistic processing (Williams 1983). In museums, good orientation and structuring of materials would help accommodate left brain dominant people.

Impulsive-Reflective:- People have their processing inclinations in this dimension (Dunn and Dunn 1992). Some tend to plunge into the problem immediately whereas others prefer to ponder before solving it. In other words, the impulsive people tend to think in actions whereas the reflective people act in thinking. Both inclinations have advantages. Science centre exhibits mostly cater for the impulsive but nor as much to the reflective personality. Dioramic and visual exhibits cater for the reflective learners while interactive exhibits cater to the impulsive learners. More often, reflective learners tend to be global thinkers; the impulsive learners on the other hand tend to be analytic thinkers. The impulsive learners are sometimes called active learners (Kolb 1984).

TOWARD A 'WEAVE' APPROACH TO MUSEUM LEARNING STYLES

Many learning theories are successfully applied in the school environment. For example, McCarthy's (1980 and 1985) 4MAT system is successful as there is a teacher who can deliver the four formats (4MAT) depending upon individual learning styles of students. Similarly, the Dunn and Dunn model has also been very effectively used and applied in the school setting (Dunn and Dunn 1992; Carbo, Dunn and Dunn 1991). A Centre for the Study of Learning and Teaching styles, under the directorship of Dr. Rita Dunn at St. John's University of New York, is devoted to conducting pioneering researches and programmes in learning styles.

The one- and two-dimensional learning styles are good at fitting people into neatly defined styles. Although it may be very useful and effective in a school setting, fitting people into neatly defined styles as done, for example, by McCarthy is not necessary and is not helpful in a museum setting. Multi-dimensional learning styles might lack generalisation and might be unable to fit individuals into definite, neat, but narrow styles. They do, however, attempt to give a complete and comprehensive picture of reality and are therefore more useful in understanding the learning situation in a holistic way. In museums, there is no teacher per se and museum exhibitions are purely learning environments although teaching sometimes takes place out of the interaction between parents, children, friends, partners, visitors and guides. This difference between museums and schools hinders the applicability of the 4MAT system within the museum setting. However, McCarthy's four learning styles are still useful in designing programming to suit the four learners as suggested by Ames (1993).

Unlike school students, museum visitors vary enormously in terms of their personal, social and intellectual levels. They are in museums by choice and they can choose to do anything that interests them. In a free-choice environment such as the museum, the one- or two-dimensional leaning styles have limited applications apart from giving the idea that the exhibition should attempt to enable people to answer questions such as why, what, how, and what if? As they do not include Dunn's sensual preferences, physiological, psychological and motivational factors, or Canfield's conditions, expectations, areas of interest and modes, the one- and two-dimensional learning styles are obviously lacking in describing the museum visitor in terms of his or her preference and function in museum conditions.

Instruments used to measure multi-dimensional learning styles have more advantages than those used to measure the other learning styles. For example, the Dunns' instruments used items which are broad, concrete and specific questions rather than abstract adjectives which were used by Kolb and Gregorc. The concrete and contextualised questions may more readily evoke answers than the abstract adjectives. This is further corroborated when Kolb himself acknowledges that his inventory will be a biased one as people with a concrete learning style would find difficulty in responding to the test, which requires active and abstract thinking (Kolb, 1978).

There are two critics of museum learning styles. The criticisms raised against the notion of learning styles in museum studies must be looked at carefully as they are often found to be true only in the case of the one- and two- dimensional types but not in the case of multi-dimensional learning styles. The broad-based approach followed in the multi-dimensional learning styles are found to be missing in the one- and two-dimensional learning styles.

Beverly Serrel, a Chicago consultant and a well known museum evaluator, provided an overview of the learning style theories (Serrell 1990a). This overview kindled my interest and played a key role in my decision to research this area. This overview and other studies on museum learning styles have unfortunately concentrated only on the one- and two-dimensional learning styles; these museum studies never showed any recognition of the existence of the multi-dimensional learning styles.

Having later diverted her research efforts to find out what she called 'visitor styles', with visitors being described as streakers, studiers, browsers or grazers, Serrell came up with many criticisms of these styles. Her visitors' styles are of course very narrow for they consider only the ways in which visitors move inside the exhibition. They are similar to the one- or two- dimensional learning styles, which often concentrate on cognitive aspects only. Therefore Serrell's criticisms, though applicable to one- and two- dimensional learning styles, can not be extended to the multi-dimensional learning styles.

Having reviewed seven ways that exhibitions are designed in museums, Bitgood (1994) identified the individual-difference approach as one of them. This approach has commonalty with the learning style approach for they both consider the individual differences of museum visitors in a learning situation. In this approach, an exhibit is designed to provide something for everyone.

Bitgood identified two strengths of this approach: first, the approach recognised the existence of diverse audiences and this should encourage the designing of exhibits for the broadest range of audiences; second, the individual approach gave credence to the possibility that interests, preferences, and/or cognitive abilities or styles may influence the impact of the exhibits.

Bitgood also identified four criticisms: first, there has been no systematic replication of the studies by Greenglass (1986) and Vance and Schroeder (1992); second, critiques argue that the dimensions selected represent continuums rather than discrete categories (e.g. Serrell 1993); third, there is often a problem in defining individual differences; and fourth, there is a danger of stereotyping visitors.

That the dimensions selected present continuums rather than discrete categories is in fact an advantage, for it gives the museum designer the opportunity to accommodate a range of dimensions in the same setting rather than just matching the categories. The very concept of learning style is that it is a bipolar dimension in a continuum.

The fourth criticism can not exist in principle as learning styles are not categories (also corroborated in the second criticism) and therefore it is impossible and unnecessary to label and stereotype museum visitors. So, many elements of complementary and redundant information can be built into an exhibition to cater for various learning styles. There are two examples of multiple provision in museum exhibitions. First, Vance and Schroeder (1992) created and set up two different labels for sensing and intuitive types in the same exhibition; second, Davidson et al (1991) attempted to enrich dioramas with sound, smell and labels, to accommodate various modalities of museum visitors.

Bitgood's first criticisms can be overcome by directing more research efforts in this area. In overcoming Bitgood's third criticism, the present study, for instance, contributes through defining learning styles into a broad framework.

After carefully analysing and reviewing Gardner's multiple theory of intelliegences, Jung's personality types and many theories of learning styles, it can be concluded that people are simultaneously affected by various factors in various levels. Every individual interacts with nature and culture on two different bases: one is on an individual basis and the other is on a collective basis. These four elements constitute a weave pattern (see Figure 4.6), on which an individual travels metaphorically while inside a museum.

The interaction of a person with nature on the individual basis is called the physiological level; the interaction of a person with culture on the individual basis is called the psychological level; the interaction of a person with nature on the collective basis is called the environmental level; and the interaction with culture on the collective basis is called the sociological level. Every person is subjected to all the four levels at any point of time, but the amount of influence of each level may vary from person to person. This variation leads to a number of learning styles in any person and thereby creates disparate needs of the museum visitor.

Each of the four levels consists of a number of learning style dimensions. The psychological level consists of many dimensions such as feeling-thinking, impulsive-reflective, intrinsic-extrinsic motivation, abstract-concrete, people and animate, and flexible-strict structure. The physiological level consists of many dimensions such as strongly-weakly kinaesthetic, strongly-weakly visual, left-right brain dominant, morning-evening time of the day, and intake a must-unnecessary. The sociological level contains many elements such as outstanding-below average expectation, intimate-distant affiliation, alone-many of the group status and high-low responsibility. The environmental level consists of many elements such as low-bright light, formal-informal design, and cool-warm temperature.

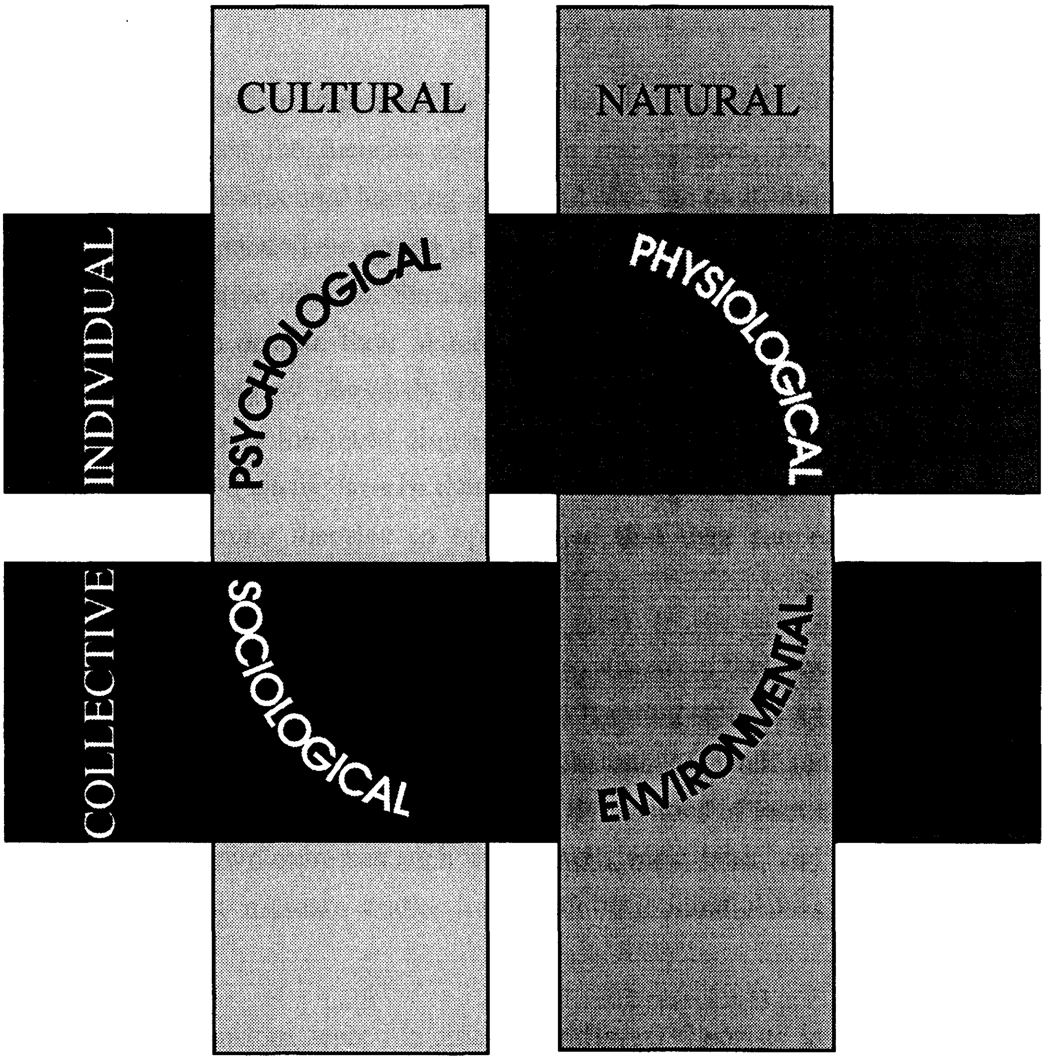


Figure 4.6: A wholistic 'weave' model for museum learning styles: a visitor travels in the metaphorical weave. Humans act fundamentally in four major levels — physiological, environmental, psychological and sociological. These are the results of the confluence or the 'weave' of four influences that affect humans — natural and cultural; and individual and collective. The number of individual dimensions within each Level is deliberately kept open for future additions and updates.

In hindsight and reflection, the levels proposed in the 'weave' approach seem to have similarities with contexts and spaces. What I proposed in the psychological level most closely resembles Falk and Dierking's personal context or Annis's cognitive space.

Similarly, the sociological level is very close to Falk and Dierking's social context or Annis's pragmatic space. The environmental level is, more or less, the same as Falk and Dierking's physical context or Annis's dream space. While the studies of Falk and Dierking and Annis concentrated only on the external factors, the current research has gone a step forward to include many internal factors by introducing another physiological level. It therefore follows that the biological structure within each person is as equally important as the factors outside the person.

CONCLUSIONS

Unlike the museum studies that have so far researched learning styles, the present study reviewed not just the theories of multiple intelligences, Jung's psychological types, one- and two-dimensional learning styles but also the multi-dimensional learning styles. Although he expanded the notion of the intelligence to seven areas, Gardner still acted within the cognitive domain. Similarly, Myer and Briggs have not gone beyond the psychology per se despite their sixteen types. In the same way, one- and two-dimensional learning styles obviously concentrated on cognitive and information processing domains. Only the multi-dimensional learning styles, differing from all the other theories, included many factors that affect learning. This difference makes the multi-dimensional learning theories so open-ended that they can easily incorporate dimensions from the other theories.

What is a common thread connecting these disparate theories on intelligences, types and styles? The answer is the concept of the learning style as a bipolar dimension in a continuum. For example, the seven dimensions of intelligences, the sixteen dimensions of psychological types, and the many dimensions of learning styles all have their dimensions with two extremes such as low-high, most-least, and weakly-strongly. This might explain why museum studies treated all these intelligences, types and styles as learning styles.

Different dimensions were identified by different theorists in one-dimensional learning styles. These are Witkin's field independent-dependent, Hunt's low-high conceptual level and a range of others. In two-dimensional learning styles, Kolb's, Gregorc's and McCarthy's learning styles were found to identify more or less the same four learning styles: innovative, analytic, commonsense and dynamic learners. In multi-dimensional learning styles, Canfield and the Dunns identified about 11 and 21 learning style dimensions respectively.

Museum visitors have been measured for their learning styles in two dimensions only. These are Myers and Brigg's sensing-intuition dimension and Hunt's low-high conceptual levels. Ames (1993) found McCarthy's four learning styles useful in designing museum programmes such as orientation, interpretation, sensitivity to visitors and museum tours to suit visitors with different learning styles. Recognising the importance of Gardner's theory of multiple intelligences, Dierking (1991) and Hooper-Greenhill (1994) offer many suggestions to incorporate them into the museum activities so that visitors with seven different intelligences can benefit from their visit.

Finally, after a thorough analysis of all these theories, a 'weave' approach was conceived to explicate the museum learning styles. This approach suggests that the museum visitor is simultaneously influenced by four levels namely psychological, physiological, sociological and environmental. This influence leads museum visitors to a myriad of learning styles. Many learning style elements, or dimensions, constitute each level. This approach is neither thorough nor free from limitations. Apart from a few, many dimensions in this approach are needed to be empirically tested with museum visitors. However, this simplified approach merely puts various dimensions identified by many theorists into a usable framework, which helps to further our understanding of the museum visitor.

This chapter concludes the Systematics part of the thesis. In this I attempted to contribute towards the understanding of the nature of museum education, the evolution of science museums, the exhibition developmental processes, the nature of museum learning and the nature of the museum visitor in terms of their learning styles. In the following Pragmatics part, I will present the results of three empirical studies, conducted to shed light on the nature of museum learning, the nature of the museum visitor and the nature of the museum visit.

CHAPTER V

INFLUENCES OF GENDER, GROUP, AGE AND OTHER DIFFERENCES BETWEEN MUSEUM VISITORS ON THEIR VISITS: RESULTS OF A SURVEY

INTRODUCTION

Survey is the most common research method in museums, second only to observation. The survey approach was popularised by the Canadian experts, Abbey and Cameron (1959 and 1960) in the museum setting and was later followed in a number of museums throughout the world due to its ease of application and effectiveness. It is a good, easy and effective method for collecting data if the purpose is to find out some demographic information of the museum visitor and answers on the general nature of the museum visit. A questionnaire survey was therefore designed to understand the process of museum visits by Indian visitors in terms of why, with whom and for how long they visit the museum. The sample size of the survey is 479 visitors to the Periyar Science and Technology Centre in Madras (hereinafter called the Centre). The Centre consists of five exhibition galleries namely the *Periyar Gallery*, the *Transport Gallery*, the *Children's Gallery*, the *Electronics and Communication Gallery*, and the *Physical Science Gallery*. Even though the Centre administers a Birla Planetarium (fee payable) and a Science Park (free), they have independent entrances and exits. They are not therefore treated as parts of the Centre in this study. The Survey was conducted between 15 June 1993 and 22 August 1993.

The subjects for this study were chosen as they walked through the entrance door of the Centre. In order to make the sample more representative and as random as possible, always selecting the first person entering the museum was avoided. A rotational procedure was worked out. To begin with, the first person who entered would be interviewed; in the following interview the second person of the group would be chosen and in the third interview the third person of the group, and so on until the ordinal number of the person was greater than the number of persons in the group itself, in which case, the ordinal number of the person would be reset to one.

In sum, if the n^{th} person was selected in the previous interview, and if the number of persons in the following group was less than n, then the first person would be selected for the next interview. Otherwise, the $(n+1)^{th}$ person would be selected. In this way, the sample could achieve inclusion of those who followed and those who led, those who escorted and those who had been escorted, those who paid for the group and those who had been paid for, children and adults, and those who were pushy as well as those who were humble.

Frequency and 'crosstab' (cross-tabulation) procedures of SPSS for Windows were run on the data obtained from the study to find out associations between different variables. Correspondence analysis[1] and chi-square tests[2] were also done on appropriate data sets to reveal associations among variables and/or observations.

The analysis and results of the Survey study are presented in terms of who the visitors are with respect to their gender, type of visit, nature of the group, age group and place of residence. These will be referred to as the five basic characteristics or variables of visitors. This is followed by various relations and associations among these five variables. Also, some of these variables are compared with data obtained from similar studies conducted in the UK and North American museums. After having found some relationships among these five basic variables, I will proceed to discuss six topics: 1) whose idea it was to visit the Centre, 2) media and other information sources consulted before the visit, 3) reasons for visiting the Centre, 4) the length of time the visitors intended to spend, 5) what else the visitors planned to do in Madras on the day of the visit, and finally 6) what the visitors do in their spare time. All these topics are analysed using crosstabs for any significant variations in the five basic characteristics of the visitors.

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[1]Correspondence analysis is a technique to find a multidimensional representation of the association between the row and column categories of a two-, three-, or multi-way contingency table. What it does is basically to convert a matrix of data into a particular type of graphical display in which the rows and columns of the matrix are depicted as points. This technique has other names such as reciprocal averaging in the field of ecology or dual scaling in the field of psychology. This is a variant of Principal Components Analysis but tailored to categorical data rather than ordinal and interval variables.

[2]While making use of the chi-square statistic to reject the independence between two variables, the following guidelines were strictly adhered to. Although there has been debate about these, the practice of leading authorities has been to proscribe the use of chi-square when:

1. In 2 x 2 tables, any of the expected frequencies is less than 5.
2. In larger tables, any of the expected frequencies is less than 1 or more than 20% of the expected frequencies are less than 5 (Kinnear and Collin, 1994).

When one of the two conditions was met, the chi-square statistic, however high or statistically significant it may be, would be rejected and hence the null hypothesis retained.

In order to establish and measure the strength of the association between two variables, SPSS's 'crosstab' procedure returns two coefficients namely phi coefficient and Cramer's V. Delucchi (1983: p173) shows that the maximum value of phi is equal to the square root of the minimum of (number of rows-1) or (number of columns -1). Therefore, for a 2x2, 2xC, or Rx2 table, the maximum value of phi will be 1; but for other tables, the value of phi will exceed 1. For example, the maximum value of phi will be $\sqrt{2}$ for a 3x3 table. However, to retain the maximum value of the phi coefficient within one even for the higher order tables, Cramer (1946) introduced Cramer's V which is nothing but phi divided by 'the maximum value of phi'. For this reason, while phi (ϕ) is just appropriate for a 2x2, 2xC, or Rx2 contingency table, Cramer's V is preferred and found to be more appropriate for two-way contingency tables involving both row and column variables with more than two categories (Kinnear and Collin, 1994). Wherever found appropriate, both phi and Cramer's V are reported.

WHO THE VISITORS ARE

The nature of the visitors to the Centre are described in terms of five variables: gender, the type of visit, the age group, the nature of the group, and the place of residence. The percentage and number of categories of each variable are presented in Table 5.1.

Gender Ratio

More men (57%) than women (43%) visited the Centre (Table 5.1). It will be of interest here to compare the male-female ratio of visitors to the Centre with that of the four major art and science museums in the UK, drawing data from similar surveys conducted in the National Portrait Gallery in London (Harvey, 1987: p 7), the Victoria and Albert Museum in London, the National Railway Museum in York, and the Science Museum in London (Heady, 1984). As evident from the results (see Figure 5.1), a distinct difference emerges between the visitors to the art museums and those to the science museums: more women tend to visit the art museum whereas more men tend to visit the science museum. The same trend also holds true for visitors to the Centre as they are made up of more male visitors than female visitors.

However, some studies conducted in museums also found that visitors to science museums and natural history museums can equally be females or males and that the gender difference among visitors is found to be insignificant. For example, in one study, roughly equal portions of males (51%) and females (49%) visited the National Maritime Museum, Greenwich (Smyth and Ayton, 1985). In another study, Alt (1980) concluded from the results of the four surveys he conducted in the London Natural History Museum that men (59%) used to outnumber women (41%) in 1976, but this gap narrowed significantly in 1979 (53% of men against 47% of women). A recent study conducted in the National Museum of Natural History, Washington DC, St. Louis Science Centre, St. Louis, Miami Museum of Science, Miami, and California Academy of Sciences, San Francisco, reported that slightly more women (53%) than men (47%) visited the above museums (Korn, 1995). The gender differences in visiting art and science museums seem therefore not to be omnipresent. Although they existed in some science museums, gender differences did not however imply that women, once there, found science museums less enjoyable than men do (Heady, 1984).

The differences in gender representation in some science museums might possibly exist because science museums generally tend to deal with mostly physical science exhibits, less in relation to the biological or human sciences, in which women may perhaps have as much interest as men. A survey conducted in the Alberta area of Canada by Bradburne and Wake (1993: 10) reported that men showed high interest in physics, chemistry, engineering, and computer science; women on the other hand indicated a high interest in biology, medicine, and the environmental and social sciences. Also, girls are found to have a more positive attitude towards biology and chemistry (Baker, 1992). Similarly, it also appears that men and women may perhaps be equally interested in science subjects such as the Human Body, as research evidence in Boston's Museum of Science suggests (Boisvert and Slez, 1994).

Nowadays, some science museums in North America, and to some extent in the UK, are beginning to hold exhibitions on health, human, environmental and psychological sciences. However, a large number of science museums, including almost all in India, hardly attempt to follow this example. If science museums attempt to design and hold exhibitions on the subjects of natural and human sciences, women might be as likely as men to visit them. This would obviously narrow the gender differences in visiting science museums.

The Type of Visit (i.e. first-time or repeat visit)

Most of the visitors to the Centre were first-time visitors, while a quarter of them were repeat visitors (Table 5.1). The question that can be asked here is which people are more likely to make repeat visits to the Centre. Factors that might be likely to influence repeat visiting are considered to be the age group, the nature of the group, their gender and their place of residence. However, the age and place of residence do influence repeat-visits as shown in Tables 5.2 and 5.3 respectively, but gender and the nature of the group do not influence the type of visit. A relatively larger percentage of young visitors in the age group 6-14 years repeat their visit to the Centre than do visitors in the age group of 15-34 years (24.6% as opposed to the marginal 13.8%). Similarly, most of those visitors who repeated their visits to the Centre are from Madras and fewer from 'other' places. This therefore suggests that mobility of visitors (youth) and vicinity of the Centre (local residents) may be likely factors responsible for more repeat visits.

The Age Group

Nearly half of the visitors to the Centre are those who are less than 24 years of age; the remaining are those aged 25-50 years of age but visitors of 50+ years are very few (Table 5.1). When the distribution of the age groups of visitors to the Centre is compared with that of the four major museums of the UK using the data from Harvey (1987) and Heady (1984), the result (see Table 5.4) is interesting. The National Portrait Gallery in London, the National Railway Museum in York, and the Victoria &

Albert Museum in London are visited by a good number of people over 50 years of age and relatively fewer young and middle-aged people of less than 50 years. In contrast, the Science Museum in London was visited by a greater percentage of young and middle-aged people of less than 50 years and a smaller percentage of older people over 50 years. The visitors to the Centre follow more closely the pattern of the London Science Museum. This trend suggests that young and old in India and in Britain perceive and visit the science museums in a more or less similar way.

The Nature of the Group

Nearly half of the visitors came with their families. The remaining came with friends, families, school classes and other groups. How does the nature of the group of visitors to the Centre compare with that of the four major museums of the UK? Three interesting points emerge from the results (Table 5.5).

First, the visitors to the Centre are similar to those visiting the York National Railway Museum and the London Science Museum as they come more often with families as part of a day-out. This trend is also common in America as visitor demographics there show that family groups constitute approximately 60% of all visitors (Dierking and Falk, 1994). This is also the case in science museums (74%) and natural history museums (53%) of the USA (Korn, 1995: 155).

Secondly, the singleton constituency, which is more frequent in the London National Portrait Gallery and the London Victoria and Albert Museum, is conspicuously less in number in the three science museums; singletons might perhaps seem to be interested more in the art objects rather than being in the social milieu, as observed by Harvey (1987). This may be due to the nature of the art experience which is a generally solitary contemplation rather than an active exploration, as in the case of the science experience. Along with this trend, US science museums (3%) and natural history museums (8%) attract very few singletons (Korn, 1995).

The third point is related to the organised visit. A greater number of visitors (13% or more) visited the science museums in organised groups than the National Portrait Gallery in London (4%). This trend can not be generalised to science museums as some American science museums (2%) and natural history museums (2%) have very few visitors who come in tour groups (Korn, 1995).

Does gender, the age group, or the place of residence influence the nature of the group of museum visitors? Chi-square tests of independence reveal that gender and the age group, but not the place of residence, do influence the nature of the group.

Male Indian visitors are more likely than Indian females to visit the Centre on their own or with their friends; Indian females visit the Centre mostly with their family or they visit in a significantly large number with a school class, but they are very much less likely to visit alone (Table 5.6). This reflects a common situation in India. Indian men have more freedom to move around than Indian women who are often subjected to cultural and religious factors that check their movement on their own. This is the reason why Indian women are always in more formal and conventional groups, namely the family and the school.

A similar comparison is made possible for the National Portrait Gallery in London from the percentage data of Harvey (1987) and leads to a more or less similar pattern, but the strength of the association is relatively weaker in this case than found amongst Indian visitors: male visitors are more likely to visit the National Portrait Gallery on their own, and less likely to be visiting with friends or family than females are (Table 5.7). Similarly, a relatively high percentage of men visited the National Maritime Museum in Greenwich alone than did women, who visited more in groups (Smyth and Ayton, 1985).

In sum, men are more likely than women to visit the museum alone whereas women come to the museum more often in family or other groups. Besides this general trend, British females are relatively more independent because they visit museums with mixed groups and they are not as restricted as Indian females, who mostly visit only with family groups.

The gender differences in the nature of the group while visiting the museums depend, amongst others, on mainly three factors. They are, family attachment, independent decision making and reasons for the museum visit. Women come more often with their family to visit museums because it seems that they are generally more attached to their family than men are. Not only is this the case with the visitors to the Centre in Madras but it is also the case with the visitors to the National Railway Museum in York and the Science Museum in London (Heady, 1984: p 20). This strongly supports the idea that women, irrespective of whether they are British or Indian, are more likely than men to visit museums in family groups.

The nature of the group also depends upon who amongst the group members makes the decision to visit the museum. As it emerges, men and boys are more likely to visit the Centre in response to their own or their friend's idea than do women and girls, who are more likely to visit the museum as a response to ideas from their family or school (Table 5.12). This difference in making independent decisions (discussed in detail in the next section) suggests that men will visit museums will lead men to visit the museum more often on their own , and women will usually with their families.

In regard to reasons for visiting the museum, women are more likely than men to visit the Centre because they like 'to bring their children', they are 'on a family outing', they 'like museums', they want 'to see the planetarium', and/or they are 'touring Madras'. On the other hand, men are more likely than women to visit the Centre 'to see a specific exhibition' (Table 5.21). This difference in their reasons also suggests why men are more likely than women to visit alone and women with their family.

All age groups except the 15-24 year group visit the Centre more often in family groups, but the people in the age group of 15-24 years are more likely than other age groups to visit the Centre with friends or alone and are less likely than other age groups to go with a school class or with their family (Table 5.8). This obviously reflects the fact that people in the 15-24 year group value the importance of peer groups more than family groups. In addition to visiting in family groups, the 15-24 year group and the 35-49 year group are more likely than other age groups to go with a school class. This may be due to the fact that teachers (representing the 35-49 year group) and students (representing 15-24 year group) constitute school classes. People in the 25-34 year group, the 50+ year group and the 15-24 year group are more likely than 6-14 year group to visit the Centre on their own. This may well support the fact that people perhaps become increasingly independent at the age of 15 years and above and therefore can visit museums on their own without being accompanied by elders.

In summary, gender and age groups seem to influence whether or not the visitors go to the museum alone or accompanied with others. Men are more likely to visit the museum alone and are less likely to be accompanied with others, than women. All people except the 15-24 year group visit the museum more often in family groups. Though very few people, on the whole, visit the museum on their own (7.3 %; see Table 5.8), visitors at the age of 15 years or older are more likely than young visitors to visit the museum alone.

The Place of Residence

The majority of the visitors are residents of Madras. Only a fraction (about 6%) of them are residents of the state, i.e., Tamilnadu, whereas the rest of the visitors (about 38%), mainly come from other parts of the country. A few among them are from foreign countries like America, Britain and some Arab countries (Table 5.1). Is there any pattern in 'where they come from' with respect to their type of visit, gender, nature of the group, and age group? It turns out that only the age group of visitors has some relationship with where they come from, but males and females, family and singletons, first-time and repeat visitors are equally likely to come from Madras, Tamilnadu or other places (Table 5.9). Young visitors (6-14 years), being accompanied by their parents or school class, are more likely to come from Madras than from Tamilnadu and 'other' places. Visitors in the 15-24 year group, being partly independent, are equally likely to be from Madras and Tamilnadu but are less likely to be from 'other' places. The 25-34 year group, the 35-49 year group and the 50+ year group are more likely to come from 'other' places outside the state of Tamilnadu to which Madras is the capital. This result suggests a linear upward trend in travelling from farther places as they grow older.

So far I have shown in this section who the visitors are and their characteristics. In the following section, I will discuss who made the decision to visit the museum.

Table 5.1: Number and percentage of visitors to the Centre according to their categories.

Category	Sub-categories	Number	Percentage
Type of visit	First time	361	75.4
	Repeat	118	24.6
	Total	479	100
Gender	Male	273	57.0
	Female	206	43.0
	Total	479	100
Nature of the group	On their own	35	7.3
	Families	241	50.3
	Friends	128	26.7
	Families & friends	19	4.0
	Clubs/societies	1	.2
	School classes	43	9.0
	Colleges/ Uni.	10	2.1
	Others	2	.4
	Total	479	100
Age	6-14 years	66	13.8
	15-24 years	177	37.0
	25-34 years	131	27.3
	35-49 years	82	17.1
	50+ years	23	4.8
	Total	479	100
Place of residence	Madras	268	55.9
	Tamilnadu	30	6.3
	Others	181	37.8
	Total	479	100

Table 5.2: Age groups of visitors to the Centre are cross-tabulated with their type of visit (i.e., first time and repeat visitors). Each cell contains a count (whole number) and a percentage (a single digit decimal).

Type	6-14 years	15-24 years	25-34 years	35-49 years	50+ years	Overall
First time	37	141	108	58	17	361
	10.2	39.1	29.9	16.1	4.7	75.4
Repeat	29	36	23	24	6	118
	24.6	30.5	19.5	20.3	5.1	24.6
Number	66	177	131	82	23	479
Percent	13.8	37.0	27.3	17.1	4.8	100

$\chi^2 = 19.516$; df = 4; $p < .001$; $\Phi = .202$

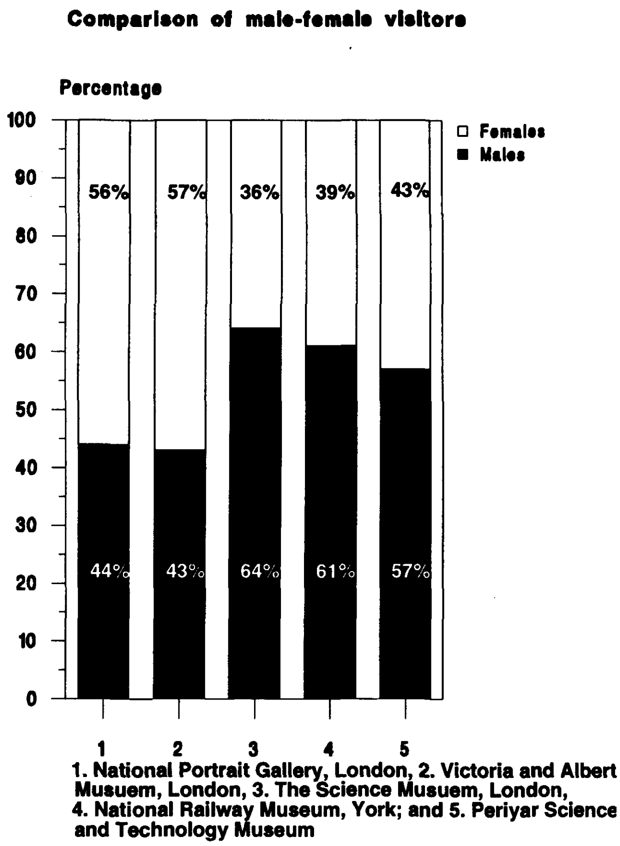

Figure 5.1: Comparison of male-female visitors to the Periyar Science & Technology Centre, Madras, with two art and two science museums of the UK.

Table 5.3: The place of residence of visitors to the Centre is cross-tabulated with their type of visit . Each cell contains a count (whole number) and a percentage (a single digit decimal).

Type	Madras	Tamilnadu	Others	Overall
First time	177	22	162	361
	49.0	6.1	44.9	75.4
Repeat	91	8	19	118
	77.1	6.8	16.1	24.6
Number	268	30	181	479
Percent	55.9	6.3	37.8	100.0

$\chi^2 = 32.092$; df = 2; $p < .001$; $\phi = .259$

Table 5.4: Age distribution of the visitors to the Centre, the National Portrait Gallery in London (NPG), the Victoria and Albert Museum in London (V&A), the National Railway Museum in York (NRM) and the Science Museum in London (SM).

AGE	NPG*	V&A**	NRM**	SM**	PSTC
	%	%	%	%	%
<= 50 years	74	82	86	91	95
>50 years	24	16	16	7	5
N (number)	814	891	787	920	479

*Data from Harvey, 1987 (Table 3.5: p7); ** Data from Heady 1984.

population age distribution?

Table 5.5: The nature of the group of the visitors to the Centre, the London Science Museum, the London National Portrait Gallery, the York National Railway Museum, and the Victoria and Albert Museum in London.

Nature of the Group	NPG*	V&A**	NRM**	SM**	PSTC
	%	%	%	%	%
Family	31	38	64	45	50
Friends	31	24	11	20	27
On my own	35	26	5	10	7
Organised Party***	4	12	20	25	13
Others	0	0	0	0	3
N (in number)	815	891	920	787	479

* Data from Harvey (1987: Table 3.2, p6); ** Data from Heady (1984); *** Organised party also includes school classes (Harvey, 1987, p.6).

Table 5.6: The nature of the group of the visitors to the Centre is cross-tabulated with their gender . Each cell contains a count (whole number) and a percentage (a single digit decimal).

Sex	On your own	Family	Friends	School Class	Others	Overall
Male	34	101	109	13	16	273
	12.5	37.0	39.9	4.8	5.9	57.0
Female	1	140	19	30	16	206
	.5	68.0	9.2	14.6	7.8	43.0
Number	35	241	128	43	32	479
Percent	7.3	50.3	26.7	9.0	6.7	100.0

$X^2 = 100.013$; df = 4; $p < .001$; $\Phi = .457$

Table 5.7: The nature of the group of the visitors to the National Portrait Gallery, London, is cross-tabulated with their gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Sex	On your own	Family	Friends	Others	Overall
Male	164	120	108	12	404
	40.6	29.7	26.7	3.0	44.7
Female	150	165	175	10	500
	30.0	33.0	35.0	2.0	55.3
Number	314	285	283	22	904
Percent	34.7	31.5	31.3	2.4	100

Counts were obtained from percentage data from Harvey, 1987, (Table 3.4; p6) and inputted to compute a chi-square statistic.

$X^2 = 13.734$; df = 3; $p = .003$; $\Phi = .123$

Table 5.8: The nature of the group of the visitors to the Centre is cross-tabulated with their age groups. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Age	On your own	Family	Friends	School class	Others	Overall
6 - 14 years	2	34	15	15	0	66
	3.0	51.5	22.7	22.7	0.0	13.8
15 - 24 years	15	66	67	9	20	177
	8.5	37.3	37.9	5.1	11.3	37.0
25 - 34 years	12	76	30	8	5	131
	9.2	58.0	22.9	6.1	3.8	27.3
35 - 49 years	3	50	14	10	5	82
	3.7	61.0	17.1	12.2	6.1	17.1
50 + years	3	15	2	1	2	23
	13.0	65.2	8.7	4.3	8.7	4.8
Number	35	241	128	43	32	479
Percent	7.3	50.3	26.7	9.0	6.7	100.0

$X^2 = 61.934$; df =16; $p < .001$; $\Phi = .360$; Cramer's V = .180

Table 5.9: The place of residence of the visitors to the Centre is cross-tabulated with their age groups. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Age	**Madras**	**Tamilnadu**	**Others**	**Overall**
6 - 14 years	52	3	11	66
	78.8	4.5	16.7	13.8
15 - 24 years	100	17	60	177
	56.5	9.6	33.9	37.0
25 - 34 years	70	7	54	131
	53.4	5.3	41.2	27.3
35 - 49 years	42	3	37	82
	51.2	3.7	45.1	17.1
50 + years	4	0	19	23
	17.4	.0	82.6	4.8
Number	268	30	181	479
Percent	55.9	6.3	37.8	100.0

$X^2 = 41.026$; df =8; $p < .001$; $\Phi = .293$; Cramer's V = .207

WHOSE IDEA IT WAS TO VISIT THE CENTRE IN MADRAS

For the inhabitants and visitors to any city or town, the museums in it are leisure attractions. The major considerations in leisure-time decision making are the availability of time, money, energy, educational level, social class and a range of other socio-economic characteristics.

The decision to visit any leisure attraction involves matching the interests and desires of people with the perceived outcomes of the visit. Hood (1983) identified six criteria for adult decision-making on the use of leisure time. They are 1) being with people; 2) doing something worthwhile; 3) feeling comfortable and at ease in one's surroundings; 4) having a challenge of new experiences; 5) having an opportunity to learn; and finally 6) participating actively. These attributes give a clue as to how people make judgements about the benefits of leisure experiences.

In addition to these socio-economic and psychographic variables, the possibility of selecting museums as a choice of leisure-time activity, on practical terms, depends on three important points: first, people should have heard about the museum; secondly, they should have valid and beneficial reasons to go to the museum; and thirdly, some one must make the decision to visit the museum. These three points are explored in this survey and discussed in this and the following two sections. I will present who made the decision to visit the Centre, on the day of the visit, in this section.

The possible responses to 'whose idea was it to visit today?' are; my own, a friend's, the family's, the school's and a number of 'others'. Almost one-third of the people in the sample took the decision to visit it; about one-fifth of the people visited the Centre because their friends or families made the decision for them to visit; and about 9% of the people visited the Centre because their school decided for them.

Relationship of 'whose idea' with the visitors' five characteristics

Besides these overall patterns discussed earlier, 'whose idea was it to visit today?' varies depending on the five characteristics of the visitors. Chi-square tests of association reveal significant relationships of 'whose idea was it to visit the Centre' with the type of visit, the age group, gender, the nature of the group and the place of residence.

The Type of Visit

People coming to the Centre for the first-time are more likely to visit because someone else (i.e., family or friends) has decided for them. However, people who re-visit the

Centre do so because they or their school have made the decision. As most of the visitors (about 75 per cent) are first-time visitors, this association might suggest that family members and friends are mainly making the decision to visit the Centre (Table 5.10).

The Age Group

With regard to the age groups, the following significant pattern emerges: visitors in the 6-14 year group are more likely than other age groups to visit the Centre at their family's suggestion to some extent, and at their school's suggestion to a large extent; visitors in the 15-24 year group are more likely than other age groups to visit the Centre at their family's suggestion, at their friend's suggestion to a large extent, and at their school's suggestion; and visitors of 25 years and above are more likely than visitors of less than 25 years, to go to the Centre on their own initiative (Table 5.11). This result helps to conclude that older people (25 years and above) more often decide to visit museums perhaps to take and show younger visitors. This result is further corroborated when males of above 35 years and females of above 25 years are more likely to visit the Centre 'to bring their children' than are others (Table 5.22 and Figure 5.2).

Gender

Boys and men visit the museum because they or their friends often decide for them. On the other hand, girls and women visit the Centre because the decision is much more often made by their family members, their school or 'others' (Table 5.12). The above results are possible because, for cultural and social reasons discussed earlier, while visiting the museum Indian females are always in a more formal and conventional group, such as a family or a school and Indian males are in an informal peer group or alone.

Even amongst family groups, men and boys more often decide to visit the museum than do women and girls. This result is in contradiction to the more common assumption in the USA and the UK. For example, to explain the low participation of African Americans in museums, Falk (1993b; p83) axiomatically assumes that it is usually women ('Jane Q. Americans') who decide to visit the museum. He also found out that African American groups were much more likely to be led by females than by males due to the attitude of African American males that museums, schools and churches are for their wives and children but not for them. This contradiction may be interpreted in two equally plausible ways. On the one hand, Indian men might be more patriarchal in their attitude than their western counter parts and more knowledgeable than Indian women, so that Indian men almost always decide what is good for their family. On the other hand, as Indian men are more concerned with their family welfare than their western counterparts, the former might therefore prefer to choose their leisure-activities, a museum visit for example, that give an opportunity to be with and contribute to the general development and enlightenment of their family members.

The Nature of the Group

A highly significant and strong relationship emerges between the nature of the group and whose idea it was to visit the Centre. Visitors on their own tend to pay a visit in response to their own idea; people with their family visit in response to their family's idea; people with their friends visit in response to their friend's idea; and people in school classes visit in response to their school's idea (Table 5.13). This result implies that the decision for the visit always comes from the member of the group, or from himself or herself in the case of singletons; and that visiting museums for the majority of the people is a social event. Though the result might seem obvious and nothing but common sense, it may however suggest a partial validity to the survey by reflecting the consistency of responses of the subjects.

The Place of Residence

There also emerges a significant but weak pattern on 'whose idea it was to visit' with respect to where the visitors come from. People from Madras visit the Centre because they or their school slightly more often made the decision than others. Similarly, people from Tamilnadu visit the Centre because they or their friends slightly more often made the decision than others. However, people from 'other' places visit the Centre because their families or 'others' slightly more often made the decision than themselves, their friends, and their schools (Table 5.14). Clearly, people from Madras and Tamilnadu are more likely to decide for themselves than are people from 'other' places, who were brought to the Centre by their family members.

In conclusion, more people, on the whole, visit the Centre because they decide for themselves. However, men and older people (i.e., above 25 years) are more likely to decide to visit the Centre than are women and young people. This result may lead to two completely contradictory interpretations. On the one hand, it might show that India is a hierarchical and patriarchal society in which the old and the men might be more powerful than the young and the women. On the other, it might show that Indian men are as caring as Western women towards their families; and that Indian men are more likely to select family-oriented leisure time activities such as visiting museums rather than going out drinking, playing sport and gambling on their own, which are more likely to be done by British men as their leisure pursuit away from home (Woodward and Green, 1990). Conclusive interpretations are not possible.

In the case of Madras students visiting the Centre, schools play a significant role but schools in Tamilnadu need to promote museum visits more positively. Giving more information particularly to men and boys, older people, and schools, and providing enriching experiences to all visitors, would encourage more of them to suggest a visit to the Centre next time. This will eventually attract more and more visitors. These results question the effectiveness of information sources through which people hear about the Centre, which I will consider in the following section.

Table 5.10: Whose idea it was to visit the Centre is cross-tabulated with their type of visit (i.e. first time or repeat visit). Each cell contains a count (whole number) and a percentage (a single digit decimal).

Type	My own	Friend's	Family's	School's	Others	Overall
First time	97	87	88	33	56	361
	26.9	24.1	24.4	9.1	15.5	75.4
Repeat	54	15	20	11	18	118
	45.8	12.7	16.9	9.3	15.3	24.6
Number	151	102	108	44	74	479
Percent	31.5	21.3	22.5	9.2	15.4	100.0

$X^2 = 17.668$; df = 4; $p = .001$; $\Phi = .192$

Table 5.11: Whose idea it was to visit the Centre is cross-tabulated with their age groups). Each cell contains a count (whole number) and a percentage (a single digit decimal).

Age	My own	Friend's	Family's	School's	Others	Overall
6 - 14 years	16	10	23	15	2	66
	24.2	15.2	34.8	22.7	3.0	13.8
15 - 24	37	55	49	18	18	177
years	20.9	31.1	27.7	10.2	10.2	37.0
25 - 34	53	24	22	6	26	131
years	40.5	18.3	16.8	4.6	19.8	27.3
35 - 49	37	10	11	4	20	82
years	45.1	12.2	13.4	4.9	24.4	17.1
50+ years	8	3	3	1	8	23
	34.8	13.0	13.0	4.3	34.8	4.8
Number	151	102	108	44	74	479
Percent	31.5	21.3	22.5	9.2	15.4	100.0

$X^2 = 81.471$; df =16; $p < .001$; $\Phi = .412$; Cramer's V = .206

Table 5.12: Whose idea it was to visit the Centre is cross-tabulated with their gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Sex	My own	Friend's	Family's	School's	Others'	Overall
Male	107	75	34	17	40	273
	39.2	27.5	12.5	6.2	14.7	57.0
Female	44	27	74	27	34	206
	21.4	13.1	35.9	13.1	16.5	43.0
Number	151	102	108	44	74	479
Percent	31.5	21.3	22.5	9.2	15.4	100.0

$X^2 = 58.214$; df =4; $p < .001$; $\Phi = .349$

Table 5.13: Whose idea it was to visit the Centre is cross-tabulated with the nature of their group. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Nature of the group	My own	Friend's	Family's	School's	Others	Overall
On your own	29 82.9	4 11.4	0 .0	0 .0	2 5.7	35 7.3
Family	73 30.3	17 7.1	101 41.9	2 .8	48 19.9	241 50.3
Friends	36 28.1	75 58.6	2 1.6	1 .8	14 10.9	128 26.7
School class	7 16.3	1 2.3	0 .0	32 74.4	3 7.0	43 9.0
Others	6 18.8	5 15.6	5 15.6	9 28.1	7 21.9	32 6.7
Number	151	102	108	44	74	479
Percent	31.5	21.3	22.5	9.2	15.4	100.0

$X^2 = 486.800$; df = 16; $p < .001$; $\Phi = 1.008$ (the upper bound value of Φ exceeds unity for reasons explained in note 2 on page 2); Cramer's V = .504

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Table 5.14: Whose idea it was to visit the Centre is cross-tabulated with their place of residence. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Place	My own	Friend's	Family's	School's	Others	Overall
Madras	88 32.8	52 19.4	53 19.8	32 11.9	43 16.0	268 55.9
Tamilnadu	10 33.3	12 40.0	5 16.7	1 3.3	2 6.7	30 6.3
Others	53 29.3	38 21.0	50 27.6	11 6.1	29 16.0	181 37.8
Number	151	102	108	44	74	479
Percent	31.5	21.3	22.5	9.2	15.4	100.0

$X^2 = 16.130$; df = 8; $p = .041$; $\Phi = .184$; Cramer's V = .130

MEDIA AND OTHER RELATED INFORMATION SOURCES THROUGH WHICH VISITORS HEARD ABOUT THE CENTRE

People can not decide to visit the museum unless they know and hear about it. It is therefore important to consider how this happens. There are many sources, for example, newspapers, friends and relatives. This study attempts to find out what the information sources are through which the visitors hear about the Centre.

Nearly 68% of the visitors to the Centre heard about it either from friends or relatives, that is, by word of mouth (Table 5.15). Schools contributed about 15% by informing the availability of the Centre to students. Other sources through which people came to know about the Centre, are newspapers (12.7%), magazines (3.8%) and television (2%).

When the results are compared with those of Harvey (1987), the patterns in both cases remain the same, as visitors to both the Centre and to the National Portrait Gallery in London come to know about the facilities mainly by word of mouth with media coverage keeping only a very low profile. This means that Ross Loomis (1987: p123) was correct when he said that a museum's single most effective source of publicity and public relations is a conversational suggestion to friends and relatives. Word of mouth is also a dominant source of information in a large number of American museums; they are, for example, the Colonial Williamsburgh in Virginia, Franklin Institute Science Museum in Philadelphia, and Anniston Museum of Natural History in Alabama (Falk and Dierking, 1992: p 28).

In museum visits, word of mouth remains the most important source because it has at least four, if not more, advantages than media sources: 1) it is free from biases of people who make, sell, and deliver the goods or services; 2) it is a spontaneous suggestion; 3) it has more credibility and social validity as there is no vested interest; and 4) above all, it is simply effective (Falk and Dierking, 1992:29).

Relationship between the sources of information and the five characteristics of the visitors.

Do the sources through which visitors come to know about the Centre depend on their type of visit, age group, gender, place of residence, and nature of the group? Yes, they do, as revealed by chi-square tests of association.

The Type of Visit

People who came for the first-time are slightly more likely to hear about the Centre from friends than are others who made a return visit to the Centre (Table 5.15a).

The Age Group

Visitors in their late teens are more likely to hear about the Centre from friends than are other age groups; young and late teen visitors are more likely to hear about the Centre from relatives than are other age groups; older (above 25 years) visitors are more likely to hear about the Centre through newspapers than are others; and Young visitors are more likely to hear about the Centre from schools than are other age groups (Table 5.16).

Gender

Women and girls are slightly more likely to hear about the Centre from relatives or friends than are men and boys (Table 5.17).

The Place of Residence

People from Madras are slightly more likely to hear about the Centre in school than are people from Tamilnadu and 'other' places (Table 5.18).

The Nature of the Group

Singletons and friends are more likely to hear about the Centre from friends than are families and school classes; Family groups are more likely to hear about the Centre from relatives than are singletons, friends and school classes; Singletons and family groups are more likely to hear about the Centre from newspapers than are friends and school classes; and school classes are slightly more likely to hear about the Centre in school than are singletons, families, and friends (Table 5.19).

In conclusion, it appears that 'through friends' is a highly significant source for visitors in the 15-24 year group, visitors on their own and with their friends, and visitors who came for the first-time; 'through relatives' is a major significant source for 6-14 year olds, females, visitors with their families; and schools play a significant role in providing information about the Centre for young and late teen visitors, females, Madras residents, and school classes. Newspapers are a significantly more important source for lower and upper middle aged visitors, visitors on their own and with their families.

Besides word of mouth, schools play a very substantial role as an information source for the Centre. It is therefore very important to keep the schools informed about the Centre's programmes and facilities. This study also demonstrates the use of newspapers as an information source to mainly reach middle aged visitors. My experience in the Birla Industrial and Technological Museum at Calcutta showed a clear increase in attendance just after the insertion of an advertisement on the activities of the museum in the local newspaper. The low profiles of magazines and TV may be due to two possible reasons. It may be that they are not at all important sources as people are least likely to consult them; or it may be due to the paucity of information about the Centre in these sources. Conclusive explanations are possible only with further experimentation by using TV and magazines as information sources.

Clearly, more people can be informed about the Centre not just by increasing the effectiveness of information sources, namely newspapers, magazines, television and schools, but also by providing a comfortable, pleasurable, memorable and worthy experience to visitors inside the museum, which would in turn increase the effectiveness of 'word of mouth' sources - friends and relatives. Having seen the media and information sources consulted by the visitors, I will present the purposes of the museum visit in the following section.

Table 5.15: Selected sources of information by which visitors come to know about the Centre, and the London National Portrait Gallery.

Source	PSTC, Madras**	NPG, London*
	%	%
Word of mouth or always known about it	68	76
Media coverage	19	5
Others	36	19
N of sample (in number)	479	876

* Data from Harvey, 1987 (Table 4.1; p11); ** Multiple choices were allowed.

Table 5.15a: Sources of information consulted by the visitors to the Centre according to their type of visit. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Type of Visit	[1]Fri-ends	Re-latives	News-paper	Maga zines	On TV	In school	Others	Over-all
First-	179	78	44	18	8	48	71	361
time	49.6	21.6	12.2	5.0	2.2	13.3	19.7	75.4
Repeat	42	29	18	1	2	24	27	118
	35.6	24.6	15.3	.8	1.7	20.3	22.9	24.6
Number	221	107	62	19	10	72	98	479
Percent	46.1	22.3	12.9	4.0	2.1	15.0	20.5	100

[1] $x^2 = 7.005$; df = 1; p = .008; $\Phi = .121$.

Table 5.16: Sources of information consulted by the visitors to the Centre according to their age groups. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Age	[1]Fri-ends	[2]Re-latives	[3]News-paper	Maga zines	On TV	[4]In school	Others	Over-all
6 - 14	25	23	5	0	1	18	6	66
years	37.9	34.8	7.6	.0	1.5	27.3	9.1	13.8
15 - 24	100	44	12	10	1	27	34	177
years	56.5	24.9	6.8	5.6	.6	15.3	19.2	37.0
25 - 34	58	23	26	6	5	12	30	131
years	44.3	17.6	19.8	4.6	3.8	9.2	22.9	27.3
35 - 49	28	13	16	2	3	12	22	82
years	34.1	15.9	19.5	2.4	3.7	14.6	26.8	17.1
50 +	10	4	3	1	0	3	6	23
years	43.5	17.4	13.0	4.3	.0	13.0	26.1	4.8
Number	221	107	62	19	10	72	98	479
Percent	46.1	22.3	12.9	4.0	2.1	15.0	20.5	100.0

[1] $x^2 = 14.448$; df = 4; p = .006; $\Phi = .174$. [2] $x^2 = 10.640$; df = 4; p = .031; $\Phi = .149$.
[3] $x^2 = 16.337$; df = 4; p = .003; $\Phi = .185$. [4] $x^2 = 11.367$; df = 4; p = .022; $\Phi = .154$.

Table 5.17: Sources of information consulted by the visitors to the Centre according to their gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Sex	Fri-ends	[1]Re-latives	News-paper	Maga zines	On TV	[2]In school	[3]Others	Over-all
Male	134	49	37	11	6	29	64	273
	49.1	17.9	13.6	4.0	2.2	10.6	23.4	57.0
Female	87	58	25	8	4	43	34	206
	42.2	28.2	12.1	3.9	1.9	20.9	16.5	43.0
Number	221	107	62	19	10	72	98	479
Percent	46.1	22.3	12.9	4.0	2.1	15.0	20.5	100.0

1: $X^2 = 7.050$; df = 1; p = 008.; $\Phi = -.121$. 2: $X^2 = 9.660$; df = 1; p = 002.; $\Phi = -.142$.
3: $X^2 = 4.583$; df = 1; p = 032.; $\Phi = .098$.

Table 5.18: Sources of information consulted by the visitors to the Centre according to their place of residence. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Place	Fri-ends	Re-latives	News-paper	Maga zines	On TV	[1]In school	Others	Over-all
Madras	121	56	38	8	7	50	56	268
	45.1	20.9	14.2	3.0	2.6	18.7	20.9	55.9
Tamil-	20	5	7	0	0	3	1	30
nadu	66.7	16.7	23.3	.0	.0	10.0	3.3	6.3
Others	80	46	17	11	3	19	41	181
	44.2	25.4	9.4	6.1	1.7	10.5	22.7	37.8
Number	221	107	62	19	10	72	98	479
Percent	46.1	22.3	12.9	4.0	2.1	15.0	20.5	100.0

1: 1: $X^2 = 6.266$; df = 2; p = 044.; $\Phi = .114$

Table 5.19: Sources of information consulted by the visitors to the Centre according to the nature of their group. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Nature of the group	[1]Fri-ends	[2]Re-latives	[3]News-paper	Maga zines	On TV	[4]In school	Others	Over-all
On your	18	4	8	1	0	2	11	35
own	51.4	11.4	22.9	2.9	.0	5.7	31.4	7.3
Family	94	69	39	7	6	22	55	241
	39.0	28.6	16.2	2.9	2.5	9.1	22.8	50.3
Friends	85	21	11	8	2	11	19	128
	66.4	16.4	8.6	6.3	1.6	8.6	14.8	26.7
School	7	5	3	0	1	29	8	43
class	16.3	11.6	7.0	.0	2.3	67.4	18.6	9.0
Others	17	8	1	3	1	8	5	32
	53.1	25.0	3.1	9.4	3.1	25.0	15.6	6.7
Number	221	107	62	19	10	72	98	479
Percent	46.1	22.3	12.9	4.0	2.1	15.0	20.5	100.0

1: $X^2 = 42.544$; df = 4; p < .001; $\Phi = .298$ 2: $X^2 = 13.472$; df = 4; p = .009; $\Phi = .168$
3: $X^2 = 11.542$; df = 4; p = ..021; $\Phi = .155$ 4: $X^2 = 108.077$; df = 4; p < .001; $\Phi = .114$

REASONS FOR VISITING THE CENTRE

People visit museums for a number of reasons. The reasons might be educational, social, recreational, reverential or all of these. The purpose of visiting the museum may also depend on people's previous knowledge, and expectations often shaped by 'word of mouth' sources. For example, a relative's suggestion that it is ideal for children's learning would lead to the purpose of learning; or a friend's suggestion that it is an ideal place for a picnic would lead to the purpose of an outing. In this study, visitors were asked why they visited the Centre. They were allowed to select more than one answer if applicable. The percentages of visitors in each category of the reasons for visiting the Centre are presented in Table 5.20, which, along with others, also compares the results from this study with a Canadian survey (Dixon, Courtney and Bailey, 1974) and an American study (Borun, 1977). The three studies have some similarities and differences. On the similarity side, the items for answers are more or less the same in all three studies and they are therefore comparable; the subjects in all three studies were free to choose more than one item. On the difference side, the American and Indian studies were conducted with museum visitors while the Canadian study was with the Canadian public. Even though the populations amongst the three studies are different, some interesting similarities emerge from the comparisons.

To learn

Most of the people (73%) visited the Centre with a reason to learn something about science. Almost the same result was obtained in the Canadian study as 'learning something' was the primary reason for 82% of the Canadian public. So, the main agenda for visiting the museum considered by the majority of the Canadian public and the Indian visitors was to learn something. But this trend is not that conspicuous amongst a slice of American visitors (Borun, 1977). Small percentages (less than 39%, which is the maximum) for every reason in Borun's study, reveal an important point by which Americans differ from Indian visitors and Canadians. Borun's results were possible only when Americans might not have combined reasons, for example learning-related reasons with fun-related reasons; but Indian visitors and Canadians did not seem to have problems in combining them as reflected by the large percentages in some cases (see Table 5.20). However, some older Indian visitors seemed to have difficulty in accepting that they wanted to learn in the museum and they often expressed the idea that they were too old to learn. They readily agreed though, that the Centre could help children's learning and that it was precisely for that reason that they brought their children to the museum.

To see what is inside the museum

Almost 69% of visitors to the Centre reported that they wanted to see what was inside the museum. In contrast to the Canadian survey, a very high proportion of visitors in India want to see the museum and this may possibly be due to the novelty factor as the science museum or centre is a relatively new concept to the Indian population. As one director during the Interview study (Chapter VII) said:

> What I felt during my career of about 27 years in the science museums in India, is that visitors generally come with the fundamental curiosity, because, this kind of institution is something newer to them. They know of other kinds of museums, but science museums are not very familiar to them; at least it was so when we first started the museum in this country about three decades back. And so, they come, out of a sense of curiosity, ***just to see what is there in this institution*** (Interview #7, 1993; emphasis mine).

For Fun

An interesting and intriguing result that emerges from this study is that only a small percentage of people (25%) come to visit the Centre for fun. Many of them might have said 'no' to fun, because they considered the Centre to be a serious institution and they tended to have explicit intentions of learning. A number of them told me that if they wanted fun they would have gone to the cinema, not to the Centre. They commented that they wanted to do something constructive and useful in the Centre. This result matches well with another finding of this Survey, which is that only 39% of the visitors would like to go to movies against the remaining 61% of the visitors who would like to do something else worthwhile in their spare time. However, results from the Canadian study indicate a high percentage of people visit museums for fun which is contradictory to the Survey findings. There may possibly be two reasons for this discrepancy. This may be something to do with the Indian visitors' perception of science centres; or maybe they pretend to be more serious than they really are. The first reason is perhaps more likely to be true in an Indian situation. A further analysis will help to understand this.

In India, science is perceived as omnipotent. This perception is partly due to the success and opulence of western countries from where science is said to originate. Additionally, doctors and engineers are socially recognised professions for which science is a compulsory subject. Indian parents and teachers always encourage their children and students to take up science options and have hopes that they may become doctors and engineers. Parents are willing to pay considerable amount of money towards this end. This powerful image and social recognition of science may have led the Indian visitors to take the science centre visit very seriously and therefore they tend to devote more time in learning science and to seeing what is inside the Centre rather than having fun. In addition, India is a country that produces the largest number of cinema films and is also one of the few countries in the world where the cinema industry is flourishing and has a vast audience. Going to the cinema is a major, though not the only, form of entertainment; most of the Indian visitors may therefore consider themselves as having fun when they go to the cinema, but not when they go to the science centre.

Touring, to see special exhibitions, and others

More Canadians than Indian and American visitors tend to visit museums 'when they tour the city' and 'to see specific or special exhibitions'. It may be true that Indians might travel less frequently than Canadians; and therefore Indians tend to visit museums, perhaps, less often during their travelling. The small percentage of Americans who visit museums when they tour, seems puzzling (Borun, 1977). One explanation may be that Americans did not combine seemingly different reasons in their response during the study. That may probably have contributed to the low percentage in all the categories of reasons including this (Table 5.20). On the other hand, the low profile of Indians to the reason 'to see special and specific exhibitions' is certainly due to the fact that the Centre has not so far attempted to make special or specific exhibitions (for example, travelling exhibitions) to encourage visitors to repeat their visit. However, special exhibitions are being set up and circulated in many other museums in India. In addition to visiting museums primarily to learn something, there are also similarities between Canadians and Indian visitors to visit museums for the purpose of showing their children and friends.

Relationship of reasons for the museum visit with the five characteristics of the visitors

Do the reasons for the museum visit have associations with their type of visit, gender, age group, nature of the group and place of residence? For example, would males visit the museum for different reasons than would females? Or would family groups have different sets of reasons than would singletons? To answer these questions, the first two variables, namely the type of visit and gender are analysed using two-way contingency tables (Table 5.21). The remaining three variables, namely the age group, the nature of the group and the place of residence are analysed using three-way contingency tables controlling for gender. A multiple correspondence analysis (a 'categorical' equivalent of factor analysis) and a hierarchical log-linear analysis[3] (a 'categorical' equivalent of ANOVA, i.e., Analysis of Variance) were done on three-way contingency tables (Tables 5.22 to 5.24) besides chi-square tests (a 'categorical' equivalent of t-tests), which were done for all cross-tabulations to find out significant interactions or associations. Many reasons are found to vary or interact significantly with these variables.

<u>The Type of Visit and Gender</u>

First-time visitors have significantly different reasons for visiting than do repeat visitors; similarly, males tend to have different set of reasons than do females (Table 5.21). Chi-square tests reveal that first-time visitors are more likely than repeat visitors to come to the Centre 'to see what is inside the museum', 'to see the planetarium show', and/or 'because they are touring Madras'; and first-time visitors are slightly more likely than repeat visitors to come to the Centre 'as part of a group tour'. Also, repeat visitors are more likely than first-time visitors to visit the Centre 'to show the Centre to their friends'; and repeat visitors are slightly more likely than first-time visitors to visit the Centre 'to see specific /special exhibitions'.

With regard to gender, men are more likely than women to visit the Centre 'to show their friends'; and men are slightly more likely than women to come to the Centre 'to see special and specific exhibitions'. Women, on the other hand, are more likely than men to visit the Centre 'because they are on family outings'; and women are slightly more likely than men to visit the Centre 'because they are with school classes', 'because they like the museum', 'to bring their children', and/or 'because they are touring Madras'.

<u>The Age Group Controlled for Gender</u>

Do visitors in different age groups tend to have different reasons for visiting museums? Chi-square tests reveal significant results (Table 5.22): five reasons are found to interact with age group controlling for gender. First, young males (6-14 years) are more likely to visit the museum for fun than are other males; but females in the 15-24 are group and the 50+ age group tend to be more likely to visit museums for fun than do other females. This shows that matured males are a little more serious than matured females who tend to have fun-related reasons for visiting the museum. Secondly, males in the 15-24 age group are more likely to visit the museum to learn something about science than are males in other age groups; females on the other hand do not differ

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[3]Log-linear analysis is a method to study the structural relations between variables in a three- or multi-way contingency tables as chi-square test is for two-way tables. Log-linear models are for categorical variables as ANOVA models are for interval or ratio variables. Unlike in the ANOVA situation, there is no underlying empirical scale for a dependent variable. The dependent variable here is the logarithm of a frequency.

much in respect to their age groups. Thirdly, males of 25 years and above are more likely to visit the Centre to see the planetarium show than are those males of less than 25 years; but amongst females, the 25-34 age group is less likely to visit the Centre 'to see the planetarium show' than the other age groups. Fourthly, differing very much more significantly from other age groups, male visitors of above 35 years and female visitors in the 25-49 age group visit the Centre to bring their children. It is an interesting fact that females visit the museum to bring their children in their earlier age (25 years) than males (35 years). This may possibly reflect a common situation where females enter the family state at an earlier age. Lastly, males in different age groups do not differ significantly in visiting the museum on family outings; but amongst females, older females (50+) and females of 15-34 years are more likely than females of other age groups to visit the Centre on family outings.

The complete and whole pattern of the above situation is captured in a multiple correspondence analysis plot (Figure 5.2). To read and interpret a correspondence analysis plot, the following points are to be borne in mind. The distances between row points or between column points in space are equal to chi-square distances. That is, row (or column) points that are close together in the space correspond to rows (or columns) with similar profiles in the frequency table. The profiles of the marginal row and column frequencies are both projected to the origin in this space. Thus, when the profile of a given row (column) is similar to the marginal profile, the corresponding distance of the row (column) point to the origin is small. This means that if a point is near the origin, it can then be interpreted that the variable corresponding to that point does not significantly interact with other variables. The greater the distance from the origin, the stronger will be the interaction. For example, Chi, Out, Scho and Spec are some of the variables that have a longer distance from the origin in Figure 5.2. The nearest observations to the variable Chi (to bring children) are F25 (females of 25-35 years) and M35 (males of 35-49 years). This shows that males of 35-49 years and females of 25-34 years are more likely to visit museums 'to bring their children' than are other males and females. The gender and age dimensions alone account for 66% variation of the overall association (Chi-square = 298.845).

It must be emphasised that correspondence analysis may suggest patterns of the association among variables in contingency tables, but it does not establish whether these patterns are significant. It therefore warrants the use of chi-square tests and log-linear analysis to look for significant patterns; and the interpretation of multiple correspondence analysis plot should be carried out only in the light of those confirmed associations.

The Nature of the Group Controlled for Gender

How does the nature of the group of male and female Indian visitors influence the reasons for visiting the Centre? Only three out of the fifteen reasons are found to be statistically significant amongst the nature of the group of only male visitors, but none in the case of female visitors (Table 5.22). The reasons are 'to learn how things work', 'to show my friends' and 'to bring my children'. These associations do not reveal anything interesting but the obvious fact: for example, visitors with their family are more likely than others to visit the Centre 'to bring their children'. These results are not very revealing.

The overall patterns are captured in a multiple correspondence analysis plot (Figure 5.3). Most of the variable and observation points are clustered around the origin reflecting the non-significance. Although the patterns show strong associations, some of them are common sense: for example, visitors with their school class visit the Centre primarily because they are with their school class; and family visitors because they are 'on family outings' and 'to bring their children'. On the other hand, visitors on their own and with friends are more likely than others to visit the Centre 'to see specific things'. The nearness of points corresponding to male and female groups (for example, MS (Male visitors with School class) and FS (Female visitors with School class)) is due to the significant association between gender and the nature of the group. The nature of the group and gender dimensions alone account for 78% of the overall association (chi-square = 722.799).

The Place of Residence Controlled for Gender

Does the place of residence seem to affect the reasons for visiting the Centre? Five reasons are found to have significant relationships with the place of residence in the cases of both males and females (Table 5.24).

Male visitors from Madras and Tamilnadu, differing significantly from people from 'other' places, visit the Centre 'to learn how things work' and 'to see a specific exhibition'. Male visitors from 'other' places are more likely to visit the Centre 'to see what is in the Centre', and are much more likely to visit the Centre because they are 'touring Madras'. Males from Tamilnadu and 'other' places are more likely to come to the Centre 'to see the planetarium show' than other males.

Female visitors from Tamilnadu and 'other' places, differing significantly from female residents of Madras, are more likely to visit the Centre 'for fun', and 'because they are on family outings'; but are very much more likely to visit the Centre 'because they are touring Madras'. Female visitors from Tamilnadu are much more likely to visit the Centre 'to see the demonstration' than are other females. Female visitors from

Madras are more likely to visit the Centre 'to show their friends' than other females are.

In sum, there emerge two interesting patterns. First, male Madras residents have a tendency to visit the Centre more often for serious learning-related reasons namely 'to learn how things work', and 'to see a specific exhibition'. Second, female visitors from 'other' places more often tend to have fun-related reasons namely 'for fun', 'on family outings', and 'touring Madras'. Male visitors from Tamilnadu align more closely with Madras males, but female visitors from Tamilnadu align more closely with female visitors from 'other' places (see Figure 5.4 for the nearness between MT and MM and between FO and FT). The gender and the place of residence dimensions alone account for 74% of the overall association (chi-square = 211.493).

A further analysis will help understand why these patterns emerge. There can be two factors responsible for this situation: seriousness and expertise. If males are often more serious and 'dry', this may explain the nature of males from Madras and Tamilnadu. But it can not explain the behaviour of males from 'other' places who are not more likely to have serious learning-related reasons. In a similar vein, if females are more fun-loving and light-hearted, this can explain the behaviour of females from Tamilnadu and 'other' places, but not that of females from Madras who are less likely to have fun-related reasons. If it can be assumed that the geographical distance is a barrier of information, then people from Madras will be better informed about the educational nature of the Centre and what to expect from it than people from Tamilnadu and 'other' places. This again can explain the behaviour of all the others except the behaviour of males from 'other' places and females from Madras as they are less likely to have learning-related and fun-related reasons respectively. It therefore appears that the result can not be explained by considering gender and the place of residence separately.

A hierarchical log-linear analysis (saturated model with backward elimination) done on the three-way table (Table 5.24) reveals two-way and three-way significant interactions for the learning-related and fun-related reasons (Table 5.25). These interactions reveal that gender (SEX) and the place of residence (PLACE) interact with different reasons individually and separately though they do not themselves interact directly. These influences of gender (seriousness) and the place of residence (expertise) together may explain the whole situation. For 'serious' males who generally tend to have learning-related reasons, the farther their place of residence is the more their reasons shift toward fun-related ones; but for 'fun-loving' females who generally tend to have fun-related reasons, the nearer their place of residence is the more their reasons shift toward learning-related ones.

Table 5.25: Two-way and three-way interactions in a result of the hierarchical log-linear analysis.

Interactions	Likelihood Ratio Chisq	df	p
PLACE*FUN,	7.532	2	.023
PLACE*TLEA,	6.461	2	.040
SEX*SPEC,	50447	1	.020
SEX*TOUR,	7.998	1	.005
PLACE*TOUR,	67.064	2	<.001
SEX*PLACE*OUT.	7.341	2	.026

Miscellaneous reasons for the museum visit

So far, analyses were done on the structured or closed categories. But, about sixty responses to the question on the 'reasons for the visit', did not fit in any of the choices given. These were therefore noted down under 'others'. In order to figure out the pattern, the responses can be grouped into approximately seven categories depending upon their nature: *vicinity* of the centre; *learning-related* purposes; *sharing* personal *experiences*; professional *duty*; *fun*; *re-experience* and *different* reasons.

The first category ranges from a neighbourhood boy who originally went to play football in the sprawling ground of the Centre but would in the meantime visit it, to the university professors or staff who went to the University of Madras which is adjacent to the Centre and therefore would extend a visit to the Centre also. In this case, the mere vicinity of the Centre influences the visit.

The second category of people visit the Centre with explicit learning-related intentions. The learning-related purposes which came out from the visitors are shown in Figure 5.5.

The third category consists of those people who bring their friends and relatives to have a good experience which they think important to share and enjoy. Some of the expressions are reproduced in verbatim as follows:

The grandson brought us to show the planetarium

My father brought me

... to show my cousin who has come from abroad.

My cousin brought me here as he likes science fiction

Considering this as an important place, I came with friends

The fourth category of visitors comprises teachers and managers of orphan and day care centres. What follows are some purposes as described by the visitors themselves, reflecting a sense of duty:

Mainly for children and as well as for me as I am teaching.

To show the children of the orphanage.

...technical, to show my daughter and teach her

To bring my class

To show college students.

I came with a school group

...enlighten the scientific knowledge of studying children

The fifth category of visitors go to the centre for the sake of fun as presented in their words:

Picnic

To spend time

To enjoy

Showing around the places

Some people visit the Centre to compare or simply re-experience once again the earlier experiences they had elsewhere: for example, a postgraduate student wants to re-experience the Birla Planetarium in Madras and compare this with the one at Hyderabad; an engineer looks for gadgets and machines that he had experienced in a science museum at Bangalore; and a tourist likes to visit the Centre as he had already visited one at Singapore.

And finally, a few people visit the Centre for other completely different reasons: for example, a political fanatic decided to visit the Centre as he could see, through the glass window, his political leader's portrait (fondly called Kazhaigar); or a model maker's family visits the Centre as he is busy with his work in the non-public-side of the Centre.

Factors that reflect the visitors' reasons for the museum visit

I have thus far analysed the fifteen reasons for visiting museums on an individual basis. As the subjects in this study are free to choose as many of the reasons that apply as they wish, it is also interesting to explore the data for the existence of a few underlying factors that can approximately account for all these fifteen reasons. Factor analysis[4] is an appropriate tool for this purpose. The dichotomous data for the fifteen variables were therefore subjected to an exploratory factor analysis of principal components method with varimax rotation. The outcomes of the analysis are six factors out of the fifteen categories of the reasons. The factors and their corresponding items, and loadings of items are shown in Table 5.26. A close inspection of the factors and how the individual reasons load with these factors reveal an interesting overall pattern. The six factors can be reasonably named Learning (Factor 1), Seeing (2), Having fun (3), Showing (4), Specific (5), and Tour (6). Learning alone accounts for 13% of the variance and all together accounts for 55% of the variance (Table 5.26). I will present the results of the factor analysis in two phases. First, I will discuss in detail the loadings of individual reasons with factors; secondly, I will present how the factors vary in relation to the visitors' characteristics.

It is interesting to note that some individual reasons load positively with more than one factor and that some reasons load negatively some factors. These two loadings need to be carefully examined so that they are acceptable within reasonable interpretations. For example, the almost equal loadings of 'part of a group tour' and 'on a trip with school class' to the factor 'Tour' indicate that some students perceive their museum visit as part of a tour. This is particularly true in India as students in some schools are taken away once a year as part of an annual excursion. For them, the concept of a field trip is absent. Similarly, the positive and almost equal loading of the reason 'because I like the museum' to the factors 'Learning' and 'Having fun' indicates that people may like the museum for both its educational and entertaining roles.

The negative loading of 'other' reasons to the factor 'Having fun' is indicative of a plethora of learning-related reasons (Figure 5.5). Similarly, the reason 'to show my friends the museum' has negatively loaded with the factor 'Seeing'. This might suggest a fact that visitors whose reason is 'to show their friends the museum' are less likely to visit the Centre for 'Seeing', which would have been preferred by people who visit the museum 'to bring their children', for example. Similarly, the negative loading of the reason 'to see the planetarium show' to the factor 'Specific' indicates that people whose reason is 'to see the planetarium' are less likely to visit the Centre to see a specific exhibition or demonstration.

How individual subjects in this study are faring in each of the six factors can be measured by what is called factor scores. These six factor scores are subjected to one-

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[4]Factor analysis is a data reduction technique which determines the nature of underlying patterns among a large number of variables.

way ANOVAs[5] with respect to the nature of the group, place of residence, age group, and length of stay, and to two-tailed t-tests for their gender (Table 5.27).

Even though the factor Learning accounts for maximum variance, the factor score in this case does not vary significantly with respect to the visitors' characteristics. Only the length of stay is found to affect this factor: those who planned to stay for 1-3 hours are more likely to come for learning than are others who planned to stay for less than an hour or more than three hours. What does this imply? Clearly, people in India visit the museum primarily for learning (the first factor responsible for the maximum variance) irrespective of their demographic and social characteristics. This is also evident in all multiple correspondence analysis plots (Figures 5.2-5.4 and 5.6) as the Tlea (to learn how things work) and Slea (to learn something about science) are always found near the origin indicating these variables are not away from the marginal profiles and therefore they do not differ significantly with most of the observations.

Other significant results of the ANOVAs and t-tests are as follows (Table 5.27). Amongst the age groups, visitors of 25-34 years are more likely than young visitors (6-14 years) to come for 'Seeing'. Visitors of 25-49 years are more likely than visitors of 6-14 and 15-24 years to come for 'Showing'. This result might possibly be because older visitors perhaps bring younger and late teen visitors to show and expose them to the museum.

Amongst the nature of the group, families are more likely than other groups to visit the Centre for 'Seeing', 'Having fun', and 'Showing'; school classes are more likely than singletons, families, friends, and others to come on 'Tour'.

Amongst the place of residence, visitors from 'other' places are more likely than people from Madras and Tamilnadu to come for 'Seeing'; visitors from Madras are more likely than people from 'other' places to come for 'Showing'; and Tamilnadu visitors are more likely than people from 'other' places to come for 'Having fun', and 'Seeing specific exhibitions'.

In terms of the length of stay, visitors who planned to stay for 1-2 hours are more likely than those who planned to stay for less than an hour, to come for 'Seeing specific' things in the Centre.

[5] In ANOVAs, Scheffe test was used *post hoc* to detect significant differences between any two groups at the .05 level.

The t-tests show that females are more likely than males to visit the Centre for 'Seeing' and 'Having fun'.

To recap, there are many reasons for visiting museums. People, on the whole, visit museums primarily to learn something and to see what is inside. Visitors' characteristics tend to influence their purpose to visit the museum. For example, first-time visitors and males more often tend to have a different set of reasons than repeat visitors and females respectively. Similarly, visitors' age group, nature of the group, place of residence, and planned length of stay, also seem to play a definite role in influencing their reasons for the museum visit. Besides the closely structured reasons, there also exists a plethora of reasons for which people visit museums. Overall, six factors are found to influence the museum visit: they are learning, seeing, having fun, showing, seeing specific exhibits, and touring. In the next section I will present the results on how long visitors plan to stay during their museum visits.

Table 5.20: Reasons for visiting the museum in descending order.

Reason for the visit	**Madras** (%)	**Canada*** (%)	**USA**** (%)
To learn something about science (Slea)	73	82	21
To see the planetarium show (Pnet)	69	—	30
To see what is inside the museum (See)	67	44	38
To learn how things work (Tlea)	49	—	16
Because I like museums (Like)	38	—	19
For fun (Fun)	25	79	33
To bring my children (Chi)	19	24	32
To show my friends the museum (Frid)	37	37	39
I am on a family outing (Out)	18	—	24
A number of other reasons (Oths)	16	—	—
I am touring alone or with my family (Tour)	13	34	11
I am on a trip with my school class (Scho)	09	12	2
To see the demonstration (Demo)	09	—	23
To see special or specific exhibitions (Spec)	08	38	9
I am part of a group tour (Gtou)	04	13	8
N (in number)	479	4428	700

*Data from Dixon, Courtney and Bailey, 1974; Table VI-14; p 180
**Data from Borun, 1977; p 9 and 11.

Table 5.21: Reasons for visiting the Centre with respect to the visitors' type and gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

	Type (O)		Sex (✱)	
Reasons	First time	Repeat	Male	Female
For fun	87 74.4	30 25.6	63 53.8	54 46.2
Because I like museums❶	140 77.3	41 22.7	92 50.8	89 49.2
To learn something about science	266 75.1	88 24.9	200 56.5	154 43.5
To learn how things work	173 71.8	68 28.2	141 58.5	100 41.5
To see what is in the museum ①	267 83.7	52 16.3	177 55.5	142 44.5
To see a specific or special exhibition②❷	22 61.1	14 38.9	27 75.0	9 25.0
To see the planetarium show③	262 79.6	67 20.4	183 55.6	146 44.4
To see the demonstration	30 71.4	12 28.6	28 66.7	14 33.3
To bring my children❸	66 72.5	25 27.5	41 45.1	50 54.9
On a family outing ❹	70 83.3	14 16.7	22 26.2	62 73.8
To show my friends the museum④❺	47 51.6	44 48.4	64 70.3	27 29.7
Touring Madras⑤❻	56 93.3	4 6.7	24 40.0	36 60.0
Part of a group tour⑥	21 100.0	0 .0	12 57.1	9 42.9
On a trip with my school class ❼	28 65.1	15 34.9	13 30.2	30 69.8
Other reasons	58 78.4	16 21.6	48 64.9	26 35.1
Number	361	118	273	206
Percent	75.4	24.6	57.0	43.0

①: $X^2 = 35.754$; df = 1; $p < .001$; $\Phi = .273$
②: $X^2 = 4.260$; df = 1; $p = .039$; $\Phi = -.094$
③: $X^2 = 10.317$; df = 1; $p = .001$; $\Phi = .147$
④: $X^2 = 34.037$; df = 1; $p < .001$; $\Phi = -.267$
⑤: $X^2 = 11.928$; df = 1; $p < .001$; $\Phi = .158$
⑥: $X^2 = 7.179$; df = 1; $p = .007$; $\Phi = .122$

❶: $X^2 = 4.511$; df = 1; $p = .033$; $\Phi = -.098$
❷: $X^2 = 5.149$; df = 1; $p = .023$; $\Phi = .103$
❸: $X^2 = 6.533$; df = 1; $p = .011$; $\Phi = -.116$
❹: $X^2 = 39.432$; df = 1; $p < .001$; $\Phi = -.286$
❺: $X^2 = 8.151$; df = 1; $p = .004$; $\Phi = .130$
❻: $X^2 = 8.082$; df = 1; $p = .005$; $\Phi = -.130$
❼: $X^2 = 13.803$; df = 1; $p < .001$; $\Phi = -.170$

Table 5.22: Reasons for visiting the Centre with respect to the visitors' age groups controlled for gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Reasons	Male (O)					Female (✱)				
	6-14	15-24	25-34	35-49	50+	6-14	15-24	25-34	35-49	50+
For fun①❶	18 28.6	20 31.7	12 19.0	9 14.3	4 6.3	8 14.8	23 42.6	14 25.9	4 7.4	5 9.3
Because I like museums	19 20.7	28 30.4	23 25.0	16 17.4	6 6.5	15 16.9	33 37.1	24 27.0	15 16.9	2 2.2
To learn something about science②	25 12.5	82 41.0	48 24.0	35 17.5	10 5.0	24 15.6	59 38.3	46 29.9	23 14.9	2 1.3
To learn how things work	21 14.9	57 40.4	35 24.8	23 16.3	5 3.5	13 13.0	38 38.0	31 31.0	16 16.0	2 2.0
To see what is in the museum	20 11.3	59 33.3	49 27.7	35 19.8	14 7.9	19 13.4	61 43.0	40 28.2	17 12.0	5 3.5
To see a specific or special exhibition	2 7.4	15 55.6	8 29.6	2 7.4	0 .0	2 22.2	4 44.4	1 11.1	2 22.2	0 .0
To see the planetarium show③	16 8.7	62 33.9	51 27.9	41 22.4	13 7.1	24 16.4	56 38.4	38 26.0	23 15.8	5 3.4
To see the demonstration	3 10.7	11 39.3	8 28.6	5 17.9	1 3.6	0 .0	9 64.3	2 14.3	3 21.4	0 .0
To bring my children④❷	0 .0	5 12.2	8 19.5	24 58.5	4 9.8	0 .0	5 10.0	32 64.0	12 24.0	1 2.0
On a family outing ❸	3 13.6	1 4.5	8 36.4	9 40.9	1 4.5	3 4.8	30 48.4	19 30.6	7 11.3	3 4.8
To show my friends the museum	7 10.9	24 37.5	13 20.3	16 25.0	4 6.3	0 .0	6 22.2	14 51.9	7 25.9	0 .0
Touring Madras	3 12.5	6 25.0	9 37.5	4 16.7	2 8.3	3 8.3	18 50.0	10 27.8	5 13.9	0 .0
Part of a group tour	1 8.3	3 25.0	4 33.3	3 25.0	1 8.3	0 .0	5 55.6	2 22.2	1 11.1	1 11.1
On a trip with my school class	4 30.8	4 30.8	3 23.1	2 15.4	0 .0	11 36.7	5 16.7	5 16.7	8 26.7	1 3.3
Other reasons	4 8.3	21 43.8	7 14.6	13 27.1	3 6.3	3 11.5	10 38.5	7 26.9	6 23.1	0 .0
Number Percent	34 12.5	98 35.9	70 25.6	54 19.8	17 6.2	32 15.5	79 38.3	61 29.6	28 13.6	6 2.9

①: $X^2 = 20.116$; df = 4; $p < .001$; $\Phi = .271$
②: $X^2 = 9.986$; df = 4; $p = .041$; $\Phi = .191$
③: $X^2 = 10.460$; df = 4; $p = .033$; $\Phi = .196$
④: $X^2 = 51.867$; df = 4; $p < .001$; $\Phi = .436$

❶: $X^2 = 12.884$; df=4; $p = .012$; $\Phi = .250$
❷: $X^2 = 55.912$; df = 4; $p < .001$; $\Phi = .521$
❸: $X^2 = 10.369$; df = 4; $p = .034$; $\Phi = .224$

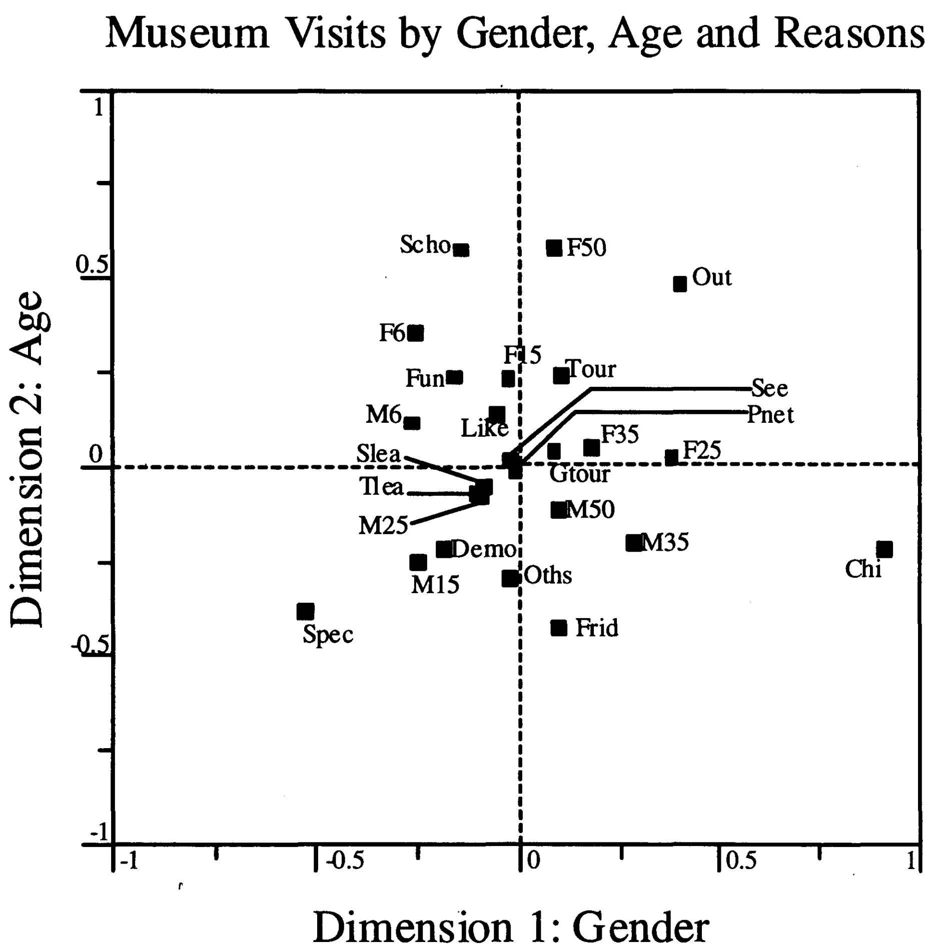

Figure 5.2: A multiple correspondence analysis plot for reasons and age-gender.

Chi	To bring my children
Demo	To see the demonstration
Frid	To show my friends the museum
Fun	For fun
Gtou	I am part of a group tour
Like	Because I like museums
Oths	Other reasons
Out	I am on a family outing
Pnet	To see the planetarium show
Scho	I am on a trip with my school class
See	To see what is inside the museum
Slea	To learn something about science
Spec	To see special or specific exhibitions
Tlea	To learn how things work
Tour	I am touring alone or with my family
M6	Males of 6-14 years
M15	Males of 15-24 years
M25	Males of 25-34 years
M35	Males of 35-49 years
M50	Males of 50 + years
F6	Females of 6-14 years
F15	Females of 15-24 years
F25	Females of 25-34 years
F35	Females of 35-49 years
F50	Females of 50 + years

Table 5.23: Reasons for visiting the Centre with respect to the visitors' nature of the group controlled for gender. Each cell contains a count (whole number) and a percentage (a decimal).

	Male (O)					Female (✸)				
Reasons	Aln	Fam	Frs.	Sch.	Oth.	Aln	Fam	Frs.	Sch.	Oth.
For fun	4	27	28	2	2	0	43	4	4	3
	6.3	42.9	44.4	3.2	3.2	.0	79.6	7.4	7.4	5.6
Because I like	16	32	37	3	4	0	56	11	12	10
museums	17.4	34.8	40.2	3.3	4.3	.0	62.9	12.4	13.5	11.2
To learn science	26	71	82	10	11	1	99	16	25	13
	13.0	35.5	41.0	5.0	5.5	.6	64.3	10.4	16.2	8.4
To learn how things	26	49	55	6	5	1	69	12	12	6
work①	18.4	34.8	39.0	4.3	3.5	1.0	69.0	12.0	12.0	6.0
To see what is in	21	65	70	7	14	0	96	14	18	14
the museum	11.9	36.7	39.5	4.0	7.9	.0	67.6	9.9	12.7	9.9
To see a specific	6	5	15	0	1	0	5	1	3	0
exhibition	22.2	18.5	55.6	.0	3.7	.0	3.6	5.3	10.0	.0
To see the	22	72	68	8	13	1	102	13	23	7
planetarium show	12.0	39.3	37.2	4.4	7.1	.7	69.9	8.9	15.8	4.8
To see the	2	12	11	1	2	0	8	2	2	2
demonstration	7.1	42.9	39.3	3.6	7.1	.0	57.1	14.3	14.3	14.3
To bring my	0	36	0	2	3	0	45	0	4	1
children②	.0	87.8	.0	4.9	7.3	.0	90.0	.0	8.0	2.0
On a family outing	0	19	0	0	3	0	57	0	0	5
	.0	86.4	.0	.0	13.6	.0	91.9	.0	.0	8.1
To show my friends	0	25	35	2	2	0	23	2	2	0
③	.0	39.1	54.7	3.1	3.1	.0	85.2	7.4	7.4	.0
Touring Madras	2	9	9	0	4	0	30	0	3	3
	8.3	37.5	37.5	.0	16.7	.0	83.3	.0	8.3	8.3
Part of a group tour	1	2	2	2	5	0	0	2	2	5
	8.3	16.7	16.7	16.7	41.7	.0	.0	22.2	22.2	55.6
On a trip with my	0	0	0	13	0	0	0	0	30	0
school class	.0	.0	.0	100	.0	.0	.0	.0	100	.0
Other reasons	6	15	19	3	5	0	15	4	6	1
	12.5	31.3	39.6	6.3	10.4	.0	57.7	15.4	23.1	3.8
Number	34	101	109	13	16	1	140	19	30	16
Percent	12.5	37.0	39.9	4.8	5.9	.5	68.0	9.2	14.6	7.8

①: $X^2 = 11.671$; df = 4; $p = .019$; $\Phi = .207$
②: $X^2 = 59.112$; df = 4; $p < .001$; $\Phi = .465$
③: $X^2 = 16.608$; df = 4; $p = .002$; $\Phi = .247$

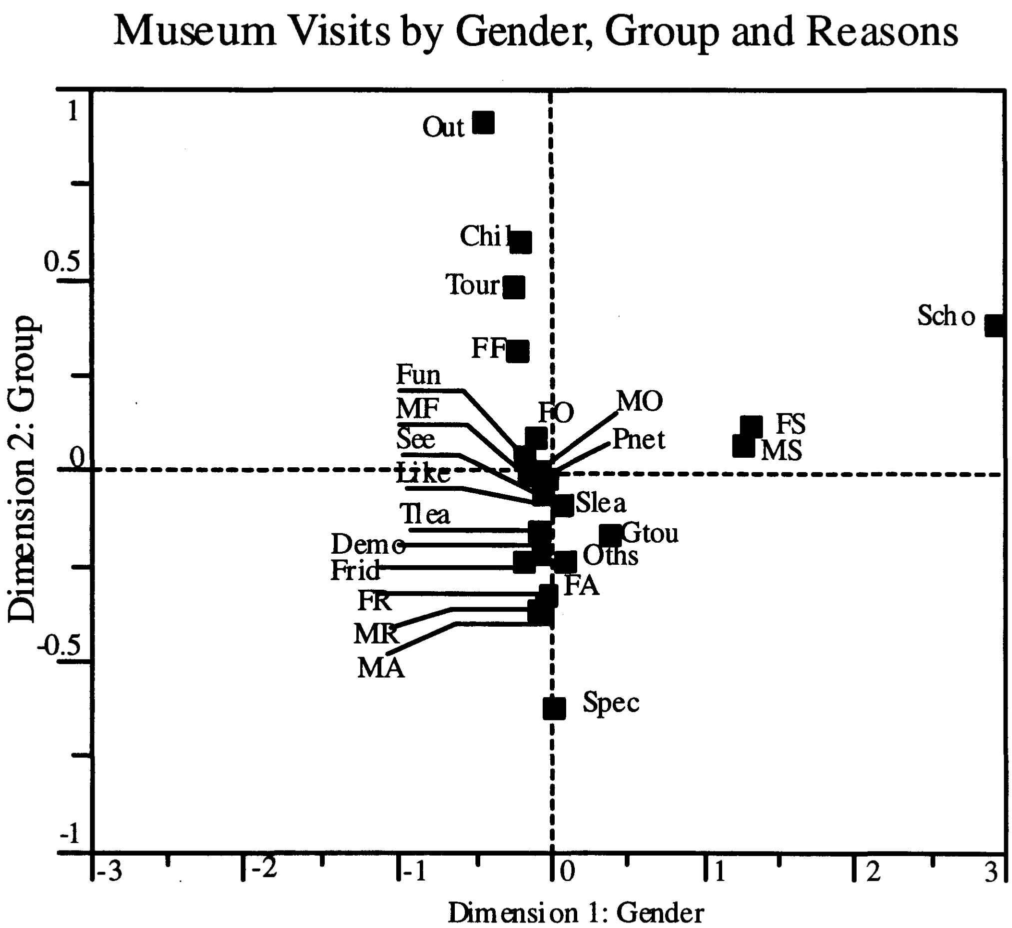

Figure 5.3: A multiple correspondence analysis plot for reasons and group-gender.

Chi	To bring my children
Demo	To see the demonstration
Frid	To show my friends the museum
Fun	For fun
Gtou	I am part of a group tour
Like	Because I like museums
Oths	Other reasons
Out	I am on a family outing
Pnet	To see the planetarium show
Scho	I am on a trip with my school class
See	To see what is inside the museum
Slea	To learn something about science
Spec	To see special or specific exhibitions
Tlea	To learn how things work
Tour	I am touring alone or with my family
MA	Males on their own
MF	Males with their family
MR	Males with their friends
MS	Males with their school class
MO	Males with other groups
FA	Females on their own
FF	Females with their family
FR	Females with their friends
FS	Females with their school class
FO	Females with other groups

Table 5.24: Reasons for visiting the Centre with respect to the visitors' place of residence controlled for gender. Each cell contains a count (whole number) and a percentage (a decimal).

Reasons	Male (O)			Female (✱)		
	Madras	Tamilnadu	Others	Madras	Tamilnadu	Others
For fun❶	36 57.1	6 9.5	21 33.3	26 48.1	8 14.8	20 37.0
Because I like museums	53 57.6	5 5.4	34 37.0	52 58.4	9 10.1	28 31.5
To learn science	114 57.0	13 6.5	73 36.5	88 57.1	12 7.8	54 35.1
To learn how things work①	86 61.0	12 8.5	43 30.5	59 59.0	6 6.0	35 35.0
To see what is in the museum②	90 50.8	5 2.8	82 46.3	78 54.9	8 5.6	56 39.4
To see a specific exhibition③	16 59.3	5 18.5	6 22.2	6 66.7	0 .0	3 33.3
To see the planetarium show④	90 49.2	11 6.0	82 44.8	85 58.2	10 6.8	51 34.9
To see the demon-stration❷	17 60.7	2 7.1	9 32.1	5 35.7	5 35.7	4 28.6
To bring my children	28 68.3	2 4.9	11 26.8	31 62.0	4 8.0	15 30.0
On a family outing ❸	14 63.6	0 .0	8 36.4	26 41.9	5 8.1	31 50.0
To show my friends the museum❹	42 65.6	5 7.8	17 26.6	21 77.8	0 .0	6 22.2
Touring Madras⑤❺	2 8.3	1 4.2	21 87.5	4 11.1	3 8.3	29 80.6
Part of a group tour	5 41.7	0 .0	7 58.3	6 66.7	1 11.1	2 22.2
On a trip with my school class	6 46.2	1 7.7	6 46.2	20 66.7	1 3.3	9 30.0
Other reasons	26 54.2	1 2.1	21 43.8	18 69.2	0 .0	8 30.8
Number Percent	150 54.9	16 5.9	107 39.2	118 57.3	14 6.8	74 35.9

①: $X^2 = 11.063$; df = 2; $p = .003$; $\Phi = .201$

②: $X^2 = 15.989$; df = 2; $p < .001$; $\Phi = .242$

③: $X^2 = 10.495$; df = 2; $p = .005$; $\Phi = .196$

④: $X^2 = 7.843$; df = 2; $p = .019$; $\Phi = .170$

⑤: $X^2 = 26.200$; df = 2; $p < .001$; $\Phi = .310$

❶: $X^2 = 8.015$; df = 2; $p = .018$; $\Phi = .197$

❷: $X^2 = 19.929$; df = 2; $p < .001$; $\Phi = .311$

❸: $X^2 = 8.750$; df = 2; $p = .012$; $\Phi = .206$

❹: $X^2 = 6.014$; df = 2; $p = .049$; $\Phi = .171$

❺: $X^2 = 40.578$; df = 2; $p < .001$; $\Phi = .444$

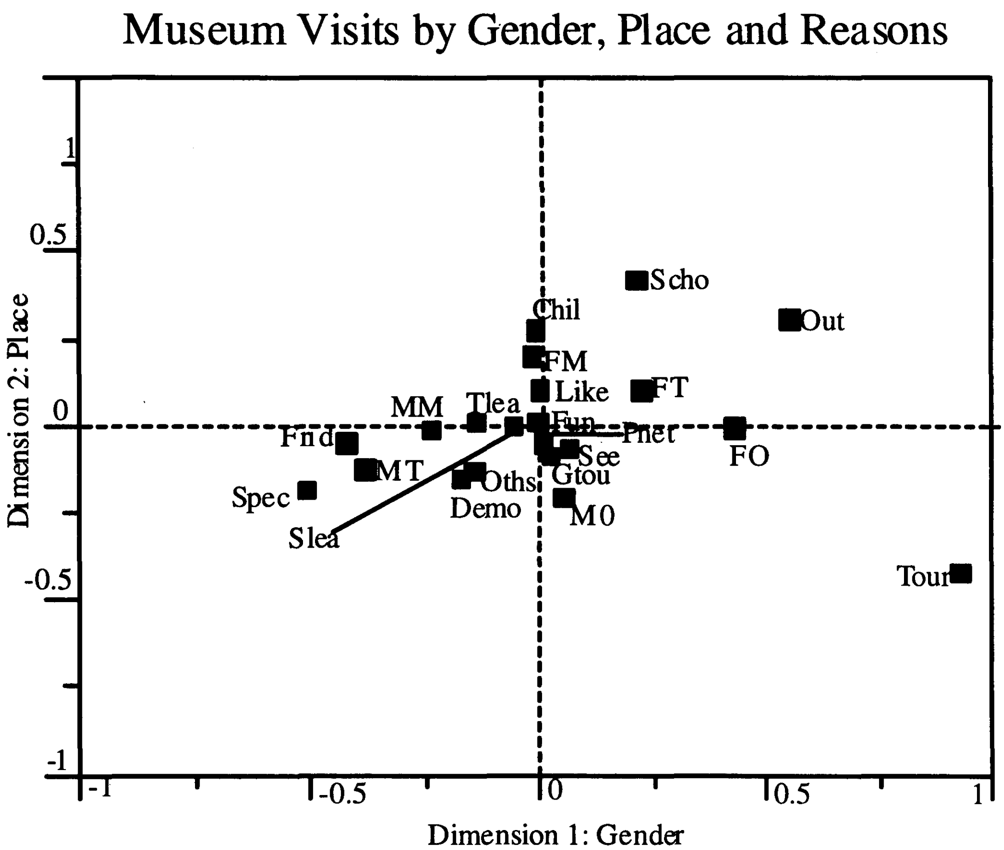

Figure 5.4: A multiple correspondence analysis plot for reasons and place-gender.

Chi	To bring my children
Demo	To see the demonstration
Frid	To show my friends the museum
Fun	For fun
Gtou	I am part of a group tour
Like	Because I like museums
Oths	Other reasons
Out	I am on a family outing
Pnet	To see the planetarium show
Scho	I am on a trip with my school class
See	To see what is inside the museum
Slea	To learn something about science
Spec	To see special or specific exhibitions
Tlea	To learn how things work
Tour	I am touring alone or with my family
MM	Males from Madras
MT	Males from Tamilnadu
MO	Males from other places
FM	Females from Madras
FT	Females from Tamilnadu
FO	Females from other places

Table 5.26: Factor loadings of reasons for the visit extracted by a factor analysis (principal factor method with varimax rotation). Loadings less than |0.4| are omitted (N=479).

Reasons for the museum visit	1 Learning	2 Seeing	3 Having fun	4 Showing	5 Specific	6 Tour
To learn something about science	.776					
To learn show things work	.772					
To see the planetarium show	.406				-.499	
To see what is inside the museum		.527				
On a family outing		.643				
Touring Madras		.564				
For fun			.671			
Because I like museums	.428		.595			
To bring my children				.832		
To show my friends the museum		-.432		.613		
To see specific exhibition					.478	
To see the demonstration					.771	
Part of a group tour						.779
On a trip with my school class						.431
Other reasons			-.562			
Percentage of variance	12.7	10.1	9.7	8.5	7.3	7
Cumulative percentage	12.7	22.8	32.5	41	48.3	55.3

Table 5.27: F- and t- values with their corresponding significant values for age, group, stay, and gender are presented according to the six factors — results of ANOVAs and t-tests on factor scores.

Factors	Age		Group		Place		Stay		Gender	
	F	p	F	p	F	p	F	p	t	p
Factor 1: Learning	—	NS	—	NS	—	NS	6.810	.002	—	NS
Factor 2: Seeing	2.641	.033	20.346	<.001	24.526	<.001	—	NS	5.26	<.001
Factor 3: Having fun	2.549	.039	5.625	<.001	4.769	.008	—	NS	2.09	.037
Factor 4: Showing	18.049	<.001	15.986	<.001	4.973	.007	—	NS	—	NS
Factor 5: Seeing Specific	—	NS	—	NS	3.934	.020	3.896	.009	—	NS
Factor 6: Touring	—	NS	41.893	<.001	—	NS	—	NS	—	NS

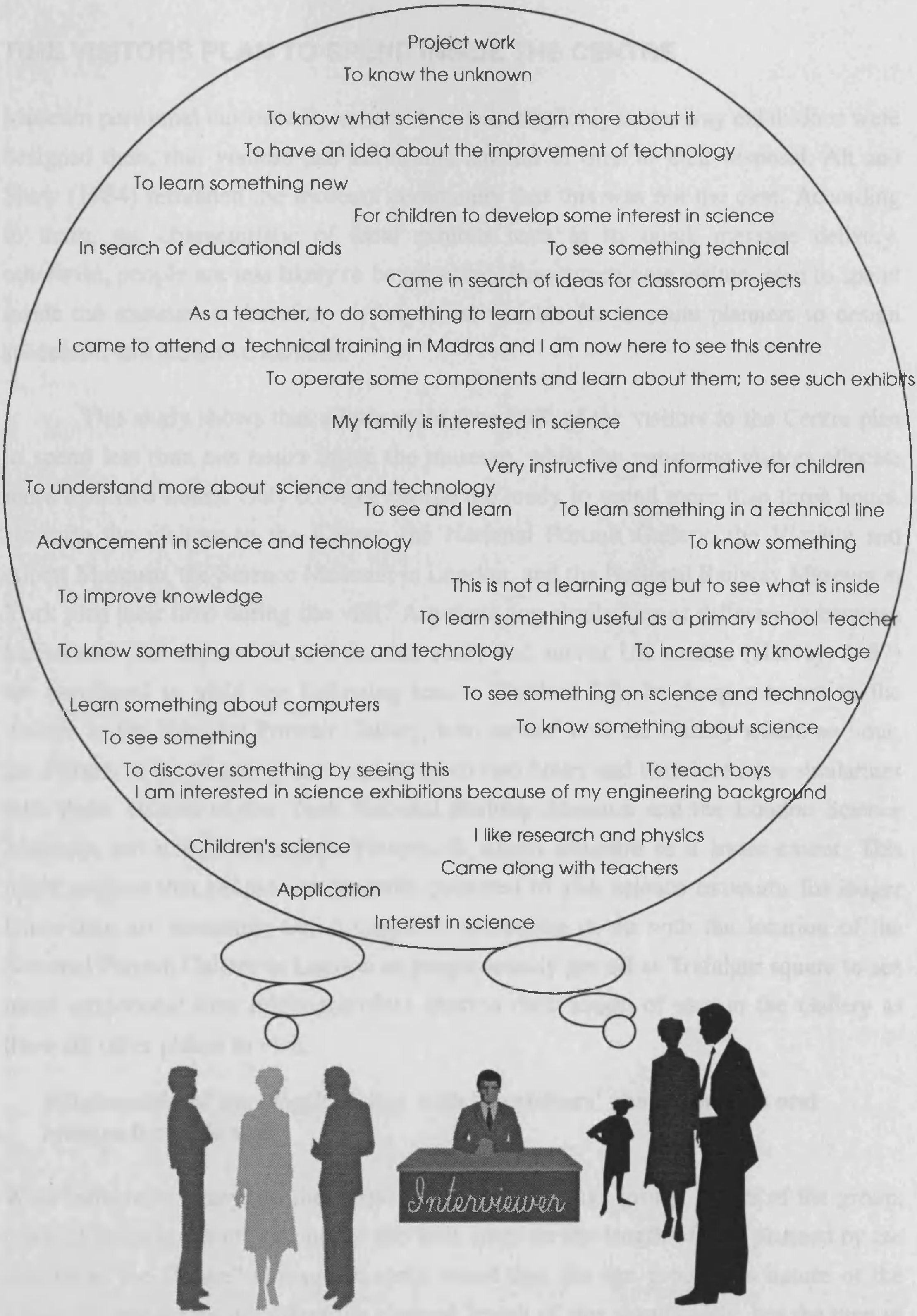

Figure 5.5: Learning-related reasons for visiting the Centre.

TIME VISITORS PLAN TO SPEND INSIDE THE CENTRE

Museum personnel customarily assumed, at least implicitly in the way exhibitions were designed then, that visitors had an infinite amount of time at their disposal. Alt and Shaw (1984) reminded the museum community that this was not the case. According to them, the characteristic of ideal exhibits rests in its quick message delivery, otherwise, people are less likely to be attracted. How much time visitors plan to spend inside the museum is therefore an important variable for museum planners to design successful and attractive exhibits.

This study shows that a little more than 80% of the visitors to the Centre plan to spend less than *two hours* inside the museum, while the remaining visitors allocate more than two hours. Only 6.3% of people are ready to spend more than three hours. How do the visitors to the Centre, the National Portrait Gallery, the Victoria and Albert Museum, the Science Museum in London, and the National Railway Museum in York plan their time during the visit? Are there any similarities or differences between Indian and UK visitors? Data from this study and similar UK studies (Harvey, 1987) are compared to yield the following results (Table 5.28): In sharp contrast to the visitors to the National Portrait Gallery, who mostly visit the Gallery within an hour, the visitors to the Centre plan to spend up to two hours and therefore have similarities with those visitors to the York National Railway Museum and the London Science Museum, but with the London Victoria & Albert Museum to a lesser extent. This might suggest that people are generally prepared to visit science museums for longer hours than art museums. Or, it might be something to do with the location of the National Portrait Gallery in London as people usually get off at Trafalgar square to see many attractions; they might therefore shorten their length of stay in the Gallery as there are other places to visit.

Relationship of the length of stay with the visitors' characteristics and reasons for their visit

What influences, if any, do their type of visit, gender, age group, nature of the group, place of residence, and reasons for the visit, have on the length of stay planned by the visitors to the Centre? Chi-square tests reveal that the age group, the nature of the group and gender do not affect the planned length of stay significantly, but the type of visit, the place of residence, and some other reasons do. A multiple correspondence analysis also reveals a pattern of inter-relationships among gender, planned length of stay and reasons.

The Type of Visit

First-time visitors are more likely than repeat visitors to visit the Centre for less than an hour and more than three hours. Repeat visitors are more likely than first-time visitors to visit for 1-2 hours and 2-3 hours. This means that first-time visitors are prepared to visit either for a short or a long visit, but the repeat visitors plan for a middle-range visit (Table 5.29). As first-time visitors may not know exactly what to expect from the Centre and how long it will take to complete a visit, they might plan either a short or a long stay. The repeat visitors, having learnt from previous experience, would come with some expectation —often learning-related, and they might therefore plan a middle range stay.

The Place of Residence

Madras-resident visitors are more likely to plan to visit for more than 2 hours. But Tamilnadu visitors are more likely to visit for more than an hour. Significantly differing from both Madras and Tamilnadu visitors, visitors from 'other' places are more likely to visit for less than an hour (Table 5.30). The farther the place of residence, the shorter the length of stay. This might possibly be because people from more distant places may plan to visit other sightseeing places on the day of the visit while local people are able to restrict their visit only to the Centre (Table 5.35).

Reasons for the museum visit

As we have seen earlier, the purposes of the museum visit are many and therefore the budgeting of time should also vary according to the purposes: for example, those who came to the museum for picnic purposes would prefer to spend more than three hours whereas student classes would swiftly pass through the museum within an hour, either to go back to school or to visit another place planned during the day.

As can be seen, the length of stay has four categories, namely a short stay or period (<1 hrs), a lower middle-range stay (1-2 hrs.), an upper middle-range stay (2-3 hrs.) and a long stay (>3 hrs.). Chi-square tests on the cross-tabulations between reasons and length-of-stay controlling for gender reveal four reasons that significantly interact with the planned length-of-stay in the case of males and just one reason in the case of females (Table 5.31).

First, male visitors whose reason is to visit the museum because they like it are more likely to plan to stay between one and two hours, but less likely to stay for a short, long, or upper-middle range period. Second, male visitors whose reason is to learn science are more likely to stay for more than one hour, but are less likely to stay for a short period. Third, male visitors whose reason is to learn how things work are more likely to stay for a minimum of one hour and a maximum of three hours, but are less likely to visit the Centre for a short or long stay. Fourth, males whose reason is to see what is inside the museum are more likely to plan a short or long stay, but are less likely to plan a lower or upper middle range stay.

However, females whose reason is to see what is inside the museum are more likely to visit for a short, upper middle-range, or long stay than for a lower middle-range stay. In short, people planning for a short or long stay are more likely to have fun-related reasons than people planning for a middle-range stay, who are more likely to have serious learning-related reason.

A multiple correspondence analysis plot shows an interesting overall pattern of interaction between reasons and gender-stay categories (Figure 5.6). Gender and stay dimensions alone account for 71% of the overall association (Chi-square = 150.612). Unlike the earlier plots (Figures 5.2-4), this plot shows a clear segregation of reasons and stay-gender categories in both axes: All male categories are nicely clustered in the left half whereas all female categories are in the right half; similarly, both short and long stay categories occupy the bottom half while both middle-range stay categories are in the upper half. So, it follows that men are more likely to visit museums for reasons in the left half (for example, Spec) than those reasons in the right half (for example, Out) for which women visit the museum; similarly, visitors who planned to stay for a middle-range stay are more likely to visit the museum for reasons in the top half (for example, Gtou) than those in the bottom half (for example, See and Fun), for which people planning for a short or long stay visit the museum.

In conclusion, visitors generally spend less than two hours on average visiting the museum. Corroborating this finding, the results from the observational study (presented in detail in Chapter VI) also show that the average time spent inside the Centre is about 90 minutes. After spending about an hour and half in exhibition galleries, visitors tend to spend the rest of the time, up to two hours, relaxing outside in the veranda of the Centre, inside the Planetarium, in the Science Park or in all of them. The 90 minutes inside the exhibition space was also evidenced in studies conducted at the Florida Museum of Natural History and National Museum of Natural History of Washington (Falk et al. 1985). Falk and his associates found that the 90-minute visit could be divided into four distinct phases: an orientation phase lasting 3-10 minutes; intense exhibit viewing, lasting 25-30 minutes; exhibit 'cruising', lasting 30-40 minutes; and preparation for departure, lasting 5-10 minutes. After having seen how the visitors plan to stay inside the museum, I will present two leisure aspects of the museum visit in the sections to follow.

Table 5.28: Planned length of stay by visitors to the Centre (PSTC), the London National Portrait Gallery (NPG), the London Victoria and Albert Museum (V&A), the London Science Museum (SM) and the York National Railway Museum (NRM).

Duration of the visit	**NPG***	**V&A****	**NRM****	**SM****	**PSTC**
	%	%	%	%	%
Less than one hour	67	31	29	22	41
1-2 hours	28	43	53	41	42
2 hours or more	5	26	17	37	17
N of sample (in number)	815	891	920	787	479

* Data from Harvey, 1987 (Table 5.2; p 15); ** Data from Heady, 1984 (Table 12.10; p 103).

Table 5.29: Planned length of stay by visitors to the Centre according to their type of visit (i.e. first time or repeat visit). Each cell contains a count (whole number) and a percentage (a single digit decimal).

Type	**< 1 hour**	**1-2 hours**	**2-3 hours**	**> 3 hours**	**Overall**
First	160	142	33	26	361
	44.3	39.3	9.1	7.2	75.4
Repeat	38	58	18	4	118
	32.2	49.2	15.3	3.4	24.6
Number	198	200	51	30	479
Percent	41.3	41.8	10.6	6.3	100.0

$X^2 = 10.397$; df = 3; p = .015; $\Phi = .147$.

Table 5.30: Planned length of stay by visitors to the Centre according to their place of residence. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Place	<1 hour	1-2 hours	2-3 hours	>3 hours	Overall
Madras	104	109	35	20	268
	38.8	40.7	13.1	7.5	55.9
Tamilnadu	4	19	5	2	30
	13.3	63.3	16.7	6.7	6.3
Others	90	72	11	8	181
	49.7	39.8	6.1	4.4	37.8
Number	198	200	51	30	479
Percent	41.3	41.8	10.6	6.3	100.0

$X^2 = 20.418$; df = 6; p = .002; $\Phi = .206$; Cramer's V = .146

Table 5.31: Planned length of stay, controlled for gender, according to the reasons for visiting the Centre. Each cell contains a count (whole number) and a percentage (a single digit decimal).

	Male				Female			
Reasons	<1 hr	1-2 hrs.	2-3 hrs	>3 hrs.	<1 hr	1-2 hrs.	2-3 hrs	>3 hrs.
For fun	26	25	8	4	29	20	2	3
	41.3	39.7	12.7	6.3	53.7	37.0	3.7	5.6
Because I like	33	48	8	3	37	38	10	4
museums (m1)	35.9	52.2	8.7	3.3	41.6	42.7	11.2	4.5
To learn science[1] (m2)	65	92	25	18	66	64	20	4
	32.5	46.0	12.5	9.0	42.9	41.6	13.0	2.6
To learn how things	40	71	20	10	36	46	14	4
work[2] (m3)	28.4	50.4	14.2	7.1	36.0	46.0	14.0	4.0
To see what is in the	79	66	16	16	70	49	16	7
museum[3] (m4,f1)	44.6	37.3	9.0	9.0	49.3	34.5	11.3	4.9
To see a specific	6	12	6	3	4	5	0	0
exhibition	22.2	44.4	22.2	11.1	44.4	55.6	.0	.0
To see the planetarium	73	76	17	17	68	53	17	8
show	39.9	41.5	9.3	9.3	46.6	36.3	11.6	5.5
To see the demon-	12	14	2	0	2	11	1	0
stration	42.9	50.0	7.1	.0	14.3	78.6	7.1	.0
To bring my children	18	14	6	3	15	26	6	3
	43.9	34.1	14.6	7.3	30.0	52.0	12.0	6.0
On a family outing	11	8	2	1	23	27	7	5
	50.0	36.4	9.1	4.5	37.1	43.5	11.3	8.1
To show my friends	24	27	8	5	13	10	3	1
the museum	37.5	42.2	12.5	7.8	48.1	37.0	11.1	3.7
Touring Madras	5	12	3	4	17	15	3	1
	20.8	50.0	12.5	16.7	47.2	41.7	8.3	2.8
Part of a group tour	3	6	2	1	3	4	2	0
	25.0	50.0	16.7	8.3	33.3	44.4	22.2	.0
On a trip with my	6	7	0	0	14	11	5	0
school class	46.2	53.8	.0	.0	46.7	36.7	16.7	.0
Other reasons	23	17	4	4	16	8	2	0
	47.9	35.4	8.3	8.3	61.5	30.8	7.7	.0
Number	106	116	29	22	92	84	22	8
Percent	38.8	42.5	10.6	8.1	44.7	40.8	10.7	3.9

Amongst males (m) or females (f):-
m1: $X^2 = 7.823$; df = 3; p = .050; $\Phi = .169$;
m2: $X^2 = 13.85$; df = 3; p = .004; $\Phi = .220$;
m3: $X^2 = 16.280$; df = 3; p < .001; $\Phi = .244$;
m4: $X^2 = 9.363$; df = 3; p = .025; $\Phi = .185$;
f1: $X^2 = 8.041$; df = 3; p = .045; $\Phi = .198$.

For whole sample:-
1: $X^2 = 13.330$; df = 3; p = .003; $\Phi = .167$
2: $X^2 = 22.249$; df = 3; p < .001; $\Phi = .216$
3: $X^2 = 15.816$; df = 3; p = .001; $\Phi = .182$

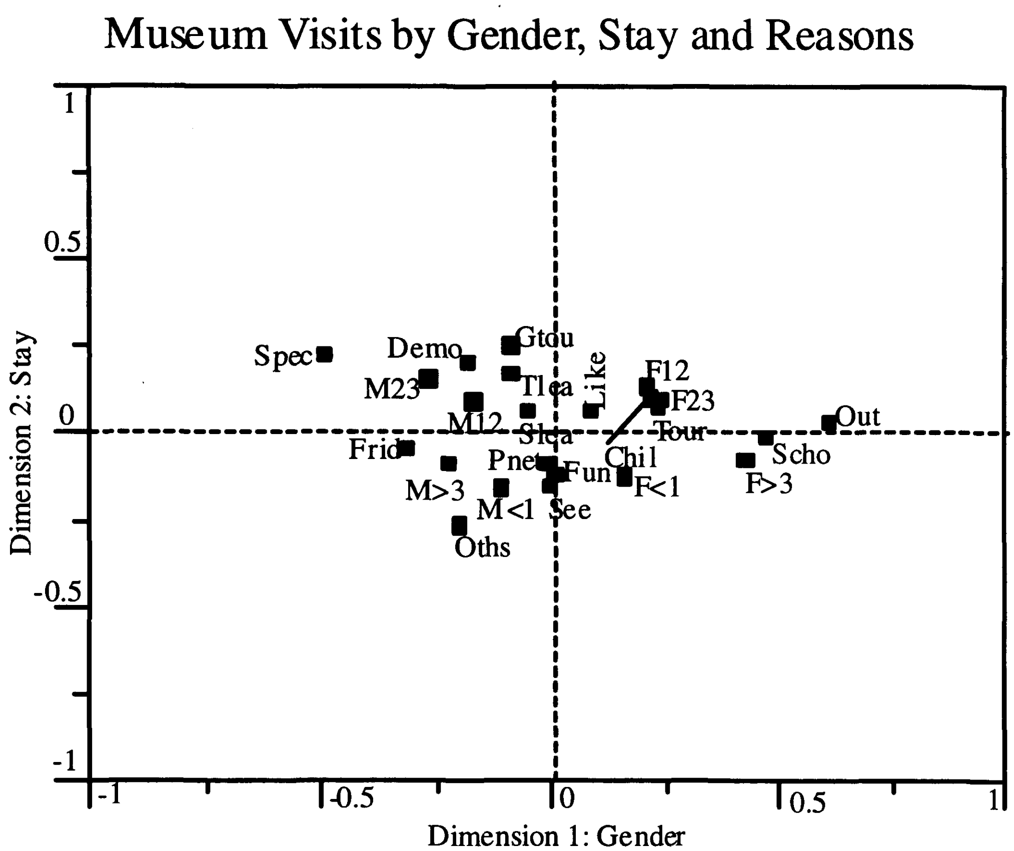

Figure 5.6: A multiple correspondence analysis plot for reasons and stay-gender.

Chi	To bring my children
Demo	To see the demonstration
Frid	To show my friends the museum
Fun	For fun
Gtou	I am part of a group tour
Like	Because I like museums
Oths	Other reasons
Out	I am on a family outing
Pnet	To see the planetarium show
Scho	I am on a trip with my school class
See	To see what is inside the museum
Slea	To learn something about science
Spec	To see special or specific exhibitions
Tlea	To learn how things work
Tour	I am touring alone or with my family
M<1	Males who planned to stay for less than an hour
M12	Males who planned to stay for 1-2 hours
M23	Males who planned to stay for 2-3 hours
M>3	Males who planned to stay for more than 3 hours
F<1	Females who planned to stay for less than an hour
F12	Females who planned to stay for 1-2 hours
F23	Females who planned to stay for 2-3 hours
F>3	Females who planned to stay for more than 3 hours

VISITING OTHER PLACES IN MADRAS ON THE DAY OF THE VISIT

Museum visiting is generally not an isolated activity; some people often tend to combine it with other activities. In this section and the section that follows, an attempt will therefore be made to seek answers to two important questions relating to leisure aspects of the museum visit: what are the activities that usually or intentionally go along with the museum visit? And, what are the activities people do in their spare time? The answer to the first question is that only 35% of visitors to the Centre visit at least one other place in Madras whereas the remaining 65% of the visitors exclusively come to visit only the Centre (Figure 5.7).

Among the things done by the visitors on the day of the visit, sight-seeing is the most important single event. A number of places in Madras have been identified by visitors for sight-seeing and other purposes. They are *important places* where school children are often taken for exposure; *religious places* often visited by older people; *parks*; *beaches*; and *cultural places* like memorials and museums. The *important places* include the Harbour and the High Court. The *religious places* include St. Thomas Mount, Adyar *Koil*, Church, Temples, and the Christian Assembly Conference (this is a week-long conference on the Marina beach at the time when the study was being conducted). The *beaches* include the Golden Beach and the Marina Beach. The *parks* include the Children's Park, Adyar Park, Snake Park and Guindy Park. The *cultural places* include the Fort Museum, Egmore Museum, Vandalur Zoo, Mahabalipuram, Valluvar Kottam, MGR Memorial, Anna Memorial, Gandhi Mandapam, Light House, Science Park, Book Exhibition and Shoe Exhibition. In addition to these things, people tend to combine their personal engagements with the museum visit. The personal engagements include scout's meetings, attending weddings, and 'to attend functions'.

Relationship of 'visiting other places in Madras' with the visitors' characteristics and length of stay

After having seen the overall picture of what the visitors do in Madras on the day of the visit, it is necessary to ask whether or not the overall pattern is stable. What roles do their gender, type of visit, age group, nature of the group, place of residence and length of stay, play in influencing the visitors to visit other places or do other things in Madras? Chi-square tests reveal that all the six variables are found to significantly influence only a few activities that are done in Madras. Multiple correspondence analysis was done on 'what was done in Madras' with respect to the age group, the nature of the group, the place of residence, and length of stay, all controlling for gender. However, for lack of any interesting and useful outcomes from the multiple correspondence analysis, in what follows, I will present only the results of the chi-square analyses.

The Type of Visit and Gender

First-time visitors are more likely to do sight-seeing and slightly more likely to go to restaurants on the day of the visit than are repeat visitors (It is a pity that the Centre does not have one!). Repeat visitors, however, are more likely than first-time visitors to visit only the Centre. In regard to gender, females are slightly more likely than males to go shopping in Madras on the day of the visit (Table 5.32).

The Age Group controlled for Gender

Male visitors in the age group of above 25 years are more likely than other males to go shopping on the day of the visit. But in the case of females this age difference is not found to be significant (Table 5.33).

The Nature of the Group controlled for Gender

People who visited alone, with friends, or with 'others' are more likely than other age groups to visit only the Centre. People with their family or with their school class, are slightly more likely than other groups to go sight-seeing on the day of the visit. But people with school classes or 'others' are slightly more likely to visit the zoo than people in the other groups. School classes more often visit the zoo because teachers can often plan out a number of other places to visit during the day as it is often economical to hire a bus for a whole day and visit different places on the same day rather than on different days.

All these significant relationships disappeared when the nature of the group was controlled for gender (Table 5.34). This disappearance of significance tells us two things: one relating to the result and another relating to the nature (weakness) of the test itself. Relating to the result, though there are significant differences among the nature of the group within the whole sample in so far as 'what was done in Madras', they do not exist among males or females of the sample separately. Relating to the test, the chi-square test does depend on the sample size: by simply increasing the sample size any non-significant relationship can be made significant or to put it differently, any significant relationship will become non-significant if the sample size becomes small. This is a major weakness of the chi-square test. However, coefficients such as phi or Cramer's V can be used to assess the strength of the association. As only very weak relationships usually tend to disappear, the chi-square test should be used to assess the relationship in conjunction with the coefficients of the strength of the association. Indeed, the coefficients of phi and Cramer's V are nothing but chi-square values divided by the size of the sample. The coefficients are therefore free from the weakness of chi-square.

The Place of Residence controlled for Gender

Males and females display the same significant pattern in 'what was done in Madras' with respect to their place of residence: Madras males and females are more likely to visit only the Centre than are others; males and females from Tamilnadu and 'other' places are more likely to go sight-seeing and to visit the zoo in Madras than are people from Madras; and males and females from 'other' places are much more likely to visit a number of other places in Madras than are people from Madras and Tamilnadu. However, females from Tamilnadu and 'other' places are more likely to go shopping in Madras than females of Madras on the day of the visit, but this pattern is not significant among males (Table 5.35). In this case, all the significant relationships are also true for the whole sample.

Length of Stay

Visitors who planned to stay for less than an hour and who planned to stay for more than two hours are slightly more likely than others to visit only the Centre. But visitors who planned to stay for 1-2 hours are slightly more likely than the rest to go sight-seeing in Madras. However, visitors who planned to stay for up to 2 hours are more likely to go shopping on the day of the visit than other visitors are. All these, though weak, significant relationships disappear when the length of stay is controlled for gender, but a new significant relationship emerges: among male visitors, those who planned to stay for less than an hour are more likely to do 'other' things in Madras on the day of the visit than other males (Table 5.36). As seen earlier, the 'other' places include important religious and cultural places besides parks and beaches.

In sum, the great majority of the people visited only the Centre. Females are more likely than males to go shopping on the day of the visit. First-time visitors are more likely than repeat visitors to go sight-seeing and go to restaurant than are repeat visitors who are more likely to visit only the Centre. Males of above 25 years are more likely to go shopping on the day of the visit than are males of less than 25 years. Madras residents are more likely to visit only the Centre than are others who are more likely to go shopping and to visit the zoo. Females from Tamilnadu and 'other' places are more likely to go shopping than are Madras females. After having seen what the visitor did in Madras on the day of the visit, I will present the results on what they did in their spare time in the following section.

VISITING OTHER PLACES IN MADRAS

N = 479

Figure 5.7: Visiting other places in Madras on the day of the visit.

Table 5.32: What the visitors to the Centre planned to do on the day of the visit according to their gender and type of visit. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Do in Madras	Gender○			Type✸		
	Male	Female	Overall	First	Repeat	Overall
Only visiting	187	124	311	216	95	311
centre❶	60.1	39.9	64.9	69.5	30.5	64.9
Sightseeing❷	86	82	168	145	23	168
	51.2	48.8	35.1	86.3	13.7	35.1
Shopping①	26	32	58	47	11	58
	44.8	55.2	12.1	81.0	19.	12.1
Restaurant❸	16	12	28	27	1	28
	57.1	42.9	5.8	96.4	3.6	5.8
Drama or	1	1	2	2	0	2
concert	50.0	50.0	.4	100.0	.0	.4
Sporting event	3	2	5	5	0	5
	60.0	40.0	1.0	100.0	.0	1.0
Zoo	16	19	35	28	7	35
	45.7	54.3	7.3	80.0	20.0	7.3
Movies	8	5	13	10	3	13
	61.5	38.5	2.7	76.9	23.1	2.7
Visit friends	13	18	31	24	7	31
	41.9	58.1	6.5	77.4	22.6	6.5
Others	62	46	108	87	21	108
	57.4	42.6	22.5	80.6	19.4	22.5
Total	273	206	479	361	118	479
Percent	57.0	43.0	100.0	75.4	24.6	100.0

①: $X^2 = 3.985$; df = 1; p = .045; $\Phi = -.091$

❶: $X^2 = 16.693$; df = 1; p < .001; $\Phi = -.187$

❷: $X^2 = 16.693$; df = 1; p < .001; $\Phi = 187$

❸: $X^2 = 7.106$; df = 1; p = .007; $\Phi = .121$

Table 5.33: What the visitors to the Centre planned to do on the day of the visit according to their age groups. Each cell contains a count (whole number) and a percentage (decimal).

Visiting	Male					Female				
in Madras	6-14	15-24	25-34	35-49	50+	6-14	15-24	25-34	35-49	50+
Only visiting centre	23 12.3	71 38.0	46 24.6	34 18.2	13 7.0	23 18.5	49 39.5	32 25.8	16 12.9	4 3.2
Sightseeing	11 12.8	27 31.4	24 27.9	20 23.3	4 4.7	9 11.0	30 36.6	29 35.4	12 14.6	2 2.4
Shopping (1, m1)	1 3.8	6 23.1	8 30.8	6 23.1	5 19.2	1 3.1	11 34.4	13 40.6	6 18.8	1 3.1
Restaurant	0 .0	6 37.5	5 31.3	4 25.0	1 6.3	0 .0	9 75.0	2 16.7	1 8.3	0 .0
Drama or concert	0 .0	0 .0	1 100	0 .0	0 .0	0 .0	1 100	0 .0	0 .0	0 .0
Sporting event	1 33.3	2 66.7	0 .0	0 .0	0 .0	0 .0	2 100	0 .0	0 .0	0 .0
Zoo	3 18.8	5 31.3	4 25.0	4 25.0	0 .0	4 21.1	7 36.8	4 21.1	4 21.1	0 .0
Movies	0 .0	6 75.0	2 25.0	0 .0	0 .0	1 20.0	3 60.0	1 20.0	0 .0	0 .0
Visit friends	0 .0	5 38.5	5 38.5	2 15.4	1 7.7	0 .0	7 38.9	6 33.3	5 27.8	0 .0
Others (2)	5 8.1	17 27.4	16 25.8	17 27.4	7 11.3	5 10.9	16 34.8	14 30.4	8 17.4	3 6.5
Total Percent	34 12.5	98 35.9	70 25.6	54 19.8	17 6.2	32 15.5	79 38.3	61 29.6	28 13.6	6 2.9

For whole sample:- 1: $X^2 = 12.762$; df = 4; p = .012; $\Phi = .163$ 2: $X^2 = 12.351$; df = 4; p = .014; $\Phi = .161$;
Amongst males (m) or females (f):- m1: $X^2 = 11.282$; df = 4; p = .026; $\Phi = .203$

Table 5.34: What the visitors planned to do on the day of the visit according to the nature of their group. Each cell contains a count (whole number) and a percentage (decimal).

Visiting	Male					Female				
in Madras	Alone	Fam	Frid	Schoo	Oths	Alone	Fam	Frid	Schoo	Oths
Only visiting centre (1)	28 15.0	64 34.2	76 40.6	8 4.3	11 5.9	1 .8	85 68.5	14 11.3	13 10.5	11 8.9
Sightseeing (2)	6 7.0	37 43.0	33 38.4	5 5.8	5 5.8	0 .0	55 67.1	5 6.1	17 20.7	5 6.1
Shopping	2 7.7	10 38.5	13 50.0	0 .0	1 3.8	0 .0	25 78.1	1 3.1	3 9.4	3 9.4
Restaurant	0 .0	7 43.8	9 56.3	0 .0	0 .0	0 .0	9 75.0	1 8.3	1 8.3	1 8.3
Drama or concert	0 .0	0 .0	1 100	0 .0	0 .0	0 .0	1 100	0 .0	0 .0	0 .0
Sporting event	0 .0	0 .0	1 33.3	0 .0	2 66.7	0 .0	2 100	0 .0	0 .0	0 .0
Zoo (3)	1 6.3	4 25.0	4 25.0	5 31.3	2 12.5	0 .0	11 57.9	2 10.5	5 26.3	1 5.3
Movies	1 12.5	0 .0	7 87.5	0 .0	0 .0	0 .0	4 80.0	0 .0	0 .0	1 20.0
Visit friends	0 .0	6 46.2	6 46.2	0 .0	1 7.7	0 .0	14 77.8	3 16.7	0 .0	1 5.6
Others	3 4.8	29 46.8	22 35.5	5 8.1	3 4.8	0 .0	33 71.7	1 2.2	10 21.7	2 4.3
Total/Percent	34 12.5	101 37.0	109 39.9	13 4.8	16 5.9	1 .5	140 68.0	19 9.2	30 14.6	16 7.8

For whole sample:- 1: $X^2 = 9.489$; df = 3; p = .023; $\Phi = .141$; 2: $X^2 = 9.489$; df = 3; p = .023; $\Phi = .141$;
3: $X^2 = 13.869$; df = 3; p < .001; $\Phi = .170$

Table 5.35: What the visitors planned to do on the day of the visit according to their place of residence. Each cell contains a count (whole number) and a percentage (decimal).

Visiting in Madras	Male			Female		
	Madras	Tamilnadu	Others	Madras	Tamilnadu	Others
Only Centre (1,m1,f1)	124	8	55	85	7	32
	66.3	4.3	29.4	68.5	5.6	25.8
Sightseeing (2,m2,f2)	26	8	52	33	7	42
	30.2	9.3	60.5	40.2	8.5	51.2
Shopping (3,f3)	9	2	15	9	3	20
	34.6	7.7	57.7	28.1	9.4	62.5
Restaurant	9	2	5	4	1	7
	56.3	12.5	31.3	33.3	8.3	58.3
Drama or concert	0	0	1	0	0	1
	.0	.0	100	.0	.0	100
Sporting event	3	0	0	0	0	2
	100	.0	.0	.0	.0	100
Zoo (4,m3,f4)	2	4	10	6	4	9
	12.5	25.0	62.5	31.6	21.1	47.4
Movies	3	3	2	1	0	4
	37.5	37.5	25.0	20.0	.0	80.0
Visit friends	6	2	5	9	0	9
	46.2	15.4	38.5	50.0	.0	50.0
Others (5,m4,f5)	22	2	38	19	1	26
	35.5	3.2	61.3	41.3	2.2	56.5
Total/Percent	150	16	107	118	14	74
	54.9	5.9	39.2	57.3	6.8	35.9

For whole sample:- 1: $X^2 = 45.599$; df = 2; p < .001; $\Phi = .309$ 2: $X^2 = 45.599$; df = 2; p < .001; $\Phi = .309$
3: $X^2 = 16.794$; df = 2; p < .001; $\Phi = .187$ 4: $X^2 = 26.712$; df = 2; p < .001; $\Phi = .236$
5: $X^2 = 27.781$; df = 2; p < .001; $\Phi = .241$;

Amongst males (m) or females (f):-
m1: $X^2 = 30.986$; df = 2; p < .001; $\Phi = .337$; f1: $X^2 = 16.385$; df = 2; p < .001; $\Phi = .282$;
m2: $X^2 = 30.986$; df = 2; p < .001; $\Phi = .337$; f2: $X^2 = 16.385$; df = 2; p < .001; $\Phi = .282$;
m3: $X^2 = 18.551$; df = 2; p < .001; $\Phi = .261$; f3: $X^2 = 13.443$; df = 2; p = .001; $\Phi = .255$;
m4: $X^2 = 16.473$; df = 2; p < .001; $\Phi = .246$; f4: $X^2 = 9.473$; df = 2; p = .009; $\Phi = .214$;
f5: $X^2 = 411.497$; df = 2; p = .003; $\Phi = .236$

Table 5.36: What the visitors to the Centre planned to do on the day of the visit according to their length of stay. Each cell contains a count (whole number) and a percentage (decimal).

Visiting	Male				Female			
in Madras	<1 hr	1-2 hrs	2-3 hrs	>3 hrs	<1 hr	1-2 hrs	2-3 hrs	>3 hrs
Only visiting centre (1)	73	73	24	17	56	46	16	6
	39.0	39.0	12.8	9.1	45.2	37.1	12.9	4.8
Sightseeing (2)	33	43	5	5	36	38	6	2
	38.4	50.0	5.8	5.8	43.9	46.3	7.3	2.4
Shopping (3)	10	13	3	0	17	14	1	0
	38.5	50.0	11.5	.0	53.1	43.8	3.1	.0
Restaurant	3	11	2	0	7	4	1	0
	18.8	68.8	12.5	.0	58.3	33.3	8.3	.0
Drama or concert	0	1	0	0	1	0	0	0
	.0	100	.0	.0	100	.0	.0	.0
Sporting event	0	2	0	1	2	0	0	0
	.0	66.7	.0	33.3	100	.0	.0	.0
Zoo	8	7	0	1	8	9	1	1
	50.0	43.8	.0	6.3	42.1	47.4	5.3	5.3
Movies	1	6	1	0	3	2	0	0
	12.5	75.0	12.5	.0	60.0	40.0	.0	.0
Visit friends	4	8	0	1	9	8	1	0
	30.8	61.5	.0	7.7	50.0	44.4	5.6	.0
Others (m1)	39	19	1	3	22	19	4	1
	62.9	30.6	1.6	4.8	47.8	41.3	8.7	2.2
Total/Percent	106	116	29	22	92	84	22	8
	38.8	42.5	10.6	8.1	44.7	40.8	10.7	3.9

For whole sample:- 1: X^2 =8.491; df = 3; p = .037; Φ = .133 2: X^2 =8.491; df = 3; p = .037; Φ = .133
3: X^2 = 15.379; df = 3; p = .002; Φ = .179;
Amongst males (m) or females (f):- m1: X^2 = 21.788; df = 3; p < .001; Φ = .283

WHAT VISITORS DO IN THEIR SPARE TIME

Finally, it is important to know what people do in their spare time. Visitors to the Centre mainly do two things during their spare time: watching TV and reading. In addition to these two very common activities, they visit friends and relatives followed by shopping, going to the movies and so on (Table 5.37). There are also a number of other activities which occupy visitors and they fall under different categories namely religious pastimes, politics, sleeping, scientific reading, scientific activities, playing and listening to music, socialising, outings, vocational works, family works, sports, business, hobbies and agricultural activities. Overall, Indian visitors seem to spend a substantial portion of their spare time in home-oriented activities.

This is also the case with Americans as reflected by their favourite activities: gardening, hobbies, exercise, card games, board games, listening to music, reading, talking with friends, and watching television (Falk and Dierking, 1992:p12). They are, again, all in-home activities.

Most of the Canadians are also found to be mainly watching TV and reading books, magazines and newspapers in their spare time (Dixon, Courtney and Bailey, 1974; Table 5.37). However, unlike Indian visitors, Canadians go to the movies and theatres and participate in or watch sporting events more often.

Relationship of 'spare-time activities' with the visitors' characteristics and their length of stay

Multiple correspondence analyses and chi-square analyses were done on 'what visitors do in their spare time' with respect to the age group, the nature of the group, place of residence, and length of stay, all controlling for gender. Though the nature of the group, and the length of stay are found to have some association with what visitors do in their spare time, they both can not, in any logical sense, influence the visitors' spare time activities, though they can influence what they do on the day the visit. It is therefore sensible to assume that the associations due to these two variables may be spurious. Also, as the results of the multiple correspondence analysis lack interesting and useful outcomes, I will present only the results of the chi-square analyses of the three characteristics, namely gender, the type of visit, and the place of residence.

<u>Gender</u>

All the spare time activities except 'going to movies' are found to have significant, though weak, relationships with gender in the case of Canadians and only three activities are found to have significant associations with gender in the case of Indian visitors (Table 5.38). In India, male visitors are more likely than female visitors to watch sporting events and drama or go to concerts; female visitors, on the other hand, are more likely than male visitors to go shopping. In Canada, males are slightly more likely than females to watch sporting events, and TV; females are slightly more likely than males to read and go to drama performances or concerts.

The Type of Visit

Visitors who returned to the Centre are more likely to do a number of activities that come under 'others' than are first-time visitors. As the activities under 'others' are so varied, little useful interpretation will emerge from this result (Table 5.38).

The Age Group controlled for Gender

Male visitors in their late teens are more likely to 'go to the movies' and 'visit friends', and less likely to 'go shopping' during their spare time than are other males. Similarly, men above 25 years are more likely to go to drama performances or concerts than do other males. These patterns are not significant for females (Table 5.39).

The Place of Residence controlled for Gender

Female visitors from Madras are more likely to 'go to the movies' during their spare time than are other females. Similarly, females from Madras and 'other' places are more likely to 'go shopping' and 'to do other things' than are other females. In the same way, females from Tamilnadu and 'other' places are more likely to 'visit friends' than are other females. Though the above patterns are not found to be significant among males, a new pattern emerges: males from Madras and Tamilnadu are more likely to 'read' during their spare time than males from 'other' places (Table 5.40).

In sum, people are generally engaged in in-house activities during their spare time. Visiting museums will come into their agenda only if people have enough time, money and energy. Even though the main activities such as 'reading' and 'watching TV' do not differ significantly with respect to the visitors' characteristics, some activities are found to have some associations: for example, 'watching sports events' is more likely for males than for females; 'going to drama performances or concerts' is more likely for males and old visitors than for females and young visitors; 'going shopping' is more likely for females than for males; and 'visiting friends' is more likely for visitors in the 15-24 age group than for others. After having analysed and presented the results of the survey study in detail, I will now present a brief summary and reach conclusions in the next section.

Table 5.37: What visitors to the Centre and the Canadian public do in their spare time.

People do in their spare time	PSTC, Madras %	The Canadian Public* %
Read	87	96
Watch TV	87	97
Visit friends	66	—
Go shopping	42	—
Go to the movies	39	67
Watch sporting events	23	69
Go to Drama or Concert	20	49
Others	49	—
N of sample (in number)	479	15,301

*Data from Dixon, Courtney and Bailey, 1974 (Table II-2; p 8).

Table 5.38: What the visitors to the Centre do in their spare time according to their gender and type of visit. What Canadians do in their spare time with respect to their gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

Activities	Gender (Madras) (O)			Gender (Canada)*			Type (✱)		
	Male	Female	Over all	Male	Female	Over all	First	Repeat	Over all
Go to the	117	71	188	5165	5162	10327	142	46	188
movies	62.2	37.8	39.2	50.0	50.0	67.5	75.5	24.5	39.2
Sporting	79	29	108	5773	4700	10473	83	25	108
events①	73.1	26.9	22.5	55.1	44.9	68.4	76.9	23.1	22.5
Go shopping	90	111	201	—	—	—	158	43	201
②	44.8	55.2	42.0				78.6	21.4	42.0
Read	235	180	415	7126	7397	14613	308	107	415
	56.6	43.4	86.6	49.4	50.6	95.5	74.2	25.8	86.6
Watch TV	229	184	413	7444	7474	14918	311	102	413
	55.4	44.6	86.2	49.9	50.1	97.5	75.3	24.7	86.2
Drama or	68	28	96	3494	3930	7575	66	30	96
concert③	70.8	29.2	20.0	47.1	52.9	48.5	68.8	31.3	20.0
Visit friends	187	126	313	—	—	—	239	74	313
	59.7	40.3	65.3				76.4	23.6	65.3
Others❶	142	92	234	—	—	—	166	68	234
	60.7	39.3	48.9				70.9	29.1	48.9
Column	273	206	479	7596	7705	15301	361	118	479
Total	57.0	43.0	100.0	49.6	50.4	100	75.4	24.6	100.0

*Counts were obtained from percentage data from Dixon, Courtney and Bailey, 1974 (Table II-7:p 18)

* All of the activities except going to the movies have a weak but statistically significant association with gender at the .05 level.

①: $X^2 = 14.846$; df = 1; $p < .001$; $\Phi = .176$; ❶: $X^2 = 4.825$; df = 1; $p = .028$; $\Phi = -.100$;

②: $X^2 = 21.091$; df = 1; $p < .001$; $\Phi = -.210$;

③: $X^2 = 9.382$; df = 1; $p = .002$; $\Phi = .140$

Table 5.39: What the visitors do in their spare time according to their age groups controlled for gender. Each cell contains a count and a percentage.

	Male					Female				
Activities	6-14	15-24	25-35	36-49	50+	6-14	15-24	25-35	36-49	50+
Go to movies[1]	14	53	29	17	4	16	31	18	5	1
(m1)	12.0	45.3	24.8	14.5	3.4	22.5	43.7	25.4	7.0	1.4
Sporting	13	31	15	16	4	3	12	7	6	1
events	16.5	39.2	19.0	20.3	5.1	10.3	41.4	24.1	20.7	3.4
Go shopping	14	21	27	25	3	16	46	33	13	3
(m2)	15.6	23.3	30.0	27.8	3.3	14.4	41.4	29.7	11.7	2.7
Read	26	88	60	48	13	28	70	55	23	4
	11.1	37.4	25.5	20.4	5.5	15.6	38.9	30.6	12.8	2.2
Watch TV	32	77	58	48	14	29	74	57	19	5
	14.0	33.6	25.3	21.0	6.1	15.8	40.2	31.0	10.3	2.7
Drama or	4	18	21	20	5	7	12	4	4	1
concert (m3)	5.9	26.5	30.9	29.4	7.4	25.0	42.9	14.3	14.3	3.6
Visit friends[2]	21	77	48	34	7	17	52	34	20	3
(m4)	11.2	41.2	25.7	18.2	3.7	13.5	41.3	27.0	15.9	2.4
Others[3]	24	52	26	30	10	22	26	24	15	5
(m5,f1)	16.9	36.6	18.3	21.1	7.0	23.9	28.3	26.1	16.3	5.4
Total	34	98	70	54	17	32	79	61	28	6
	12.5	35.9	25.6	19.8	6.2	15.5	38.3	29.6	13.6	2.9

For whole sample:- 1: X^2=14.954; df=4; p =.005; Φ=.177 2: X^2=11.502; df=4; p = .021; Φ=.155
3: X^2=22.740; df=4; p < .001; Φ=.218;
Amongst males (m) or females (f):- m1: X^2=10.586; df=4; p= .032; Φ=.197; f1: X^2= 17.154; df=4; p= .002; Φ=.289
m2: X^2= 14.083; df=4; p= .007; Φ=.227;
m3: X^2= 10.783; df=4; p= .029; Φ=.198;
m4: X^2= 11.971; df=4; p= .018; Φ=.209;
m5: X^2= 11.532; df=4; p= .021; Φ=.206;

Table 5.40: What the visitors to the Centre do in their spare time according to their place of residence, controlling for gender. Each cell contains a count (whole number) and a percentage (a single digit decimal).

	Male			Female		
Activities	Madras	Tamilnadu	Others	Madras	Tamilnadu	Others
Go to movies	65	8	44	51	1	19
(f1)	55.6	6.8	37.6	71.8	1.4	26.8
Sporting	46	3	30	15	3	11
events	58.2	3.8	38.0	51.7	10.3	37.9
Go shopping[1]	50	3	37	67	2	42
(f2)	55.6	3.3	41.1	60.4	1.8	37.8
Read (m1)	133	16	86	104	11	65
	56.6	6.8	36.6	57.8	6.1	36.1
Watch TV	131	14	84	105	11	68
	57.2	6.1	36.7	57.1	6.0	37.0
Drama or	38	3	27	16	1	11
concert	55.9	4.4	39.7	57.1	3.6	39.3
Visit friends	105	10	72	65	12	49
(f3)	56.1	5.3	38.5	51.6	9.5	38.9
Others[2] (f4)	74	6	62	56	1	35
	52.1	4.2	43.7	60.9	1.1	38.0
Total	150	16	107	118	14	74
	54.9	5.9	39.2	57.3	6.8	35.9

For whole sample:- 1: X^2 = 8.409; df = 2; p = .015; Φ = .133 2: X^2 = 9.458; df = 2; p = .009; Φ = .141;
Amongst males (m) or females (f):- m1: X^2 = 6.333; df = 2; p = .042; Φ = .152 f1: X^2 = 11.163; df = 2; p = .004; Φ = .233;
f2: X^2 = 9.478; df = 2; p = .009; Φ = .215;
f3: X^2 = 6.183; df = 2; p = .045; Φ = .173;
f4: X^2 = 8.555; df = 2; p = .014; Φ = .204;

SUMMARY AND CONCLUSIONS

The survey study attempted to find out who the visitors to the Periyar Science and Technology Centre in Madras are, how they plan to visit it in terms of time and ideas, how they hear about it, why they visit it, what they plan to do in Madras on the day of the visit and what they do in their spare time. All these processes of the museum visit and related activities significantly differ in terms of the visitors' type of visit, gender, age, group, place of residence and/or length of stay.

On the whole, word of mouth is found to be the primary source of information by which people come to know about the Centre. Schools also play a definite role in informing students about the Centre. Mostly, people visit the Centre to learn something and to see what is inside it. Six factors are found to reflect the reasons for the museum visit; they are learning, seeing, showing, having fun, seeing specific exhibits, and touring. Visitors generally plan to spend less than two hours at the Centre. The majority of the people visited only the Centre; others, however, planned to visit at least one other place in Madras on the day of the visit. People generally engage themselves in in-home activities during their spare time. Unless people have enough time, visiting museums will not get into their agenda. I will now present the individual differences due to gender, age, group, and vicinity.

Gender differences — Although some science museums are more frequented by males than females and some art museums are more frequented by females than males, some other science museums and natural history museums attract roughly equal proportions of men and women. In terms of the nature of the group, male visitors are more likely to visit the Centre on their own or with friends than females who are more likely to visit the Centre mostly with their families. In terms of ideas, males are more likely to visit the Centre in response to their own or their friend's idea than females who are more likely to visit in response to their family's, school's or other's idea. Also, males are more likely than females to make the decision to visit. As far as the reasons are concerned, male visitors are more likely to have a different set of reasons, namely 'to see special and specific exhibitions' and 'to show their friends' than female visitors, who are more likely to have reasons such as 'because they like the museum', 'on family outings', 'touring Madras', 'with school classes', and 'to bring their children'. In addition, females are more likely than males to visit the Centre for 'Seeing' and 'Having fun'. On the day of the visit, females are more likely to go shopping than males. During their spare time, males are more likely to watch sporting events and drama shows or concerts than females, who are more likely to go shopping.

Age differences —Young visitors are more likely than others to repeat their visit to the centre. In terms of the nature of the group, except for the late teens who are more likely to visit with friends or alone, all age groups are more likely to visit the museum in family groups. In terms of the place of residence, young, late-teen and older visitors are more likely to come from Madras, Tamilnadu and 'other' places respectively, suggesting a linear upward trend. In terms of idea, older people (above 25 years) more often make the decision to visit the Centre than young people do. In terms of reasons, males in their 6-14 years and females in their 15-24 and 50+ years are more likely than others to visit the museum for fun. Males in their 15-24 years are more likely than other males to visit the Centre to learn about science. Similarly, males of above 35 years and females of above 25 years are more likely than others to visit the Centre to bring children. In the same way, older visitors are more likely to come for 'Showing' and 'Seeing' than are young visitors. On the day of the visit, males of above 25 years are more likely than other males to go shopping. No significant age difference is found amongst females. During their spare time, males in their late teens are more likely to 'go to the movies' and 'visit friends' than others who are more likely to 'go shopping'.

Group differences —Family groups constitute almost half of the visiting population to the Centre. Insofar as the reasons are concerned, males on their own are more likely to visit the Centre 'to learn how things work' than other are males; male visitors with their families are more likely to visit the Centre 'to bring their children' than are other males. Families are more likely to come to the centre for 'Seeing', 'Having fun' and 'Showing' than are other groups; school classes are more likely than other groups to come on 'Tour'. On the day of the visit, people who visited the Centre alone, with friends, or with 'others' are likely to visit only the Centre than other groups. People with their families or school classes are also more likely than the rest of the groups to go sight-seeing. School classes are more likely than the rest of the groups to visit the zoo.

Vicinity influences — In terms of ideas, people from 'other' places are more likely than people from Madras and Tamilnadu to visit the Centre at their family's or others' suggestion. People from Tamilnadu are more likely than people from Madras and from 'other' places to visit the Centre at their own or their friend's suggestion. People from Madras are more likely than people from Tamilnadu and from 'other' places to visit the Centre at their own suggestion or their school's. In terms of reasons, male Madras residents are more likely to visit the Centre for learning-related reasons namely 'learn how things work' and 'to see specific exhibitions' than are other males; female visitors from 'other' places are more likely to have fun-related reasons namely 'for fun', 'on family outings', and 'touring Madras' than are other females. While male visitors from Tamilnadu align more closely with Madras males, female visitors from Tamilnadu align more closely with female visitors from 'other' places. In addition, visitors from 'other' places are more likely than those from Madras and Tamilnadu to come for 'Seeing'; visitors from Madras are more likely than people from 'other' places to come for 'Showing'; and visitors from Tamilnadu are more likely than people from 'other' places to come for 'Having fun', and 'Seeing specific exhibits'.

In regard to the length of stay, Madras residents are more likely to stay for more than 2 hours; Tamilnadu visitors are more likely to stay for more than an hour; and visitors from 'other' places are more likely to stay for less than an hour. On the day of the visit, Madras residents, both females and males, are more likely to visit only the Centre than others who are more likely to go shopping and to visit the zoo. Females from Tamilnadu and 'other' places are more likely to go shopping on the day of the visit than Madras females. During their spare time, Madras females are more likely to go to the movies and go shopping than other females; females from Tamilnadu are more likely to 'visit friends' than other females. Also, males from Madras and Tamilnadu are more likely to 'read' during their spare time than males from 'other' places.

In conclusion, these individual differences of museum visitors have considerable effects on how and why they visit the museum. Each museum visitor is influenced at a physiological level by their gender and age differences, at a sociological level by their group differences and at an environmental level by the vicinity and other influences simultaneously, as suggested in the 'weave' approach (Chapter IV). These influences shape the pattern of the museum visit and the nature of museum learning. It is therefore essential for a museum to meet the needs of its visitors and to make the visit a memorable one by providing more varied and disparate opportunities.

When compared with American, British and Canadian studies, the present study has some similarities and some differences. However, I will highlight some similar aspects which will allow me to draw some generalisations into the Indian situation.

First, Indian visitors plan to spend approximately two hours at a museum, as do their western counterparts ~~do~~. This result suggests a need to have an effective orientation programme as many western museums have. Unless they know holistically what facilities are there to see and plan their tour according to their taste and preference, visitors will tend to waste much of their time in locating and searching for exhibits. Therefore effective orientation materials such as the museum lay-out flyers, and 'what is on' leaflets need to be made available to visitors because a substantial number of people are planning to stay only for less than one hour and the vast majority up to two hours only.

Second, the six factors reflecting the reasons for the museum visit suggest that people visit museums not just for learning but also for five other factors. In particular, Indian female and tourist visitors will benefit from having a museum shop and a restaurant as they are more likely to go shopping and to go to restaurants on the day of the visit than other visitors. Given the spread and variation in the reasons for visiting museums, the museum experience not only includes what is learnt but also incorporates fun, what is bought, and many other so called peripheral activities. Also in many western museums, a successful museum experience on offer is defined as the one that provides a pleasurable and satisfying experience with a meal at the restaurant and a souvenir from the museum shop in addition to some intellectual understanding. How can this be achieved if the museum does not have a museum shop or a restaurant? This is the situation in almost all Indian science museums. So providing facilities such as these would help to accommodate particularly female, old-age and tourist visitors and encourage people stay longer thereby increasing the likelihood of making the experience successful.

Third, as I have shown earlier, some western museums have successfully narrowed the gender gap in visiting the science museum by creating exhibitions on human, natural and psychological sciences. Indian science museums should follow this path to set up natural science exhibitions and create scientific programmes using art media such as drama and puppet shows. The gender gap can thus be narrowed as the arts and natural sciences are of more interest to female visitors.

In a multi-cultural and postmodern society, the individual differences should have to be taken into account so that every one feels inclusive and empowered. This is particularly true in India because of its vastness and diversity of culture and languages. How these could be achieved particularly for females, young and old visitors, tourists and others is a topic covered in Chapter VIII. To do that it is necessary to understand the nature of the museum visit and learning, in terms of what the visitors actually do inside the science centre. An observational study was therefore designed to record the behaviour which occurred and the time spent in front of exhibits, to which I will turn in the next chapter.

CHAPTER VI

BEHAVIOUR AND TIME DURING THE MUSEUM VISIT: RESULTS OF AN OBSERVATIONAL STUDY

INTRODUCTION

In Chapter V, I presented the nature of the museum visit in terms of what the visitors to the Centre reported in the survey study. In order to further this understanding, an observational study was planned to track the visitors during their whole-visit. Observational work is considered to offer a more direct approach to the evaluation of exhibit effectiveness than pre- and post-test questions, which can be appropriate in a formal educational setting (Miles and Tout, 1979; 218).

Observation is the earliest method used in a museum setting for research and evaluation purposes. This method was practised and popularised by the two Yale psychologists, Edward S. Robinson and his student Arthur W. Melton (Robinson, 1928; and Melton, 1935 and 1972). Since then many observational studies have been conducted in museums (for example, Diamond, 1986; and Hilke and Balling, 1984). Understanding the nature of an informal learning setting is a hard task because when they come to know that they are being observed people are often found to change their behaviours. Alt (1980) found that people were so much sensitised that they always displayed good behaviours. So, it is almost difficult to observe *obtrusively* what is really going on in an informal setting without disturbing the very nature of its informality.

To retain the informal nature of the museum visit, it is essential to observe people *unobtrusively*. Having found that people learnt more from a museum exhibit when they displayed an increased frequency of engaging behaviours coupled with an increased length of time, Falk (1983) proved that behaviour and time are the reliable predictors of learning using a stepwise regression analysis. In the present research, in order to understand the nature of museum learning and the nature of the museum visit, visitors were therefore observed to capture on an exploratory level what they actually did and how long they spent during the museum visit. The observation thus generated two kinds of data: the behaviours which occurred and the time spent in front of the exhibits. In this chapter, I will present the methods adopted to conduct the observation, the kinds of data collected and finally the results of the analysis of these data.

METHOD OF OBSERVATION: SETTING, NATURE OF OBSERVATION, ROLE OF OBSERVER, AND SUBJECTS

People in any setting can be observed in many ways. The setting in museums, for example, can be an exhibit, exhibition, or a whole museum. The 'people' can refer to an individual museum visitor or a group. The nature of the observation can have a closed-structure or an open-structure. In closed-structure observation, pre-planned categories are check-listed as they occur. On the other hand, in open-structured observation, the behaviours of the observee are noted as they happen and are coded later on for analysis. There are advantages and disadvantages in both methods. The role of the observer can also vary. If the observer is a participant, the observation can be a participant observation; if the observer is not a participant, it can then be called a non-participant observation. In what follows, I will discuss the setting, the nature of the observation, the role of the observer, and the subjects in this research.

Setting

An observational setting can be anything. It can be a community, a classroom or an institution. In museums, an exhibit, an exhibition or a whole museum can be treated as a setting. If the purpose is to compare the effectiveness of different type of exhibits or exhibitions, the setting can be chosen accordingly. If the purpose is to explore holistically what is happening inside a museum, the setting would be the whole museum rather than its parts. This would obviously increase the reality of the true picture. As this research intended to explore what museum visitors do, the whole museum was treated as a setting; it was therefore decided that observation would be conducted for the entire museum visit rather than in a selected exhibition.

The setting is the Periyar Science and Technology Centre (hereinafter referred to as the Centre), a well-known science centre in Madras under the aegis of the Ministry of Education, Government of Tamilnadu. The Centre is situated in an area of 21 acres in the heart of Madras. Madras, the capital of Tamilnadu, has been the centre of learning for many centuries. It has many leading educational institutions and industries. To popularise science and technology to people in all walks of life, the Government set up a network of science centres, called the Tamilnadu Science and Technology Centres (TNSTC). The Centre is a member of the network. Some of the other members are planned in cities like Trichi, Madurai, Salem, and Coimbatore. The Centre at the time of the observation consisted of five exhibitions: the Periyar's, the Transport, the Children's, the Electronics and Communication, and the Physical

Science galleries. Each gallery occupies an exhibition area of 2000 sq. ft. approximately (see Figure 6.4 for the lay-out of exhibits in each case).

The first gallery after entering the main door of the Centre, is the Periyar Gallery, which consists of about ten wall mounted portraits and writings of Periyar's teachings. The term *Periyar* literally means 'Big Man' and figuratively stands for a statesman. Periyar is a title conferred on E.V. Ramasamy, a great politician and statesman of Tamilnadu, in recognition of his involvement in the rational movement of southern India. As science is basically a rational thinking, the Centre is named after him.

At the exit of the Periyar Gallery, a visitor can continue further on the same level or can climb the stairs to reach the first floor level. The Children's Gallery is on the first floor whereas all the other galleries are on the ground floor.

The Children's Gallery comprises about 60 interactive exhibits on basic science (mainly physical and mathematical) and technology. The list of exhibits and floor plan of this gallery is in Appendix E.

The Transport Gallery depicts a historical development of land, rail, air and water transport using about 60 working models, real-life engines, and dioramas (see Appendix E for a list of exhibits).

The Electronics and Communication Gallery consists of about fifty exhibits on telegraphy, telephony, facsimile, wireless, and satellite communications. Most the exhibits in this gallery are interactive and working types (see Appendix E).

The Physical Science Gallery consists of about 60 exhibits on the physical principles of time, sound, magnetism, light and dynamics, and the physical properties of liquids and gases (see Appendix E).

Besides these five galleries where visitors were observed for behaviour and time, the Centre also has a Birla Planetarium and a Science Park. The Centre however does not have a cafe or a museum shop, but it only has a snack kiosk just outside the building.

Nature of Observation

Observation can be open-ended or pre-planned. In pre-planned observation, behavioural categories are thought out and coded beforehand. Usually, a check-list is prepared to tick as and when the behaviour occurs. The pre-planned observation is more useful in hypothesis testing research. In open-ended observation, on the other hand, the behaviours are noted down in the form of narrative or short-hand as they occur. These behaviour narratives can be coded later into categories. The open-ended observation has more advantages as there are always opportunities to expand on what actually happens. Therefore, this method is more suitable if the research is of an exploratory nature. Research studies in Indian museums are rare. This can be gauged by the abundance of specualtive articles in the only professional museum journal, Indian Museum Journal, irregularly published by the Museum Association of India. As the research question was to find out holistically what is going on during the museum visit, this present research adopted an open-ended observation method.

Role of Observer

In an observational study, an observer can strictly avoid or show indifference to influencing the behaviour of the observees. If this is the intention, then the observer undertakes observation without the knowledge of the observees. In this case the observation is said to be unobtrusive. On the other hand, if the observation purely attempts to study the interactions, irrespective of whether or not they are influenced, then the observer can take note of the behaviours of the observees with their knowledge. In this case, the observation is said to be obtrusive. In museum studies, Diamond's (1986) study is an obtrusive observation; Hilke's (1984) study is an unobtrusive observation.

Also, an observer in an observational study plays crucial and different roles to observe different things. If the observer participates in the observation as a researcher or a non-researcher, the observation is said to be participant. If the observer, on the other hand, does not participate in the observation but only observes the situation, then the study is said to be non-participant. Combining the researcher's role and the extent of influence, there emerge three types of observation: unobtrusive participant, obtrusive participant, and unobtrusive non-participant observation.

An observation is called unobtrusive participant observation when the researcher participates in the setting only in a non-researcher role and conducts research without the knowledge of the observees. To illustrate this point with an example, a teacher in a classroom or an explainer in a science centre participates in the setting in a teaching or explaining role and makes observation and records them without letting the observees know his or her research intention. This is therefore an unobtrusive participant observation. An unobtrusive participant observation, although teachers may find it easy to conduct in classroom settings, is really difficult to conduct in museums as reflected by the virtual non-existence of the museum observation studies in this category.

On the other hand, if the observer plays a non-researcher role or a researcher role and the observees know of the researcher's intention, then the observation becomes obtrusive participant observation. In museum studies, Diamond's (1986) study falls in this category.

In case the observer plays no role in the observational setting and undertakes observation without the knowledge of the observees, then the observation becomes unobtrusive non-participant observation. In museum studies, Hilke's (1984) study falls in this category.

Non-participant observation, unlike participant observation, will always be unobtrusive. It can never be obtrusive. In other words, the researcher being unobtrusive can still be a participant or a non-participant; but the researcher being obtrusive is always a participant. Therefore, obtrusive non-participant observation will not exist.

In the present study, the role of observer was restricted to be an unobtrusive non-participant so as not to influence the visitors' behaviours in any way. Visitors were therefore observed without their knowledge. In order to maintain the observation as unobtrusive as possible, the conversations between the members of the groups were not recorded and only their behaviours were noted.

Subjects

In observational studies, behaviours can be observed in two different ways as far as the subjects are concerned. If the behaviours of one individual in a group are observed, it can be called individual observation; or if the behaviours of all members in a group are observed, it can be called group observation. From my experience during the pilot study at Snibston Discovery Park in Coalville, it was only possible to be systematic and thorough while doing individual observation, not group observation. Obviously, it was impossible to note every behaviour of every member of a group as they might at some time move toward different exhibits, especially when the observation was unobtrusive. However, group observation is plausible if the observation is done obtrusively on pre-planned categories, as done by Diamond (1986).

As set out in Chapter II, the research question for this thesis is to investigate the nature of museum learning, the museum visitor and the museum visit. To partially answer the research question, the present observation was planned to capture a real, complete and whole picture of the museum visit, which will in turn explicate the holistic nature of museum learning. To maintain the true nature of the museum visit: first, the observation must not influence the observees in any ways; second, it must be exploratory rather than pre-meditated; and third, it must be systematic. For these three reasons, subjects were therefore observed unobtrusive, open-ended, and on an individual basis.

Twenty seven visitors to the Centre were tracked from the moment they entered until they left the Centre. The observation was conducted between May 1993 and September 1993. A typical visit lasted from one hour up to four hours. The numbers and percentages of the observees are shown in Table 6.1.

Table 6.1: Number and percentage of the subjects in the observational study according to their categories.

Category	Sub-categories	Number	Percentage
Gender	Male	14	51.9
	Female	13	48.1
	Total	27	100
Nature of the group	Alone or singleton	0	0.0
	With one or two-person group	7	25.9
	With two or three-person group	4	14.8
	With three or four-person group	4	14.8
	With more or many-person group	12	44.4
	Total	27	100
Age	6-14 years	6	22.2
	15-24 years	6	22.2
	25-34 years	10	37.0
	35-49 years	5	18.5
	50+ years	0	0.0
	Total	27	100

DATA COLLECTION AND CODING PROCEDURE OF BEHAVIOURS

As planned the visitors to the Periyar Science and Technology Centre at Madras were tracked to collect two kinds of data. The times spent by the visitors in front of exhibits, in exhibition galleries, and inside the whole science centre and the behaviours occurred in front of individual exhibits were recorded.

The time data were noted in seconds for every exhibit at which the observee stopped. The start and finish times of the observation (and therefore the visit) were also noted. As the entry and exit times for each gallery were not noted, the time spent in the exhibition galleries were computed by adding the time spent in individual exhibits in that gallery. The time spent inside the whole Centre would include the time spent moving between exhibits and between exhibitions, but the time spent inside the galleries would not include the time spent between exhibits. This approach to measure the time spent inside the exhibition is more correct because it can discriminate a good gallery that engages visitors purposefully from a bad gallery that confuses visitors and wastes their time. Melton (1935) also suggests that the time spent in the gallery should exclude the time wasted; otherwise, a most confusing gallery will engage a visitor for longer time.

To guide the researcher in collecting the behaviour data, a list of behaviours that could possibly happen during a science centre visit was prepared from published research evidence. The list included look at, manipulate, read, show, ask for information, tell someone to do something, interpret (e.g. rewording a label) or explain, watch, follow, listen, initiate, help others, take notes, control others, and read aloud.

A typical observation narrative is shown in Figure 6.1. After having coded the behaviours, many different and appropriate analyses were conducted on the data. In what follows, I will present the results of the analyses of the behaviour data and the time data.

RESULTS OF THE ANALYSIS OF BEHAVIOUR DATA

The frequencies and percentages of visitors' behaviours inside the whole Centre are shown in Table 6.2 and are graphically illustrated in Figure 6.2.

It was found that *manipulate* and *look* were the two dominant behaviours and constitutes 48% of all the behaviours observed. This result suggests that almost half of the total behaviours observed are relating to exhibits and these behaviours suggest that visitors want to understand the exhibits by touching and looking at them. The next two behaviours are *reading* and *watching* how others behave. These all support the idea that visitors constantly try to make sense out of the exhibitions using their senses for example, touching, seeing and hearing and by watching others. These results support Hilke's observations and findings that once inside the museum visitors display learning and exhibits-related behaviours for most of the time (Hilke, 1984).

Visitors to the Centre were not found to use their taste and smell behaviours as there were no opportunities inside the Centre. Similarly, other behaviours were observed that were not solely information-searching or leaning-related. These behaviours are: help others, control others, and so on.

In sum, visitors to the Centre displayed about sixteen behaviours. These behaviours were mostly learning-related or information-driven, but some of them were also social in nature.

Figure 6.1: A typical observation narrative is shown below. How they are coded is shown within brackets. Each exhibit in every gallery is serially numbered and noted at the beginning of each entry. Time in front of each exhibit is noted at the end of each entry.

Tracking study #: 05 Time:3:08 PM to 4.57 PM Date: 27.08.93

Visitor's Profile: Alone With one person With Two With three With more✓

Age: 6-14 years 15-24 years✓ 25-34 years 35-49 years 50+ yearsSex: Male Female✓

Periyar Gallery

Looking around (ID-001; look -1) 1m 03.23 s

Children's Gallery

6 Joining others; penetrating the crowd; watching; hold the receiver and press the button (ID- 106; watch-1; follow-1; manipulate-1; look-1; the rest of the behaviours are coded 0) 1m18.62s

7 Look at; lifting the blue panel; going to 8 (ID-107; look-1; manipulate-1; the rest of the behaviours are coded 0) 0m30.93s

21 Look at the blocks (ID-121; look-1; the rest of the behaviours are coded 0) 0m16.32s

57 Look at the ball moving; approach the exhibit; show to teacher; ask the teacher to demonstrate; approached the exhibit; rotate the handle; released the ball; shouts 'iyaho! super!'; moves around to see the movement of the ball (ID-157; look-1; manipulate-1; show-1; ask-1; the rest of the behaviours are coded 0) 1m28.24s

26 Pumps; pumps and points to some one (ID-126; manipulate-1; show-1; the rest of the behaviours are coded 0) 1m28.24s

22 Lift some grains; look around; look at exhibit; look at exhibit 57; move to 57 (ID-122; manipulate-1; the rest of the behaviours are coded 0) 0m 41.82s

57 Calls a friend to show the ball; look at (ID-157; look-1; show-1; the rest of the behaviours are coded 0) 1m49.69s

22 Lift some paddies and put them in another place; rotate the pulley (ID-122; manipulate-1; the rest of the behaviours are coded 0) 1m38.57s

57 Rotate the wheel to lift the ball; sister (nun) helps the subject rotate; sister explains; the subject is not interested; look at (ID-157; listen-1; manipulate-1; look-1; the rest of the behaviours are coded 0) 2m14.04s

Table 6.2: Frequency and percentage of the behaviours of visitors to the Periyar Science and Technology Centre, Madras.

Behaviours	Frequency	Percentage
Manipulate	1294	27
Look	1044	21
Read	593	12
Watch	524	11
Follow	293	6
Listen	211	4
Non-exhibit	205	4
Tell others	163	3
Explain to others	147	3
Show others	117	2
Initiate	70	1
Ask others	66	1
Help others	53	1
Read aloud	44	<1
Note taking	24	<1
Control others	20	<1
Taste	0	0

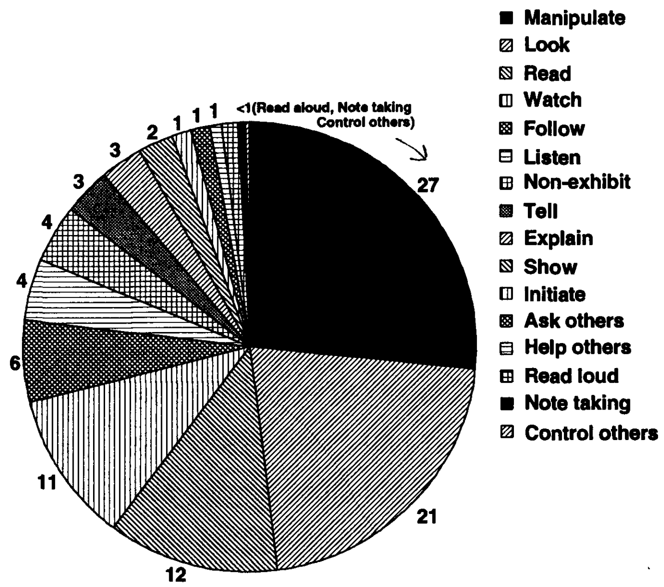

Figure 6.2: Percentages of the occurrences of the observed behaviours of the visitors to the Periyar Science and Technology Centre, Madras.

Factor Analysis - Learning, Teaching, and Care-taking

By carefully looking at the data, the behaviours observed with visitors were of a wide range. They are, for example, information-driven, learning-related, exhibit related, exhibit-unrelated, and social. Although most of the behaviours such as *manipulate*, and *look* are found to be learning-related, behaviours such as *controlling others*, *telling others* are observed mainly to control the situation and they are therefore exhibit-unrelated. Some behaviours such as *help*ing friends or family members, are found to be social in nature. It is therefore inevitable to ask if these sixteen behaviours may be reduced to a few useful dimensions. To find out objectively how many dimensions or factors may account for the occurrence of these sixteen behaviours, a factor analysis was considered to be an ideal technique.

A data set was therefore prepared by aggregating the visitors' scores on each of the sixteen behaviours. From this data set, a correlation matrix was constructed. A careful and thorough study of the correlation matrix revealed that note-taking did not correlate significantly with any other behaviours. In such a situation, scholars suggest that such uncorrelated variables should be omitted from the factor analysis. In general, if the variables do not correlate at all, the number of variables will be the number of factors. Only if correlation exists amongst variables, can factors be expected to be fewer than the number of variables. By acceding to the informed and authoritative opinion, the variable, note-taking was omitted and a new correlation matrix was created and inputted to the factor analysis. A principal components method with varimax rotation extracted three factors. The factors and their loading with individual variables are presented in Table 6.3.

I prefer to call these three factors Learning, Teaching and Care-Taking. *Listen*, *watch*, *look*, *follow*, *manipulate* and *read* are the variables that load heavily to the factor Learning. *Explain*, *read aloud*, *show*, *read* and *manipulate* constitute the factor Teaching. *Help others*, *tell others*, *control others*, *non-exhibit*, and *initiate* are the variables that load heavily to the third factor, Care-Taking. Clearly, the loading of the behavioural variables indicates the nature of the factor. Basically, it appears that people on the whole exhibit behaviours that relate to learning, teaching or care-taking. This indicates that some people come for learning, others come for teaching, and some are there for care-taking purposes. Although there may be some overlap in the roles played by parents and children, or teachers and students, a typical situation might suggest that a child might be a learner, a parent might be a teacher, and another parent or some elder in the family group or a teacher in the school group might play a care-taking role. The first factor, Learning, accounts for 38% of the variance; the second factor,

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sl ?

Teaching, accounts for 13% of the variance; the third factor, care-taking, accounts for 9% of the variance; and all three together account for 60% of the variance.

Table 6.3: Factor loadings of learning-related behaviours extracted by a factor analysis (principal components method with varimax rotation). Loadings less than |0.4| were omitted (N=27).

		Factors	
Behaviours	**Learning**	**Teaching**	**Care-Taking**
Listen	.79627		
Watch	.77417		
Look	.74909		
Follow	.66973		
Manipulate	.65180	.43528	
Read	.56118	.53860	
Explain		.83989	
Read aloud		.75795	
Show		.71742	
Ask others		.55285	
Help others			.74421
Tell others			.70641
Control others			.66706
Non-exhibit	.46654		.58027
Initiate			.42491
Variance %	38.7	12.5	9
Cumulative %	38.7	51.2	60.2

In conclusion, the fifteen behaviours observed with visitors to the Centre can fall into three dimensions: Learning, Teaching, or Care-Taking. Visitors to the Centre, in short, mainly play one of the three roles during the whole museum visit or they change dynamically their role during the visit. For instance, a visitor might be a learner in one exhibition; he or she may become a teacher in another exhibition; or he or she may be care-taking in the third exhibition. Being the first factor, learning is the dominant dimension inside the museum visit. Although care-taking behaviours are less frequent, they are nonetheless important because they indirectly help increase the frequency of the learning or teaching behaviours.

Having seen the overall picture of the behaviours, it is always interesting to ask who can play a learner role, a teacher role or a care-taker role. What individual characteristics of visitors if at all influence the roles? To answer these questions, the behaviour scores and the factor scores are subjected to t-tests in the case of gender, and to ANOVAs in the cases of age, the nature of the group, and the type of exhibition. I will present the result of these analyses in the following section.

Impact of Gender, Age, Group and other variables on the Behaviours

Gender Differences

The scores for each of the sixteen behaviours for the 27 visitors are subjected to t-Tests with respect to gender. There exist no significant differences between males and females in any behaviours except the behaviour *manipulate*. The result thus shows that male visitors are more likely to manipulate exhibits than female visitors ($t = 2.82$; $p = 0.010$). In the 'aMAZEing Science' exhibition at the Bishop Museum of Honolulu, Greenfield (1995) also found that more boys than girls were interacting with the science museum exhibits. Although adult female visitors, when in adult groups, tend to explore exhibits actively, when in adult-children groups, the females tend to display submissive care-taking behaviours (McManus 1987). In Indian families, there are strong emphases, and social expectations of, nurturing role of women. This might be the reason for the overall low performance of females in manipulating exhibits.

Age Differences

A one-way analysis of variance with post hoc Scheffe reveals a significant difference between different age groups with respect to the behaviour *asking* ($F= 3.220$; $p = 0.0415$). All other behaviours are equally likely to occur irrespective of the visitors' age. A post hoc Scheffe test[1] finds that amongst the five age groups, visitors in their young age (6-15 years) are more likely to elicit information regarding the exhibit-related topics than visitors in their late teens (16-25 years). This might support a view that people of a young age are curious and uninhibited to ask questions more openly than when they grow up. The older people, however, strike a middle ground as they do not significantly differ from both visitors in their young age and in their late teens.

Group Differences

Out of the sixteen behaviours, three behaviours were found to differ significantly with respect to the nature of the group. The behaviours were *watch*, *read*, and *look*. The nature of the group consisted of five categories: 1) alone, 2) with one person or two-person group, 3) with two persons or three-person group, 4) with three persons or

[1]All Scheffe tests were conducted at the 0.05 significant level in this study. A Scheffe test tells us whether or not the difference between means of any two groups is significant. It is one of the many tests available in the ANOVA procedure of the SPSS for Windows.

four-person group, and 5) with more than three persons or many-person group. None of the subjects in this study came alone.

Watch: The three-person group was least likely to exhibit the watch behaviours followed by the many-person group, the four-person group, and finally the two-person group ($F = 3.9545$; $p = 0.027$). A post hoc Scheffe test reveals that visitors in the four-person group are more likely to watch than visitors in the many-person group.

Read: The many-person group was least likely to read labels followed by the three-person group, the two-person group, and finally the four-person group ($F = 3.7238$; $p = 0.0218$). A post hoc Scheffe test suggests that the four-person group is more likely to read labels than the many-person group.

Look: The three-person group was least likely to look at exhibits followed by the many-person group, the four-person group, and the two-person group ($F = 3.7238$; $p = 0.0256$). A post hoc Scheffe test finds that the two-person group is more likely to look at exhibits than the many-person group.

In sum, though most of the behaviours do not differ significantly with respect to the nature of the group, some of them do. They are, watch, read and look. The four-person group is found to be dominant in all three behaviours whereas the three-person group is least likely to display these behaviours. As Falk (1983) proved that behaviour and time are the indicators of learning, this result of the present study suggests an important point. For visiting museums, the group should ideally consist of four persons, or to some extent, two persons. The three-person group and many-person group are the least effective group for visiting museums. A further analysis will help understand this situation.

The three-person group may possibly have four combinations: two adults and one child; one adult and two children; three adults; or three children. The possibilities for the first two combinations are more likely than the last two. In all combinations, one person is always dynamically left alone when the other two form a dyad and interact. This person can be any one, sometimes a father, mother, child or anybody else. The result is therefore the limited occurrence of the behaviours of any person you choose to observe. There seems to be a truth in the age old saying 'three don't go together'. It might apply for the museum visit too. In the many-person group, there exist opportunities to leave a person alone or in a group larger than two people. This again accounts for the low occurrence of the behaviours. So, people in pairs learn more effectively in museums.

Exhibition Types

As the visitors were observed in five different galleries of the Centre, it was interesting to ask whether or not there existed significant differences in the display of visitors' behaviours in the different galleries. As the Periyar Gallery mostly failed to retain visitors even for a small amount of time, it would not be appropriate to include the gallery in the analysis, as a difference would definitely be there. It was therefore decided to omit the Periyar Gallery, for the time-being, from the analysis and continue with the rest of the four galleries to capture the differences of visitors' behaviours between any two of these four galleries. Nine out of sixteen behaviours were found to differ significantly with respect to exhibition types (see Table 6.4).

Table 6.4: The F statistics and p-values from the Analysis of Variance of the behaviours.

Behaviours	**F**	**df**	**p**
Watch	7.332	3	<0.001
Show	5.370	3	0.002
Read	4.260	3	0.007
Non-exhibits	10.284	3	<0.001
Look	4.092	3	0.009
Listen	10.287	3	<0.001
Help others	6.017	3	<0.001
Follow	3.200	3	0.026
Asking	6.381	3	0.001

Scheffe tests were conducted post hoc to find out significant sub groups among the four galleries. It emerged that the Children's Gallery was found popular amongst visitors as they were more likely to watch, show, read, look, listen, help others, follow others, ask others about exhibits, and do something not related to the exhibits in this gallery than in any of the other three galleries. In sum, the five galleries of the Centre can be divided into three subgroups: Periyar Gallery in the lower end, Children's Gallery in the upper end, and the other three galleries in the middle.

Besides these nine behaviours, five more behaviours namely read aloud, manipulate, initiate, explain, and control others were found to significantly differ when the Periyar Gallery was later included in the analysis. The only behaviour that did not significantly differ among all five galleries was note-taking. This result might suggest that if a person wanted to take note he or she would continue to do that in all galleries regardless of their nature. Or it might be that they did not prefer to take note for a significantly more time in a particular gallery than other galleries as the visitors possibly wanted some basic information about all galleries. From the current data only, conclusive interpretations are not possible.

Impact of Gender, the Type of Exhibition, Age and the Nature of the Group on the Factors

As we have already seen, there emerged three factors out of the fifteen behaviours observed during the tracking study. The factor scores were saved and subjected to a t-test for gender differences, and to ANOVAs for differences due to exhibit types, age and the nature of the group.

Gender difference: Male and female visitors are equally likely to display learning-related behaviours and care-taking behaviours. However, men are more likely to display teaching behaviours than women ($t = 2.24$; $p = 0.027$). This behaviour of men assuming a didactic teaching role was also found in studies conducted by McManus (1987), Lakota (1975) and Koran et al. (1988).

Differences due to exhibition types: When Periyar Gallery is included in the analysis all three factors are found to have an overall significant F value. However, amongst four galleries, only the learning factor is found to differ significantly with respect to exhibition type ($F = 6.0247$; $p = .008$). A Scheffe test suggests that learning occurred more in the Children's Gallery than in the other three galleries namely, Transport Gallery, Electronics and Communication Gallery, and Physical Science Gallery.

Age differences: none of the factors is found to vary significantly with respect to the age of the visitors. This might suggest that both parents and children, adults and children learn, teach, and care-take each other.

Group differences: The factor learning is found to vary significantly with respect to the nature of the group ($F = 3.227$; $p = 0.025$). Although there exist an overall significant variance, a Scheffe test failed to suggest a difference between any two groups.

In sum, the factors Learning, Teaching and Care-Taking do not differ with respect to age and the nature of the group of the visitors. However, men are more likely than women to assume a teaching role inside the museum exhibition. Amongst the five galleries of the Centre, the Children's Gallery is found to solicit more learning-related behaviours from visitors than other galleries. If an exhibition is designed so that it allows visitors to see all the exhibits at the entry point, the exhibition can be called a bird's-eye-view exhibition. If an exhibition is designed so that visitors can see only some of the exhibits as many of them are hidden behind the partition wall, the exhibition is then called a tunnel-view exhibition. While Children's Gallery follows the bird's-eye-view design, the other galleries follow the tunnel-view design. The success of the Children's Gallery can be explained in the light of Falk (1993) findings that bird's-eye-view galleries are more successful than tunnel-view galleries.

ANALYSES OF TIME-RELATED DATA AND THEIR RESULTS:

As mentioned earlier, the time spent by visitors in front of the exhibits and in the whole science centre were recorded in this observational study. However, the time spent inside the galleries were later computed by adding the time spent in the individual exhibits of each gallery. This is a more efficient way of calculating the time spent in galleries as it does not include time wasted between exhibits or in other social or trivial engagements. This measure can naturally determine which exhibition is more effective in terms of time spent in it.

As the sample in the observation study is only 27 visitors, another study, called the Time-Visit study, was planned to measure only the time spent inside the whole science centre, for a larger sample of visitors. Almost every group that entered the Centre participated in the Time-Visit study. One visitor in a group was selected and handed over the slip with a request to fill in the best three exhibits of the Centre and to return it at the time of leaving or going out of the Centre. While handing over the slip the time was noted in the 'entry time' column against the unique code number, which is pre-printed on the slip and the form (see Appendix D for the specimen of the slip and the form). At the time of returning the slip, the time was again noted on the 'leaving time' column against the same code number on the slip. The difference between the entry time and the leaving time was computed to find out the time spent inside the Centre, for 394 visitors. In this way the total time was indirectly measured. Out of the 1000 slips distributed, only 394 slips were returned. The average time in this case was 91 minutes (see Table 6.5), which was almost the same as the one obtained during the observational study (i.e. 93 minutes). This result gives an indirect validity to the smaller sample observational study.

From the results of the observation study, the average time spent by visitors inside the whole museum is found to be 93 minutes, as shown in Table 6.5. The time spent by the visitors in each of the five galleries of the Periyar Science and Technology Centre, Madras, was computed and is shown in Table 6.6. As can be seen, the

Children's Gallery was visited for the longest time followed by the Electronics and Communications Gallery, Physical Science Gallery, Transport Gallery, and finally the Periyar Gallery.

Table 6.5: The total time spent inside the science centre at Madras from two different studies with different sample sizes.

Name of the Study	Mean time	Standard Deviation	Minimum	Maximum	N (in number)
		in minutes			
Time-Visit study	91	42	15	256	394
The Observation	93	44	29	207	27

Table 6.6: Time spent by the visitors in front of the exhibits in each of the five galleries of the Periyar Science and Technology Centre, Madras.

NAME OF GALLERY	Mean Time	Std. deviation	Minimum	Maximum
		in seconds;	N=27	
Periyar Gallery	**30**	**63**	**0**	**297**
Transport Gallery	**703**	**564**	**89**	**2048**
Physical Science Gallery	**742**	**649**	**0**	**2643**
Electronics Gallery	**756**	**521**	**0**	**2233**
Children's Gallery	**1601**	**1055**	**0**	**4454**

There is another interesting fact that, as revealed in Table 6.5, the minimum time in the case of the Transport Gallery was 89.44 seconds, whereas in all other galleries it was zero. This means that all of the 27 visitors tracked visited the Transport Gallery regardless of the time they spent inside it. However, not all visitors went to the other galleries. This may be due to the strategically important location of the Transport Gallery because every visitor has pass through it to go to the other galleries. But in spite of its strategic location, the Transport Gallery lags behind in the average time when compared to the other galleries, such as the Electronics and Communication, and Physical Science galleries.

A brief literature review of attracting and holding powers

The time data from observing 27 visitors interacting with about 250 exhibits of the Centre are arranged in a matrix form for analysis. This kind of raw data is totalled in different ways in different studies to reach reasonable measures such as attraction, spread, holding and arrestment, which will shed light on the state of the exhibits and the exhibitions (Melton, 1935; Bechtel, 1967; Lakota, 1975; Shettel et al, 1968). As attraction and holding are agreed to be the best general measures (Shettel, 1976; Screven, 1976; and Miles and Tout, 1979), I will explore these two parameters further.

Screven (1986), Koran and Koran (1985), and Wolf (1985) also suggested that attracting and holding powers are important variables in understanding the museum visit in general and museum learning in particular.

Attracting and holding powers are defined in many ways by many authors. In order to paint a thorough picture of what is going on in this area, we need to look at the interaction between visitors and exhibits in the form of a matrix as shown in Figure 6.3. Suppose there are n visitors and m exhibits, each being identified by subscripts i and j respectively, the time spent by visitor i in front of exhibit j will be t_{ij}. As it is possible that each visitor may omit some exhibits, the time spent in those omitted exhibits will be zero. Let P_j be the number of non-zero interaction for exhibit j. Let Pi be the number of exhibits stopped by visitor i. Various totals can be obtained out of the matrix as follows:

Tj -- Total time spent by all visitors at exhibit j
Ti -- Total time spent by visitor i at all exhibits
T -- Total time spent by all visitors at all exhibits
P -- Total number of non-zero interactions with all exhibits

		Exhibit (j)					Total		
		1	2	3	4	...... m	T_i	p_i	T_i/p_i
	1								
	2								
	3								
Visitor (i)	4			t_{ij}					
	.								
	.								
	n								
	T_j						T (Grand Total)		
	p_j						P		
	T_j/p_j						T/P		

Figure 6.3: Matrix of interaction between the visitor and the exhibit. Symbols are explained inside the text.

Table 6.7: Attracting and holding powers of the exhibit and the exhibition according to various authors. Symbols are explained in Figure 6.3.

Authors	attracting power of the exhibit (a)	holding power of the exhibit (h)	Attracting Power of the exhibition (A)	Holding Power of the exhibition (H)
Melton, 1935	p_j (Drawing Power, p 260)	T_j/p_j (Holding Power, p 260)	p_i (spread)	T_i (Total time spent minus time spent in irrelevant actions
Shettel, 1976	p_j (Attracting Power)	T_j/p_j and T_j/n (Holding Power)	--	--
Screven, 1976	p_j(Attraction)	T_j(Holding)	--	--
Miles and Tout, 1979	p_j/n (Attraction)	T_j/p_j (Holding Power)	P/mn (Attraction)	T/P (Holding Power)
Alt, 1980	p_j/n (Attracting power)	T_j/p_j (Holding Power)	p_i (Attractive-ness)	T_i/p_i (Arrestment)
Boisvert and Slez, 1995	--	--	p_i (Attraction)	Time taken form entry to exit (Holding Power)
Peart, 1984	p_j	Ratio of actual viewing time divided by the minimum required viewing time	--	--
The present study	p_j (Attracting power(a))	T_j/p_j (Holding power (h)); T_j/n (Average time (t))	p_i (Attracting Power (A))	T_i (Holding Power (H)) T_i/p_i (Staying Power)

While defining attraction and holding power, Screven (1976) describes the procedure involved in computing the attraction and holding as follows:

1. Frequency of Stops ('Attraction') - The number of people in the target population who enter a pre-defined area and the number of these who stop (look) at any part of the exhibit for five seconds or more.

2. Duration of viewing ('Holding') - The total minutes and seconds each visitor remains at the exhibit.

As the time spent in front of exhibits depends on factors such as size, text and complexity of exhibits, the absolute duration can not be compared between exhibits. One way, as Shettel (1976) suggested, is to use an index called 'holding power ratio' and is defined as follows:

Holding Power Ratio = Actual Viewing Time/ Required Viewing Time

Although this kind of ratio is useful, the estimation of required viewing time raises questions especially when about 250 exhibits are involved. Also, due to its cumbersome approach in estimating the required viewing time, the ratio is not widely used. A thorough and better model, which broadens and delineates more precisely the concept of attraction and holding is proposed by Miles and Tout (1979). This model identified four statistics, namely, attraction of the exhibit, attraction of the whole exhibition, holding power of the exhibit, and holding power of the whole exhibition. These statistics are defined in various ways by various authors (see Table 6.7).

Having computed the above four and some other related statistics in this present study, I will present the results in this order: first, attracting and holding powers of the exhibit and second, those of the exhibition.

Attracting Power (a) and Holding Power (h)— attention paid and time spent by visitors in front of the exhibit

In the present study, Attracting power (a) is defined as the number of people who stopped at the exhibit for more than five seconds or so (P_j). This may therefore have values from 0 when none of the visitors stopped at the exhibit to 27 when all the visitors tracked stopped at the exhibit.

In regard to the distribution of attracting power (see Figure 6.4), the majority of the exhibits attracted more than 6 persons as represented by the coloured (pink, violet, blue, and green) spots. The exhibits that have attracted just 5 or less than 5 persons are very small in number, as represented by the spots shaded by the red colour. The number of exhibits that attracted most of the people (between 21-15 persons) is only eight (pink in colour) of which the majority are from the Children's Gallery.

Holding power is defined in a number of ways in a number of studies. In this study, it is defined as the mean of the time taken by only those visitors who stopped at the exhibits (Tj/Pj). This does not include those who did not stop at the exhibits while the mean is computed. Therefore, another parameter, called average time (Tj/n), is computed by including all those who stopped or did not stop at the exhibits. The average time will therefore determine the efficiency of the exhibits in holding all the visitors. The holding power will, however, determine the efficiency of the exhibits in holding the visitors who stopped at it.

In the case of the holding power (see Figure 6.5), the exhibits that hold visitors for the longest time (120 seconds to 164 seconds) are just three exhibits, of which two are from the Children's Gallery. More than half of the exhibits in all the five galleries hold the visitors for less than 30 seconds, as represented by the red coloured spots. This tendency of the holding power is just the opposite to that of the attracting power. Although more than half of the total exhibits attract a good number of visitors, only a few exhibits hold them for a long time. In other words, a greater number of visitors are held in front of the exhibits for a very short time duration.

In the case of average time (see Figure 6.6), almost three-quarters of the exhibits have an average time of less than 30 seconds. This means that only a quarter of the total exhibits attract and hold for a reasonable time, i.e. more than 30 seconds.

The ten commendable exhibits

There are ten exhibits that stand out in terms of their holding and attracting powers (Table 6.8). The criterion based on which the ten exhibits are selected is that the exhibit must stop more 75 per cent of the total visitors (i.e. more than 21 persons out of the total 27 persons) or it must hold on average the visitor for more than 121 seconds in front of it.

See Your Voice is an exhibit in the Children's Gallery. It has a telephone connected to an oscilloscope. When they lift the handset and speak visitors can see the wave pattern on the oscilloscope. Visitors are found to enjoy producing various sounds to see different kinds of patterns on the screen. This exhibit provides visitors with immediate responses and opportunity for interactions.

Table 6.8: The ten exhibits which either attracted a very high number of the visitors or held the visitors for a very long period of time (see also Appendix E).

Exhibit ID	Name of the exhibit	Attracting Power (in number)	Holding Power (in seconds)	Average time (in seconds)
T9	Electric Train	22 or 82%	23.06	18.79
C48	Fantastic mirror	22 or 82%	46.34	37.76
E25	CCTV system	22 or 82%	54.20	44.16
C47	Floating ball	22 or 82%	58.09	47.33
C06	See your voice	23 or 85%	59.13	50.37
P10	World clock	21 or 78%	61.74	54.24
C22	Grain pit	24 or 89%	77.88	69.22
E42	Electronic quiz	15 or 56%	122.16	67.92
C32	Videogame	15 or 56%	131.34	72.97
C57	Circus of forces	21 or 78%	163.19	126.92

Grain Pit is also in the Children's Gallery. Visitors can turn handles to move grain around the exhibit using a variety of mechanisms, including conveyor belts, slides, buckets and an Archimedes screw. This exhibit is intuitively obvious and therefore encourages co-operation and social activity spontaneously.

Videogame is another exhibit in the Children's Gallery. This exhibit houses a TV monitor with control switches to move up, down, left or right and fire. Visitors can play some commercially available videogames. Although a solo activity, many visitors were found to get excited while watching what was going on. Some visitors were particularly hooked to this exhibit for an unusually longer period, although this exhibit and the Electronic Quiz could not attract as many visitors as other exhibits could. This exhibit provides visitors with opportunities for play, fantasy and challenge.

Floating Ball is also from the Children's Gallery. This exhibit attempts to demonstrate the Bernoulli's principle of air flow. It has a blower with a flexible plastic tube to change the direction of the air flow. A beach ball is placed at the tip of the plastic tube. As the visitor switches on the blower, the beach ball floats; visitors can also change direction of the flow and observe the ball moves synchronously. This exhibit arouses curiousity and provides opportunity for interactions.

Fantastic Mirror in the Children's Gallery, has many mirrors in funny shapes: concave, convex and wavy shapes. Visitors are in this exhibit are reflected upside down, back to front, in and out. They will search in vain for a still refection among fun and giggles. This exhibit creates a sense of wonder and playful activities.

Circus of Forces also in the Children's Gallery, has a huge metal structure to guide a wooden ball around the exhibit. Visitors rotates a small wheel to lift the ball and release it on the track to observe the movement of the ball. On its way, it loops, bumps, goes down the slope, rings the bells and chimes. These actions of the ball explains various ways energy transformed from one type to another. For example, the potential energy into the kinetic energy, or the mechanical energy into the sound energy. Being the biggest in size, this exhibit attracts attention of visitors more easily. It also generates movements, sounds, and opportunities for interactions.

Electric Train in the Transport Gallery, is a large scaled-down working model of a railway traffic system. An elliptical rail track is laid down with two railway stations and its signalling networks. At the push of a switch, a toy train starts from one end and travels round the track and stops. The primary aims of the exhibit are to illustrate how people are transported using trains and to demonstrate how the railway signalling keeps the trains going. This exhibit generates movements and has working parts.

Electronic Quiz in the Electronics and Communication Gallery poses many general knowledge questions with a multiple choice of answers. Visitors upon answering all questions correctly can shake hands with a robot and can hear 'congratulations'. This exhibit gives visitors feedback whether or not their answers are correct. This exhibit is found to hold some selective visitors for a longer period.

CCTV System also in the Electronics and Communication Gallery, consists of a television camera and a television monitor. As the visitors pass by, they can see their picture on the TV. This exhibit provides opportunity for participation and for making personal connections.

World Clock in the Physical Science Gallery, attempts to explain the local standard time adopted at different countries by showing the time at some important cities such as New York, London, and Paris. A rotating globe also demonstrates how the spin of the earth is responsible for different time zones. This exhibit enables museum visitors to make personal connection by relating to the city where they have been or come from.

Clearly, all these ten exhibits are found to have one or more of the key characteristics of the successful exhibit. The characteristics are: making personal connections, generating movements, providing feedback, arousing curiousity, instilling a sense of wonder, being in a big size, and offering opportunities for interactions.

Relationship between Holding Power (h), Attracting Power (a), and Average Time (t): Results of Correlation and Multiple Regression Analysis

To find out a relationship between these three parameters, whether they are linear or non-linear, scatter plots (Figures 6.7 to 6.9) were done between average time and attracting power, between average time and holding power, and attracting power and holding power. A close inspection of the plots shows that the relationships are linear.

Having found out a linear relationship between the parameters, I computed the correlation coefficients to quantify these relations. The results of the correlation are shown in Table 6.9. From that, the average time is found to be very highly correlated with the holding power, and just highly correlated with attracting power. The holding power is moderately correlated with attracting power. The results from this present study support the idea that an exhibit that attracts more visitors would also, to some extent, hold visitors on average for a longer time. Unlike the present study, Peart (1984) found that attracting power correlated highly with holding power.

To explore this linear relationship further, a multiple regression analysis was done on the data by considering the average time as DV (Dependent Variable) and the other two variables namely attracting power and holding power, as IVs (Independent Variables). The outcome of the analysis is shown in Table 6.10. It appears that the average time can be expressed as a linear combination of attracting power and holding power as follows:

$$\text{av. time} = -16.350656 + .514140\,(\text{holding power}) + 1.318528\,(\text{attracting power})$$

The average time may therefore be considered to be a measure that combines and depends on both attracting power and holding power.

While holding power alone accounts for 79% and attracting power alone accounts for 52% of the variance of average time, both holding power and attracting power together account for 92% of the variance of the average time. Thus the fit of the model is very good. I will now present the exhibition measures in the following section.

ATTRACTING POWER

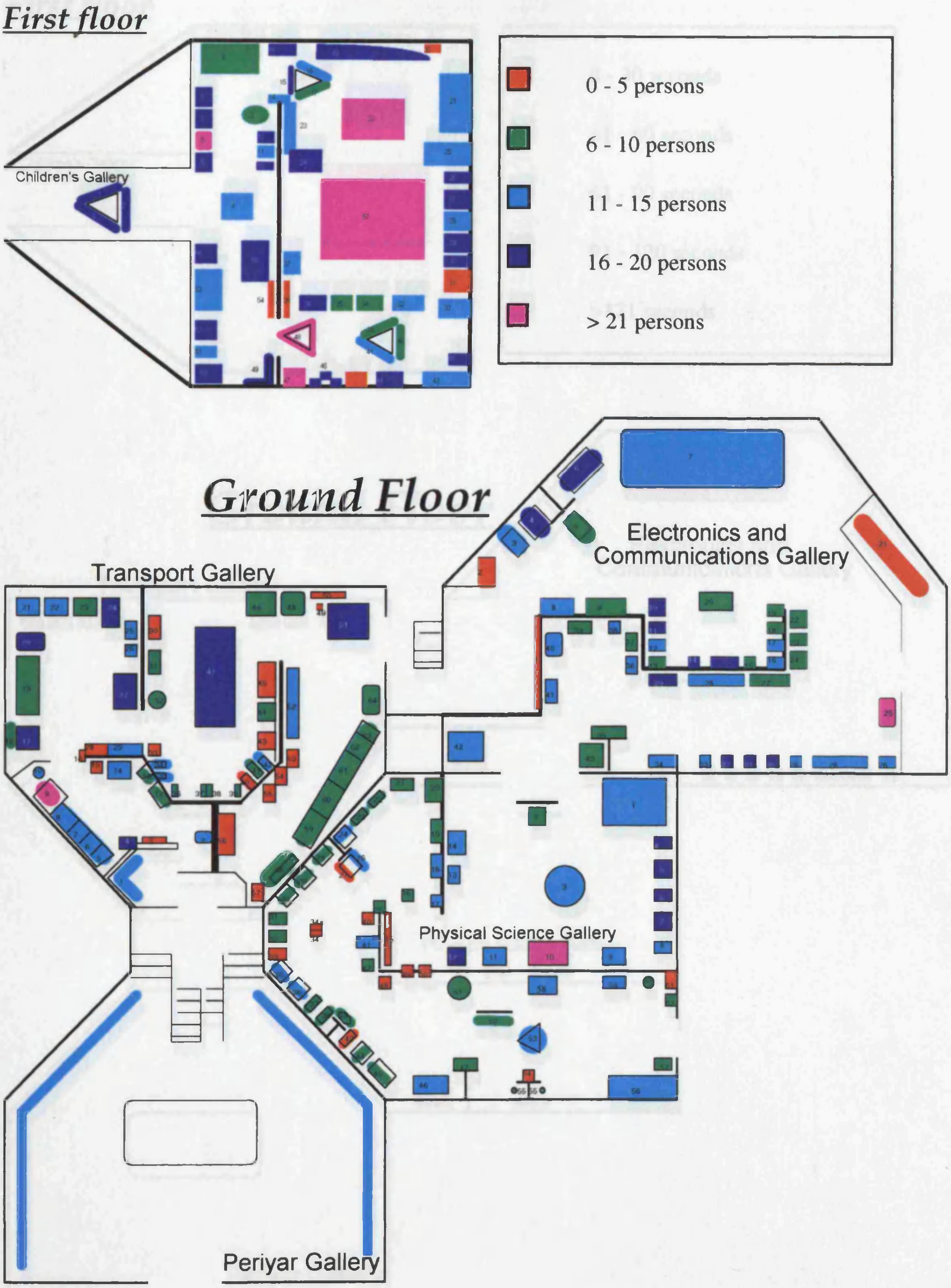


Figure 6.4: A colour map of the five galleries of the Periyar Science and Technology Centre in Madras showing attracting power of the exhibit in number of visitors who stopped in front the exhibits irrespective of how long they stayed.

HOLDING POWER

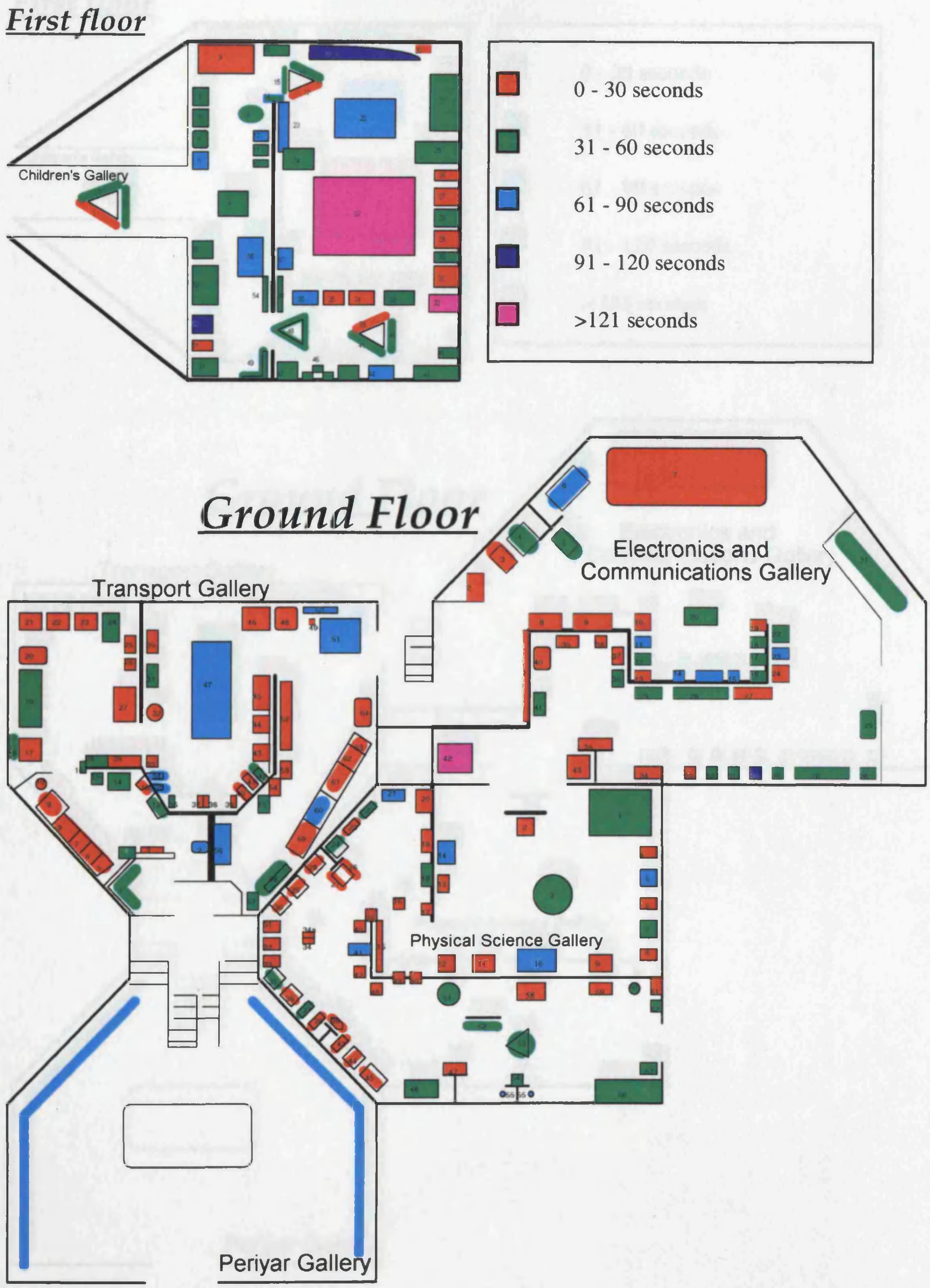


Figure 6.5: A colour map of the five galleries of the Periyar Science and Technology Centre in Madras for holding power of the exhibits in seconds, which is the average time spent in front of the exhibits by only those who stopped or were attracted.

AVERAGE TIME

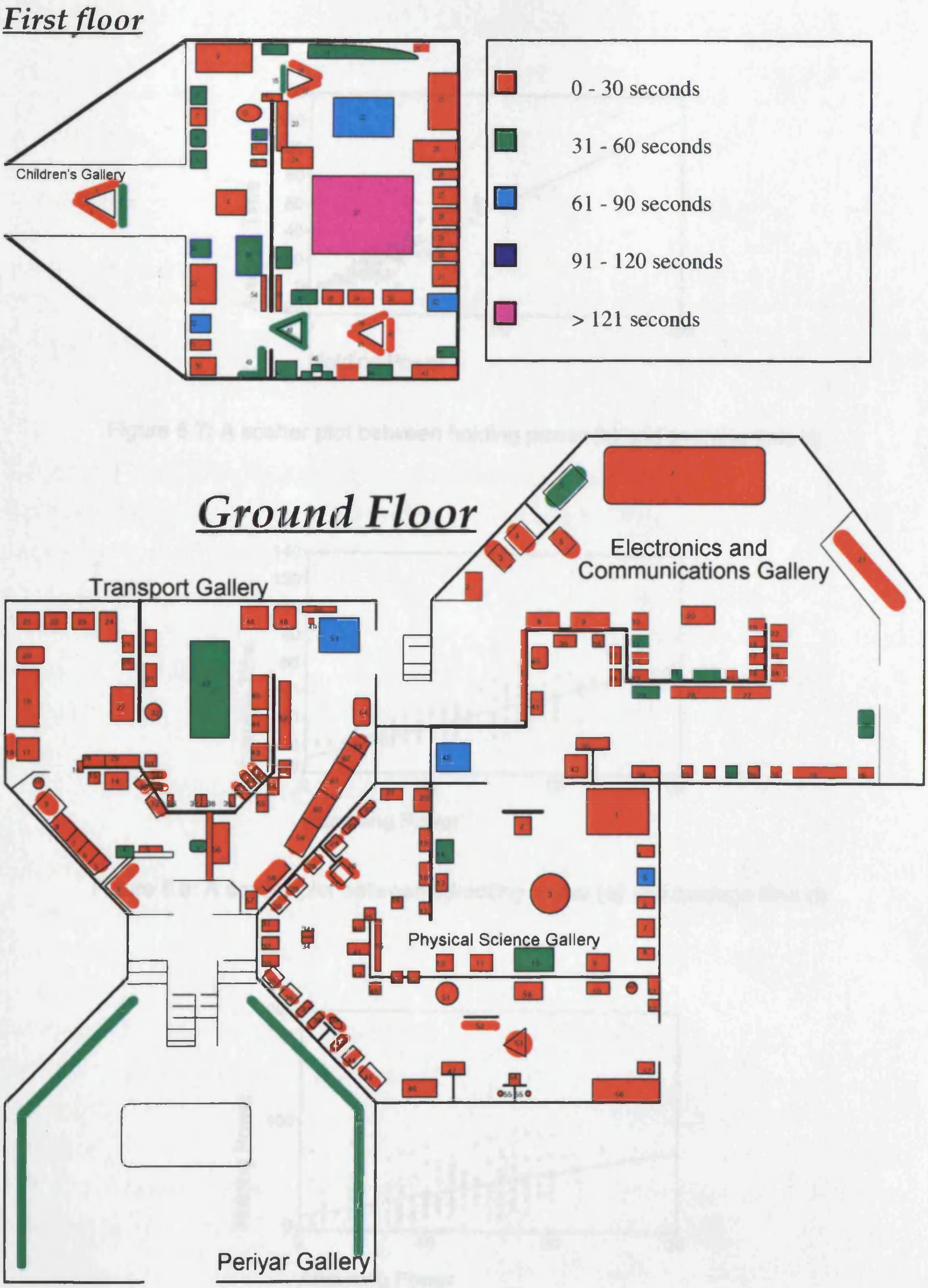


Figure 6.6: A colour map of the five galleries of the Periyar Science and Technology Centre in Madras for the average time in seconds, which takes into account of all the visitors irrespective of whether or not they stopped at while averaging the time spent in front of the exhibits.

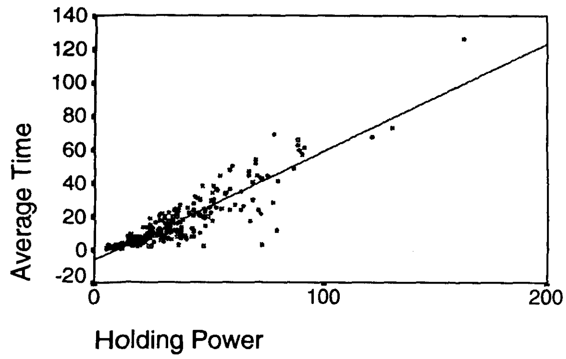


Figure 6.7: A scatter plot between holding power (h) and average time (t)

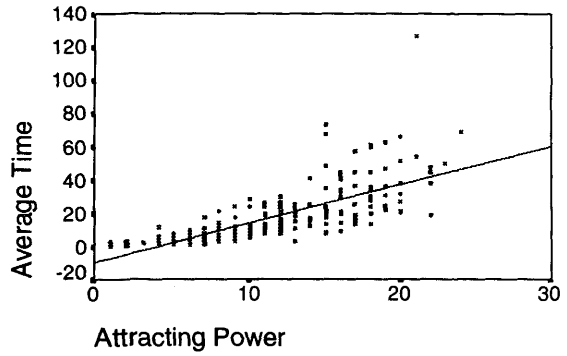


Figure 6.8: A scatter plot between attracting power (a) and average time (t)

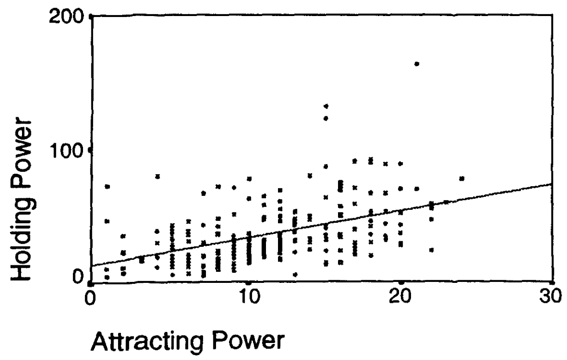


Figure 6.9 A scatter plot between attracting power (a) and holding power (h)

Table 6.9: Correlation matrix for average time (t), holding power (h), and attracting power (a).

	Average time	Holding power	Attracting power
Average time	1.0000	.8895*	.7267*
Holding power	.8895*	1.0000	.4486*
Attracting power	.7267*	.4486*	1.0000

* Significant at the .05 level.

Table 6.10: Outcome of the multiple regression analysis.

Both independent variables, attracting power and holding power, are included

Dependent Variable is Average Time

			Analysis of Variance		
Multiple R	.96213				
R Square	.92569		DF	Sum of Squares	Mean Square
Adjusted R Square	.92502	Regression	2	58411.06868	29205.53434
Standard Error	4.60611	Residual	221	4688.79593	21.21627
			F =	1376.56302	Signif F = <.001

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Holding Power	.514140	.014952	.705493	34.386	<.001
Attracting Power	1.318528	.065939	.410256	19.996	<.001
(Constant)	-16.350656	.762688		-21.438	<.001

Independent variable attracting power is included individually

Dependent Variable is Average Time; Method: Enter

			Analysis of Variance		
Multiple R	.72672				
R Square	.52812		DF	Sum of Squares	Mean Square
Adjusted R Square	.52600	Regression	1	33324.40680	33324.40680
Standard Error	11.58118	Residual	222	29775.45780	134.12368
			F =	248.46027	Signif F = <.001

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Attracting Power	2.335615	.148174	.726720	15.763	<.001
(Constant)	-9.318434	1.847409		-5.044	<.001

Table 6.10 (contd.): Outcome of the multiple regression analysis.

Independent variable holding power is included individually

Dependent Variable is Average Time; Method: Enter

Multiple R	.88952		Analysis of Variance		
R Square	.79125		DF	Sum of Squares	Mean Square
Adjusted R Square	.79031	Regression	1	49927.71072	49927.71072
Standard Error	7.70286	Residual	222	13172.15389	59.33403
			F =	841.46844	Signif F = <.001

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Holding Power	.648255	.022347	.889522	29.008	<.001
(Constant)	-6.261083	.956440		-6.546	<.001

Attracting Power (A) and Holding Power (H) — attention paid and time spent by visitors inside the exhibition

The Attractive Power of the exhibition (A) is defined in this present study as the number of exhibits a visitor stopped at in that particular exhibition (p_i). This variable is calculated for every visitor. This parameter is also called 'spread' by Melton (1935) and 'attractiveness' by Alt (1980).

Holding Power(H) of the exhibition is defined in this study as the sum of the times taken in front of the exhibits in that exhibition (T_i).

Table 6.11: Mean values of Attracting and Holding Powers of exhibitions, and Staying Power of visitors.

Variable	Children's	Transport	Electronics	Phy. sci.	All
Attracting Power in number (S.D.)	31.3 (13.9)	21.4 (12.6)	16.5 (9.3)	18.3 (13.8)	21.9 (13.6)
Holding Power in seconds (S.D.)	1601.4 (1055.0)	703.0 (564.3)	755.9 (520.8)	742.2 (648.8)	950.6 811.8
Staying Power in seconds (S.D.)	46.0 (21.0)	33.3 (19.7)	43.0 (20.4)	35.3 (20.4)	39.4 (20.8)

Similar to the holding power (h), another parameter possible, which I refer to as the staying power of the visitor, is the ratio between the Holding Power and the Attracting Power of the exhibition (T_i/p_i). This staying power was, however, called 'arrestment' by Alt (1980). As can be seen, since the parameter actually means the average time a visitor is willing to spend in front of a single exhibit in an exhibition, the parameter is of the visitor but definitely not of the exhibition, as Alt conceived. It therefore makes more sense to refer to it as the staying power of the visitor rather than the 'arrestment' of the exhibition. The mean values of these three parameters are presented in Table 6.11.

Whereas Attracting Powers and Holding Powers of the five galleries differ significantly amongst themselves (For Attracting Power, $F = 7.5214$; $p < .001$; and for Holding Power, $F = 9.5959$; $p < .001$), the staying power of visitors does not differ with respect to the different galleries. However, visitors are found to stop at more exhibits and to spend a longer time at exhibits in the Children's Gallery than in the other three galleries namely Transport, Electronics and Communication, and Physical Science. The reason for this might be three, if not many. First, this is the Gallery visited first by most of the visitors (89%); so the visitors are free from museum fatigue originating from both physical and psychological sources. Second, this gallery has almost all interactive exhibits; so there exists ample opportunity for interaction. Third, this gallery has a single door for both entry and exit unlike other galleries that have separate entry and exit points; so visitors are not influenced by 'exit gradient' to miss some of the exhibits while circumnavigating the exhibits.

As revealed by the staying power, visitors are willing to stay, on average, the same amount of time irrespective of the nature of the galleries, but some galleries provide more opportunities by having more interesting exhibits than others. It also appears that visitors are willing to spend, on average, the same amount of time in front of a single exhibit, irrespective of its gallery location. The increase of the Attracting and Holding Powers of a particular exhibition only supports that the exhibition is able to attract visitors to stop at in front of more exhibits and therefore to spend more time there. It is therefore essential to make the exhibits more interesting, more meaningful and more effective.

Having seen the overall picture of these parameters, I will now present whether or not these parameters of the exhibition depend on visitor characteristics.

Visitor Characteristics and Attracting and Holding Power

Many museum studies have looked at the influence of visitor characteristics such as gender, group, and age on the attracting and holding powers of the exhibition. In an evaluation study of an exhibition on the 18th century farm life, Munley (1985) found that women rarely looked at farm equipment and men rarely looked at items found in the kitchen. Thus, gender played a role in determining which exhibits to stop and view. In another study, Koran et al. (1986) found that the attraction and holding power of the exhibition are related to visitor age and gender. Females spent consistently more time than males in a sea shell exhibit. Children and early adolescents spent a longer period of time viewing the exhibit than did adults. In a natural history museum, Wolf and Tymitz (1978) observed that visitors in a pair were more attentive to exhibits than individuals or groups of three or more. A similar result was also obtained in a study of children on a field trip to a science centre (Gottfried, 1979).

To capture the relationship between these three time-related parameters and visitor characteristics, the data were analysed in two ways in this study. First, the analysis of the data was done individually for each of the four galleries, except the Periyar Gallery. Second, the analysis was carried out pooling the data of the four galleries together.

When analysis was carried out individually, the data were subjected to a t-test with respect to gender, and to ANOVAs with respect to age and the nature of the group. In the case of the Children's, Transport, Electronics and Communication, or Physical Science galleries, the t-tests and ANOVAs could not find any significant influence of visitors characteristics on attracting, holding and staying powers.

The differences seen by Munley (1985) between male and female visitors in attracting and holding powers, are not found in this present study. Similarly, Boisvert and Slez (1995) found no differences between males and females in the Human Body Discovery Space at Boston Museum of Science. There might be two reasons for the insignificant difference between males and females in terms of how long they stayed in the exhibition: the first is to do with the topics covered in the exhibition; and the second is to do with the style of the exhibits. Topics such as basic sciences, transport and electronics that were dealt within the four galleries might interest equally both males and females. However, this interpretation needs to be supported by further evidence. The style of the exhibits, such as interactive exhibits, might involve equally both males and females. Irrespective of whether they are manipulating (men's proclivity) or watching (women's preference), males and females might spend more or less equal amount of time inside the exhibition.

That the staying power was not found to relate with visitor's characteristics may suggest an important point. Visitors, irrespective of their characteristics, would be willing to spend only a certain amount of time in front of exhibits. There is a truth in Alt's findings that visitors will leave the exhibit if they find that they need to invest more time to benefit from it.

By combining the data of the four galleries together, another data set was pooled. When this data set was subjected to a t-test with respect to gender and ANOVAs with respect to age and the nature of the group, attracting and holding powers were found to relate significantly with gender and the nature of the group.

The attracting power of the exhibition is significantly higher for males than for females ($t = 2.08$; $p = .040$). But the holding powers and the staying powers were not found to differ significantly between males and females. Although women stopped at fewer exhibits, they however spent as much time in the exhibition as men did.

The Attracting Power was also found to have a significant overall relationship with the nature of the group ($F = 3.1265$; $p = .029$). But a post hoc Scheffe test failed to show a significant difference between any two groups. However, the Holding Power related significantly with the nature of the group ($F = 3.2347$; $p = .025$). A post hoc Scheffe test resulted in a finding that the exhibition tended to have higher Holding Power for the four-person group than for the many-person group. However, the staying power was not found to relate significantly with the nature of the group.

Age did not relate significantly with Attracting Power, Holding Power and staying power.

A significant relationship between holding power and learning was found by Falk (1983). Peart (1984) also found a positive correlation between holding power and knowledge gain. In the present study, Holding Power was found to have a very strong positive correlation with Attracting Power and learning factor; a moderate positive correlation with teaching factor and a weak correlation with care-taking factor (Table 6.12). Attracting Power, on the other hand, had a strong correlation with Holding Power and learning factor; a moderate correlation with staying power and teaching factor, and a weak correlation with care-taking factor. This result may therefore suggest that holding power and attracting power are reliable parameters to measure learning unobtrusively. Further, staying power was found to correlate positively but moderately with attracting power and holding power, and weakly with all three factors.

Whereas the staying power of visitors in the exhibitions correlated weakly with all three factors, the Attracting and Holding Powers, on the contrary, correlated very strongly with learning factor, moderately with teaching factor, and weakly with care-taking factor. This makes an important point that a visitor is generally willing to stay inside an exhibition more or less the same time for learning, teaching or care-taking. However, visitors will stop at more number of exhibits and spend more time in the exhibition when they are learning or to some extent teaching than when they are care-taking. Therefore, it is through the design and style of the exhibition and the number of interactive exhibits that the Holding and Attracting Powers can be increased.

Table 6.12: Correlation between Attracting Power, Holding Power, staying power and the three behavioural factors.

	Attracting Power (A)	Holding Power (H)	Staying Power	Learning factor	Teaching factor	Care-taking factor
Attracting Power (A)	1.0000	.8576	.3142	.7791	.3561	.1611
Holding Power (H)	.8576	1.0000	.5819	.6730	.4723	.2539
Staying Power	.3142	.5819	1.0000	.2171	.2990	.2060
Learning factor	.7791	.6730	.2171	1.0000	.0000	.0000
Teaching factor	.3561	.4723	.2990	.0000	1.0000	.0000
Care-taking factor	.1611	.2539	.2060	.0000	.0000	1.0000

Survival Analysis of the Exhibitions of the Centre

Survival analysis is a technique that measures and plots the rate at which people survive or remain as time passes. Although he has not used the term 'survival', Alt (1979) used this technique to show the cumulative frequency distribution of viewing times in an audio visual programme at the London Natural History Museum. In that he plotted the time in seconds on a horizontal axis and the percentage of visitors remaining on a vertical axis.

Recently, Menninger (1990) reported the advantages of this technique in museum studies. According to her, survival analysis, being a non-parametric or distribution-free statistic, can overcome two problems associated with time data. The first is the non-normality of time distribution, which occurs when visitors spend short periods of time in one exhibit and relatively longer periods of time in other exhibits; the second is the insufficient and incomplete data, which occurs when observation of visitors can not be continued for some reason or when the visit terminates prematurely.

Survival analysis computes a probability function called the cumulative survival function with respect to the lapse of time. The value of this function lies between 0 and 1; but the value if expressed in percentage ranges from 0 to 100. For example, if the gallery has a survival function of .7 (or 70%) and the lapse of time is 10 minutes, then it can be said that the gallery is capable of holding seventy visitors out of one hundred visitors for up to 10 minutes. In other words, there is a 70% chance that a visitor will remain in the gallery for 10 minutes.

This technique may be used to compare the survival rate of visitors with respect to different factors, such as type of exhibition, visitor's gender, age and nature of the group. Statistical tests like Mantel-Cox or Wilcoxon are available to find out statistically significant differences between two or more groups.

As mentioned earlier, the time a visitor spent inside the five galleries was obtained by adding up the time the visitor spent in front of the individual exhibits of the corresponding galleries. This data set was subjected to survival analysis using the SPSS for windows. An overlay plot for the five galleries is presented in Figure 6.10.

As each gallery occupies the same area, it is very reasonable to compare one gallery with another. As can be seen in Figure 6.10, the steepest of them is the Periyar Gallery, followed by the Transport, Electronics and Communication, Physical Science, and finally the Children's Gallery. This reveals an interesting fact, that the Children's Gallery has the highest survival function. If a half life of an exhibition can be defined as the duration of time the exhibition retains half of the total visitors, then the half life of the Children's Gallery is thirty times that of the Periyar Gallery; three times that of the Transport Gallery; and twice that of the Electronics and Communication Gallery and of the Physical Science Gallery.

Coincidentally, the Children's Gallery has almost all of its exhibits hands-on and interactive in nature. The finding that the Children's Gallery has a highest survival function might suggest that the interactive exhibits may retain more visitors than other not so interactive galleries. This was also proved by Menniger (1990) from a study in the Education Gallery of the J. Paul Getty Museum at Los Angeles. When the Education Gallery was interactive, about 70% of the visitors stayed two or more minutes; but when it was non-interactive, only about 40% spent one or more minutes in the gallery.

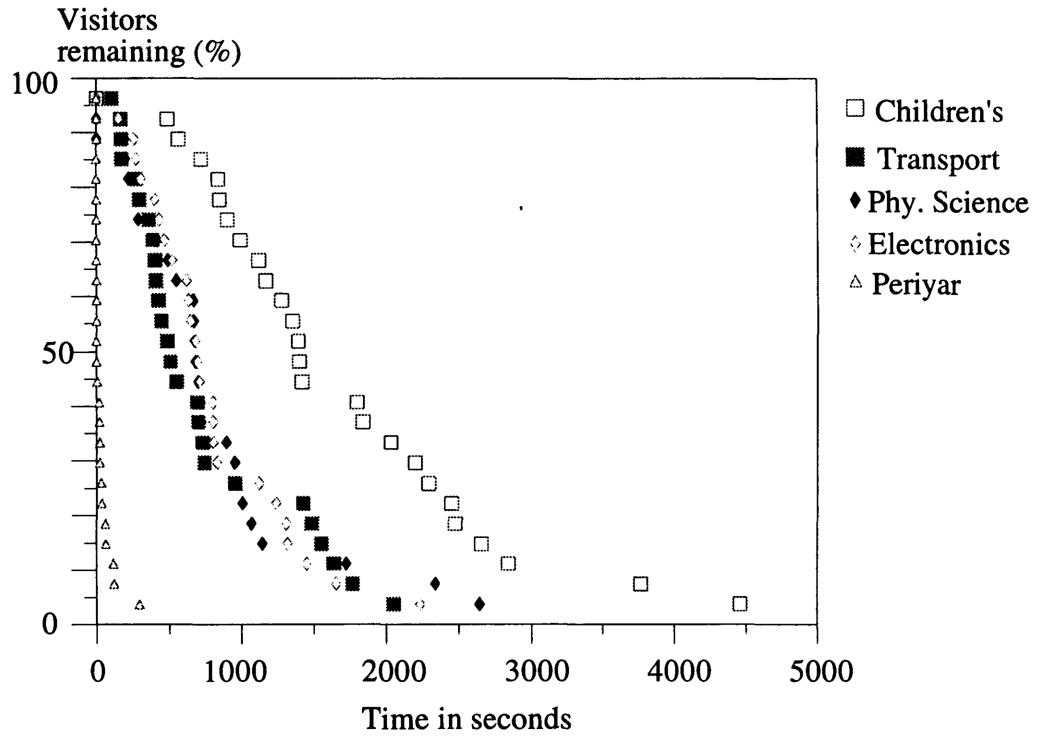


Figure 6.10: A comparison of the survival plots of the five galleries of the Periyar Science and Technology Centre at Madras (Wilcoxon=62.719; df=4; p < .001).

Table 6.13: Statistics of comparative survival analyses of different galleries.

Comparisons	Wilcoxon (Gehan) Statistics	df	p
Overall	62.719	4	<.001
Children's vs Transport	12.517	1	.0004
Children's vs Electronics	12.656	1	.0004
Children's vs Physical Science	12.521	1	.0004
Children's vs Periyar	32.728	1	<.001
Transport vs Periyar	38.216	1	<.001
Electronics vs Periyar	24.970	1	<.001
Physical Science vs Periyar	32.127	1	<.001
Transport vs Electronics	.108	1	.7423
Transport vs Physical Science	.566	1	.4517
Electronics vs Physical Science	.103	1	.7488

Survival analyses were also done for each of the five galleries with respect to visitors' gender, age, and nature of the group. But no significant results emerged from statistical tests. This result might suggest that the time a visitor spends inside the museum gallery does not differ significantly with respect to the visitor's gender, age and group, but depends only on the type of exhibitions.

In sum, the results of survival analyses show that the Children's Gallery is most successful in retaining visitors, while the Periyar Gallery is the least successful in retaining visitors, even though the area of these two galleries remains equal. The other three galleries strike a middle ground. Again, the galleries of the Centre can be grouped into three -- the Children's' Gallery in the upper end, Periyar gallery in the bottom end, and the remaining in the middle (Table 6.13). Visitors, regardless of their characteristics, do not differ significantly in the length of time that they remain in the galleries.

CONCLUSIONS

In this study, twenty seven museum visitors were observed as they interacted with about 250 exhibits. The data collected was of two types; they are the behaviours which occurred and the time spent in front of the exhibits. A large-sample and narrow-scope Time-Visit study was conducted with 476 visitors to find out only the total time spent inside the Centre.

Sixteen behaviours were observed during the museum visit. A factor analysis revealed three factors, namely, learning, teaching and care-taking. During the museum visit, visitors were mainly learning, teaching or care-taking. There were some individual differences in the behaviour patterns of the visitors. Male visitors were more likely to manipulate exhibits than female visitors; visitors of a young age were more likely to elicit information regarding exhibit-related topics than those in their late teens. Four-person groups were more often found to display behaviours such as watch, read and look than three-person and many-person groups. Visitors were more likely to watch, show, look, help others, follow others, ask about exhibits, do something unrelated to exhibits, and listen in the Children's Gallery than in any of the other galleries. In regard to the factors, men were more likely to display teaching behaviours than women. The Children's Gallery was found to evoke more learning-related behaviours than any of the other galleries.

Visitors were found to spend about 90 minutes inside the Centre, from the present observation and the large-sample Time-Visit study. Visitors spent on average about 1601 seconds in the Children's Gallery, 756 seconds in the Electronics Gallery, 742 seconds in the Physical Science gallery, 703 seconds in the Transport Gallery, and 30 seconds in the Periyar Gallery.

Based on a matrix of interaction between visitors and exhibits, four useful measures were conceived from the published observational studies. The present study defined three measures for the exhibits (attracting power, holding power, and average time). Scatter plots, correlation, and multiple regression revealed that the average time was found to have a linear relationship with both attracting power and holding power.

In the present study, three measures were also defined for the exhibitions (Attracting Power, Holding Power, and staying power). Attracting Power and Holding Power were found to be significantly greater in the Children's Gallery than in other galleries. But staying power was not found to differ significantly with respect to different galleries. When the analysis was done for all the galleries individually, Attracting Power and Holding Power of the individual galleries were not found to differ significantly with respect to visitors characteristics. But when the analysis was done on data combining all four galleries, except the Periyar Gallery, Attracting Powers were found to be significantly larger for men than for women; Holding Powers were also found to be significantly higher for the four-person group than other groups.

Attracting, Holding and staying powers, and Learning, Teaching, and Care-taking factors were found to correlate positively with mixed intensities. Correlating strongly between themselves, Attracting Power and Holding Power correlated strongly with the learning factor. Staying power, on the other hand, moderately correlated with Attracting and Holding Powers, but correlated weakly with all three factors namely learning, teaching, and care-taking.

When the average time spent by visitors inside the five galleries was subjected to survival analysis, the findings suggested that the Children's Gallery was found to retain visitors for a significantly longer time than other galleries. Again, the Periyar Gallery was found to be the least effective in retaining visitors. The retaining capacity of galleries, however, did not differ with respect to visitors' characteristics. This result was almost the same as that obtained from the ANOVAs and t-tests earlier.

After having shown what museum visitors say they do and actually do inside a science centre, I will now present what the Indian museum directors think and say about some important aspects of the museum visit, museum learning and the museum visitor in the following chapter.

CHAPTER VII

QUALITATIVE ANALYSIS OF THE INTERVIEW STUDY

INTRODUCTION

From a total of about 30 science museums or centres in India, ten of them have been selected and visited by the writer for two different purposes: first, to conduct interviews with their directors, and second to case-study individually the exhibition departments of the science museums. The list of the directors with their institutions is shown in Table 7.1. The places visited were Madras, Trivandrum, Calcutta, New Delhi, Pilani, Bangalore, Hyderabad, and Bombay. In all, there were ten directors interviewed in this study: three directors from Calcutta, two directors from New Delhi, none from Bombay, and one from each of the remaining places. The length of each interview was for a period of between 45 minutes and 90 minutes. The results of the case-studies of the exhibition departments are presented in Chapter II.

All ten interviews were transcribed and quoted in verbatim at different places during the argument and analysis. The data were analysed qualitatively to find out what the directors thought about learning and other learning-related aspects, in science museums. I will present the findings of the analysis in four major categories: *learning in museums*, *important criteria in the development of exhibitions*, *evaluation and visitor studies*, and finally *interest in science and the nature of the scientific temper*. I will consider the first category, what the Indian directors think of learning in museums in general and in their museums in particular, next.

LEARNING IN MUSEUMS

Learning science in informal settings, including museums and science centres, is an issue that has received, and is still receiving, considerable debate. During and just after the 1970s, many authors discussed the potential of science learning in the informal setting (Kimche, 1978; and Tressel, 1980). There were a number of criticisms as well. The nature and definition of the science museum or the science centre generated vigorous debates, and a number of criticisms were made against the science centres for their lack of objects. Even now, many museum personnel and professional bodies, particularly the British Museum Association, have difficulty in recognising the science centre as a type of science museum. This ongoing debate creates a binary pair, to use Pearce's term, 'science museum: science centre'. Pearce (1989) identified a range of binary pairs of which 'leisure: work' is one. This binary pair can be equated with 'play:learning'. This false dichotomy of 'play or learning' is the main reason for many of the criticisms of the science centres, even though they have been shown to be very successful with visitors, across the world.

Table 7.1: The list of Directors who have been selected for the Interview study provides for each director the address, and the planned and achieved dates of the interview.

Name and address	Planned	Achieved
Dr. Gopala Raman, Executive Director Tamilnadu Science and Technology Centres Gandhi Mandapam Road MADRAS -600 025	3-5.9. 1993	29.5.1993
Dr. C.H. Abdul Bukhari, Director Kerala State Science and Technology Museum Vikash Bhavan P.O. Thiruvananthapuram - 695 033	31.5 - 2.6.1993	8.6.1993
Mr. S. Goswamy, Director Birla Industrial and Technological Museums 19a, Gurusaday Road Calcutta - 700 019.	10-16.5.93	25.6.93
Mr. I. K. Mukherjee, Director Central Research and Training Laboratory Block 'GN' Sector 'V' Saltlake City Calcutta -700 091	10-16.5.93	26.2.93
Dr. T.K. Ganguly, Director National Council of Science Museums Block 'GN' Sector 'V' Saltlake City Calcutta -700 091	10-16.5.93	declined as unprepared
Dr. Saroj Ghose, Director General National Council of Science Museums Block 'GN' Sector 'V' Saltlake City Calcutta -700 091	10-16.5.93	declined as busy and suggested a substitute: Director, Science City.
Mr. V Nagarajan, Director Science City C/o National Council of Science Museums Block 'GN' Sector 'V' Saltlake City Calcutta -700 091	—	27.6.93

Table 7.1 (cont.): The list of Directors who have been selected for the Interview study provides for each director the address, and the planned and achieved dates of the interview.

Name and address	Planned	Achieved
Dr. G. Sukumaran, Director National Science Centre Near Gate no: 1 Pragati Maidan New Delhi - 110 001	17-18.5.93	31.6.93
Mr. G.S. Rautela, Director Hall of Science Technology and Energy c/o National Science Centre Near Gate no: 1 Pragati Maidan New Delhi - 110 001	—	30.6.93
Mr V.P. Beri, Director Birla Museum Pilani Rajasthan India - 333 031	19-21.5.93	31.6.93
Mr. R.M. Chakraborty, Director Nehru Science Centre Dr. E. Moses Road Worli Bombay - 400 018	24-26.5.93	declined and completely unwilling.
Mr. M. Parvatinathan, Director Visvesvaraya Industrial and Technological Museum Kasturba Road Bangalore- 560 001	27-28.5.93	16.8.93
Dr. B. G. Sidharth, Director General B.M. Birla Science Centre and Planetarium Adarshnagar Hyderabad - 500 463	6-8.6.93	9.8.93
Director A P Science and Technology Centre 5-9-1109 Gun Foundry Hyderabad -500 029	6-8.6.93	declined as busy

Amongst a number of criticisms revolving around education and entertainment in the museum setting, the most important and pertinent comments were made by Shortland (1987). He mainly observed four important problematics in the science centre approach to dealing with science learning: 1) visitors do not learn through play or through an 'exploratory situation'; 2) children do not take time to read labels; 3) visitors do not acquire appropriate knowledge of science through the science centre experience; and 4) education will be the loser if education and entertainment are combined in the same setting.

I have analysed his four points in detail elsewhere (Yahya, 1995). In summary, his first point is very questionable as learning and playing are just two different modes of learning in museums. His second assertion is proved wrong through the research of McManus (1989), who uncovered a revealing fact that visitors, including children, do read labels. Regarding his third point, Porter (1993) asks who decides what is appropriate and criticises the tendency to measure the public understanding of science in terms of whether or not people know certain facts. Though his fourth point, that education would be the loser if it was combined with entertainment, has been accepted by some museum personnel (For example, Ames, 1988; and Parkyn, 1993), there is research evidence from visitor studies conducted in science centres and EPCOT-like theme parks that support the fact that education and entertainment can be effectively and efficiently combined in a single setting (Wellington 1989 and 1990; Mintz 1994; and MacDonald 1988). A similar debate was also exchanged between Wymer (1991) and Quin (1991). While Wymer takes the views of Shortland, Quin argues that learning can be fun.

In her most recent work, Quin (1994) argues that the question 'Are they learning or merely playing?', should be reversed to 'Are they playing - developing an exploratory approach to life itself and the basis perhaps for a career in scientific research - or merely learning facts and figures?' This reversal reflects the importance of play in all walks of life. As Kubie comments:

> The free play of preconscious processes accomplishes two goals concurrently: it supplies an endless stream of old data rearranged into new combinations of wholes and fragments on grounds of analogic elements; and it exercises a continuous selective influence not only on free associations, but also the minutiae of living, thinking, walking, talking, dreaming, and indeed of every moment of life (Lawrence S. Kubie 1971: 39).

Quin further suggests that the exhibits are only the tip of the iceberg of science communication. Science centres offer, more than just exhibits, a number of special events and programmes to provide opportunities for play and learning: these are in-house educational programmes; outreach programmes; science gardens; laboratory science; audio-visual or multimedia shows; lecture demonstrations; science drama; planetarium shows and a range of others.

According to a Canadian survey (Dixon, Courtney and Bailey, 1974), there is a strong indication that the public wants the museum to perform the educative role but not at the cost of entertainment. Museum-goers identify themselves as active persons who seek interaction rather than passive reception of knowledge. These findings support the view that education and entertainment can be combined but the primary focus should be on learning. We have thus far discussed some criticisms and counter arguments and pondered over the importance of entertainment and education in relation to learning in museums. What the Indian directors have to say about learning will be considered next.

When they were asked about museum learning, the responses of the directors fell into four different categories. The first category (three out of ten directors) admitted that visitors do not come with a clear intent of learning, but they do learn, in its broadest sense of the term, from the museum experience:

> The common public don't come for the (learning) purpose. I am sure that they just come to enjoy the atmosphere. They certainly learn something and pick up certain ideas and information. But if you mean a formal kind of or level of education, then I would not be able to say (Interview #1, 1993).

> They (visitors) feel that they should enjoy the day. At the same time, it should be fruitful to them. So they make it a point to come here and see that children participate and learn something from it. In that context, people who come here definitely learn some new things, although the purpose of their visit may be to have a picnic or a holiday in a place other than the normal residential location (Interview #3, 1993).

> They come here for a sort of fun, *tamasha*. It is a casual learning, or I will even say, it is camouflaged learning. Most people come out of sheer curiosity and fun and in the process they learn something subconsciously or not so consciously. (Interview #9, 1993).

The second category (three out of ten directors) considered that people visit museums with a clear intention of learning but also want to have fun at the same time. These directors tend to support the adage 'learn while you have fun':

> People come here with an expectation of the learning of science. They come with an idea of relaxation, that is, spending some time perhaps in a relaxed mood. So, the basic approach to education here should be learn

> through fun, not a stereo type or classroom type of learning. But we as curators try to see that, during the process of recreation, we could introduce some sort of education in them (Interview #4, 1993).

> Right now, visitors not only come to the museum to learn, to study, to get non-formal education and all these heavy things but also to get amusement and fun (Interview #5, 1993).

> Visitors come to museums to learn. They also come here to have fun as well. That is why the science museum is different from any other kind of museums. Here, people come to have more interaction with exhibits and that gives them some fun (Interview #7, 1993).

The third category (two out of ten directors) brings out the difference between the student and adult visitors to museums, with respect to their intentions. Student visitors, it seems, often visit museums with the intention of learning and they do learn from the experience; but the adult group primarily visits museums to simply see what is inside them. As the directors put it:

> They (visitors) really do not come with some idea in their mind that out of this visit they are going to learn something about science. But student visitors or younger visitors come with a fundamental feeling in their mind that if they come to the museum they will learn something more interesting about science. Adult population come with their fundamental curiosity that they want to see what is inside this institution, nothing more than that. But after their first visit, maybe they might have learnt a few things just out of their observations (Interview #6, 1993).

> When a visitor comes to a science centre, how much he learns, and whether he comes to learn may not be quantitatively assumed. But I would definitely say that learning does take place. The student groups come with an objective of learning in the science centre and definitely learn some concepts of science. This has been established in an Indian context (Interview #8, 1993)

The final category (one out of ten directors) suggests that visitors to museums comprise two types of people: one with the intention of learning and the other with the intention of having fun. As one director put it:

> There are two types of people: first, those who come for learning and second, those who come for just seeing or for having fun (Interview #2, 1993)

Underlying all these categories, there emerges a view that people visit the science museum or science centre not only for learning, but also to have fun. Implicitly or explicitly all the directors tend to differentiate the kind of learning that takes place in museums with that which takes place in the 'formal' or 'school' setting. This may be due to the traditional meaning attached to the term 'learning'. They all agreed that learning does take place in the museum irrespective of whether or not the visitors have this intention, but they also feel that museum learning can not be measured, unlike school learning. This feeling was also echoed by Barnard and Loomis (1994), who, arguing that the museum exhibition is a visual learning medium, concluded that interpretative information learned in a museum setting may not be accessible by the recall method of testing, as the information may return to mind when a person sees the interpreted object or a picture of the object again.

None of the directors sees any problem in accommodating the seemingly conflicting terms, *learn and fun* or *education and entertainment*. Therefore, Indian science centres could more readily follow the American-type contemporary science centre movement, which showed a mushrooming of science centres after the inception of the NCSM in 1978. Virtually all Indian science centres are mostly government-funded, unlike British science centres, which are mostly independent and privately managed. This financial freedom or availability of funding from the government might also have played key roles in the rapid growth of Indian science centres.

Indian science museums or centres attempt to make permanent and temporary exhibitions in mainly five areas in which museum visitors can learn: they are expositions of *industrial activities*, *disjointed group of exhibits*, *science and technology*, *multi-disciplinary* exhibitions and exhibitions on *eminent scientist*s.

First, the *industrial activities* are traditionally depicted using dioramas and artefacts. For example, an illustration of iron making. This trend continues in many of the earlier science museums, including the Birla Museum in Pilani, the BITM in Calcutta and the VITM in Bangalore. Some galleries at the Pilani Birla Museum have many scaled-down working models of metal industries, such as steel or iron. In the BITM, a gallery on Petroleum Iron and Steel has some working dioramas to explicate the industrial processes involved in iron and steel extracting. In the VITM, a gallery shows the processes involved in paper and timber industries.

Second, a *disjointed group of exhibits* often covers basic scientific (mostly physical) phenomena; galleries with such exhibits are often called *Popular Science* or *Fun Science* in Indian science centres. This approach to exhibition was originally pioneered by the Exploratorium in San Francisco and was later followed in science centres throughout the world including those in the UK. The Exploratory in Bristol, Techniquest in Cardiff, and Science Alive at the Snibston Discovery Park in Coalville are some of the British examples. Almost all Indian science museums or centres have one or two galleries dedicated to this approach. Some examples are the Fun Science Gallery at the National Science Centre in New Delhi, the Physical Science Gallery at the PSTC in Madras, the Children's Gallery or Popular Science Gallery at the BITM in Calcutta.

Third, exhibitions on *science and technology* include a range of topics namely electronics, electrical sciences, transport, communication, health care, energy, space, agriculture, nuclear or atomic sciences. Most of the Indian science centres have, or are planning to have, exhibitions on these areas. For example, the BITM in Calcutta and the PSTC in Madras, particularly, have exhibition galleries on Transport, Communication, Electronics, Atoms and so on. Exhibition topics such as health care, and agriculture are those which are the least covered in Indian science centres, and topics such as transport, communication and electronics are the most common.

Fourth, *multi-disciplinary* exhibitions include environment, atmosphere, sun, biotechnology and global changes. These exhibitions are called multi-disciplinary as they often present a topic from the perspectives of many different disciplines. For example, a gallery at the Regional Science Centre of Bhubaneshwar examines the sun from the perspectives of myth, science and even religion. Another example is a gallery on atmosphere, called Umbrella, at the Raman Science Centre in Nagpur, which presents the physics, chemistry, biology and sociology of atmosphere.

Finally, galleries on Indian *eminent scientists* display heritage of Indian science through the life and works of Indian scientists. To name a few, they are the Heritage Gallery in the National Science Centre at New Delhi and the Raman Gallery at the Raman Science Centre at Nagpur.

Clearly, science museum exhibitions, according to some directors, have recently become multidisciplinary to accommodate the various levels and interests of visitors although they began as discipline-based presentations such as electricity, electronics and physical science galleries.

IMPORTANT CRITERIA IN THE DEVELOPMENT OF EXHIBITIONS

As they often come from backgrounds of different disciplines, the directors consider different criteria to be more important in the development of exhibitions. While scientists emphasise the contents of exhibits and engineers emphasise the mechanical aspects of exhibits, the directors from art backgrounds emphasise the attractiveness and aesthetics of exhibits. The open-ended, or leading, question 'what are the important criteria in the development of exhibitions?' was followed by two probing questions. The first was used to find out how different levels of visitors are to be accommodated: for example by meeting just the lowest common denominator level or by meeting different levels using different exhibits or using different components in a single exhibit. The second sought opinions on combining education and fun in a single exhibit.

The 'lead' question brought out some important criteria for the successful development of exhibitions. Most of the directors felt that attractiveness was the most important criterion for a successful exhibit. Many museum studies support this view. For example, in their three factor theory of exhibit effectiveness, Shettel and his associates (1968) propounded that an effective exhibit should first attract the visitor, secondly, maintain the attraction for a considerable amount of time and thirdly, maximise the amount of visitors' learning in museums. However important and interesting an exhibit may be, no learning can occur unless the visitor stops in front of it.

The other criteria are connected, in one way or another, with form, content, mechanics and methods of exhibitions. Such things as 'aesthetics', 'friendliness or participatory nature of exhibits' may be related to the form. As far as the contents of exhibits are concerned, they are to be worthy of didactic values, extremely simple and easily understandable. The mechanical aspects of the exhibit incorporate safety, making it durable to accommodate constant handling by visitors, and making use of long lasting materials so that it survives for a reasonable period of time. The methods for conveying the content of exhibits include setting objectives, dividing topics into divisions, accommodating different age groups and presenting the exhibition mostly using the thematic approach.

After the introduction of the first 'probing' question, everyone agreed that an exhibition or an individual exhibit should cater for different intellectual levels of visitors. A few directors were of the opinion that a single exhibit can accommodate various levels from 'just seeing' to 'understanding' the concepts involved. Others counter-argued that if an exhibit meets, for example, the requirements of a novice then the concept will be so elementary and fundamental that an expert will find it very dull and not informative. For these directors, different exhibits or different components of an exhibit should meet the visitors' different levels. Some directors also felt that accommodating all the visitors' levels in an exhibit would not be possible, but that it should be attempted as far as possible.

The present study reveals at least six ways with which various levels of visitors have already been accommodated in some Indian science museums. These are: making use of dioramas, interactive and dynamic exhibits; having exhibitions on different topics; planning galleries in different modes such as permanent, travelling and temporary exhibitions; giving a real life analogy to exhibit concepts; delivering exhibit contents in different media; and using the multi-disciplinary approach to a topic.

First, dioramas and interactive or dynamic exhibits often do meet the different levels of visitors. How the diorama can accommodate a lay person as well as an informed visitor is illustrated by one director:

> I think diorama is the main thing which would be very attractive for a lay person and an educated person as well. For example, consider the diorama on the blast furnace. Even those people who have been to steel plants or have worked in steel plants, spend two minutes just to see the kind of lay-out and to take note of details they have known. They try to interpret, try to suggest, and try even to suggest to us to add a particular thing so that it certainly shows that is relevant. At the same time, the lay man who is not exposed to that field or is not knowledgeable, spent more than 5 minutes in this particular exhibit. I think that this [diorama] is attractive for all the levels of audiences (Interview #1, 1993).

The abilities of the diorama to accommodate holistic and visual learners were discussed by Williams (1988). Drawing on her personal experiences in the California Academy of Sciences and the Provincial Museum in Victoria, British Columbia, Williams argued that there is something magical about a really good diorama which stimulates the imagination by giving a context or habitat to the exhibited objects or specimens respectively. At the same time, in a Boston New England gallery, Davidson et al (1991) found that accessibility can be tremendously increased by introducing a few added elements to the simple diorama. The visual richness of the diorama can convey the completeness of the subject that can not at all be represented by any number of words. Many simple techniques can be used to enhance the effectiveness of dioramas.

Unlike dioramas, interactive exhibits mainly serve the 'sensing' types and extroverts who more often plunge in to explore the exhibit than wait to read. Similarly, dynamic or interactive exhibits may attract a greater number of visitors than passive exhibits because the former provide opportunities to touch, handle and manipulate.

Second, having exhibitions on different topics provides different people with different areas of interest. In a non-museum setting, Canfield (1983) found that people tend to have interests in different areas namely, working with people, working with things, working with language, and working with logics and mathematics. Individuals differ with their level of interest in many areas of science (for example, physical, chemical or life sciences). From the museum side, visitors to the Franklin Institute Science Museum of Philadelphia give credence to the above hypothesis when 46% of them are found to be interested in physical science, 45% in biological sciences, 45% in social science, and only 17% in mathematics (Borun, 1977). Clearly, setting up exhibitions in various sciences and areas would provide more opportunities for more visitors.

Third, planning exhibitions in different modes (such as permanent, temporary, travelling and mobile exhibitions) will also cater for different populations. For instance, a permanent exhibition may cater for those who can afford to visit the museum, who live in cities and who are first-time visitors. A temporary exhibition, on the other hand, would encourage people to visit again. A travelling exhibition would cater for a large population as it can travel from one city to another; and it also creates an opportunity for small museums to set up a new exhibition within a reasonable budget, thereby encouraging repeat visits. A mobile exhibition can mainly cater for rural people who do not often travel to cities; for people in villages this initial exposure to museum activities will perhaps act like a spring board to visit museums in cities later on.

Fourth, some people who do not share many assumptions within the scientific tradition will have difficulty in understanding scientific concepts; giving a real-life analogy to scientific concepts would accommodate these outsiders. For example, one director describes his experience with a well-known exhibit on 'Strowger Type of Telephone Exchange', which is a very common and popular exhibit in any communication exhibition throughout the world:

> They were rural folks from Bengal and Bihar. I took them round. When I explained this [Strowger Switching System] first, they couldn't immediately understand what this is about. 'This will not get into our mind!' they said. Then I told them 'no'. Suddenly I got an idea and said. Have you seen very big building? As you might have seen in Calcutta, so

> many big buildings with stair-cases, so many flats on this side and that side. They said 'yes, we have seen'. If you want to go to somebody's house how do you do it? Suppose there is a flat number, say, 58. To reach, first you start climbing vertically 5 levels, then you go counting the number in the door and when you reach the 8th door, you see the flat number 58. You have located the person. So this device also does the same thing. When you dial a number 58, or say 72, it climbs 7 vertical steps and then it counts 1, 2, so it has located the door number 72. The system sends a bell as you would knock the door after reaching the flat. So the electromechanical device which appeared funny and complicated becomes very simple to them when you draw a real life situation which they can understand because it is a physical system, which they have seen very often. So this kind of thing, I don't think the formal teachers would ever think of such things, because they are trying to teach some scientific principles and technological principles to a particular set of individuals who have a base knowledge and who are more or less homogenous in their level of understanding whereas the science museum curator is expected to impart non-formal education to a totally heterogeneous audience and that is the challenge and that is the excitement (Interview #6, 1993).

Fifth, an exhibit may be made accessible to more visitors by providing the exhibit contents in different media: video, graphics, simplified or supporting components of exhibits. One director illustrates this idea with a typical example of his experience in the Festival of Science exhibition which travelled to the USA in the late 1980s.

> You know in one of the exhibits we made for the Festival of India exhibition which we sent abroad. There was an exhibit which was showing the medieval large masonry observatories which were built around the middle of the 17th century in Jaipur, New Delhi and other places. We very faithfully reproduced the scaled down replica of the real things; but we found that handling and understanding them are a bit difficult, and only few people can understand what message we wanted to convey. So we had to supplement the exhibit with a video of what one has to do, many graphics and a few simplified small exhibits showing components by components, parts by parts, the function of the original instrument. And that really made the exhibit more comprehensive. Because some people were satisfied first to see the

> video and then they went back and handled the parts and components and understood how each part has to be handled and then they finally went back to the main replica and handled all the things and comprehended each of them (Interview #5, 1993).

Similarly, another director supports this view when he observed that ordinary people may be accommodated by giving a physical analogy to electronic concepts:

> All exhibits can not cater uniformly to all visitors. When a visitor enters, for example, a gallery on Electronics, the name definitely suggests that something concerning the latest developments in electronics will definitely be displayed. When we are dealing with such areas, particularly electronics, we have tried to expose the visitors to common phenomena. When we are trying to explain electronic oscillators, we have exposed them to a number of exhibits on pendulum; similarly for electronic filters, we exposed them to common types of sand filter, optical filters and then finally to electronic filters. So this is the approach we have to take and have taken to explain difficult topics to a common man (Interview #4,1993).

Last, the use of the multidisciplinary approach to a topic would help to accommodate more people. Simply put:

> You see we prepare exhibitions for the general public. It is not that the students who are studying physics will get something out of it. Now when I will make an exhibition on, say, Satyan Bose, the famous physicist of our country, I will not only simply deal with the physics he taught or discovered, but also I will bring in definitely a human component to it. I will bring in so many other components so that it becomes comprehensive and becomes acceptable to the general cross section of the society. Anybody coming in will get something to see, something to learn. So that is the approach (Interview #5, 1993).

> When you deal with a theme, a particular theme, you tend to touch upon all the related concepts or aspects of that particular topic and that will help all the visitors to gain or experience something. (Interview #8,1993).

This multidisciplinary approach to Sun Gallery at the Regional Science Centre in Bhubaneshwar accommodates non-scientists, as people can relate with and recognise the Sun God from the perspective of the Hindu religion. The Information Revolution Gallery of the National Science Centre in New Delhi follows this approach by attempting to explicate the information contained in different postures of the Indian classical dances, and in reconstructed cave paintings. Thus, the gallery will obviously accommodate visitors with an art background.

Recently, the Museums Journal (November 1993) brought out a feature on how this multidisciplinary approach was adopted in many British museums. One interesting example is an exhibition about parrots. This exhibition approached the topic from various angles — natural history, art, literature and humour. The natural history of parrots was mixed with sketches, prints, cartoons, costumes and knitted sculptures on parrots. Langridge (1993) found this approach was very popular particularly because it appealed to a wide range of people.

In addition to the suggestions and observations of the directors regarding the accommodation of the various levels of museum visitors within the museum exhibition, non-scientists may be further accommodated by giving interesting anecdotes behind some important scientific inventions and discoveries. For example, the story behind the Strowger Switching System may encourage ordinary people to think that a breakthrough in science or technology is not always achieved only by scientists.

The story is as follows. Almond B. Strowger, the inventor of the Switching System for the telephone exchange was by profession an undertaker in Kansas City. He found his business decreasing as more phones were installed in the city. He later discovered that the head operator who trained all the other operators was the wife of another undertaker. When someone asked for the undertaker, they were connected always to her husband. Strowger decided to do something about this and finally attempted to find a way for telephone callers to get him without going through the operators. The result of this attempt led to his invention the 'Strowger Switching System', patented in 1888. This interesting story illustrates an outsider's contribution to science, and there are many other examples. Until now we have discussed many interesting outcomes of the first 'probing' question. In what follows, I will look at the findings of the second 'probing' question.

In response to the question on 'mixing of education and entertainment', none of the science museum directors saw anything wrong in blending education with fun, but they did find things wrong when education and fun were not brought together. One director said that even in a more serious classroom teachers often crack jokes to help hold the attention of students. In the same way it was felt that entertainment or fun would help attract visitors, which was a most important criterion in the development of exhibitions. However, a few directors felt that there should be more education but less entertainment. The fun components may include magic, participation and play. For these directors, fun and entertainment are very essential elements, not as separately valid ones, but to attract visitors and accommodate their various levels — from those who want mere enjoyment to those who want learning as well. This is a right and realistic expectation in a volitional and free-choice environment like museums, where people visit by choice and it is they, not we, who can choose to learn or simply to enjoy. In order to keep this option, fun and education have to be mixed so that visitors can learn while they are enjoying. Most science museum exhibits do have these two levels and so they can be approached at the appropriate level.

EVALUATION AND VISITOR STUDIES

In order to understand what the Indian museum directors think about evaluation and visitor studies, and their use in the development of exhibitions, I have asked two 'lead' questions with a few 'probing' questions in each case (see Appendix ?).

First, when they were asked what they thought about evaluation and its application in the development of exhibitions, all directors agreed that evaluation must be carried out but admitted that it were not carried out to the level it ought to be for many reasons: these include lack of priority, funding, time and methodology. It appears that all the directors have some, if not many, misconceptions about evaluation. The directors often tend to equate evaluation with only summative evaluation, that is, measuring the success or failure of the exhibition; or sometimes they equate evaluation with the critical appraisal of the exhibition committee of the museum; or they often equate evaluation with recording and getting feedback through visitor books. Almost completely missing are the concepts of front-end evaluation, formative evaluation, remedial evaluation and roles of evaluation. This is not only the case in India as there is evidence that this and a range of other misconceptions are held by many museum professionals as observed by Hayward (1991), Hood (1991), Bitgood (1991a) and Hamberger (1991).

Second, when they were asked 'What do you think about seeking opinions from visitors and the importance of visitor studies in the developmental process of exhibitions?', all directors welcomed the idea except for a few directors who suggested that visitors rather than experts would not be able to contribute to the improvement of exhibits or exhibitions. Some directors attribute the current situation of the existence of very few numbers of visitor studies to the lack of experts in the field. Most directors hesitate to admit that they have not conducted any study in their museums, but they always make a point that they have conducted some studies, which are most often found to be very informal and consisting of getting feedback from visitor's books and some complaints from visitors.

Even though most directors did not explicitly accept the lack of experts and awareness, they did expose their dissatisfaction with the few informal studies so far conducted in India. These studies do not reflect a real picture as they have two problems. First, one director defines the 'classical barrier', as he put it, as the tendency of people hesitating to be critical of the facility of the museum and their willingness to appreciate, in order to please the interviewers. This nature of people not being openly critical of others, according to another director, is rooted in the cultural tradition of India, which prohibits people from pointing out something even if it is wrong. Second, some directors also raised the difference between male and female visitors in responding to an interview or survey and suggested that the timidity of female visitors can only be overcome by having female interviewers.

None of them answered the question specifically except one, who frankly said that the reasons for not conducting evaluation in Indian museums are simply the lack of know-how, techniques and priority and nothing else:

> We never bothered about it [evaluation] till a few years ago. Now we are just thinking about it since we get the second generation staff. The first generation staff were like me. They had no idea about this. They were just told to do something as I was told to do certain thing (Interview #1; 1993).
>
> I think it [the reason for not conducting evaluation] was a question of priority. We had many other priorities on maintenance, on upkeep, on reception, and on many things like that and this [evaluation] was the least (Interview #1, 1993).

The second generation or 'younger staff' not only in Indian museums but also in British museums contributed to some pioneering evaluation studies. One example is an attitude study conducted in London, as illustrated by Hooper-Greenhill:

> During the late 1980s and early 1990s the introduction of marketing methods to museum coincided with the rise to power of younger staff who frequently held strong convictions that museums should be made more open and more democratic. These two forces both focused on audiences and their needs, and this resulted in the opening up of the issue for the first time of what people felt about museums. The combination of marketing and the move to democratise

museums led to a pioneering study in London of the attitudes towards museums of people who were not regular visitors (Hooper-Greenhill, 1995: 5).

All directors, except one who advocated the museum should conduct only informal evaluation, supported conducting major and elaborate evaluations and visitor studies. They all felt that these had immense potential in the development of exhibitions. Every one of them supported the view that museums should try to accommodate visitor's interests, if there is a conflict of interest between visitors and museums, as after all the museum is for the visitor not the other way around. The paramount importance of visitors is in the words of Hooper-Greenhill:

> Without a genuine and heartfelt conviction, a passion, on the part of museum staff to reach out to the people who will pay for their futures, those futures will not come into being. Without visitors who are concerned, fulfilled, and eager to return, museums and galleries will perish (Hooper-Greenhill, 1994: 182).

INTEREST IN SCIENCE AND THE NATURE OF THE SCIENTIFIC TEMPER

'Learning in museums', 'Exhibition development' and 'Evaluation and visitor studies', discussed so far in the earlier sections, are the main themes of the thesis. As there is no guarantee that the ideas that have been successful elsewhere can be successfully implemented in India, it is necessary for the current research to be responsive to the Indian situation. For that reason, as we have discussed above, the directors of the Indian science museums were interviewed to find out their perceptions and opinions on the issues and ideas in respect to the applicability and caveats in applying the ideas in an Indian situation. Unlike the earlier sections, the theme to be addressed now, 'interest in science and nature of the scientific temper' is not an area of priority in this thesis though it is an important and potential topic of its own.

The reasons for including this theme in the Interview study are three. Firstly, there exists a similar study *The Art of Seeing* (Csikszentmihalyi and Robinson, 1990) conducted with art museum personnel to find out the structure and content of the aesthetic experience. Secondly, a seemingly equivalent term, 'scientific temper' in science, like 'aesthetic experience' in arts, exists in India, and one of the objectives of many Indian science museums is often found to be 'inculcation or promotion of the scientific temper'. Thirdly, as a decision had been made to interview the directors of Indian science museums for the three themes, introducing another theme would not constitute any additional workload. Therefore it was decided to include a set of questions that attempted to ask the Indian directors about the nature of the scientific temper through their personal interest in science and scientific exhibits.

Scientific temper is a term used in the objective of all Indian science museums or centres including those under the NCSM. The objectives of the science museum or centre, in the words of Dr. Saroj K. Ghose, the Director General of the National Council of Science Museums at Calcutta, are 'communication of science, fostering spirit of inquiry and creativity, *inculcating the scientific temper* in the community and imparting non formal education' (Ghose, 1986: 104, emphasis mine). Similarly, one objective of the Birla and Industrial and Technological Museum is 'to inculcate and arouse *scientific [temper] awareness* among our people' (BITM, 1991; emphasis and brackets mine). In the same way, an objective of the Periyar Science and Technology Centre is to 'establish science centres in the field of propagation of scientific thought and *promotion of the scientific temper*' (TNSTC, no date; emphasis mine).

Although the term 'scientific temper' could not be located in the English dictionary, there exist a few relative terms such as 'scientific spirit', or 'scientific minded' which mean almost the same. This term has often been attributed to the first Prime Minister of India, Jawaharlal Nehru, who spoke about it. As Ghose (1992) states:

> Jawaharlal Nehru, the architect of modern India, used the term 'scientific temper' quite frequently as a goal to achieve through the science and technology planning of the country. This is something like generating a new line of thinking, a new culture, a new ethos (Ghose 1992: 88).

The true and complete meaning of it is not yet available, as evidenced by considerable confusion about its meaning. This study attempts to redress this absence by giving a reasonable account of the meaning and scope of the scientific temper and how it can be facilitated or inculcated through the activities of science centres.

Before considering the results of the qualitative analysis of this last part of the Interview study, I will first present *The Art of Seeing* study as to what are the assumptions with which it proceeded and how the phenomenon of aesthetic experience is explicated in terms of its structure and contents. Finally I will present the similarities between the two diametrically opposite phenomena: the aesthetic experience that hails from *intuition* and the scientific temper that hails from rationalistic *thinking*.

While tracing the roots of the aesthetic experience, Csikszentmihalyi and Robinson (1990) observed that the western philosophy had attempted mainly to inquire into the development of cognitive dimensions of human consciousness by studying and justifying the rational processes of the mind. The above writers also found that the western philosophy in comparison with the eastern traditions, had neglected the emotional, the intuitive, and to a lesser extent the volitional aspects of consciousness.

On the other hand, the eastern traditions' preoccupation with the non-rational elements of consciousness might have lead to the isolation of people from the awareness of the development of science and technology. This isolation might be the reason for the existence of many superstitious beliefs within Indian traditions.

The western rationalists like Alexander Baumgarten expressed dissatisfaction with the rationalistic view of consciousness. Arguing that sensations and perceptions though inherently confused are however a valuable form of knowledge, Baumgarten coined the term aesthetic as a 'way of apprehending reality in contrast to the logical thinking Descartes extracted from the flux of consciousness' (Csikszentmihalyi and Robinson, 1990: 8).

On the contrary, people from the eastern traditions found themselves amongst a plethora of superstitions and backwardness and tended to emphasise and invigorate the rational elements of consciousness with a belief that only reasoning can change the situation and make the society free from superstitions. It seems therefore that the supremacy of rational thought was revitalised in India by Jawaharlal Nehru who coined the term 'scientific temper' to mean the use of logic and the scientific method by the people to question and understand what is happening around them in all walks of life.

By comparing and recognising similarities between the criteria of the aesthetic experience (Beardsley, 1982) and their own flow experience (discussed in Chapter III of this thesis under 'motivational theories' section), Csikszentmihalyi and Robinson came up with a structure and four major dimensions for the contents of the aesthetic experience. They acknowledge that the aesthetic experience is not a single and universal reaction and is built from culturally defined contents and also from personal meanings developed throughout the individual's life.

The aesthetic experience, according to them, has four major dimensions namely perceptual, emotional, intellectual and communicative and was described as follows:

> a perceptual response that concentrated on elements such as balance, form and harmony; and emotional response, which emphasised reactions to the emotional content of the work and personal associations; and intellectual response, which focused on theoretical and art historical questions; and finally

the communicative response, wherein there was a desire to relate to the artist, or to his or her time, or to his or her culture, through the mediation of the work of art (Csikszentmihalyi and Robinson, 1990: 30).

The suggestions given by the informants in *The Art of Seeing* study to facilitate the aesthetic experience in museums include many things: these are, good lighting, less intrusive guards, more benches and rest rooms, areas conducive to calm and relaxation, refreshments and effective handling of crowds and noise. These facilities all together eliminate distractions and give the opportunity for visitors to focus attention. Having shown what Csikszentmihalyi and Robinson have done to the aesthetic experience briefly, I will now discuss how the Indian science museum directors became interested in science and what they think of the scientific temper.

In order to understand what is science and what is the scientific temper, the Interview attempted to probe in-depth about how the directors first became interested in science, and how their interest in science led to the understanding of the scientific temper and finally, to attempt to ask whether or not the scientific temper could be inculcated within the museum visitor.

Analysis of the transcribed Interview data revealed many interesting facts. First of all, the interest in science was most often generated, amongst others, by teachers, parents and the media. The launching of the sputnik is often attributed to have had tremendous impact on science education and school curriculum reformation in the US. It is also interesting to note that the media coverage of this event also aroused a director's interest in science in general and astronomy in particular. For another director, the interest in science is gradual with no particular formative incident but the whole experience in the industry sustained his interest and involvement with science. The teacher's inspiration or influence over students is another important element in the generation of interest in science. Parental influence in recognising and fostering values of science also played crucial roles. For example, a father's advice to his son to concentrate on only three subjects namely science, maths, and English, out of the six subjects; or a father's suggestion to his son to join the civil service (science institution) rather than do military service. In addition to the above three important influences that created an interest in science, there are also many others: for example, success and being awarded a prize in a science exhibition stimulates interest in science; a range of inspirations from literature and books; and the natural inclination towards observation, questioning, and involvement in projects and successful completion of them.

Apart from one director who admitted that he was aware of the term scientific temper but does not understand the meaning of it, all the other directors had a number of comments. According to them, the scientific temper has three distinct meanings: first, it is considered as an experience, something like aesthetics in the arts or some sort of feeling when exposed to scientific activities; second, it is considered as an attitude rather than an experience or a general scientific awareness, that encourages individuals to question everything and proceed in a logical or rational way; and third, it is simply an interest in science. Whereas the first and third views are supported by only a few directors, the majority support the second view and think that the scientific temper cuts across whole activities in life rather than only scientific aspects, as evidenced by the following quotes:

> The scientific temper is built in everybody irrespective of their educational qualifications. Even common day-to-day activities involve the scientific temper: for example, drying chillies in the sun, heating water by placing a bucketful under the sun-light and food preservation; making use of technology in pumping water; using a bifocal for reading newspapers even though the person does not need it otherwise; and using the video cassette recorder to record the programmes to view later at a convenient time. These are some of the activities that demonstrate the scientific temper (Interview #3, 1993).

> The scientific temper is something a person possesses. The person would be able to apply scientific thinking, or apply science, in explaining, or trying to explain, the happening (Interview #5, 1993).

> The scientific temper is not an experience but is an attitude to be rationalistic in one's life. The scientific temper is approaching problems in an analytical way. The general way of approaching science is with an open-mind (Interview #6, 1993).

> The scientific temper is too broad and should have to be split into two parts: a general non-superstitious scientific awareness and an interest in science (Interview #9, 1993).

> The scientific temper is not an experience but an experience may lead to the development of the scientific temper. It applies not only to understanding or knowing science but also to every sphere of life where the method of science can be applied. According to this, one should be logical, and should reason out before accepting any opinion that should be followed by hypothesis and generalisation. The questioning mind to some extent is initially to be developed (Interview #8, 1993).

All directors agreed that the scientific temper can be inculcated and the purpose of exhibitions is to inculcate the scientific temper, though a few admitted that it is very difficult to incorporate all the factors in exhibitions but attempts can be more easily made in special programmes to eradicate various superstitious beliefs by demonstrating various scientific principles behind them. The majority of the directors identify environment and curiosity as the important factors in the development of the scientific temper within the individual. One director points out that in order to develop the scientific temper, it is not only enough to learn from the science centre's experience but one has to encounter similar experiences in a range of other related media like TV, radio, newspapers and so on.

Csikszentmihalyi and Robinson argued that the aesthetic experience can take place anywhere including the subway or a Mexican village. It is therefore logical to extend this aesthetic experience to the scientific exhibits. As can be seen in the questions put to the directors (Appendix A), the scientific temper, scientific experience or encountering scientific projects or exhibits, is used interchangeably in this study with the assumption that they all are very closely connected. The scientific temper is most often considered by the directors as something a person possesses in the form of a scientific mind or mood. So, the term 'scientific experience' can be more effectively equated to the aesthetic experience. The corresponding terms in art for the scientific mind and the scientific mood can be the aesthetic mind and the aesthetic mood, although the latter are less commonly used. The prevalence of the term 'aesthetic experience' in arts and the term 'scientific temper' or 'scientific mind' in science might suggest the artist's preoccupation with the process (experience) and the scientist's preoccupation with thinking (mind or mood).

The aesthetic experience and the scientific experience were philosophically considered as intuitive (non-rational) and thinking (rational) modes of apprehension of consciousness respectively. The aesthetic experience contains emotional, intellectual, and perceptual dimensions as captured by Csikszentmihalyi and Robinson (1990). Similarly, the scientific experience also contains emotional elements as suggested by the director's experiences with scientific exhibits in this study and what is going on in the process of learning in museums. As I have discussed elsewhere in the spiral approach (see Chapter III or Yahya 1995), visitors' exploration, or learning in its broadest sense, ranges from play to learning, or learning to play, in a cyclical fashion on a metaphorical tetrahedron of three domains of knowledge — cognitive, affective and psychomotor. These domains more closely resemble the intellectual, emotional and perceptual dimensions. Therefore, the scientific experience constitutes three dimensions, namely intellect, emotional and perceptual dimensions.

Supporting the similarities between art and science exhibits, Sudbury (1993) argues that the total separation that often exists between the arts and the sciences is both artificial and unnecessary. After thoroughly illustrating how objects can be used simultaneously in three different levels namely form, function and association, Sudbury observed that the time had already come not only to present the rational aspects but also the aesthetic and humanistic aspects of science in order to create awareness and understanding of science to the public. There exists a large body of evidence that supports the view that the aesthetic and scientific experiences are similar in their structure and dimensions of contents. The current study however can not suggest that they are the same as there may be many aspects in which they might differ. Only future studies on these lines may provide information about how they differ.

CONCLUSION

The directors of the Indian science centres have many things to say about museum learning, the important criteria in the development of exhibitions, evaluations and visitor studies and their use in the development of exhibitions, and the nature of the scientific temper.

It seems possible for museum visitors to have fun although they come with an intention of learning, or to learn despite their intention of having fun. Whereas the student visitors generally have a clear purpose of learning, the adult visitors usually visit the museum for entertainment reasons. Having recognised no problems in combining education and entertainment in the museum setting, the directors argued that effective learning is only possible when opportunities are provided for both education and entertainment. A visitor can learn in at least five areas in Indian science museums as they develop and set up exhibitions on these areas. These are industrial activities, basic sciences, science and technology, multidisciplinary subjects and eminent scientists.

The most important criteria in the development of museum exhibitions is attractiveness. There are a number criteria that fall into one of the four phases of the exhibitions: form, content, mechanics and methods of exhibitions. Museum visitors are heterogeneous as they have different intellectual levels, expectations and social obligations. To meet the various levels of the visitors, museum exhibitions should incorporate many strategies. There are six ways that the Indian science museums have already followed to accommodate people of many levels: making use of dioramas and interactive exhibits in a single setting; developing exhibitions on different and disparate topics; planning galleries in different modes namely permanent, travelling and temporary exhibitions; giving real-life analogy to exhibits; delivering exhibit contents in different media; and using the multi-disciplinary approach to a topic.

Having welcomed and recognised the importance of evaluation and visitor studies, the directors were not satisfied with the current situation in India and attributed it to the lack of experts and methodology. The second generation staff need to shoulder the responsibility by developing expertise and methodology to conduct evaluation and visitor studies of a high standard.

The scientific temper has three meanings, according to the Indian science museum directors. It may be an experience, an attitude toward science or a general interest in science. The scientific temper can be inculcated using science museum exhibits, but that has to be supplemented by other media such as newspapers, TV and radio. Parents and teachers should play their role to develop a sense of curiosity and to provide a positive environment so that people can reason out and make informed decisions. Like the aesthetic experience, the scientific experience has at least three dimensions namely intellectual, emotional and perceptual dimensions.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

INTRODUCTION

In this final chapter, I will draw together the findings from this research, both theoretical and empirical, and discuss their implications to the development of museum exhibitions in particular and museums in general. As planned, the thesis attempted to explore the nature of museum learning, the nature of the museum visitor and the nature of the museum visit based on the published research evidence and on the results of the studies conducted for this purpose in an Indian science centre. First, I will suggest in sequence a complete and coherent understanding of these three topics. Second, I will indicate how this understanding and a broad-based approach to these concepts will help develop effective museum exhibitions in Indian science museums. Third, I will present how this understanding affects the nature of museum activities beyond exhibitions. Finally I will conclude with the responsibilities that lie ahead for the children of the midnight children; I will also present some spin-offs and limitations of this present research and suggest some directions for future research.

MUSEUM LEARNING

As I have analysed and discussed in Chapter I, museums began and remained educational institutions until the Victorian period. Whereas the curatorial hegemony led to the predominance of collection, the change of the day-school code led to the subsumption of museum education into the service of school students. The 1970s and 1980s saw an upheaval in museum education. Many museums, particularly American museums, emphasised the educational roles and recognised the museums' educational potential. This can be gauged by the shift in emphasis to museum education for the public in the 1967 Belmont Report to museum education for diverse audiences in the 1992 Excellence and Equity Report of AAM.

This changing trend of museum education led to the evolution of science museums. The four-stage theory of science museum evolution suggests that the first stage museums emphasised mainly collection, the second stage museums emphasised collection with education, the third stage museums emphasised entirely education, and the fourth stage museums emphasised the right balance between collection and education.

This changing trend of museum education affected in many ways the role and responsibilities of the museum educator. On the one hand, the educational function of museums is the responsibility of all of the museum personnel, not just the educator. On the other, educators, who used to develop and deliver programmes on the installed exhibitions or use their own collection materials, were encouraged to take part not just in the designing of museum exhibitions but also in the design of the whole museum.

Since gaining independence fifty years ago, India has seen a tremendous growth of museums. Having realised the importance of science and scientific development in the amelioration of the country, the visionaries crafted government policies to support a chain of science museums. This led to the increase of science museums from none in 1947 to about thirty in 1997.

In India, science museums have also undergone reforms in responding to the global changes and to its own shifting course. In the museum education field, the educators have been brought inside the exhibition space in the form of explainers but none are at senior management level. The evaluators or audience advocates are invisible. Although Indian science museums introduced many outreach programmes and developed many interesting exhibitions in responding to the development in the science museum field, they however lagged behind in responding to the changes that were happening in the museum education field.

Museum learning is one of the many issues to which the present research sought some answers through three empirical studies. The survey attempted to find out what the Indian museum visitors thought and said about museum learning. The observation tried to capture what they actually did inside the museum. The interview sought to find out from the Indian museum directors what they thought about museum learning. I will now discuss the results of the empirical studies that relate to museum learning only.

In the survey (Chapter V), 73 per cent of the visitors to the Centre said they visited it to learn something about science and 49 per cent of them reported that their reason was also to learn how things work. A factor analysis of the dichotomous data of the fifteen reasons for the visit to the Centre resulted in six factors. The first factor that accounts for the maximum variance is what I called 'learning', as this factor is loaded by the items 'to learn something about science', 'to learn how things work' and 'to see the planetarium show'.

In the observation (Chapter VI), the six most frequent behaviours of the visitors to the Centre are manipulate (27%), look (21%), read (12%), watch (11%), follow (6%) and listen (4%). All these six behaviours, as revealed by a factor analysis, load heavily to the first factor 'learning', which accounts for 38% of the total variance. Therefore the visitors mainly learn in the Centre by listening to and watching others, looking at exhibits, following others, manipulating on their own or in order to demonstrate to others, and by reading labels and titles of the exhibits. The present research thus finds that visitors to the Centre not only say that they visit it for learning something but also demonstrate this by displaying learning-related behaviours.

In the interview study (Chapter VII), the Indian science museum directors also expressed their belief that museum visitors learn inside the museum irrespective of whether they have this intention. Museum learning, according to the directors, differs from school learning and includes fun, play and entertainment. Indian museum visitors may learn in five areas, although these may sometimes overlap. These areas are: expositions of Indian industrial activities, basic science exhibitions, exhibitions on disciplinary science and technology, multidisciplinary exhibitions, and exhibitions on eminent scientists.

In summary, the present empirical studies suggest that visitors come to the museum with an intention to learn and most of the time they conduct and utter to make sense of the exhibitions and thus the whole museum. Differing from school learning, museum learning includes not only learning facts but also play, entertainment and fun. Museum visitors therefore seem to engage in playing (a mindless learning) and learning (a mindful play). Indian science museums provide opportunities for museum visitors to learn in areas such as industrial development, science, technology and the environment.

On a theoretical level (Chapter III), I have analysed and drawn together various learning theories and some holistic museum studies to synthesise a broad-based 'spiral' approach to museum learning. The present empirical results, described briefly above and elaborately in Chapters V, VI and VII, support the nature of museum learning suggested in the 'spiral' approach.

As further evidence to the spiral approach, Diamond (1996) suggests three ways in which play helps learning: first, play provides both adults and children with experiences on which to build later learning; second, play promotes flexibility and possibly creativity in problem solving, which may or may not lead to more successful problem solving; and third, play can relieve factors that inhibit learning, such as stress. In rebuttal to a common expression of some museum personnel that 'kids seemed to run and jump through the museum, with little time for serious activity', she shows research evidence in support of a fact that the very act of running and jumping through the museum might help make serious learning possible by relaxing the learners, by familiarising them with a variety of stimuli, and sometimes by acquainting them with components that later will be relevant for a task.

Does the exhibit fail if the visitors choose not to engage in the intended task of an exhibit? No. The visitor can still make personal meaning from it, which is nothing but learning from the perspective of constructivism. The visitor in that case acquires the ability to approach a task by inventing an original solution. The construction of personal meaning and the ability to invent new solutions may in fact be more important for later learning than the communication of the exhibit's original message.

Hein (1995) supports this stance by defining learning using the theory of constructivism.

> Once we accept the idea of constructivism, i.e. the notion of the active role of the learner, then we realise that teaching and learning are not necessarily connected. If I want to ensure that my student focuses on a specific task, attends only to it and achieves a precisely specific goal, then I am likely to shape an environment in which concentration on that task is assured, and use all my verbal and other skills to 'keep the student on task'. On the other hand, if I concentrate on the conditions of learning more broadly (for example, by patterning my education on what we know about how young children learn), then I am likely to provide a rich and varied environment, a number of ways to interact with the resources that are offered, and to subscribe to the attributes that developmental, constructivist theoreticians suggest to us. But in doing so, and thus maximising the opportunities to learn, I also increase the possibilities that the learner will focus on aspects of the situation that are not of interest to me. Precisely because the environment is rich, and multiple interactions are possible, I cannot limit the attention of the learner or ensure that the focus is on a specific concept/fact or skill (Hein, 1995:191).

Comparing that school situation to the museum situation, Hein observes that a museum is a place for learning rather than teaching. Using a constructivist theory, he argues that more fruitful learning space can only be contrived if we make museum exhibitions and activities more open, ambiguous, and able to be manipulated in a variety of ways by visitors, even though we can not predict what could be learned.

Similarly, Feher (1996) suggests that our museums should take a constructivist approach to museum exhibition learning. This can be achieved by

- providing rich environments that help expand the visitors' experience with the world;
- encouraging visitors to actively make sense out of their experiences, to give meaning to what they experience;
- attempting to provide links to what they already know;
- deepening our own understanding of our visitors by observing them in action, talking to them, finding out what they think and why they think so; and
- providing ample opportunities for social interactions.

In all, the 'spiral' approach is found to explicate the nature of museum learning. There exists strong empirical, theoretical and research evidence supporting the approach.

THE MUSEUM VISITOR

The expanded concept of museum learning defines it as a collaborative process involving both the public and the staff. Silverman (1991) attributes this collaborative process to the three paradigm shifts or conceptual shifts in the field of media studies and communication theory, which draws ideas from a range of fields, namely anthropology, sociology and psychology. According to the first paradigm, the medium is considered to be all powerful and it can be effective in influencing the audiences just like an aimed bullet or hypodermic needle. The second paradigm shifts the importance completely to audiences, as they are proactive and will only take whatever they want to take from the media and not the other way around. In the third paradigm, both audiences and museums are joined together in a process of dialogue and communication is achieved through a process of negotiation or partnership.

Kavanagh (1995) identified two groups of museums with respect to exhibition communication. They are 1) absolutely unconcerned with visitors and 2) concerned with visitors but in the lowest common denominator level, without taking into account their 'socio-political circumstances, cultural backgrounds and personal interests'. Condemning both approaches to exhibitions, she advocates treating visitors as partners in a museum learning experience as 'one way of proceeding to accommodate the different objectives of visitors.'

Wallace also provides a number of examples of museum exhibitions in which the visitors are involved not just as customers but as constituents, in some UK and US museums:

> I applaud efforts to demystify and democratise museums by sharing authority with communities, involving them in planning, collecting and evaluating, and helping non-professionals to mount displays, as in the exemplary work of the Brooklyn Historical Society with Latinos, AIDs victims and others; the Chinatown History Museum's neighbourhoods collaborations; the Valentine's meetings with community spokespeople to plan and then criticise shows (including video excerpts of their opinions in the exhibitions); the extensive consultations with local reminiscence groups and the incorporation of oral histories and volunteers at Hull, the People's Story in Edinburgh and Springburn Museum in Glasgow, and the Museum of London's 'Peopling of London (Wallace, 1995: 122).

Thus, museum visitors have been made the centre of museum learning and exhibition communication. Museum visitors therefore need to be researched for who they are actually, and what they actually want from museums. Museum studies have already attempted to collect data on demographic and psychographic profiles of museum visitors. In this present research, attempts were made to capture some demographic profiles on Indian museum visitors through a survey and to extrapolate findings from a range of learning style profiles of adults in general to the nature of the museum visitor.

Through a meta-analysis of Gardner's theory of multiple intelligences, Jung's theory of personality types and some theories of learning styles, I suggest a 'weave' approach to museum learning styles to describe and explain the nature of the museum visitor (Chapter IV). According to this approach, museum visitors are simultaneously subjected to four strands of influences. They are natural, cultural, individual and collective. These four strands are woven into a fabric with four factors or levels (i.e. quadrants) namely psychological, physiological, sociological and environmental. On each level, there exist a number of dimensions along a continuum.

Dimensions such as feeling-thinking, impulsive-reflective, intrinsic-extrinsic motivation, abstract-concrete thinking, people-inanimate oriented and flexible-strict structure, constitute the psychological level. Dimensions such as strongly-weakly kinaesthetic, strongly-weakly visual, left-right brain dominant, and morning-evening time of the day, give rise to the physiological level. Dimensions such as outstanding-below average expectation, intimate-distant affiliation, alone-many of the group and high-low responsibility, form the sociological level. Dimensions such as low-bright light, formal-informal design and cool-warm temperature, constitute the environmental level.

Unlike Falk and Dierking's Interactive Experience Model and Annis's Symbolic Interactive Space Model, the 'weave' approach has gone one step ahead to incorporate many inherent factors of museum visitors by introducing a physiological level. This approach gives evidence that the biological structure within each person is equally as important as the factors outside the person.

Excepting a few, many dimensions have not yet been tested with museum visitors although they are found among adults in general and in school and college students. As adults and students are potential museum visitors, the learning style dimension can be generalised to museum visitors but with caution. The two dimensions that are found to exist among museum visitors are Jung's sensing-intuition type and Hunt's low-high conceptual types. Kolb (1978) found a relationship between learning styles and professions. For example, physicists are found be assimilators whereas sales personnel are accommodators; engineers are found to be convergers whereas journalists are divergers. As a potential museum visitor can be a physicist, a sales person, an engineer, a journalist or from any profession, it is therefore logical to extrapolate these learning styles to museum visitors. Similarly, the field independent-dependent dimension is very similar to Hunt's low-high conceptual levels. Therefore only by indirect evidence, can the learning style dimension now be generalised to museum visitors.

The present survey found who the museum visitors are (Chapter V). The visitors to the Centre consists more of males (57%) than females (43%). Three-quarters of the visitors are first-time visitors and only a quarter of them are repeat visitors. The visitors are children (6-14 years), young people (15-24 years), adults (25-49 years) and senior citizens (50+ years). Museum visitors come on their own, with their family, with their school classes or with other organised groups. Adults and males usually visit museums on their own, as a couple or in a small group while children and females participate in a more social group level, visiting the museum with their families or on school trips. The visitors may be tourists from distant places or from neighbouring places, or they may be community members from the local city. Children and young persons are more likely to come from a nearby locality whereas adults and the old people come more often from distant places.

Depending upon their gender, age group, nature of the group, place of residence and their type of visit, the visitors tend to have different sets of reasons for their visit, they tend to spend varied length of time inside the museum, and they tend to value different aspects of the museum visit.

Reasons such as 'to see specific exhibitions', and 'to show their friends' are more significant for male visitors while reasons such as 'because they like the museum', 'on a family outing', 'touring Madras', 'with school classes' and 'to bring their children' are found to influence females more significantly. Females are more likely to visit the Centre to just see what it is inside and to have fun than males. To go shopping is a significant activity for females both on the day of the visit and during their spare time. Males are more likely to watch sporting events during their spare time.

Adults most often take the decision to visit the Centre. Schools and friends are found to influence the visit of children and young persons respectively. Children, young persons and adults come from the city, the district and the faraway places respectively. Among males, children visit the Centre for fun whereas young persons visit it to learn about science; adults of above 34 years are more likely to visit the Centre to bring their children than others; adults are more likely to go for shopping on the day of the visit than children and young persons; and young persons are more likely to go to the movies and visit friends during their spare time than children and adults. Among females, young females are more likely to visit the Centre for fun than adults and children; and adults of above 25 years visit the centre to bring their children. Overall, adults are more likely to visit the Centre to see and show it to children.

Singletons, families, students and friends visit the Centre. Families constitute almost half of the visiting population. While males with their families are more likely to visit the Centre to bring their children than other males, males on their own are more likely to visit the Centre for learning how things work than other males. On the day of the visit, while students plan to do sightseeing and to visit the zoo, families plan to do sightseeing. Families are more likely to visit the Centre to have fun, to see what is inside, and to show their children than students, who mainly come just because they are on a class tour.

The centre is visited by the locals, the state-dwellers, and tourists. The locals decision to visit comes from themselves or from their schools whereas the tourists are usually receive recommendations from their families and the state-dwellers from their friends. The local males are more likely to visit the Centre for learning-related reasons, such as learning science or seeing specific exhibitions, than other males. The female tourists are more likely to visit the Centre for fun-related reasons such as having fun, family outing or touring. Similar to the local males, the male state-dwellers are more likely to have learning-related reasons than the male tourists; and like female tourists, the female state-dwellers are more likely to have fun-related reasons than the local females. Overall, the locals visit the Centre for showing their children or friends, while the state-dwellers visit for having fun and to see specific exhibitions and the tourists visit just to see. The locals usually plan to stay for longer than two hours, the tourists plan to stay for just less than an hour and the state-dwellers for little more than an hour. On the day of the visit, the locals, both females and males, visit only the Centre whereas the tourists and state-dwellers prefer to go shopping and to visit the zoo. Although the local females more often go to the movies during their spare time, they are least likely to do this on the day of the visit. In all, the locals and tourists differ many ways in visiting the Centre.

First time visitors usually visit the Centre for reasons such as 'to see what is inside the museum', 'to see the planetarium show', 'because they are touring' and 'because they are in a group tour'. Repeat visitors visit the Centre for reasons such as 'to show the Centre to their friends', and 'to see specific or special exhibitions'.

During the observation (Chapter VI), the visitors to the Centre were also found to exhibit different behaviour and to stay for different lengths of time inside the exhibitions depending on their gender, age and nature of the group. Men and boys are more likely to manipulate the exhibits and to display the teaching-related behaviours than women and girls. Children are more often found to elicit information on the exhibits than young persons. The four-person groups are more likely to watch others interacting with the exhibits and to read labels than the many-person groups. The two person-groups more often tend to look at the exhibits than the many-person groups. The holding power of the exhibition is significantly higher for the four-person group than the many-person group. So, the four-person groups, and to some extent the two-person groups, seem to learn more effectively in the museum situation. Besides the visitor characteristics, visitors behave differently in different exhibitions. They display learning-related behaviours significantly more often in the Children's Gallery than in the other four galleries of the Centre.

In summary, the museum visitor is affected by psychological, physiological, sociological and environmental factors and their dimensions. Museum visitors have therefore demographic characteristics, psychographic characteristics, and a range learning styles. Some of them are found to be barriers to access to the museum: for example, social class, poverty, educational disadvantage, ethnic and cultural background, disability and an individual's attitudes. Museum visitors tend to have different expectations and plan to stay for different periods and to plan different strategies for their museum visit depending upon their gender, age group, nature of the group, type of visit, and place of residence.

THE MUSEUM VISIT

As museum education is understood to be a core activity of the entire museum and the museum visitor has been treated as the centre of museum education, more and more attempts have been made to find out exactly what happens during the museum visit. Surveys and observations, sometimes followed by interviews, are the primary methods to know and capture what museum visitors think and actually do inside the museum. The present research sheds light on the nature of the museum visit based on the data collected during a survey and an observation and their analysis.

As discussed in detail in Chapter V, Indian museum visitors were found to spend most of their spare time on in-house activities such as watching TV and reading. Only people with a considerable amount of time, money and energy would choose to visit museums during their spare time. Even cultural factors such as education, tradition of visiting museums and social status might influence their decision to spend their leisure time inside museums. Evidently, museum visiting does not stand alone as museum visitors often combine other activities to do on the day of the visit. About 35 per cent of the visitors were found to combine other activities with visiting the Centre. They tend to visit cultural places, important places, religious places and public places. The rest of the visitors, mostly the locals, mainly visit only the Centre. Factors such as where people come from, and whether people are first-time or repeat visitors, are found to influence the visit being an exclusive or a combined one.

Although a museum visit is a time-out from the current routine activity, museum visitors do not visit the museum for its own sake. The majority of them also seem to have some clearly-defined purposes and want to do something constructive or useful. About 72 per cent of the visitors came to learn something about science; 69 per cent came to see the planetarium show; and 67 per cent came to see what is inside the museum. The visitors also came to the Centre for a number of other reasons. These total fifteen in all, fall into six major factors in their descending order of importance, as revealed by a factor analysis. The factors are learning, seeing, having fun, showing, seeing specific things and touring.

People who come with the intention of learning come mainly to learn something about science, to learn how things work and to see the planetarium show. This factor validates a hypothesis that learning is one of the most important reasons for the museum visit.

The second factor is for seeing. People on a family outing, touring Madras or simply on their own, come to the Centre to see what is inside.

The third factor supports the existence of another set of people who mainly visit museums to have fun.

The fourth factor suggests that people who come to bring their children and to show their friends, visit the Centre for mainly showing.

The fifth factor, seeing specific things, provides evidence to the existence of museum visitors who mainly visit the Centre to see a demonstration or an exhibition.

The last factor gives credence to an assumption that there are some people who visit the museum just because they are a member of a group that is visiting the museum.

Overall, visitors go to museums to seek enjoyment by having fun, showing or touring, and also to seek understanding by learning and seeing the whole museum or some specific aspects of it. These two factors, enjoyment and understanding, seem to interact in a reciprocal fashion. The more enjoyment, the more likely there will be learning. The increased learning and understanding lead to more enjoyment. This interaction signifies the role of emotion in museum learning. There is a truth in the conviction of the Indian directors that people learn in museum once they are there irrespective of their intention to learn or to have fun. So, opportunities must be increased in a museum setting for visitors to have fun and to show and share their feelings and understanding.

About 80 per cent of the visitors planned to spend just less than 2 hours on average inside the Centre. Of the remaining visitors, about ten per cent planned to stay for more than 2 hours and about 6 per cent for more than three hours. People who decide to visit only the Centre are more likely to stay for more than 2 hours than others who are more likely to stay for less than two hours (Chi-square = 7.1; df = 1; p = .007). The visitors coming for the first-time, or with fun-related reasons, are more likely to stay for less than an hour or more than three hours than the visitors repeating their visit, or those with learning-related reasons, who are more likely to stay for a period ranging from 1 hour to 3 hours. Patently, the place of residence, the type of visit and the reasons for the visit were found to influence how long visitors stayed inside the Centre.

When comparing these findings with some similar research studies in North America, Canada and Great Britain, there emerged some similarities and differences.

Similar trends were that people hear about museums mainly through word of mouth; media always plays a low profile; people prefer to spend their spare time doing some in-house activities; although learning is the main reason for the museum visit, there are also other fun-related reasons; the length of stay inside the museum is found to be about two hours. The main difference found was that Americans are more likely than Indians to visit the museum for fun. So far, I have discussed the nature of the museum visit based on what museum visitors thought and said. In what follows, I will discuss more specifically a typical visit inside a science centre in terms of what visitors actually do.

During the observation (Chapter VI), visitors were observed to turn left inside the exhibition hall. The present study resembles Alt's (1982) finding that visitors to the London Natural History Museum turn left but does not support Melton's (1935) observation that American visitors turn right. The 'left invariant' observed with museum visitors in India and Britain, or the 'right invariant' habit of American museum visitors, suggest an important point that people negotiate space using the prevailing traffic rule in their respective countries. Museum visitors were also found to exhibit exit gradient and museum fatigue. Although Stevenson (1991) and Alt (1982) could not find evidence for the existence of museum fatigue in science museums, the present study supports the original finding of Melton (1935) that it does exist.

Museum visitors were observed to display sixteen behaviours during their visit. Manipulating and looking at exhibits were found to be the most dominant as they each contributed to about a quarter of the total behaviours which occurred and together they constituted almost half of the total occurrences. A quarter of the behaviours were reading labels and other exhibit materials, watching others interacting with exhibits and following or joining others in different exhibits. So, manipulate, look, read, watch and follow together accounted for about 80 per cent of the total behaviours observed. The rest of the behaviours were listening to others, behaviours which were not related to exhibits, telling people what not or what to do, explaining exhibits, showing some aspects of exhibits, initiating some activities in exhibits, asking others about exhibits, helping others, reading loud, note taking and controlling others.

According to a three-factor solution, museum visitors exhibit behaviours that mainly relate to learning, teaching and care-taking. Behaviours such as listen, watch, look, follow, manipulate and read are found to load highly with the learning factor; behaviours such as manipulate, read, explain, read aloud, show and ask others mainly combine to constitute the teaching factor; and the care-taking factor is found to combine behaviours such as help others, tell others, control others, non-exhibit, and initiate. In all, museum visitors are found to play one of the three roles - learning, teaching or care-taking. Although the learning dimension is predominant, the other two dimensions are also equally important as they indirectly help visitors learning.

Some exhibitions were found to provide more opportunities for visitors to display certain behaviours. For example, behaviours such as watch, show, read, look, listen, help others, follow and ask were observed to be more frequent in the Children's Gallery than in the Transport Gallery, the Electronic and Communication Gallery and the Physical Science Gallery. The Periyar Gallery was found to elicit the least occurrences of visitors' behaviours.

During the observation, the time spent by the visitors in front of the exhibits and in the whole centre was noted. Another Time-Visit study was also carried out to measure the total time spent inside the whole centre for a larger sample of visitors. People spent about 90 minutes inside all or some of the five galleries. Almost the same result was obtained in both the studies and suggests an indirect validity to the small-sample observation. The mean time spent by the visitors was 30 seconds in the Periyar Gallery, 703 seconds in the Transport Gallery, 742 seconds in the Physical Science Gallery, 756 seconds in Electronics and Communication Gallery and 1601 seconds in the Children's Gallery. So, the Children's Gallery is again found to hold visitors for considerably longer than other galleries.

Based on a matrix of interaction between the visitor and the exhibits, various ways of totalling the time spent in front of the exhibits by visitors are reviewed, explained and described. From reviewing the museum literature, three parameters were adopted for the exhibits. They are attracting power, holding power and average time of the exhibit. These measures are not found to be useful in comparing the effectiveness of individual exhibits as there are at least three inherent problems. First, exhibits vary in their size and in their number of components; naturally a big exhibit with many components would obviously need more time than a small exhibit with a single component. Time spent in front of these exhibits alone can not discriminate the successful exhibit. Second, exhibits come in different types; some need just viewing while others need to be manipulated. Third, exhibits are placed in different locations, for example near the entrance and near the exit. Although some authors suggested some improved measures such as holding power ratio, the present research did not attempt make use of them because they are not considered to be flawless.

Despite their limitations, the exhibit measures do contribute to provide an overall view on how the museum visitor sample exhibits and budgets his or her time inside the exhibition space. While very few exhibits attracted more than 75 per cent of the visitors and a few attracted less than 20 per cent, a substantial number of them attracted only a moderate per cent of the visitors. However, the vast majority of the exhibits could not hold the visitors for more than 30 seconds. These combined effects are visually captured by the spread of red spots in Figure 6.6. It seems that very few exhibits can attract and hold visitors for any longer periods of time. A correlation analysis reveals a moderate to strong correlation between average time and holding and attracting powers. A multiple regression analysis also suggests that the average time is a good measure as it combines the effect of both attracting and holding powers.

The ten commendable exhibits that attracted an increasing number of visitors and held them for a longer time were See Your Voice, Grain Pit, Video Game 1, Floating Ball, Fantastic Mirror and Circus of Forces in the Children's Gallery, Electric Train in the Transport Gallery, Electronic Quiz and CCTV System in the Electronics and Communication Gallery, World Clock in the Physical Science Gallery. Upon analysis (Chapter VI), all these exhibits are found to do one or more of the following things: they make some personal connections and are of relevance to the visitors; they provide movement and opportunity for interaction; they provide immediate feedback; they arouse curiosity and instil a sense of wonder; and/or they are large in size. So, the exhibit measures are also useful as they provide evidence about the interesting exhibits and allow us to identify some general points in creating further successful ones.

The exhibition galleries occupy more or less the same area. Within an exhibition, it is possible to have different types of exhibits in different locations. The influence of exhibition type and location can therefore be reduced by introducing a variety to the exhibition space. So, comparing effectiveness of exhibitions, but not exhibits, is a more realistic option. Three exhibition measures were therefore conceived. They are Attracting Power, Holding Power and Staying Power. Analysis of variance results revealed that the Attracting Power and Holding Power are found to be significantly higher in the Children's Gallery than in other galleries; similar results were also obtained from a survival analysis suggesting that the Children's Gallery retained visitors for a significantly longer period of time than did the other galleries. A correlation analysis revealed that while the staying power correlated weakly with learning, teaching and care-taking factors, the holding and attracting powers of the exhibition correlated very strongly with the learning factor, moderately with the teaching factor, and weakly with the care-taking factor. This result may provide some evidence that it is possible to increase learning opportunities by effectively designing the museum exhibition, to which I will turn in the following section.

EFFECTIVE EXHIBITION DEVELOPMENT AND BEYOND

There are a number of forces responsible for expanding the notions of museum learning and the museum visitor. Some of them are paradigm shifts in museum communication; upheavals in museum education; articulations of both museum visitors and staff on their needs and museum provisions; and evolution of museums and technology. These forces have also affected the process of museum exhibition development.

As discussed in detail in Chapter 2, the development of museum exhibitions began as an open storage approach and gradually included instructional design, spatial design and communication design. Thanks are particularly due to some visionaries such as George Brown Goode, the Bauhaus, and Otto Neurath. The present day considerations to exhibition development include many approaches, designs and methods. In science museums, exhibition development began as only objects types and it later slowly incorporated idea-oriented exhibits. In the present day, science museums attempt to develop thematic exhibitions using both objects and ideas. Overall, museum exhibitions were initially developed using the traditional approach. Due to various visionaries and institutional developments, museum exhibitions have now been developed using the team approach.

In India, science museums, being national, state-owned or independent, develop exhibitions using the traditional approach. Unlike some North American and British museums, Indian science museums have never involved educators, evaluators or a range of others who have stakes in exhibitions. Identifying this major problem, the thesis set out to contribute towards the understanding of three concepts, namely museum learning, the museum visitor, and the museum visit. While the first two made use of the educator's expertise in applying learning theories and learning styles, the last one made use of the evaluator's expertise in conducting visitor studies. What do the broad-based approach to museum learning, the fabric of the museum visitor, and the nature of the museum visit, as presented in earlier sections, have in store for making effective exhibitions? There are at least five areas in which Indian science museums would benefit from following the best approaches practised in the best museums while developing museum exhibitions. They are, a team approach to exhibition development, structuring the exhibition materials, presenting exhibitions in different modes, accommodating some individual differences, and orientation.

As it can be seen, the areas expand beyond the process of the exhibition development. The suggestions and ideas that follow will consider some of these aspects. Although the main concern of this thesis is the exhibition development, accommodation of some individual differences of museum visitors warrants provisions beyond exhibitions. At one level, a good orientation to an exhibition should not only include sign posting within the exhibition but also include sign posting about the exhibition within the whole museum. Although such work is done outside the exhibition space, it still comes within the purview of exhibition development. At another level, diversity within the museum board, although not a process of exhibition development, will increase the inclusivity of community members.

Before I proceed to present suggestions and recommendations in the following sections, a word of caution is necessary. The examples included in the recommendations are the best ones practised by best museums; obviously it is not possible or necessary to implement all of them, due to funding and other problems. The suggestions, ideas and examples are deliberately exhaustive so that museums can have a variety of options from which to choose. The suggestions to increase accessibility are presented using both prescriptive and descriptive tones. While museum practitioners would like a descriptive tone, museum academics would be pleased to see prescriptives. In the following sections I will recommend ways to increase the effectiveness of the process of exhibition development.

Team approach to the exhibition development

Based on evidence from studies and experiments conducted in the Field Museum of Natural History in Chicago, the Natural History Museum in London, and the Royal Ontario Museum in Canada, museum exhibitions developed by a team approach are more often found to be successful than exhibitions developed by the traditional approach. The team approach involves evaluators, educators and a range of other experts as well as curators and designers. Unlike the traditional approach in which the curator too often decides, the team approach provides opportunities for every one and thereby maintains and reaches a consensus on issues.

Of late, various people and institutions that have similar interests or expertise have been brought in to constitute the exhibition planning team. For example, Native Americans were involved in the planning and reconstruction process of the Maori Meeting House (Terrel, 1993); the Museum of Fine Arts in Boston involved people with disabilities and made use of the checklists prepared by the National Endowment for the Arts to assure the increasing accessibility for disabled museum visitors; Latinos and AIDs victims were involved in the making of exhibitions of Brooklyn Historical Society; and people in the community were involved in displaying their own objects in a number of museums in the UK. So, more and more people and institutions are willing to collaborate with the museum as they share common goals.

In India, science museums could follow the team approach to develop exhibition involving educators and evaluators. Educators should be appointed in a senior management level so that they can give useful inputs to exhibition development. New posts should be created for evaluators. Some small museums, or museums with problem of funding, can make use of the educator's and evaluator's expertise by collaborating with institutions such as adult education departments, universities, and some large museums. Some societies dealing with the disabled or with people with special needs can be involved to increase the accessibility for all visitors. Museum visitors should be sought for their opinion not only by involving them indirectly through surveys and research but also by bringing some of them inside the team to give their expertise to the exhibition topic.

Structure of the exhibition

In this section I will consider why and in which ways, does the exhibition need to be structured? The structuring of the exhibition plays an important role in a learning situation because people have different capabilities and they therefore may or may not structure the learning materials on their own. Greenglass (1986) found the existence of two types of museum visitors namely low-Conceptual Level (CL) type and high-CL type. He devised a study to evaluate whether people with a low-CL will prefer a more highly structured learning environment than people with high-CL. The result of the study showed that the hypothesis that low-CL individuals would score higher in response to high-structure tasks than to low-structure tasks was supported. However, the hypothesis that high-CL subjects would perform better in response to low-structure tasks was not supported, as these individuals performed equally well in either condition. These findings therefore indicate that the museum environment should be structured in order to achieve the greatest possible learning for all visitors.

While discussing history museums, Weinberg (1995) identified three important reasons for the structure of exhibitions: first, the structure enhances the didactic potential of the permanent exhibition; second, it makes the visitor internalise and recognise the structure of the exhibition that is a precondition for its success; and third, it facilitates the cognitive process that is going on in the visitor's mind. By collecting evidence from published literature, Bicknell and Mann (1993) also found that visitors appreciate a comprehensible structure to the exhibition as a whole, even if they don't follow it. So, visitors use the structure to orientate themselves within the exhibition.

Hooper-Greenhill (1994) provides five basic guidelines for structuring learning materials: first, the contents to be learnt should be limited; second, the materials should be structured into seven (plus or minus two) 'chunks', although these can be further sub-divided; third, subject matter should move from the known to the unknown, with links made with every day life; four, ideas should be expressed in as concrete a way as possible, but links between concrete and abstract ideas should not be ignored; and five, frameworks for processing the subject matter should be incorporated and the material should be evaluated.

Although structuring should be done as much as possible, there exist various difficulties. Based on Gagne's notion of the learning hierarchy, a large 'concept hierarchy' was developed for the 'Human Biology' exhibition at the Natural History Museum, London (Miles 1986). Miles observed that the 'concept hierarchy' provided a clear logical structure to the exhibition and ensured that the displays started with familiar concepts. However, he found two problems with structuring the exhibition: first, it proved to be impossible to organise the exhibition content as a whole as a true concept or learning hierarchy because of the large number of concepts included and their diverse nature; and second, the very informal nature of setting, in which visitors should be encouraged to choose their own routes through the exhibition, acts against structuring the exhibition. In spite of these limitations, the experience of structuring the 'Human biology" exhibition remained the natural history museum's chief way of sequencing ideas or generating storylines and thereby helped the visitors in exploring the subject.

The first difficulty experienced by Miles would in fact result in a more weakly structured exhibition and demonstrates another interesting point observed by Pearce. While defining three important concepts of exhibition space, namely *depth*, *ring* and *entropy*, Pearce (1995) defined *entropy* as the ease with which the viewer comprehends the structural planning of the gallery. I will not discuss about *ring* and *depth* as only *entropy* is connected with the structuring of exhibition. She identified two types of exhibitions. The first type is exhibitions with '*strong axial structures*,' '*shallow depth*' and a '*low ring factor*' which present knowledge as if it were the map of well known terrain where the relationship of each part to another, and all to the whole, is thoroughly understood; the second type is exhibitions whose plans show a high degree of entropy (or a '*weaker structure*'), '*considerable depth*', and a '*high ring factor*' and show knowledge as a proposition that may stimulate further, or different, answering propositions. Pearce concludes that these two sorts of exhibition plans offer different models of knowledge and create a different relationship between the curator and the viewer. Her conclusion therefore supports a view that an exhibition can have a strict or flexible (weaker) structure; in other words, there can be a well defined, clear but not imposing structure so that people can determine the structure of the exhibition for themselves.

There is some empirical evidence that it is possible to have flexibly structured exhibitions. A study conducted by Falk (1993) attempted to assess the difference in learning when visitors viewed the same exhibition but arranged it in two different modes, structured mode and unstructured mode. He found that the unstructured mode was more successful than the structured mode for the former permitted visitors to self-select aspects of the exhibition on which to focus. Falk's unstructured mode can be considered as a weakly structured exhibit. Falk finally recommends that the exhibition should be developed with the following three points in mind: first, there is an array of individual elements each of which is conceptually coherent; second, these elements should be arranged to make sense to the visitor, whether they are viewed in a hierarchical manner or not; and third, arrangements of these elements should not only facilitate viewing but invite visitors to choose freely their own modes of viewing.

So, the museum exhibition space should be made legible by structuring it at two different levels - the physical and conceptual levels. On a physical level, the exhibition may be designed in such a way that visitors can see all the exhibits as they enter. On a conceptual level, cognitive frameworks following Hooper-Greenhill's guidelines and landmark exhibits will help visitors structure their visit. There is also some evidence that worksheets can be effectively used to provide a conceptual structure to museum exhibitions (Canizalles De Andrade, 1989). In conclusion, although structuring the exhibition is not always easy, Indian museums must ensure that the exhibition is always structured as far as possible.

Modes of the exhibition

Modality can be defined as the capability or preference of an individual's perception through the five senses: seeing, hearing, touching, tasting and smelling. In museums, exhibitions provide visual materials (real objects, photos, graphics, movies and videos), reading materials (labels, brochures), sound recording (audio guides, ambient and animal sounds, and music), tactile experiences (touchable objects), tasting and smelling opportunities (food and organic chemicals), and kinaesthetic activities (interactives). Museum exhibitions also provide multimedia and computers in which visitors can perceive information through a combination of modalities (reading, seeing and interacting).

Tasting and smelling create unconscious cues to a learning situation. Though people generally do not attach much importance to these modes, they are very useful and unique in certain learning situations.

Taste, for example, can be a motivator in a learning situation, especially for children, as illustrated in the following interesting anecdote:

> If you want their [children] attention, feed them. My daughter's fourth grade teacher taught class the difficulties of transposing a spherical map to a two-dimensional map by drawing the world on an orange. Then she carefully peeled the orange and laid it out on the table. She could have used paper, but the fact that she used an orange and that they got to eat the orange after it was peeled totally captivated the students. The map-on-the-orange lesson is one my daughter still remembers many years later (Williams, 1988: 333).

There are very few museum objects that can be tasted! However, eating and drinking unfamiliar things in an environment is a very memorable experience. Some museums in the UK have already ventured into this area: Children eat their way into the past at Clarke Hall Educational Museum, Wakefield; a recreation of the visit by Elizabeth I in Kenilworth Castle included a lunch; and an elaborate seventeenth century meal, including fish, rabbits, and pigeons, which was prepared and eaten, watched by huge crowds in Batley Hall (Hooper-Greenhill, 1991).

Davidson et al (1991) illustrated through an evaluation study how a traditional diorama gallery can be modified to include a number of multi-sensory components to accommodate successfully all visitors including those with disabilities and specialneeds. The study was undertaken in the New England Lifezone Hall at the Boston Museum of Science. The dioramas of visual materials alone were enhanced with an audio-guide, a smell box, and animal mounts to touch and feel the parts of the animals. These modifications produced a significant alteration in visitor behaviour patterns. The time that visitors spent in the gallery was increased, the manner in which they interacted with the exhibits became more active, and they learned more from their visit to the exhibit. The evaluators found that the redundant information provided by the variety of modalities, for example hearing, smelling, seeing and touching, was clearly of value for both the general public and the specialneeds groups. In conclusion, multisensory learning opportunities not only provide a way to reach challenged audiences, but also provide an appropriate challenge for all visitors.

A similar approach was followed in the Denver Museum of Natural History's exhibition Edge of the Wild, which is a comprehensive renovation of the Colorado mammal hall. Labels, photographs and illustrations, sounds, touch specimens and simple interactives were introduced in front of each diorama. A phone in each diorama describes the setting as the visitor picks it up. The visitor can follow an animal's track on the floor to see the particular species. An evaluation found evidence to the exhibition's improved accessibility.

A study by Barnard and Loomis (1994) also suggested that providing information through multiple modalities (for example, visual and auditory), is superior to either visual alone or auditory alone. They further recommended that a brief auditory label for each exhibit can enhance the visual learning of exhibited contents. In art museums, there are a number of audio tour systems in use. They are extremely popular with visitors and they are a great interpretative tool. The audio guides generally include artists speaking about their works in museum collections that are in view, in addition to curatorial voices giving more general background information.

Of late, a number of museums have taken advantage of these research findings and have provided information through multiple media and modalities that can accommodate more people and enhance and enrich the visitor's experience in museums. More recently, in a number of American museums, a combination of 'interaction' and 'immersion' has taken away the viewing window of the traditional diorama and gives opportunity for visitors to walk right into the exhibit to have a total immersion experience. Two examples are the *Where Next, Columbus?* exhibit at the National Air and Space Museum of the Smithsonian Institution in Washington DC, and a *Butterfly House/Tropical Rain Forest* exhibit at the Houston Museum of Natural Science in Houston (Stickler, 1995).

Where Next, Columbus? is a part of the "Exploring New Worlds" exhibition and includes a realistic simulation of the surface of Mars. Using the imagery projected back to earth from the Viking orbiters and landers, a reddish 'rock' landscape was created of urethane foams to duplicate precisely the sizes, shapes, colours and textures of a section of Kasei Valles, a steep canyon on the red planet. It even appears to be coated with a thin layer of red Martian dust. A 27-metre mural and special soft lighting create the ambience of a sunrise on Mars. Visitors walk on to the simulated Martian landscape and can choose two paths. One path leads to a human habitat with a live hydro-ponic garden, which was built into the rock surface and grows lettuce, strawberries and tomatoes from seeds supplied by NASA. The other path leads to a twenty-four seat theatre where three films on space exploration are shown continuously.

The *Butterfly House/Tropical Rain Forest* exhibit at the Houston Museum of Natural Science is also an immersion environment. This includes a waterfall over 12 metres high, a replica of an ancient Mayan temple, a grotto water feature, tropical flowers, medicinal plants, a huge artificial canopy tree, live Piranha fish, blind cave fish, and thousands of butterflies. Visitors can enjoy not only the visual experience of being inside a rain forest, but also the humid atmosphere, natural odours and sounds of the jungle. Thanks to the new technology, visitor-activated sound systems controlled by computers will ensure that anyone returning to the same spot on the path will hear different jungle noises from before.

In all, while attempting to describe the immersion experience objectively, Bitgood et al (1990) found that multiple sensory inputs to the exhibit would enhance the immersion experience. Many museums of late incorporate a number of components, traditional and new technological, into the exhibition space to accommodate the five senses. While traditional diorama meets the need for the visual learners, interactive exhibits and touch-specimens meet the need of the tactile/kinaesthetic learners. Providing audio guide in exhibits would accommodate auditory learners. Taste and smell are the two senses most often ignored. Their importance in motivating learners is of late realised and applied in a number of museums. For example, many of the living history museums, science and technology museums and natural history museums make use of smell in the exhibit in creating a mood for an authentic experience. Some of them are Jorvik Viking Centre at York, the National Museum of Air and Space at Washington DC and the Houston Museum of Natural History at Houston. A number of museums, particularly life history museums in the UK, provide an opportunity for taste in learning experiences through their organised workshops or demonstrations, in which people cook and eat authentic dishes of a particular period. The new technology enables some museums to exploit all senses in a single immersion exhibit to make the learning experience memorable.

So, presenting exhibits in multiple modes creates opportunities for all visitors to learn effectively within museums. Indian museums should involve their visitors by providing graphics, labels, audio guides, multimedia presentations and computers within the exhibition setting.

Accommodation of some individual differences

Males and Females

Although men and women may differ in many physical ways, they do not differ as much in their overall level of intelligence. If there are any differences in the intellectual function, they are found in patterns of ability, as some research evidence suggests (Kimura, 1992). Men, on average, outperform women in some activities: for example, spatial tasks, mathematical reasoning, navigating through a route using spatial cues such as distance and direction, and target-directed skills. Some activities in which women, on average, outperform men are: identifying matching items, verbal fluency, arithmetic calculation, recalling land marks from a route and some precision manual tasks.

Research evidence also suggests that girls and women do not differ very much from boys and men in their attitude towards science; in the case of biology and chemistry, girls on average have a better attitude (Baker, 1992). Some museum visitors also expressed that their areas of interest are biological and social sciences (Borun, 1977).

If there exist no attitude differences and no overall intellectual differences, why then do very few girls choose science and maths careers? Baker (1992) answers that their choices are moderated by self-concept often moulded by their parents and teachers, and contextual factors such as access to scientific equipment and computers.

In the present survey and observation, men and women differ in terms of what they think and do inside the museum. More men than women visited the Centre. Men are more often found to manipulate exhibits and engage in teaching behaviour. Although they do not differ much from women in how long they spend in front of the exhibits, men stopped at a greater number of exhibits. Men and boys more often decide to visit the Centre. Women come for fun and they are more likely to go shopping on the day of the visit and during their spare time.

A research study finds that boys and girls interact differently and spend different amounts of time in five different exhibits (Kremer and Mullins, 1992). The exhibits are Water jets (aiming at targets), Bubbles (making soap bubbles), Face Paints (painting faces with water colours), Animal Lab (learning about animals), and Build-a-House (building a house). Although exhibits such as Water Jets and Face Paints fostered gender-consistent behaviours such as shooting and applying make-up respectively, the Bubbles exhibit promoted cross-gender skills as boys used social and verbal skills while girls manipulated objects and exercised spatial visualisation skills.

In conclusion, these findings suggest that exhibitions and programmes should be developed to create a gender balanced science learning environment. First, the scope of the exhibition can be broadened by selecting exhibits of different types and from different areas of science. The exhibits that promote gender-consistent behaviours should be combined with those which promote cross-gender behaviours. The exhibits should cover not only physical sciences and mathematical concepts but also social and biological sciences concepts. So, a balanced mix of, or a reduction of, the elements of design that favour one gender over the other would make information equally attractive to both women and men.

Second, exhibitions should provide more opportunities to promote girls' self-concept about themselves and the sciences. This can be achieved in a number of ways. Use of sexist language must be completely avoided because they convey different messages to boys and girls and they leave female visitors completely alienated. The exhibition team should be advised by a panel of girls to help design exhibits to suit their needs and views. Exhibition materials should deliberately include women's achievements in the field. These will provide a role model for women. Providing female explainers as role models will also encourage female visitors to exhibit cross-gender behaviours and to enhance their self-concept or self-esteem.

Third, by presenting exhibit contents using hands-on, interactive video and multimedia and computers, female visitors can be encouraged to use them. Girls should be offered special programmes that provide them with the opportunity to interact with scientific equipment and computers. In same-sex groups, girls have a greater opportunity to explore materials and take leadership roles.

Fourth and last, exhibit explainers, school teachers and parents should be educated to examine their gender stereotypes and beliefs. They must be encouraged to define their roles: for example, boys should not dominate and girls should not simply stand back and observe. Parents, especially mothers, often need positive math and science experiences. Programmes that allow parents and children to work together can change parents' perceptions of the sciences. Family Math and Family Science are two examples of high-quality programmes that encourage parents to work with their children while teaching content, enhancing self-esteem, and changing attitudes and perceptions. By following these guidelines, Indian science museums can take active roles in making female visitors feel welcomed and included.

<u>Children, Young persons and adults</u>

Childhood is a very important phase in life-long learning as children try to establish patterns of culture which will remain throughout their lives. At the age of 6-14 years, children reach the Piagetian stages of operational and formal thinking. In these stages, children should be provided with environments which are secure, well-structured and varied, engaging all their senses. The high quality education offered by museums to children at their young age will help them develop positive attitudes and aspirations toward learning, and self-esteem and socialisation. Although it is generally considered that the museum is not for the under 6s or 5s, some museums such as Norwich Castle

Museum in the UK conduct special monthly mornings of object handling and practical activities for pre-school children under 5s and their carers.

The present research finds that children come more often with their family and they are inherently curious and do not feel inhibited to ask for information. Children are ever ready to manipulate exhibits. They also have surplus energy to be consumed by running and moving.

So, an exhibition planning team must give careful thought to ergonomic and safety aspects. The heights of exhibits should be low so that children can reach for hands-on materials. The exhibits should not have any sharp edges. They also need to be made strong and robust so that they can endure rough handling by children. Audio-guides must be built into the exhibit. An ample supply of explainers should be made available within the exhibition space to answer the many curious questions.

When children reach the age of about 14 years, they have already undergone a lot of changes physically, physiologically and intellectually and have become youths or young persons. This stage might last until they reach the age of 25. At the age of 25, people on average enter familyhood and become adults. The youth stage is therefore a unique transitional decade from childhood to adulthood. In this stage, the youth have to learn many things including integration of the physical and intellectual changes they have recently undergone and the responsibilities and choices of adulthood. Young persons are particularly concerned about their self image. Opportunities for leadership roles, dramatics and demonstrations will help the youth develop greater self awareness and self-acceptance.

As the present research reveals, the youth have a higher potential for being repeat visitors. They are more likely to visit with peer groups. They are also found to be interested in serious learning. So, emulation and experimentation seem the key words for these young people. Being ambitious and seeking recognition and acceptance from their peer group, they want to break into the system; seeking direct experience and learning, they are intensely oriented toward inner growth. In another research, a majority of young people expressed a far greater desire in creative arts such as drawing, painting, or creating art exhibits than in passive visiting (Anderson, 1997).

This tendency of active participation is also reflected in two of the many Youth Alive programmes in American science museums (ASTC Newsletter, May/June 1992: 9). First, the Pathways Project at the Children's Museum, Boston, is a three-year project designed to integrate the young people into the core staff of the museum. The youth are gradually involved as casual visitors and then in programmes, community work experience or on-the-job training designed specifically for them. Second, the Explainer Program at the Exploratorium, San Francisco, provides opportunities for the young people to involve themselves to help the visitors to understand the exhibits. By conducting demonstrations, teaching, explaining and learning, the explainers can improve their leadership and communication skills.

So, the exhibition team may include an advisory group of the young people to make the exhibit more enjoyable and accessible to young visitors. But, for these young people, the whole museum environment, not just the exhibition, should be supportive and committed to integrating them into the fabric of the museum. By maintaining consistent, sustained and regular contacts, by nurturing a positive peer culture using sensible staff and mentors, and by making the museum experiences relevant to their career possibilities and education paths, the museum can serve this slice of visitors.

Adults have different needs and tastes. They are extremely varied even in their intellectual levels: some already have a large field of interest and greater understanding and confidence; others are people with disabilities, people from ethnic minorities or the unemployed. While the former may have skills to use the museum on their own, the latter may need particular kinds of learning support.

The present research finds that adults often visit the museum with their family. Some of them may use their attention and expertise to help their children or grand children integrate into the system. For that reason, adults often suggest a visit to the museum to others. Unlike the young people, adults and children are similar as they both learn in inter-generation groups. Adults and children benefit from each other by exploring the museum together, as adults tend to read aloud the exhibit labels while children tend to manipulate exhibits. There are also some adults who come to the museum for their own learning. A research in science and natural history museums finds that adults prefer objects or artefacts, things to manipulate and docents or explainers to fall back on for information (Korn, 1995).

In all, the exhibition lay-out should make use of displays 'in the round' which enable clusters of people to see, handle and discuss while retaining eye contact with each other. This is something which cannot be achieved by traditional linear displays along walls. Exhibitions should provide ample choice of practical and hand-on activities using replicas or interactives to increase social interactions across the generations. In addition to audio-guides and wall panels of labels, booklets in a lounge will help adults to read in detail while sitting comfortably. A series of lectures or events should accompany any new exhibition. For example, the Royal Museum of Scotland arranged talks and films as part of the exhibition 'Treasure Island -Robert Louis

Stevenson' to explore Stevenson's travels, his environment and friends in Hawaii and Samoa; museum guides in that exhibition gave 10-minute readings from Stevenson's work each weekend; and besides these free programmes, a book, a cassette and a teacher's pack were available for sale.

Singletons, Friends, Families and School groups

Whom people visit the museum with depends upon their age: while singletons are mostly adults and friends are mostly youths, school groups and families mostly constitute both adults and children. This association suggests that singletons and friends do not differ much in their needs from the needs of the adults and the youths respectively. Therefore whatever suggestions offered to accommodate the adults and the youths would be equally applicable to singletons and friends. Unlike singletons and friends, schools and families are institutional. As adults and children interact in these institutions, they have additional needs beyond the needs of being just children or adults. In ANOVA's language, adults and children do have their 'main-effect' needs and their 'interaction effect' needs in the nature of the group. So, I restrict my discussions in this section to the accommodation of family and school groups in the development of exhibitions and programmes.

Families play many critical roles in nurturing children's physical and intellectual growth. More than ever before families have undergone changes. There are various forms of families: extended, nuclear, single-parent and others. Although families have differing aspirations, capabilities and potentials, they adapt and influence the behaviour of their members. Families educate their members though direct teaching of values and perceptions. In this context, museums have become an attractive destination for a family outing for they are often perceived as a relaxing environment for educational and social activities of the family. So, family visitors come to museums for educational and entertainment purposes.

Research in America, Britain and India supports the view that more than half of the museum visitors constitute family members (Falk and Dierking, 1992; McManus, 1994; and the present survey). In India, parents are particularly interested to invest their time and money in the betterment of their children because the parents, when they become old, rely on their children to be cared for, India does not operate any social security system which is available in Britain and America. Living in an extended family is also another strategy for Indians to cope up with economy in the absence of public benefits. So, Indian families visit the museum mainly to bring children and for entertainment and exploration. Museum visitors in inter-generational groups such as families were found to exhibit a high frequency of manipulation, reading and explaining, and to stay for a longer duration (McManus, 1994). Family members were also found to teach each other and they were also found to be active learners (Diamond, 1986; and Hilke and Balling, 1984).

To accommodate the intellectual needs of the family members, the exhibition should be planned to include varied types of exhibits: for example, interactives, dioramas, discovery rooms and well written labels. Museum text should be written on average in a level suitable for the 12 year old. Family packs should provide activity cards and ideas to engage the family members. The overall balance permits a family group to progress through the museum at the same speed while at the same time allowing different members to view different parts of a display with some reading and others playing.

To accommodate the physical and prosaic needs of the family members, the museum should have a museum shop, a restaurant, clean toilets and ample seating places. The museum shop, besides generating revenue, also enable museum visitors to buy some specimens, objects or souvenirs to take away with them. The restaurant in a museum not only provides family members with some simple and affordable food in a clean and cheerful atmosphere but also enlivens the atmosphere with some gastronomic exhibits. For example, Birla Industrial and Technological Museum in Calcutta have a touchscreen exhibit that allows the visitor to choose food items and displays calorific values. It also explains the importance of nutrients and a balanced diet. Many science centres in America and Europe provide exhibits within the restaurant setting. More than ever before many science centres use toilets as teaching opportunities. The toilet walls in the National Museum of Natural History in Washington DC display graphics and artefacts on the history of the water closet. Toilets in The Children's Museum in Boston present comparative displays of animal droppings, audio tracks featuring animal sound and original folk music and an exhibit on the physics of sinkers and floaters. McManus (1994) feels strongly that family members are likely to stay for longer time if they can have a relaxing and refreshing break at lunch time.

Some clear marketing and ticketing strategies are also needed to encourage family visits. For example, the museum's main leaflets, brochures and publicity photographs should attempt to project family images in which children and parents have fun while playing and learning together. A pricing structure should be worked out to provide a reasonably good concession for family members when compared to single visitors. This type of discounting system can also be encouraged for any organised or touring groups.

Adults and children together also visit museums in school groups. As I have discussed in detail in Chapter 1, museum education has been understood to be the educational programmes to school groups, and museum services are understood to be the provision of eating places for the students' lunch. Although the situation is fast changing in American and British museums, it still persists in Indian museums as almost all museum programmes such as Teachers Training Programmes, Creative Ability Programmes and Science Demonstration Lectures cater for school students only. Therefore, Indian museums should attempt to diversify the scope of museum education by creating and developing museum programmes that not only emulate the class-room type of teaching methods but also encourage creative exploration of the museum exhibitions.

The present survey found that school groups form only 10% of the total museum visitors. This is also the situation in Britain (Anderson, 1997). When an adult or a child visits with a school class, the outcome of the visit is less effective than when they are with their family. Children with their school classes are less often found to exhibit learning-related behaviours and to spend less time there.

School children will benefit greatly if the exhibition contents are attempted to bear relations with the school curriculum. Developing activity packs and making them available for students and teachers will go a long way to help make their visit fruitful. Having outdoor exhibits will also help the very active children to release their energy. Besides galleries and programmes, classrooms on scientific subjects containing specimens and objects should be made available so that students can explore interactively. Although many Indian science museums are good at developing stand-alone educational programmes for school children, they must attempt to develop programmes around exhibition themes. Workshops rather than classes should be conducted for the school teachers so that they are exposed to the facilities that are available in the museum and are encouraged to plan their visit ahead. Museum staff and explainers should be given training to be sensitive to the needs of school teachers and children. Museums should also allocate their resources to provide enough facilities and provisions such as classrooms and lunchrooms. Although many museums in India provide free entry to school groups, those museums which charge the students should adopt a discounting system to encourage many schools to take advantage of the museum facilities.

<u>Community members and tourists</u>

People belong to more than one community that is defined for example by geography, religion, ethnicity, age, occupation, disability, or personal or leisure interest. The vast majority generally retain a strong sense of identity with the place in which they live. The present research found that people from the local community are the potential repeat visitors; they often suggest a museum visit to their out-of-town guests or relatives; they visit only the museum without combining any other activities; they tend to have serious learning-related reasons; and they normally spend a little more than two hours there.

People in the community are not only interested in the raw facts of science, but they are very much interested in the way science meshes with their everyday lives. Bagchi (1986), for example, describes a programme for Karias, a local community in the Purulia district of West Bengal, which aimed to transform the lives of local people. Exhibitions should attempt to make relevant connections by highlighting the achievements of the local scientists. Involving older people from the ethnic minority communities in the museum board will give some opportunity to make them feel included. Obtaining their views and of course acting on them will greatly empower them.

Tourists visit museums mainly for fun-related reasons; they more often tend to combine other activities with the museum visit and they normally plan to stay for up to one hour. For this group of people, it is essential to create exhibits that are generally enjoyable and are quick in conveying the message. Planetarium and large-screen film shows, and other light entertainment activities should be made available. Creating and installing some outdoor scientific exhibits in public places such as a shopping mall or city centre will encourage them to pay a visit to the museum later on. Designing and placing a museum web site will also increase the opportunity for overseas tourists to plan in advance before actually visiting the museum. For example, the visitor figure in the Instirute e Museo di Stoira Della Scienzer in Florence rose by 40 per cent in the summer following its arrival on the web and many of the visitors said that the web pages prompted their visit (Keene, 1997). Although this effect may be confined to less-known museums in much-visited cities, the presence of the museum in the web site will increase the chance of visitors' mediated experiences in advance of their original visit.

<u>People with disabilities and special needs</u>

Disabilities are an issue not just for the disabled but for all of us as many will lose our hearing and our mobility if we live long enough. Even the very notion of having to have 'perfect' bodies disables all. So, we all are just temporarily able bodied, to use a politically correct term. By the year 2000, approximately 50 per cent of the people in Europe and in the USA and probably more in the developing countries, will in one way or another be disabled (Schouten, 1991). As people also live longer, more than ever before they may have to live with a disability.

Culture is not a luxury; it is an essential link between the members of a community. Active participation of disabled people in the cultural life of their community is an important factor for individual growth and social integration. According to Grosbois (1991), currently one person in four in Europe and one person in three in the USA are barred from the social community because they are in some way disabled. This section of the whole population is frozen out of culture and they can not participate to enjoy the great wealth of the arts and sciences.

People generally have physical disabilities, impaired vision, impaired hearing and may be mentally disabled. Museum professionals from European countries described and explained how various museums have taken a lead in providing better facilities for the disabled (Foundation de France and ICOM, 1991). Having worked out the cost of removing barriers to the disabled, Aznarez (1991) concludes that architects and engineers must be informed that there are no insuperable obstacles other than timidity, negative attitudes and lack of professionalism to the removal of barriers to accessibility. Museum staff must be educated about the importance of the inclusion of the disabled in museum activities.

The physical accessibility can be increased not only for people using wheel chairs and walking sticks but also for older people, parents pushing prams, very young children, pregnant women and people temporarily disabled. Ramps, hand rails, lifts, and appropriately designed toilets, appropriate seating arrangements, having wheel chairs available as in the Snibston Discovery Park, Leicestershire, and avoiding sudden changes in the floor level will help the disabled feel welcome and increase their mobility and accessibility. Exhibits should be made accessible at two different heights: one at the level of an adult in a wheel chair, which is also the same level as of a standing child; and the other at the height of a normal standing adult.

People with impaired vision can be helped by providing Braille labels, large type labels and sound cassettes. Large type and catalogues and guide books can be made available so that the disabled visitors can take them home and study them later. Handrails and rubber mats of varying textures on the floor will help partially sighted and blind people to indicate the route through the exhibition.

People with impaired hearing can be helped by providing subtitles to audio-visual programmes, graphic panels and supplementary leaflets. Museum lecture can be signed from the front and spoken at the back. Providing induction loops in lecture theatres will help partially hearing impaired people. Museums can appoint some staff who can welcome deaf visitors in sign language. La Villet in Paris has one deaf member of staff.

There are people who are mentally handicapped and mentally diseased. For these people a specially designed guided tour emphasising few points and repetition will help them overcome their difficulties. The same information repeated in different ways for example, through slide shows, talks, role play and films will achieve effective communication. The programme designed for these people should attempt first to make them feel welcome and wanted and then to convey information and incite stimulation.

Exhibits should be designed to provide experiences for the able-bodied children and adults simulating what the disabled face. For example, the Inventorium in La Villet in Paris has exhibits in which children walk up or down the stairs with their legs stiffened. Similarly, another exhibit in which people travel through a tactile maze blindfolded helps to make them aware of the problems faced by the disabled.

Provide me with some information, please!

So far I have presented how various and disparate contents, facilities and provisions should be made within museums to accommodate the different needs of individual museum visitors and thereby increasing the accessibility to all. It is not enough just to have the facilities but it is essential that the users know about them. No benefit can be reaped if the users have to spend too much time to find out where and what exists or if the users are more often funnelled down the blind alleys. For example, McManus (1994) captures the resentment, exhaustion and anger of family members when a parent takes a child in a push chair through a staircase to a non-existent toilet. There are many museum visitors who are the silent victims of poor orientation. A proper and well thought out orientation plan can make visitors feel welcomed, free them from frustration and give them comfort and options so that they can plan their museum visit according to their interests, and time availability. Orientation therefore helps the museum visitors to exercise their personal choice, a key motivator for informal learning. Orientation schemes should be planned inside the exhibition and also in the whole museum.

The Indian museum situation is rather worse in terms of orientation. For example, the visitor rarely finds museum maps, an information desk, or a foyer. When museum visitors, on average, plan to stay about two hours, they can not see everything and they have to make choices. To make these choices effectively the museum must provide information such as museum maps and a foyer to sit back for a while to read the orientation materials and panels. First and foremost, the exhibition development process should therefore put the exhibition physically in its space within the whole museum. This obviously requires an updating of the orientation materials such as maps, guides and orientation panels and labels in various places.

An exhibition should provide many formal orientation systems. The exhibition floor can be marked with different foot steps or with mats of different colours or textures to guide the visitor to different areas within the exhibition. Similarly, arrows can be used to direct the visitors. Serial numbering of individual exhibits will also help the visitor not to miss out some exhibits inadvertently. A series of diffused cross reference signs within the exhibition will provide museum visitors with a conceptual framework to decipher where they are within the subject area or the exhibition.

The museum should develop and provide visitors with a welcoming foyer, an information desk, an audio-visual show, leaflets, a museum plan with maps and people in the form of explainers or guards to fall back on. The whole institution must be put into a framework. For example, a bird's eye view will give visitors a clue that the building contains a planetarium theatre, a large screen theatre, a science centre and an outdoor science park. Based on the collective wisdom, Serrell (1996) suggests that visitors spend more time and learn more if they are provided with good conceptual and spatial orientation within museum exhibitions.

Towards universal design and access

So far I have shown how museum visitors can be accommodated in museum exhibitions and in the whole museum depending upon their characteristics, special needs, expectations, and learning styles. While discussing and identifying the needs of the museum visitor, some overlapping is inevitable not only because they have more than one characteristic at any time but also because they prefer to use different skills and abilities at different times.

Things originally done to accommodate the special needs of a section of the population are also found to create opportunities for many people. For example, when the kerbs on the roads and pedestrian ways in America and Britain were levelled originally to increase the accessibility for wheel-chair users, many parents using pushchairs enjoyed the opportunity to manoeuvre conveniently. In museums, many normal visitors were found to enjoy the tactile exhibits originally created for visually impaired people. This can also be said about visual illustrations and audio-guides.

A decade ago, museum personnel thought it was impossible to make the museum accessible for all. Many were and even now are suspicious of this attempt. Their reasons are often lack of funding. But the real reasons for these museum staff may be their timidity to adapt to the change, the lack of their professional abilities, and their poor attitudes. To their shame, the best practices, cited earlier, in the best museums in America and Europe debunked the myth and stand for a mountain of evidence that it is possible and viable to make the museum meaningful and accessible intellectually and physically for all. So, 'museums for all' has already become a buzz word. Although British museums were slower than their continental and American counterparts, they recently made a real advance to the universal design of the museum. For example, the Nottingham Castle Museum and Gallery in partnership with a group of disabled people identified areas for removing barriers and will be launching a refurbishment programme soon (Conybeare, 1997).

In 1995, the American Association of Museums instituted an AAM Accessibility Award to promote the universal design and access within American museums. Boston Museum of Fine Arts received the first award for its 'John J. Auduben: Watercolour for the Birds of America' exhibition. The 1996 award was conferred upon the Denver Museum of natural history's exhibition 'Edge of the Wild'. In both exhibitions, the exhibition team worked with outside experts, including people with disabilities, and created the exhibits with greater accessibility for people with different physiques, backgrounds, interests, and abilities. Based on substantial evidence from visitor evaluation and responses of these two exhibitions, Burda (1996) successfully proves that universal design and access are realities and not just goals stated in planning documents.

It is really now time to ask ourselves where do we in India stand? It is a pity that Indian museums are nowhere nearer, as none of them is at present accessible for wheelchair users, let alone people with impaired vision and hearing. Thus Indian museums deny opportunities for a section of the population to participate in cultural pursuits. This is in no way acceptable. By designing and developing effective museum exhibitions and programmes, increasing accessibility, and providing facilities such as a museum shop, a restaurant, toilets and others as suggested earlier, the museums in India can meet the needs of different people and provide a positive museum experience for all.

SPIN-OFFS AND LIMITATIONS OF THE PRESENT RESEARCH AND RECOMMENDATIONS FOR FUTURE RESEARCH

Just before concluding this chapter, I will first present in this section two spin-offs of this research work: the meaning of scientific temper and its usefulness as found out from interviewing Indian science museum directors. Then, I will also discuss a few limitations and suggest some directions for future research.

Scientific temper, according to the Indian science museum directors, is an attitude of individuals that encourages them to proceed in a logical and rational way although it has simply been understood sometimes to mean a general interest or an experience of science. Almost all of the directors felt that museum exhibitions should attempt to inculcate scientific temper within museum visitors so that visitors are able to question the prevailing superstitions and avoid muddleheaded thinking.

Some so called scientists suffer from 'woolly thinking'. For example, Philip Lenard, the Nazi physicist, in denouncing Einstein, declared that science, like every other human product, is racial and conditioned by blood (Gross and Levitte, 1994). Such scientists often believe in the existence of ethnic essentialism, which dictates that Jews, Indians, Arabs, and Pakistanis, for example, can not make any first rank scientific contributions as their ethnicity essentially leaves a particular stamp on their thinking. But the truth is that many scientists from ethnic minorities have made outstanding discoveries in science and have been honoured with international awards.

So, rational thinking must be fostered in museum exhibitions. Some holocaust museums around the world make real contributions on this line. By presenting and broadening the concept of the Holocaust in relation to contemporary human rights, this new breed of holocaust museums creates a world wide movement for human rights (Duffy, 1997). This type of exhibition inculcates rational thinking and scientific temper to question superstition, intolerance, narrow-mindedness, prejudice, bigotry, anti-Semitism and all forms of hatred in and around the world. Science museums have a lot to learn from this new concept.

The second spin-off from this research is the use of two techniques called correspondence analysis and log-linear analysis for analysing survey data on a multivariate level. As shown in Chapter V, the correspondent analysis graphically illustrates how the reasons for the museum visit are projected in a two dimensional space. This technique is similar to the principal components analysis. Being an equivalent to the analysis of variance, the log-linear analysis attempts to capture main effects and interaction effects of independent variables to the dependent variable. In future, the nominal data from museum surveys can be analysed using these techniques as hardly any museum studies have attempted this so far.

The present research maintained its exploratory nature by studying the understanding of three holistic concepts. In the absence of previous research in Indian museums, this understanding can help develop effective exhibitions. The learning style dimensions synthesised from the published literature as in Chapter III must be viewed carefully as many of them have not been tested with museum visitors. These dimensions are, however, experimentally tested with adults and school children. Based on her reading and experience, Serrell (1996) speculates the existence of seven dimensions of learning preferences among museum visitors. Although these dimensions can be reasonably generalised to museum visitors, they need empirical support.

So, future research may be directed towards designing and constructing reliable instruments to identify museum visitors' learning style dimensions. A factor analysis of the data of the instruments will prove empirically the existence of those dimensions among museum visitors. Furthermore, each dimension can be experimentally studied so that museum learning styles are understood in greater depth.

CONCLUSION

In 1997, India celebrates its golden jubilee. During the past fifty years, Indian science museums have grown from none to about thirty. They have achieved many aims: for example, millions of Indian visitors have learnt something about science and enjoyed their leisure time. Although they have been adept in responding to the changes in many directions, Indian science museums will greatly benefit from this present research to make effective exhibitions for all. This is not impossible, although difficult.

Jawaharlal Nehru in his enthralling and moving speech recognised the importance of utterance as follows:

> Long years ago we made a tryst with destiny, and now the time comes when we shall redeem our pledge, not wholly or in full measure but very substantially. At the stroke of the midnight hour, when the world sleeps, India will awake to life and freedom. A moment comes, which comes but rarely in history, when we step out from the old to the new, when an age ends, and when the soul of the nation, long suppressed, finds utterance (Jawaharlal Nehru, quoted in Knightly, 1997).

As Indian museum visitors and staff vocalise their ideas, they can effectively participate in a dialogue to articulate the various needs of the visitor. Only by identifying and accommodating visitors' needs, can Indian science museums be made increasingly accessible.

As I have set out in the Introduction, we are in the global village bombarded with multinationals, cable TVs and internets. Being open and receptive to many foreign ideas and practices, India must equip its citizens to manage the global changes efficiently. The universal design and the best museum practices followed in America and Britain should be.given a serious thought to be adapted in Indian museums, so that our citizens can participate sensibly in the information society. The present research marks only the end of the beginning of a new era - an era in which more articulation brings in more understanding which in turn brings in excellence to our museum practices.

APPENDIX A

Questions used in the Interview with the directors of Indian science museums and centres

The interview consists of two parts. The first part will attempt to seek your opinions and to capture your perceptions about learning, evaluation, and visitor studies and their possible implications and applications in the development of exhibits. This part is primarily done to find the relevance of these ideas in the Indian setting and to capture practical difficulties and caveats in applying these theories and methods in India. The people who indeed steer and manage the science museums or centres in India can only contribute to a real and complete picture and hence making my study responsive to the stakeholders.

The second part, drawing from the director's experience in science museums or centres of India, attempts to find out what the scientific temper is and to find out various factors that constitute or control the scientific temper. It will also seek to find out how the scientific temper may be facilitated and inculcated within museum visitors.

What follows is a set of questions that will give you an idea about the nature of questions to be asked during the interview. This may also give an idea about what I intended to produce out of the interview. I remain very grateful to your inputs through the interview to my research.

<u>Questions</u>

<u>Part I</u>

1.1 What do you think about learning in your museum or centre?

Expand on visitor's agenda for learning; broad areas on which learning may occur in your museum.

1.2 What criteria do you think important in the development of exhibits?

Should the exhibits cater for all visitors uniformly or at various levels; strategies adopted in your museum or centre to accommodate various levels; fun or educational, or both, strategies adopted in the development of exhibits to motivate, arouse curiosity or make visitors learn through fun; please feel free to use any specific sample exhibits or incidents that interest you.

1.3 What is your opinion about evaluation and its use in exhibition development?

Reasons that hinder or facilitate conducting evaluation in your centre or museum; other reasons or beliefs regarding the success or the failure of evaluation

1.4 What do you think about seeking opinions from visitors about an exhibition and about the value of visitor studies in the development of exhibits?

Extent to which visitor's opinion may be sought - please elaborate with any personal or professional experiences.

1.5 How to strike a balance when there is a conflict between the liking of the visitor and the objective of your centre or museum - please elaborate with your personal or professional experiences.

Part II

General development of interest in science

2.1 Please give me a brief review of the course of your interest in science in a more general sense. Perhaps, you can begin with an account of when it was that you first became interested in science. Are there any particular experiences that really stand out for you?

2.2 I wonder if you could talk a bit about an encounter with a scientific work or a set of exhibits that you have had recently that was particularly significant for you?

2.3 What do you think it was about this experience (i. e. encountering scientific exhibits or work) that makes it particularly significant for you?

2.4 What do you think about "scientific temper"? Is it a form of experience or what else?

2.5 If we could just focus on science again, do you feel you have experienced works or exhibits in this way throughout the entire course of your career or is this something you have had to develop or that has changed somehow through your lifetime?

2.6 Do you think that there have been particular experiences that helped you develop either some special skills or your general sensitivity to science?

Discussion of scientific temper in general

2.7 So far we have talked mostly about your own interaction with science. Given your experiences, do you have a sense that there is a general way of experiencing science? or approaching scientific exhibits?

2.8 Do you think that this experience varies depending upon the person or the work or some other factors?

2.9 Do you think that there is an optimal way of interacting with or experiencing a work of science or exhibits?

2.10 Do you think that there are any essential conditions for such an optimal experience? (i.e. innate sensitivity, training, good science, etc.)

2.11 If you could have complete control of all the elements involved, how do you think about inculcating or facilitating the scientific temper?

APPENDIX B

VISITOR'S QUESTIONNAIRE - PRE-VISIT

(Used in the Survey study)

1. Date:

2. Sex

   Male Female

3. Why did you come to the museum?

   (Please check any of the reasons that apply to you)

   For fun
   Because I like museums
   To learn something about science
   To learn how things work
   To see what is in the museum
   To see a specific/special exhibition
   To see the planetarium show
   To see the demonstration
   To bring my children
   I am on a family outing
   To show my friends the museum
   I am touring Madras alone or with my family
   I am part of a group tour
   I am on a trip with my school class
   Other. What? Please fill in____________________________
   ____

4. How long do you plan to stay? (please check one)

   Less than one hour
   1-2 hours
   2-3 hours
   More than 3 hours

5. How old are you? (please check one)

   6 - 14 years
   15 - 24 years
   25 - 34 years
   35 - 49 years
   50+ years

6. Is this your first visit to the museum

   Yes No

   If yes, please go to Question 9.

7. If this not your first visit, when was the last time you came here? (please check one)

   More than 5 years ago
   1 - 5 years ago
   6 months - 1 year ago
   Less than 6 months ago

8. If you have been before, with whom did you come on your first visit?

   Family
   School class
   Friend
   Other. Who? Please fill in______________________________

   ____

9. Where do you come from?

   Madras
   Tamilnadu
   Other. Please fill in ______________________________

   ____

10. With whom did you come here?

   On your own
   Family
   Friends
   Club/society
   School class
   college/ university
   Others. please fill in______________________________

11. Whose idea was it to come today?

My own
Spouse/partner
Children's
Friend's
Family
Joint/general decision
School's/ college's
others. please fill in.________________________________

12. How did you hear about the museum? (please check as many as apply)

From friends
From relatives
In newspaper which? ____________________________
In magazine which? _____________________________
On TV
In school
Others. Please fill in.________________________________

13. What else have you done or are you planning to do in Madras today? (please check as many as apply)

Sightseeing
Shopping
Restaurant
Drama or concert
Sporting event
Zoo
Movies
Visit friends or relatives
other. please fill in.________________________________

14. What do you like to do in your spare time?

Go to movies
Watch sporting events
Go shopping
Read
Watch TV
Go to Drama or Concert
Visit friends
Other. please fill in.________________________________

APPENDIX C

Specimen of the Index Card used in the Time-Visit study

WE NEED YOUR HELP

No: 001

Please fill in the best three exhibits in this museum.

1.

2.

3.

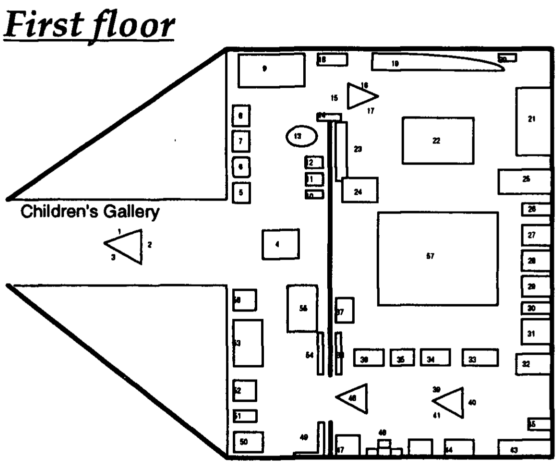
Kindly return this at the time of leaving the museum. Thanks.

Specimen of the Form used in the Time-Visit study

No.	Entry time	Exit-- time	Time	No.	Entry time	Exit-- time	Time
001				026			
002				027			
003				028			
004				029			
005				030			
006				031			
007				032			
008				033			
009				034			
010				035			
011				036			
012				037			
013				038			
014				039			
015				040			
016				041			
017				042			
018				043			
019				044			
020				045			
021				046			
022				047			
023				048			
024				049			
025				050			

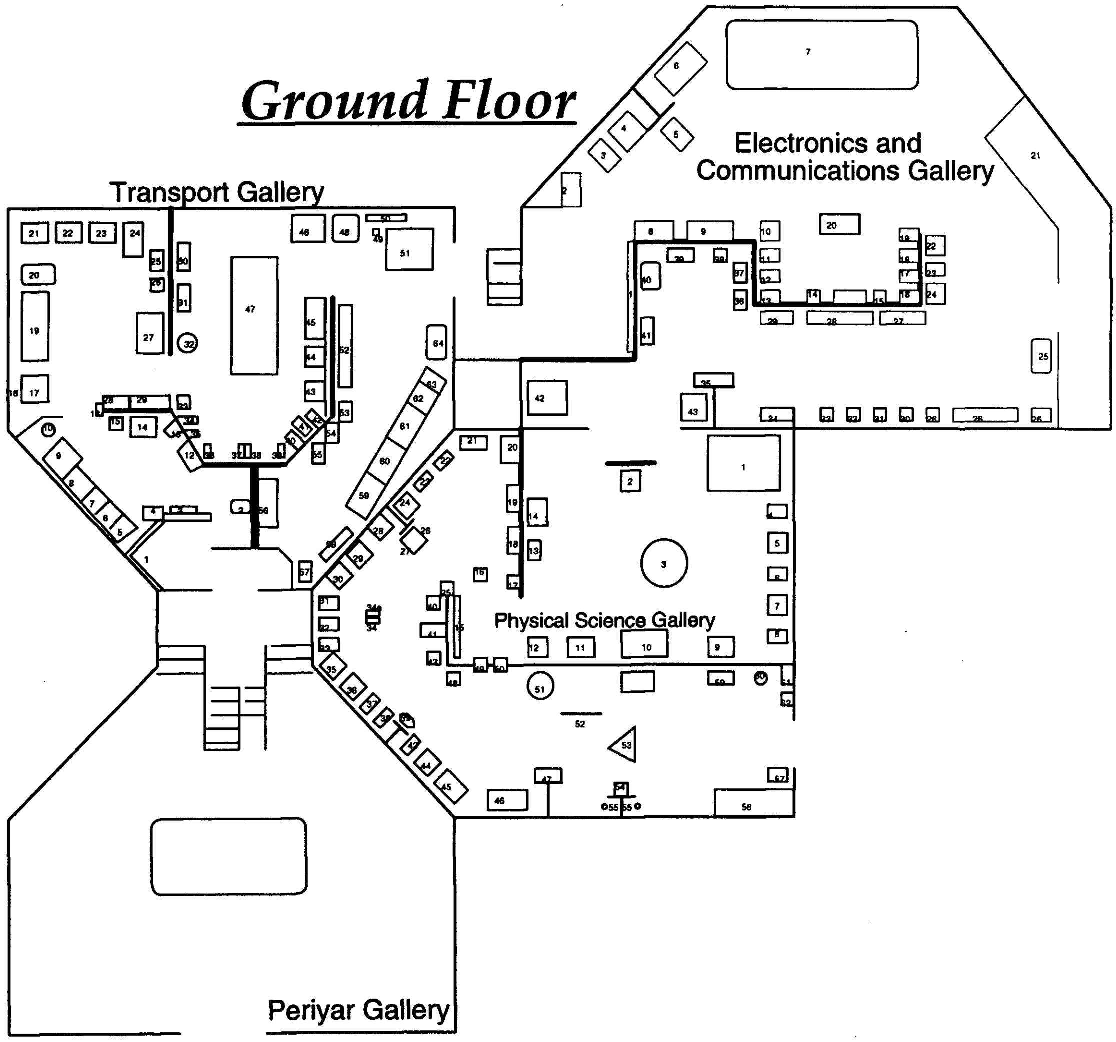
APPENDIX D

Gallery lay-out of the PSTC used in the observation form of the Tracking study



Tracking study #:
Time: _______ to _______
Date: __________

Visitor's Profile:
Alone With one person
With two person With three
With more
Age:
6-10 11-15 16-20 20+
Sex:
Male Female



APPENDIX E

The Average Time, Attracting Power, and Holding Power of the exhibits of the five galleries of the Periyar Science and Technology Centre, Madras. The number in front of each exhibit is presented with an alphabet that stands for the gallery followed by a number. PE- Periyar Gallery; C-Children's Gallery; E-Electronics Gallery; P-Physical Science Gallery; and T-Transport Gallery.

	Name of Exhibits or Galleries	Average Time (in seconds)	Holding Power (in seconds)	Attracting Power (in number)
PERIYAR GALLERY				
PE01.	Periyar Gallery	30.29	68.15	12
CHILDREN'S GALLERY				
C01.	Parrot and Cage	23.94	34.02	19
C02.	Ame's chair	36.70	52.15	19
C03.	Hyperboloid	13.18	20.93	17
C04.	Ellipse Tracing	23.27	41.88	15
C05.	Human Battery	51.40	69.39	20
C06.	See your voice	50.37	59.13	23
C07.	Minimal Surface	22.08	31.38	19
C08.	Pythagorous theorem	30.11	45.16	18
C09.	GISTNIC Booth	1.54	6.92	6
C10.	Jacob's Ladder	23.88	35.82	18
C11.	Eye Tunnel	15.39	34.62	12
C12.	Interlocked Loops	42.64	71.96	16
C13	Satellite Motion	10.38	31.15	9
C14.	Parabolas	19.21	47.15	11
C15.	Sympathetic Pendulum	30.17	50.91	16
C16.	Colour Disc	19.40	34.93	15
C17.	Newton's Cradle	2.86	9.66	8
C18.	Colour TV and Magnet	31.81	42.94	20
C19.	Train Wheel	56.90	90.38	17
C20.	Seeing is deceiving	.00		
C21.	Arch Bridge	22.22	49.99	12
C22.	Grain Pit	69.22	77.88	24
C23.	Optical Illusion	26.11	64.10	11
C24.	Bicycle Gyro	29.59	49.94	16
C25.	Cartesian Diver	22.87	47.50	13
C26.	Water Pump	18.55	29.46	17
C27.	Dancing Rings	18.44	29.29	17
C28.	Parabolic Table	16.06	36.13	12
C29.	Bernoulli's Surprise	17.55	27.87	17
C30.	Tracing Hyperbola	20.82	35.13	16
C31.	M I Table	.82	11.13	2
C32.	Video game 1	72.97	131.34	15
C33.	Perception of Depth	19.53	35.15	15
C34.	Conversion of Energy	7.69	23.08	9
C35.	Three Mirrors	2.82	8.46	9
C36.	Window Reader	59.70	89.54	18
C37.	Reaction Timer	41.22	79.50	14
C38.	Optical Illusion	5.98	32.30	5

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Name of Exhibits or Galleries		Average Time (in seconds)	Holding Power (in seconds)	Attracting Power (in number)
C39.	Constant Sum	7.18	21.55	9
C40.	Insanity Blocks	8.54	38.43	6
C41.	Double Periscope	25.59	49.35	14
C42.	Unknown exhibit	1.73	46.63	1
C43.	Triangle and Plus Puzzle	24.35	54.80	12
C44.	Video game 2	44.20	70.20	17
C45.	Kaleidoscope	33.74	50.61	18
C46.	Shape-Tower-Disc	36.59	58.11	17
C47.	Floating Ball	47.33	58.09	22
C48.	Fantastic Mirrors	37.76	46.34	22
C49.	Float in Air	35.23	52.84	18
C50.	Light Corridor	26.93	36.35	20
C51.	Multiple Reflection	3.84	17.27	6
C52.	Mathemagic	61.13	91.70	18
C53.	SPIC Model	22.32	40.17	15
C54.	Optical illusion	6.77	36.58	5
C55.	Introductory Audio	40.65	68.60	16
C56.	Cone Runs Uphill	33.21	56.04	16
C57.	Circus of Forces	126.92	163.19	21
ELECTRONICS AND COMMUNICATIONS GALLERY				
E1.	Title	.18	4.91	1
E2.	Ticket Gate	.40	10.84	1
E3.	Electronic Components	12.60	24.31	14
E4.	Fax Communication	24.97	39.67	17
E5.	Sonar and Radar	8.17	36.77	6
E6.	Satellite Communication.	46.74	66.43	19
E7.	SW Antenna	7.92	17.82	12
E8.	TV Dynamic Demo	15.26	29.43	14
E9.	C. TV Dynamic Demo	8.78	26.34	9
E10.	Electronic Toss	18.63	29.59	17
E11.	Find your Age	43.14	72.80	16
E12.	Visible- IR Detector	25.11	52.15	13
E13.	Electrical Sorting	4.60	24.86	5
E14.	Teleprinters	44.40	74.92	16
E15.	Tamil Version of 14	23.29	62.90	10
E16.	Oscillators	14.73	30.60	13
E17.	Operational Amplifier	12.33	30.25	11
E18.	Analog-digital Counter.	10.82	32.45	9
E19.	Transistor Demo	2.47	11.10	6
E20.	Things Bring Music	11.35	34.04	9

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	Name of Exhibits or Galleries	Average Time (in seconds)	Holding Power (in seconds)	Attracting Power (in number)
E21.	Model Broadcast Studio	2.62	35.33	2
E22.	Decimal-Binary Counter	11.56	31.21	10
E23.	Binary-Decimal Counter.	17.35	66.92	7
E24.	MW Transistor Receiver	4.48	15.11	8
E25.	CCTV System	44.16	54.20	22
E26	Wireless Transceiver	24.22	46.71	14
E27.	Telephone Parts	5.27	14.23	10
E28.	Introductory Audio	22.16	49.87	12
E29.	Strowger Exchange	33.60	56.70	16
E30.	Electronic Sand Glass	16.94	26.90	17
E31.	Electronic Game	37.95	51.24	20
E32.	Electronic Sirens	24.34	34.59	19
E33.	Chirping Birds	8.62	21.16	11
E34.	Cackling Hen	8.21	14.78	15
E35.	Human Chain	8.01	21.63	10
E36.	Binary Addition	23.61	57.95	11
E37.	Audio Amplifier	3.98	17.93	6
E38.	Touch Key	10.01	22.51	12
E39.	Logic Gates Demo	7.00	18.90	10
E40.	Logic Tree	8.94	21.93	11
E41.	Morse Code Tutor	21.51	44.67	13
E42.	Electronic Quiz	67.92	122.26	15
E43.	Bucket Radio	7.58	29.25	7
PHYSICAL SCIENCE GALLERY				
P1.	Our Scientists	19.87	48.77	11
P2.	Introductory Audio	5.63	15.20	10
P3.	Know the Scientists	20.08	45.19	12
P4.	Magic Water Jug	1.28	4.94	7
P5.	Heart Beat	62.50	88.81	19
P6.	Leslie Cube	13.70	23.12	16
P7.	Seebeck's Siren	19.80	33.42	16
P8.	Musical Tubes	9.66	23.72	11
P9.	Sympathetic Vibration	7.37	16.59	12
P10.	World Clock	54.24	69.74	21
P11.	Forced Oscillation	9.63	21.68	12
P12.	Magnetic. Lines of Force	20.83	28.12	20
P13.	Magnetism	11.01	22.87	13
P14.	Weight on Planets	48.22	86.79	15
P15.	Colour Shadows	1.66	22.47	2
P16.	Air Jet	4.57	20.55	6
P17.	Gravitational Lens	11.96	26.92	12
P18.	Rollers Race	17.93	37.25	13
P19.	Motion Detector	9.22	27.65	9
P20.	Motion Detection	3.06	11.80	7

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Name of Exhibits or Galleries		Average Time (in seconds)	Holding Power (in seconds)	Attracting Power (in number)
P21.	Pin Screen	21.24	71.70	8
P22.	Pythagorous Theorem.	7.63	41.20	5
P23.	Sliding and Rolling	7.32	28.23	7
P24.	Elusive Doll	14.32	32.23	12
P25.	Bobbing Bird	10.12	27.33	10
P26	Tamil Version of 27	11.90	26.77	12
P27.	Moire Patterns	1.71	15.42	3
P28.	Swinging Rings	6.29	21.23	8
P29.	Eddy Current	3.12	12.05	7
P30.	Floating Rings	4.98	19.22	7
P31.	Resonance	8.37	25.12	9
P32.	Beats	8.88	26.65	9
P33.	Lissajou's Figures	1.63	11.01	4
P34.	Touch the Spring	3.07	16.57	5
P34A.	Pin Hole Camera	.00		
P35.	Pin-hole Magnifier	12.83	31.48	11
P36.	Sight Needs Light	10.24	23.05	12
P37.	Tracing the Star	14.12	47.66	8
P38.	Gratings	4.54	13.62	9
P39.	House of Light	9.54	23.42	11
P40.	Vainu Bappu Telescope	2.05	11.07	5
P41.	Holographic Movie	27.06	60.88	12
P42.	Centrifugal Force	3.05	13.73	6
P43.	Newton's Disc	3.70	19.99	5
P44.	Spectrum of Light	5.00	16.87	8
P45.	Colours from Gas	5.29	17.87	8
P46.	Periodic Table	17.35	31.23	15
P47.	Anamorphic Drawing	6.84	23.10	8
P48.	Electric Dust	4.31	29.07	4
P49.	RNA	2.77	18.72	4
P50.	DNA	1.03	5.54	5
P51.	Proxinoscope	16.88	50.65	9
P52.	Half You -Half Me	15.07	31.29	13
P53.	Count Your Images	10.43	35.20	8
P54.	Deceptive Reflection	7.81	42.16	5
P55.	You or Me	23.65	70.96	9
P56.	Catch Your Shadow	20.40	42.38	13
P57.	Energy Disc	10.95	42.24	7
P58.	Nodes and Antinodes	11.25	27.62	11
P59.	Total Internal Reflection	7.57	18.57	11
P60.	Polarisation of Light	10.13	30.39	9
P61.	Tesla Coil	3.12	16.86	5
P62.	Mirrorly a Window	12.38	41.78	8

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	Name of Exhibits or Galleries	Average Time (in seconds)	Holding Power (in seconds)	Attracting Power (in number)
TRANSPORT GALLERY				
T1.	Development. of Transport	19.01	46.66	11
T2.	Toy Train	35.12	63.22	15
T3.	Arch (No Exhibit)	.00		
T4.	Invention of Wheel	30.92	43.94	19
T5.	R. Treveethick Loco	20.08	27.11	20
T6.	G Stephenson Loco	13.59	21.58	17
T7.	How Steam Engine Works	14.61	23.20	17
T8.	Diesel Locomotive	13.21	19.81	18
T9.	Electric Train	18.79	23.06	22
T10.	Attempts on Rail Roads	2.77	5.76	13
T11.	No exhibit	.59	7.91	2
T12.	Introductory Audio	10.86	36.65	8
T13.	Four Cdr. Engine- Model	6.80	22.95	8
T14.	Steering System	13.42	30.20	12
T15.	Gear Box- Model	10.25	30.76	9
T16.	Differential Model	7.74	41.80	5
T17.	Tractor - Model	16.08	25.54	17
T18.	Models - Cycles	6.88	30.95	6
T19.	Tractor	13.49	36.42	10
T20.	Penny Farthing	19.65	29.48	18
T21.	Perkin's Engine	12.20	27.44	12
T22.	Tata Engine	15.39	29.69	14
T23.	Viking Engine	8.04	24.13	9
T24.	Car Transmission	27.96	41.93	18
T25.	Rear Axle	7.34	13.21	15
T26.	Bullet Engine	9.83	24.12	11
T27.	Car - Model	8.83	14.90	16
T28.	Electrical System	5.76	38.85	4
T29.	Lubrication System	13.16	23.69	15
T30.	Turbo Charger	.00		
T31.	Chassis - Model	10.03	45.13	6
T32.	Karl Benz Car	4.33	14.63	8
T33.	Fuel System- Pet. En	2.59	13.99	5
T34.	Fuel System-Die En	1.83	7.05	7
T35.	Two St. diesel En.	3.26	14.66	6
T36.	Four St. Diesel En.	11.81	31.88	10
T37.	Two St. Diesel En.	3.09	9.28	9
T38.	Two St. Pet. En.	3.83	17.24	6

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	Name of Exhibits or Galleries	Average time (in number)	Holding Power (in number)	Attracting Power (in number)
T39.	Four St. Pet. En.	3.01	11.60	7
T40.	Wankel Engine	3.30	17.80	5
T41.	Synchromesh gear	9.78	26.42	10
T42.	Gear Box	17.06	32.90	14
T43.	Disc Brake System	2.66	14.39	5
T44.	Air Brake System	6.57	19.70	9
T45.	Hydraulic Brake	1.76	23.79	2
T46.	Diesel Engine	6.41	17.30	10
T47.	Working Chassis	44.30	66.44	18
T48.	Continental Engine	9.73	26.27	10
T49.	Propeller	2.78	15.02	5
T50.	Boat	2.69	72.52	1
T51.	Trainer Aircraft	65.83	88.87	20
T52.	Trading Vessel	10.85	24.41	12
T53.	MV Lok Prem Ship	1.92	17.32	3
T54.	Dredger	5.17	27.92	5
T55.	Sagar Bhushan Ship	5.78	31.20	5
T56.	Vishva Parijat Ship	11.72	79.13	4
T57.	Submarine	7.20	38.90	5
T58.	Submarine 2	7.78	35.03	6
T59.	Madras harbour 1965	5.32	17.95	8
T60.	Harbour- Model	28.67	77.40	10
T61.	Harbour (No Title)	4.70	18.11	7
T62.	Hot Air Balloon	3.26	11.00	8
T63.	Wright Brothers. Flier Model	5.80	17.39	9
T64.	Avco Lycoming Engine	8.82	23.82	10

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