THE ROLE OF SOCIAL INTERACTION IN INFORMAL LEARNING ENVIRONMENTS

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This research examines the role of social interaction in informal learning environments, focusing specifically on children visiting museums in school groups and family groups. It was hypothesized that encouraging social interaction between children (visiting a museum in school parties), and between adults and children (visiting in family groups) would be beneficial for the children, in terms of promoting learning and understanding of the museum exhibits/themes. Four studies were carried out in an attempt to assess the educational effectiveness of the museum, and the role that social interaction plays in promoting learning in such settings. The effect of social interaction on adults in family groups was also considered. Two museums were used in the studies, one presenting a historical/archaeological theme, and the other a scientific/technological theme.

Learning is examined here in terms of social, cultural and interpersonal processes, drawing on Moscovici’s (1961/76) theory of social representations and Doise’s (1978) socio-cognitive conflict hypothesis. Previous research on learning in museums has focused on individual information-processing aspects: however, the majority of people visit museums as part of a group, not as individuals. Social psychological theory and methodology were employed here in an attempt to accommodate the essentially social and informal nature of the museum visit.

Various techniques of investigation were employed, including content analysis, observation and interview procedures, and experimental interventions. Using this wide variety of techniques enabled a broader and more useful insight into the learning process.

Social interaction was found to influence learning and understanding in both school groups and family groups. However, the effectiveness of social interaction in promoting learning was dependent on several other factors, including cognitive developmental level, gender and generation influences, and the nature of the exhibit.
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1. INTRODUCTION

This chapter introduces the issues which form the main focus of this research. The fundamental question is how one should view the learning process in group situations. The group setting examined here is the museum.

The museum is of particular interest in relation to group learning, because two different worlds are represented here: the world of learning and the world of leisure.

Traditionally, museums have been concerned with the collection, conservation and display of artefacts which represent our cultural, historical and scientific heritage. The museum’s primary function has been to guard and preserve this national heritage, but in addition, through the presentation of their collections to the general public, museums fulfil an important educational role.

At the same time, the museum is a place for leisure activity. A high proportion of museum visitors are families and other groups, who come to be entertained. From this perspective, it can be seen as essentially a social setting.

Considering the museum in terms of these two different perspectives raises some interesting issues. How can these two worlds be integrated? Is the role of educator compatible with the role of entertainer? How can the museum capitalise on the social dimension in order to facilitate learning?

The first part of this chapter briefly examines the issue of learning in museums, a theme which is explored further in subsequent chapters. The latter part of this chapter gives a brief resumé of subsequent chapters.
1.1 LEARNING IN MUSEUMS

Over the last century there has been a prodigious social and technological change in Western societies, and as a result there has arisen a sharp awareness of the need to preserve that which is being rapidly replaced; it is as if we are searching for our roots and heritage. In Britain, in the last 15 years or so, there has been a vast growth of interest in preserving the past – museums, science centres, heritage and industrial archaeology centres have proliferated (Hewison 1987). In addition to this concern with the past, an awareness has developed of the need to interpret current aspects and practices in our society, and centres have opened in an attempt to bring an understanding of such activities and places as farming, the countryside and industry to a general public who may have little concrete experience of these things.

Museums themselves have been around for a long time of course. They have traditionally been concerned with the collection, conservation, study and display of objects, providing a rich and important record of man's cultural and natural heritage. The recent growing public demand to understand our past has encouraged their growth and diversification. From the beginning, museums have been seen as primarily educational establishments, although the educational goals have altered considerably over the years. It has been recognised that there is a need to put across the message of the past in everyday terms: the message should be aimed at everyone, and not merely at the specialist, as was typically the case in the past.

The alterations in the educational focus of museums, whilst reflecting social and technological developments which have occurred, have also been influenced by changes in fundamental theoretical approaches to knowledge and learning which have been developing over the last century. Psychology, as an important area of scientific research, has made a fundamental contribution to the these changes.
Developments in psychological research, especially in more recent decades, mean that learning is no longer seen simply in terms of associations, with the individual perceived as a passive receiver of external stimulus sensations. This was the view of the 19th century empiricists and early psychologists, and consequently a view on which early museum design was based. Over the century, research into perception, memory and learning has led to the recognition that the individual is in fact very active in constructing his own world of knowledge, and learning is seen as a much more complex process, influenced by many interacting psychological and social factors.

In line with advances in learning research, formal education has undergone considerable re-appraisal in recent decades; albeit the changes have occurred slowly, and often a new approach or theoretical stance will take some time to filter through the system. Nevertheless, formal education has changed dramatically as a result of the vast body of research into aspects of learning such as memory and perception - areas of investigation which have formed the building blocks of psychological theory.

Similarly, informal learning establishments, such as museums, have also reflected these changing perspectives as to how we learn: thus the way material is presented in museums nowadays is very different from the way it was presented at the beginning of the century. For example, the British Museum (Natural History), when it opened in 1881, presented an impressive but static collection of objects which were expected to speak for themselves. Nowadays the same museum recognises the need to actively encourage and facilitate learning, and emphasis is placed on the importance of interpretation, categorisation and interaction, in an effort to maximise understanding.

In particular, the new science and technology centres which have proliferated (especially in the United States) over the last few decades, have had to develop a different way of increasing the
general public's understanding of science. Since science involves an understanding of processes and relationships, this cannot be conveyed effectively by a passive display of objects. The goal of science centres is not construed as being merely to teach facts - facts can, in any case, be conveyed fairly effectively in books, films, lectures - but to help the visitor gain an understanding of the nature and processes of science. Thus active participation (the ability to physically interact with objects and to manipulate variables) has become an integral part of the educational experience offered in the modern science and technology centre, and this approach is increasingly spreading to other more conventional museums.

It can be argued, however, that the innovations which have been introduced, and the rise of the heritage industry generally, have occurred as a result of commercial interests, rather than an appreciation and awareness of developments in the theory of learning. Museums need to attract visitors, and they face increasing competition from theme parks and other new leisure facilities. Thus museums need to provide a more interesting and entertaining experience for the general public. Education is still perceived as a primary function of the museum, but education must also be fun.

It is beginning to be recognised moreover that museums, science centres, and other informal learning environments have a unique advantage when compared to schools or other more formal educational settings in our society. In schools the introduction of mass education led inevitably to the division of pupils into classes of graded abilities, and consequently achievement has traditionally been defined as progress upwards towards higher grades, status and rewards. Even today, although the segregation of different abilities has been phased out in many schools, a competitive atmosphere is still largely inherent in the school system. In primary schools, achievement is rewarded with stars and certificates; by secondary school the competitive nature of
education is even more forcefully emphasised, and reinforced by the requirements of the examination curriculum. Whilst competition may be a healthy motivating force for some, in the formal educational system the rewards are limited, and inevitably there must be losers. The constraints of the curriculum and the pressure of competition may, for many, lead to frustration rather than satisfaction.

In contrast, informal education is characterised by free choice, lack of prerequisites and credentials, heterogeneity of learner groups in background and interests, and the importance of social interaction, rather than individual effort (Laetsch 1979). In addition, informal education centres like museums, science centres and zoos, offer primary evidence. Seeing the 'real thing' as opposed to some representation of it is inherently more interesting and stimulating. Being able to look at (and perhaps touch or operate) the 'real thing' can give a visitor insight and understanding which it would be difficult to obtain from a book. Moreover, the kind of visual evidence offered by a museum or zoo can be useful at all levels of age and ability. Limited literacy skills need not inhibit or frustrate an individual's understanding in the way that it might at school.

Thus there would appear to be a great potential for encouraging learning in such environments, although the learning which occurs may differ from the kind of formal, sequential learning experienced in a classroom or from a book, and individual motivations to learn may vary widely. As Borun (1977) points out, since learning in a museum is primarily a visual and kinaesthetic experience, in this respect it differs qualitatively from classroom/book learning and indeed may involve different areas of the brain.

Yet despite this apparent potential, research on the effectiveness of museums in increasing knowledge indicates that visitors to museums actually do not learn very much (Shettel, 1973; Borun, 1977, Screven, 1974, Prince, 1984).
Research on learning in museums has largely been confined to the investigation of adult visitors, however. Yet the two main groups of visitors to museums are school groups and family groups (Laetsch et al, 1980). Very little research has investigated children's learning in a museum. In particular, little is known about learning during school field trips or in family groups. Yet for both groups, the museum offers a unique learning experience.

The museum, or other informal learning centre, is one of the few places where families can learn together, and a visit not only offers learning opportunities in a free-choice environment, but in addition may operate to strengthen family relationships. For example, Rosenfeld (1979) interviewed people visiting the San Francisco Zoo and found most of their responses related to social factors: parents emphasized that the zoo was somewhere where they and their children could do things together.

School field trips also offer a social as well as an educational experience. Whereas school groups do not generally have a choice about the field trip destination, on arrival the children will find themselves in a free-choice environment which may differ dramatically from the daily school environment. According to Gottfried (1979), in a study of school groups in science centres, most teachers view field trips as an enrichment activity which is not necessarily a continuation of school lessons. Pupils are expected to be active and exploratory, and the emphasis is on social interaction and discussion.

No research has investigated the influence of the social interaction element in relation to learning in this kind of environment, yet it is clearly an important element from the perspective of these two major visitor groups. Research into learning in museums has, however, generally been influenced by theoretical and methodological approaches drawn from cognitive-experimental psychology and formal educational theory. As a result
learning has been perceived in terms of individual cognitive processes.

This research aims to explore alternative theoretical and methodological approaches, drawn from social psychology, in an attempt to provide a more valid framework within which learning in an informal setting can be examined. Since the museum is essentially a social setting, interpersonal rather than individual aspects of learning should be focused upon, and any evaluation of learning should be assessed in the context of the social and cultural experience of the visitor. Using this perspective, the research aims to examine whether children (in both school groups and family groups) can benefit educationally from a museum visit.

1.2 RESUMÉ OF CHAPTERS

The first step in the research was to undertake a general literature review, and to identify the gaps in research. This is reported in Part 1 (Chapter 2). The findings from studies evaluating museums are examined, looking at research on attitudes, behaviour and learning. The research techniques used are explored, and the different theoretical frameworks which have directed research on learning in museums are evaluated.

Two major problems with the museum evaluation research emerge from this review of the literature. Firstly, there is an absence of clear theoretical frameworks within which the effects of a museum visit can be fully explored. Secondly, the techniques used to assess learning in museums, deriving largely from experimental and cognitive psychology and formal education, are generally inappropriate, since the focus of attention is on the individual rather than the group. The social and affective aspects of a museum visit, and how these aspects influence learning, have largely been ignored (Hallas 1985).
It also emerges that children have been neglected in this area of research. Children, in school groups and family groups, form a significant proportion of the museum visiting population, and might be expected to benefit most from a museum visit.

These issues are addressed in subsequent chapters, with Part 2 (Chapters 3 - 7) focusing on children visiting a museum in a school group, and Part 3 (Chapters 8 - 10) exploring the learning experience of the family group at the museum.

Both these investigations are carried out using a social psychological perspective, utilising Moscovici's (1961/76) theory of social representations as a broad framework, and Doise's socio-cognitive conflict hypothesis (1978) as a more specific framework within which learning can be explored. Within these theoretical frameworks, a variety of techniques of investigation are explored, in an attempt to provide a more complete explanation of learning in a museum, which takes into account the social and affective nature of the museum experience.

The first part of Chapter 3 contains a review of the literature on school visits to museums. The rest of the chapter describes the theory of social representations and evaluates its usefulness in the area of museum evaluation. Chapter 4 describes preliminary research leading to the first study (Study 1), reported in Chapter 5. This study utilises a social representations perspective in an attempt to assess whether school groups visiting a historical museum benefit educationally from their visit.

A social representations approach is useful in exploring the content of people's understanding of a museum theme; however, a more rigorous approach is needed in order to examine the processes involved in learning in museums, and how interpersonal interaction can influence this. In Chapter 6, Doise's socio-cognitive conflict approach, based on a Piagetian view of cognitive development, is described. This approach emphasises the effects of interpersonal
interaction on children's cognitive development. The applicability of a socio-cognitive developmental approach to the assessment of learning in a museum environment is explored, and Chapter 7 goes on to describe Study 2, which uses this approach to examine learning in school groups visiting a museum.

Research using the socio-cognitive conflict hypothesis has generally involved traditional Piagetian-type tasks, assessing children's operatory skills and their understanding of logico-mathematical material. Here, the model is used to examine children's understanding of history.

The first two studies lend support for the view that children's understanding of a historical theme is enhanced as a result of a museum visit, and social interaction may be an important element in the learning which occurs.

Part 3 (Chapters 8 - 10) explores these themes further, by examining the influence of socio-cognitive conflict processes in family (child-adult) groups visiting a science museum.

The first part of Chapter 8 contains a review of the literature on family groups visiting museums. The rest of the chapter examines ways of examining the family experience at the museum from a social psychological perspective. This includes examining the applicability of Doise's socio-cognitive conflict hypothesis to the investigation of learning in child-adult groups. An observational technique for the investigation of group dynamics is also described. The final part of the chapter addresses the issue of the nature of the exhibit and how this might influence learning.

Study 3 is reported in Chapter 9. This is an observational study of family interaction at three different exhibits in the Science Museum, London. The three exhibits differ in the level of participation demanded of the visitor, but they all demonstrate the same technological concept. It emerged that the exhibits
stimulated different kinds of discussion, and also some generation and gender role differentiation. Only one of the exhibits led to interactions between family members which might be conducive to the emergence of socio-cognitive conflict processes (and hence might facilitate learning).

Chapter 10 describes the final study (Study 4). This explores further the findings from the previous study, and involves comparing individual and group learning at the same three exhibits. The results again lends support to the socio-cognitive conflict hypothesis, in that children encouraged to discuss an exhibit with a parent demonstrated more understanding of the concepts underlying the exhibit than children prevented from doing so. However, the nature of the exhibit was a significant factor in stimulating useful interactions between parent and child. Significant gender differences also emerged.

The major findings of the four studies are summarised in Chapter 11, and the implications of the research are examined.
PART 1

LITERATURE REVIEW
2. LITERATURE REVIEW - RESEARCH IN INFORMAL LEARNING ENVIRONMENTS

This chapter presents a broad overview of research which has been undertaken in museums and other informal learning environments. An examination of prevailing methodologies prompts consideration of the theoretical frameworks informing research. This review seeks to identify the gaps in research, and to assess how the issue of learning has been approached by researchers in the field. Should learning in such settings be seen in terms of individual cognitive responses, or from some other perspective? At the end of the chapter an alternative approach to the assessment of learning in informal learning environments is suggested.

2.1 MUSEUM EVALUATION RESEARCH

In order to assess whether people learn in museums, and if so, how, it is necessary to evaluate the museum's effectiveness either in terms of the museum as a whole, or in terms of specific displays: do museums/exhibits convey successfully the knowledge which they are designed to convey?

Evaluation has developed into an important professional activity over the last 20 years in all spheres of life. In a museum/exhibition context, professional evaluation is recognised as a useful, indeed essential, tool and is seen as central to most exhibition planning. However, the form which the evaluation should take is subject to some debate, largely because the educational goals of museums are not clearly defined. The traditional view is that museums are primarily repositories of the world's treasures (either natural or man-made) and as such need to provide no more than concrete visual evidence which is valuable in and of itself. A more modern view is that the material presented may need to be structured and set in context in order for the visitor to properly
understand the evidence. Lucas (1983) distinguishes between this latter approach and a slightly different perspective which suggests that exhibit development should be guided by the preferences and experience of the visitors themselves.

Whilst all three positions recognise the potential for learning which exists in a museum setting, they would appear to differ in their perception of the museum visitor, and more fundamentally, in terms of how learning occurs. Whichever perspective is adopted will, to a large extent, guide the kind of evaluation research which is conducted, so that, for example, if the guiding principle is visitor preferences, much of the evaluation research will involve visitor surveys (Lucas 1983).

Evaluation can be implemented at all stages of the exhibition development. Miles (1982) distinguishes between two major types of exhibition evaluation: formative evaluation assesses and improves exhibits in their developmental stages, summative evaluation assesses the finished product. If a major concern is with assessing how effective an exhibition has been in terms of facilitating learning, this would appear to fall largely within the sphere of summative evaluation; although of course findings may be implemented subsequently in the formative stages of other exhibit planning.

Prince (1984) argues that the objectives of summative evaluation are best viewed as being arranged hierarchically from a general level to a very specific level, and isolates five levels or stages in the life of an exhibition scheme where evaluation objectives can be applied in order to generate data of summative quality. These five levels are:

Level 1: Museum policy objectives
Level 2: General Exhibition policies
Level 3: Specific exhibition objectives
Level 4: Display objectives
Level 5: Learning objectives. (Prince 1984)
Highly specialised questions relating to the transference of knowledge occur at the final level (5). Each level's objectives are defined in relation to the level preceding it, thus the categories are not mutually exclusive. Museum policy objectives (level 1) will also be generally concerned with transference of knowledge (although there will be other considerations). Thus Prince sees transference of knowledge as a major objective which pervades all aspects of museum/exhibition development.

The various methods used in summative evaluation are, of course, dependent on the kinds of questions one is seeking to answer, which not only concern learning, but also relate to which displays visitors prefer and why, which type of media they prefer, and which are most effective, and also what kind of person is attracted to the museum. However, from a perspective which sees visitor preferences as important in facilitating learning, all these aspects may be relevant when assessing the educational effectiveness of an exhibit.

Screven (1984) lists four major categories of research in museums and public exhibits:

(1) Audience surveys - visitors are sampled with respect to demographic and group characteristics, how often they visit, and reasons for visiting.

Most surveys indicate that the majority of people (excluding school groups) come in a group rather than individually, and most usually a family group (Borun 1977, Alt 1980). On the whole, museum visitors are predominantly middle-class (Klein 1974).

(2) Behaviour studies - observations of visitor behaviour in exhibition environments, involving reports of how people move and interact, how long they stay, etc.
For many years studies on visitor behaviour have focused on the 'attraction' and 'holding power' of exhibits, ie measuring the number of people attracted to a particular exhibit and the length of time spent at exhibits (Robinson 1929, Melton 1933). Falk (1982) found that, on average, the time spent looking at a particular exhibit was only 30-40 seconds; and although visitors spend, on average, two hours in a museum, only about half an hour of this time is spent looking at the exhibits, the rest of the time being taken up with visiting toilets, shop and cafe (Lucas 1983).

Clearly, there is not much time left to read the labels attached to the exhibits. Laetsch et al (1980) found that visitors to a science centre did not generally read the labels at all before interacting with an exhibit. Indeed, visitors would appear to dislike text on the whole: Lakota (1976) found that adults with children systematically avoided exhibits which contained a large proportion of text and graphics.

Other aspects which have emerged from behavioural studies include the finding that visitors have a 'right-turning tendency' when entering exhibitions, and that more time is spent near the entrance than near the exit (Melton 1933).

(3) Experimental research - studies on the effect of different independent variables (labelling, lighting, orientation systems etc.), which can be systematically varied, on visitor behaviours such as attention, learning, attitude change.

Many of the findings of behavioural observations have been used as a basis for experimental intervention. For example, using Melton's notion of a 'right-turning tendency', de Borhegyi and Hanson (in Borun 1977) showed that if people were deflected to the left, they exhibited better comprehension of exhibits.

(4) Specific evaluation studies - whilst the above procedures often have 'evaluative' aims, Screven distinguishes these from more
specific evaluative studies which are intended to assess the impact of particular exhibits, guidance devices, etc. on the learning and attitudes of visitors. This kind of study can involve elements of survey, behavioural and experimental procedures, but will have the specific aim of using the information gained in decision-making about future exhibitions. Often the evaluative data will be specific to a particular exhibition or programme and may have only limited usefulness for generalising to other museum contexts (eg Clarke's research on 'Evolving an exhibition on Evolution' (1981)). A combination of techniques may be used, including observation, interviewing and testing of target visitors.

In general, survey and behavioural methods of research concentrate on describing the kinds of people who visit museums and the preferences and attitudes which they hold, and this kind of research does not attempt to assess the effectiveness of exhibits in terms of specific knowledge gain, although it may be assumed that a popular exhibit will be more educationally effective. Experimental and evaluative studies may be concerned with assessing both preferences and learning. In assessing learning, the kinds of approaches generally used are those which focus on the manifest and measurable functions of exhibits, using techniques similar to those commonly used to assess learning in more formal settings, eg recall and recognition tests given to before and after visit samples.

In the next section, the advantages and disadvantages of the various techniques employed in museum evaluation are examined and the implications of the findings of this research are discussed.
2.2. METHODOLOGY IN MUSEUM EVALUATION RESEARCH

The main areas of concern in research on museum effectiveness are, firstly, the assessment of preferences, and secondly, the assessment of learning. These two aspects are not mutually exclusive, since an exhibit which is popular and attracts many visitors is likely to be an exhibit which people will attend to and hopefully learn from. Thus in order to properly evaluate the research findings in relation to learning, research on preferences must also be taken into account.

2.2.1. Assessing Preferences

Visitor preferences can be assessed by observations, interviews and questionnaires, and experimental intervention.

Observation

Observation is central to summative evaluation, and indeed, following visitors around is one of the oldest methods of obtaining information about the behaviour of visitors to a museum.

From observation, the 'attracting power' of particular exhibits can be calculated by simply noting how many people are attracted to an exhibit and stop in front of it. However, this requires a clear operational definition of what constitutes a 'stop' - many people may look at an exhibit without actually stopping, or stop by an exhibit without attending to it.

The 'holding power' of exhibits can also be easily calculated by noting how long visitors stay at an exhibit. Holding power has been defined by Screven (1976) as the "total minutes and seconds each visitor remains at the exhibit". However, a long time spent at an exhibit may indicate that it is difficult to understand rather than being attractive to a visitor. In any case, the comprehension of some exhibits will require less time than others (to overcome this
Miles and Tout (1979) proposed a 'holding power ratio', which is actual viewing time divided by minimum viewing time.

As noted above, most studies suggest people spend very little time observing exhibits (Robinson 1929, Falk 1982). However, Falk points out that using the mean time spent as a basis for this observation may be misleading, since visitors vary greatly in their behaviour; some visitors spend a lot of time at just a few exhibits which are of specific interest to them, whereas others attempt to take in as much of the museum as possible.

Since exhibits vary in terms of the time necessary to view them, and visitors vary in their interest and motivations, information on the attractiveness and holding power of particular exhibits would appear to have limited usefulness in terms of generalisability.

Studies of visitor orientation, however, can be useful in indicating how displays should be organised for maximum benefit. Melton's (1933) discovery of a right-turning tendency and an attention gradient in museum visitors has subsequently influenced much exhibition planning. For example, it was found that the gradient effect could be reduced by using cul-de-sacs (Miles and Tout 1979). Since this kind of information can lead to design alterations which might help to direct visitors' attention, it may also be of importance in terms of shaping visitor preferences and learning.

Other observational research has focused on interpersonal behaviour in museums. Cone and Kendall's study of family interactions at the Science Museum of Minnesota (1978) raised some interesting issues, for example, the finding that fathers directed most of their verbal behaviour towards sons and largely neglected daughters. The data for this study was obtained in two ways: by observing visitor behaviour, and by interviewing visitors. Two observers followed each family, selected at random. One observer noted the time spent at each exhibit while the other recorded the family interaction.
Both verbal interactions and movements were noted, using the following categories:

- Reads aloud
- Explains
- Questions
- Points
- Disciplines
- Separates
- Rejoins
- Leads

The results of this research raise some interesting and challenging problems for museum designers. For example, should designers be concerned with family interaction and what techniques can they employ to increase family interaction in a museum setting? Unfortunately, there is little reported research on interpersonal behaviour in a museum setting, and generally such studies restrict themselves to descriptions of behaviour and do not attempt to relate interaction patterns to visitor comprehension or attitudes. (Research on family interaction in museums is discussed more fully in Section 8.1.1.)

Whilst observations studies can be useful in guiding museum design, their usefulness is generally limited since there can be no assessment of why a visitor stops at a particular exhibit, and no analysis of what aspects of the display are attractive. The only way to properly discover visitors' motives and preferences would appear to be to engage them in conversation or interview.

Interviews and Questionnaires

Miles (1982) describes interviews as being the most ubiquitous method of data collection and outlines three different forms of interview: unstructured or non-directive, semi-structured, and fully-structured.
According to Miles (1982), the unstructured interview, allowing the subject to take the lead, is generally seen as inappropriate to exhibition evaluation, since it will only provide qualitative data. However, research in social psychology now indicates that the unstructured interview may have been generally undervalued (Harré and Secord, 1972). Farr (1982) likens unstructured interviewing, in which the interviewer engages in extensive face-to-face conversation with the interviewee, as akin to participant observation, a technique used for a long time by sociologists of the ethnomethodological school; thus the interviewer is actively involved as a participant observer, and only in this way can one develop an awareness of the social world of others. This kind of technique might be usefully applied in examining the museum experience, and has been advocated by Wolf and Tymitz at the Smithsonian institution (1979).

In semi-structured interviews, the interviewer will have more control than in an unstructured interview situation, however, neither the exact questions the interviewer asks, nor the responses the subject is permitted to make, are predetermined. Such interviews are commonly used for a more intensive study of perceptions, attitudes and motivations than a structured or standardised interview. This type of interview is thus useful when investigators are scouting a new area of research or when they want to find out what the basic issues are, how people conceptualise a topic, and how much they understand. The flexibility of the unstructured interview can help to bring out the affective and value-laden aspects of respondent's answers and to determine the personal significance of their attitudes. However, because of this flexibility, the unstructured interview can be seen as inadequate as a measurement device, since a comparison of of one interview with another is not easy. In addition, analysis is more difficult and time consuming than that of a standardized interview. The semi-structured interview is, according to Miles, useful in the formative evaluation of mock-up exhibits, but in summative evaluation, a standardised format is generally preferred.
The structured interview, with precise questions and fixed wording, whilst it provides a more reliable measuring device, is still dependent on design and the skill of the interviewer (care must be taken with respect to the language used, question order, interpretation, etc.). 'Response set' is a particular problem identified in the use of this kind of approach in museum evaluation. Miles states that when visitors to the British Museum (Natural History) have been asked to express a view on a new exhibit, responses are nearly always favourable. This may be a result of a 'halo effect' - the tendency for visitors to consistently overrate an exhibit because it concerns a topic they are particularly interested in (Miles 1982). However, to consider this a 'confounding variable' may be to ignore the importance of visitors' pre-visit intentions and interests, which in the casual learning environment could be of primary significance. It also neglects the role of affective responses in guiding one's attitude towards an exhibit. Nevertheless, there is still the problem that visitors may generally respond favourably to questions because of a desire to please the interviewer in a face-to-face situation.

Using questionnaires rather than interviews may encourage visitors to be more candid in their evaluations. Questionnaires are used widely in museum evaluation. They are useful in assessing the attitude of visitors to the museum as a whole and can utilise general psychological techniques used in attitudinal research, eg, using a Likert-type scale consisting of a set of statements and a rating scale, by which a person can express their degree of agreement. Questionnaires require much less skill to administer than an interview, and can be administered to large numbers of individuals simultaneously. Standardised wording, order of questions and instructions for recording responses means there is uniformity from one measurement situation to another.

However, from a theoretical point of view, social psychologists have been aware for some time that the assumption that people's attitudes can be properly assessed through questionnaires is a
somewhat simplistic view (Harré and Secord 1972). Research has consistently found, for example, that the relationship between what people express as their attitude on a questionnaire and how they behave is tenuous (Wicker 1969).

Indeed, the concept of 'attitude' is now undergoing considerable reappraisal within social psychology. Traditionally, attitudes have been seen as individual response dispositions or individual cognitive representations. Jaspers and Fraser (1984) suggest it would be more useful to consider attitudes as individual response dispositions based on collective representations. The shift is towards viewing people's preferences and beliefs from a standpoint which takes into account interpersonal, cultural and historical influences (Moscovici 1984), and these cannot be easily assessed by questionnaire alone.

A vast amount of information has been amassed, using both interview and questionnaire techniques, relating to the demographic characteristics of visitors to museums, why people visit, how they plan their visit, and how they feel about particular exhibits (e.g. Borun, 1977, Alt 1980). However, children are largely excluded from the samples used, although the two major visitor groups in museums have been identified as family groups and school groups (Laetsch 1979). Alt (1980) argued that children were excluded from the 1976-1979 survey of visitors at the British Museum (Natural History) because interviews with schoolchildren were "unproductive" and interviews with younger children were "entirely unsatisfactory".

**Experimental intervention**

Experimental intervention is generally seen as inappropriate for museum evaluation, particularly when one's interest is in assessing preferences. The use of simple random sampling is generally impractical in a museum setting, although quasi-experimental procedures, which will involve systematic variation of the various
elements of an exhibit and the use of experimental and control
groups, can be utilised. The effectiveness of various design
aspects can be usefully examined in this way, eg, Goins and
Griffenhagen (1957, 1958), employed experimental techniques in a
study of the effect of colour, lighting and artistic design on
exhibit appeal.

Since experimental procedures have been confined to an evaluation
of design aspects, measurements have generally been restricted to
the assessment of the more manifest and measurable aspects of
visitor behaviour (eg time spent at an exhibit, reading a label
etc.). Yet in social psychological research it has long been
recognised that experimental methods need not be confined to
laboratory settings and behavioural measures (Farr 1976). There
would appear to be no reason why experimental studies should not be
utilised in order to assess visitors affective and attitudinal
responses to exhibits.

Alt and Shaw (1984) have shown that it is possible to utilise an
experimental procedure in a museum setting which goes beyond simple
behavioural measures. They elicited the perceived characteristics
visitors associate with museum exhibits and measured the extent to
which 'real' exhibits approximate the characteristics associated
with a putative 'ideal' exhibit, drawing on a theoretical approach
drawn from cognitive psychology (Rosch 1977) in relation to concept
formation. Their study attempts to go beyond simple observational
measures of attraction and holding power by implementing
experimental techniques.

2.2.2 Asses§ing Learning

On the whole, the information which exists relating to whether the
experience people have in museum settings can actually be measured
in terms of advances in learning is relatively small. In any case,
Borun (1977) has found that whereas the goals of museum staff (in a
Science Centre) focused on science learning as the highest
priority, visitors themselves were more intent on 'having fun';
Thier and Linn (1976) found that most visitors were not attracted
to science centres to learn facts, but to experience new and
interesting phenomena.

However, the central concern of many evaluations in this area is
with the effectiveness of a museum setting in facilitating
learning. If an exhibition is viewed primarily as educational, it
is important to assess its effectiveness in communicating the
information it is intended to convey.

*Interviews and questionnaires using experimental and control groups*

In assessing learning, techniques similar to those used in
assessing preferences can be utilised. Usually, learning is
assessed by firstly interviewing visitors to gain initial profile
data, and then, by direct questioning, or the use of a
questionnaire, testing their recall of factual information. In
addition, an experimental paradigm is usually employed: the
performance of a test sample will be compared with a control groups
of people who have not visited the exhibition. Generally, this will
take the form of comparing one group before a visit and a matched
group after a visit to a particular exhibit or museum (eg Eason and
Linn 1976; DART, 1978). Thus one can assess whether learning has
occurred if the experimental group score significantly higher than
the control group. On the whole, results generally indicate
relatively little information transfer occurs during a museum visit
(Shettel 1973, Screven 1974). Borun (1977) did find evidence of
some information transfer (18 percentage points) amongst children
visiting a science centre and argued that the use of visual
material and performance tasks in her study provided a better
measure than the paper and pencil measures normally used.

Prince (1984) has outlined what he sees as the flaws in this
general approach to assessing learning. Firstly, it assumes a
simplistic view of learning, which, especially in the informal
setting of a museum, may be influenced by a variety of factors beyond the scope of the researcher's control (e.g., past experience). Secondly, it focuses on aspects of the exhibit in order to assess learning and largely neglects the characteristics of the visitor (motivational state, attitudes, etc.). Most importantly, many studies do not link learning to minor preferences/interest, yet this must exert an influence on what, and if, something is learned. Prince also acknowledges that aesthetic response, mood, and seeking play an important role in influencing behaviour generally, and certainly in the informal setting of a museum the role of these kinds of influence may be even more pronounced, particularly since learning 'facts' would not appear to be the primary goal of visitors.

Measuring learning generally involves a test of recall, e.g., using a short answer form of question; or recognition, using a multiple-choice format. The latter is generally regarded as the best type of test for measuring learning performance (Miles 1982). However, few learning theorists would today adhere to the view that performance on a recognition task of factual information could be taken as evidence for learning. In any case, the literature indicates that visitors tested in this way show very little evidence of learning, unless explicitly encouraged to do so (Shettel 1973, Screven 1974).

Perhaps the main criticism of this methodological approach is in relation to the theoretical model from which it derives. The notion of learning implicit in these kinds of studies is that embodied within the Stimulus-Response paradigm in psychology. Man is a passive receiver of information, the information he 'learns' can be assessed by testing recall/recognition of facts — easily observable and quantifiable data — and moreover, learning is facilitated by extrinsic reinforcement (e.g., Screven's 'successful' subjects were awarded a badge saying 'museum expert'). Yet few educationalists and psychologists would see the learning of isolated facts as any measure of knowledge gain or understanding. The S-R reinforcement
model has long since been discredited as an appropriate conceptual framework within which human learning and understanding can be explored (eg Neisser, 1967; Bruner 1973; Kelly 1955).

Thus not only are the methodological techniques used to assess learning in a museum inadequate, but the theoretical frameworks within which the research is conducted are inappropriate. Several authors in this area have recognised this failing, eg Borun (1977) who argues that the "primarily visual and kinaesthetic learning which takes place in the museum cannot be evaluated properly by simply copying and adapting techniques designed for left-brained, linguistically-based information transfer found in the classroom and lecture hall".

Studies using a cognitive framework

Recognising these problems, Prince (1984) argues for a more cognitive approach to assessing learning, reflecting the influence of cognitive theorists in psychology, such as Neisser, Bruner, Piaget and Kelly.

This kind of approach sees learning as active and constructive rather than a passive, repetitive process. Learning is not seen in terms of S-R associations: knowledge is not simply what our senses take in, rather we interpret the world and construct our own reality.

Although much of the recent museum literature now advocates this theoretical viewpoint, few researchers have utilised appropriate research techniques in line with a cognitive psychological perspective. Prince (1984) attempts to apply this perspective in looking at the communicational effectiveness of exhibition material by assessing the amount and type of new information internalised by a sample of visitors. However, he assesses learning by using recognition and recall tests, and to establish whether new material has been assimilated, subjects are merely asked to state which of
the recall/recognition questions they could have answered correctly before entering the exhibition.

A cognitive approach was also adopted by Thier and Linn (1976) in their research on science and technology centres. They used the framework of Piagetian theory to evaluate the effectiveness of interactive experiences for teaching important scientific concepts and thinking skills, and investigated what happens when children are allowed to choose their own science activities from a wide range of possible choices. They found significant evidence that active participation and concrete experience was invaluable at all ages, but more important than the learner's capabilities was personal motivation and interest.

Lee and Uzzell's (1980) assessment of the educational effectiveness of Farm Open Days for the Countryside Commission of Scotland was based on a different cognitive psychological perspective, using Kelly's (1955) Personal Construct Theory.

This approach sees learning as a dynamic and constructive process in the same way as Piaget, but focuses on individual constructions of reality. This theory offers a useful tool of measurement, the Repertory Grid Technique (described by Fransella and Bannister, 1977). The original form of the technique involved eliciting each subject's 'constructs', or perceptions, about certain 'elements' (things/people/events to be construed) by selecting three elements randomly and asking the subject to say in what way two of the elements are alike and different from the third. The essential notion is that all our constructions about the world (events/people/concepts) are bi-polar - we never affirm something without at the same time denying something. A matrix of personal constructs can be built up, usually by ranking or rating each element in terms of each construct on a 7-point scale, which gives an indication of the salient attributes by which an individual perceives the world. There have been many revisions of the
technique and the grid formula has evolved in a variety of ways (Fransella and Bannister 1977).

Lee and Uzzell attempted to probe any changes arising in visitors' overall perception of farming as a result of a visit to a Farm Open Day. Two groups were assessed, one before and one after a visit to an Open Day. Any significant differences in the perception of the two groups in relation to farming/countryside practices was taken as evidence of learning. The visitors were required to assess the accuracy of statements (the constructs) relating to different types of farming (the elements) on a seven-point scale.

Significant differences in perception between the pre- and post-visit groups occurred over seven of the constructs used.

All the subjects were supplied with the 14 constructs used in this study, although in the original formulation of the technique Kelly suggested subjects' own constructions about a particular topic should be elicited. By presenting a particular view of farming to the subjects in this study, it is not clear whether the views presented actually existed in the visitors' own perceptions. However, the study does attempt to assess learning in more depth than those studies which focus simply on recall or recognition skills.

This approach combines a clear theoretical framework together with a more valid, flexible and powerful tool of analysis, specifically designed to explore the theory. The study found that visitors generally gained a wider and more sophisticated awareness of farming from their visit, in other words, the structure of their thinking about the subject had changed.

On the whole, however, studies which claim to assess learning using a cognitive approach have depended too heavily on recall and recognition skills as a measure of information gain, and have ignored other factors which may be important in an informal, as
opposed to a formal, learning context. As a result, cognitive approaches have not offered any new insights into the museum learning experience. This may be because, as Kimche (1978) points out, even if no cognitive gains are apparent, this does not mean that a visit to a museum has been ineffective in terms of the affective or attitudinal impact on visitors. The influence of affective and attitudinal changes have been largely ignored in evaluation research into learning. In addition, since the museum visitor is usually part of a group (Laetsch et al 1980) and a museum visit is perceived by visitors as a social rather than a learning experience (Borun 1977), assessing learning in terms of individual cognitive processes may be inappropriate.

It would appear that the assessment of learning in a museum simply in terms of the individual's ability to recall or recognise factual information may be insufficient, since this kind of approach ignores the essentially social and informal nature of the museum. Thus whilst the use of recall and recognition tests is quite consistent with an experimental cognitive perspective, this kind of perspective itself may be inappropriate. There would appear to be a need for a re-evaluation of techniques for assessing learning in this kind of setting, and this necessitates a re-evaluation of the theoretical frameworks within which research is conducted.
2.3 THEORETICAL FRAMEWORKS USED IN MUSEUM EVALUATION

Prince (1984) has argued that most evaluation studies in exhibition settings operate in a 'theoretical vacuum'. Yet in much recent literature, frequent reference is made to theoretical models, drawn largely from cognitive psychological research.

For example, Alt and Shaw's (1984) study, described briefly above, draws on Rosch's (1977) Prototype Theory which proposes that the fundamental conceptualization of the world is in terms of discrete prototypes, and judgments of class membership depend on the distance from the prototype. Alt and Shaw thus elicited a list of characteristics used by visitors to discriminate between exhibits in order to measure the extent to which these were possessed by various real, and an 'ideal', exhibit, thus allowing them to see which real exhibits approximated to the 'ideal'.

This provided a new way of classifying exhibits from the perspective of the museum visitor, which the authors see as preferable to the usual approach which conceptualises classification systems in terms of the designer's purpose (Shettel 1973) or in terms of different types of media (Bretz 1971).

However, there is a theoretical problem here, in that a prototype view implies that an exhibit can be seen in terms of a list of characteristics/attributes (the authors in fact wanted to avoid eliciting judgments about overall similarities between exhibits and were specifically concerned to find out which exhibits resembled each other and the 'ideal' in terms of their relative attributes). Yet the overall effectiveness of an exhibit may not be reducible to individual attributes. In a museum setting, a visitor's response to a particular exhibit may be largely effective rather than cognitive, and not measurable in terms of a list of characteristics/attributes.
Nevertheless, Alt and Shaw's study is an attempt to apply a clear theoretical framework, from cognitive psychology, to an evaluation of preferences in a museum setting, and to utilise appropriate techniques of analysis within that framework. The majority of studies have no clear theoretical framework. Even where one is proposed, the techniques of investigation employed are generally very standard approaches, drawn from experimental psychology; for example, using a control group and an experimental group, and measuring learning through recall and recognition tests. Thus although more sophisticated theoretical models have been suggested, appropriate techniques of investigation in line with these models have not generally been explored.

In order to properly evaluate the museum experience, it is necessary both to find an appropriate theoretical framework, and in addition, develop an evaluative method compatible with the particular model of man used. Generally, the approach employed by investigators in this field has assumed a passive and uncharacteristic model of human behaviour.

In the next section the different 'models of human behaviour' which have emerged from museum evaluation research are examined, and their utility is explored.

2.3.1. The Empirical Model

The early museums, displaying static arrays of objects, reflect the central notion of science in Western societies, empiricism. The central idea of empiricism is that knowledge is a copy of the object, thus the world can best be studied by observing its obvious manifestations - the facts - and these facts are available to us through our senses, and are also independent of us as observers (the observer thus becomes irrelevant). In psychology empiricism led most significantly to the behaviourist approach, seeing learning in terms of stimulus-response associations, and habits formed under the influence of the environment.
The behaviourist-empiricist view has been forcibly criticised, eg by Piaget (1970a), who points out that empiricism ignores the fact that human understanding of reality is bound up with actions upon that reality, which modifies and transforms it. The power of empiricism as a tool of analysis is still reflected in most psychological research however, and indeed in the evaluation research into museum effectiveness, where it may be especially inappropriate, given the lack of control available to the researcher in such a setting, and the essentially social and affective nature of the museum experience.

Museum design has long since recognised a more dynamic concept of human behaviour, seen in the development of interpretation and interactive displays. Yet much museum evaluation research is still adhering to the empirical model.

Alt (1977) attempts to outline the problems of a strictly empirical approach in his substantive critique of Shettels's (1973) study on the educational effectiveness of museum exhibits. Shettel argues that the purpose of museum exhibits is an empirical question subject to scientific examination. Thus exhibit effectiveness is demonstrated on the basis of measurable changes in the behaviour of the audience, produced by an exhibit and consistent with the stated aims and objectives of the exhibit. These changes in behaviour are assessed by observation measures (attracting power and holding power), and more abstract measures eg answers to test items, statements of opinion etc. To assess knowledge-gain, Shettel used recall methods and recognition tests. Shettel compared four groups of subjects to measure the degree of learning as a function of varying incentives and time allowances. The casual visitor was found to have learned very little in terms of the measures used.

Shettel sees the primary role of the museum as an educational medium functioning in much the same way as educational TV, textbooks, etc, and ignores any wider educational goals. He argues that the didactic exhibit satisfies a 'need' the visitor has to
learn. This would seem to imply a drive-reduction view of museum learning, drawn from early experimental psychology. As Alt observes, "Is Shettel saying that visitors have a need to acquire knowledge when knowledge they had acquired previously has been dissipated (in the same way people need food and water)?".

In a similar way, Screven (1974) looked at the use of interactive devices to aid learning and again found little learning in casual visitors. Visitors given a booklet or tape of questions and the 'reinforcement' of an award (a badge) if they scored well in the tests, learned most. The notion of a 'reinforcement' effect obscures the complexity of human learning and is totally inappropriate in a museum context, where the essential point is that the visitor is free to choose what, and if, he learns. Although Screven's and Shettel's approaches have been widely criticised by others in the field (Alt 1977; Alt and Morris 1979) researchers still tend to adhere to similar techniques of investigation, and indeed one could argue that Shettel and Screven, by interpreting the findings they obtain, through the use of this kind of technique, in terms of 'reinforcement' and 'drive-reduction' notions, are at least being consistent with the confines of the theoretical model they adhere to.

However, it is clearly insufficient to attempt to assess human learning in a museum within a narrow empirical model, ignoring visitor characteristics such as intentions and expectations, and the essentially social nature of a museum visit. Most researchers now recognise this, although the majority still utilise the standard empirical techniques of analysis. Whilst it cannot be denied that the empirical model does offer powerful techniques of investigation, which can be utilised within other theoretical frameworks, their use may be limited if they are applied within the confines of a passive model of human learning.
2.3.2 The Cognitive Model

The Cognitive model sees learning as an active, constructive process. Museum designers, recognising this more sophisticated, model of human learning, now place much emphasis on categorization, interpretation and active participation, reflecting widely held views in cognitive psychology and mainstream education regarding the need to actively involve the learner in constructing knowledge. The introduction of participatory exhibits in many museums utilises such notions as, for example, the view that the learner should be actively involved in the act of discovery (Bruner 1957) and that concrete experiences influence a child's understanding of scientific thinking (Inhelder and Piaget 1958).

However, in museum evaluation, no clear theoretical framework, in line with this cognitive viewpoint, has emerged to guide research. The question arises as to whether any of the theories drawn from mainstream cognitive psychological research (which have clearly influenced museum design) have anything valuable to offer museum evaluators, both theoretically and methodologically, since the theories have been developed in order to explore individual information-processing mechanisms and have focused primarily on linguistically-based information transfer. In order to elucidate some of the problems inherent in applying an individualistic information-processing perspective to the study of the museum experience, it is necessary to examine some of the major theories in this area and to assess the ways they have influenced museums generally.

Neisser

Neisser's (1967) original work gave rise to the cognitive revolution in experimental psychology. Neisser, then, is the forerunner of the cognitive perspective in psychology, taking perception as the core process in the way the individual relates to the world he constructs through experience. The implications of
this view are that past experience plays a large role in shaping the kind of information which is extracted in a learning situation. Learning is seen as the product of incorporating potentially meaningful material into the learner's pre-existing structure of knowledge (Ausubel 1968). The importance of this approach to museum evaluation is that it shifts the focus of interest away from the objects/concepts themselves and sees learning in terms of the characteristics of the learner.

Prince (1984) attempts to assume this perspective. His study on the effectiveness of exhibition material attempted to assess the kind of information assimilated by visitors into their already existing knowledge schema. However, he still utilises simple recall/recognition tests in order to do this, and only assesses prior knowledge by asking subjects to state which questions they could have answered before their visit. Prince acknowledges that recall and recognition tests are not tests of learning as such but rather ways of assessing memory, and he also acknowledges that to assess prior knowledge by asking subjects to state what they think they knew before seeing the exhibition requires honesty and objectivity on the part of the interviewees which may not exist, and it may therefore be a rather unreliable measure.

The use of recall/recognition tests is, however, quite consistent with the kind of experimental-cognitive investigations Neisser and others have used. These researchers have been primarily concerned with information processing, and recall and recognition are essential aspects of this. However, the museum experience may involve something quite different. As Johnson-Laird (quoted in Zajonc, 1980) admits (with regard to information processing approaches generally): "the information-processing system that emerges... is fearfully cognitive and dispassionate. It can collect information, remember it, and work towards objectives, but it would have no available reaction to what is collected, remembered or achieved... in this respect it is a poor model of a person." Thus Zajonc (1980) has argued forcibly for a greater consideration of
affect as part of the learning experience, which is largely ignored by contemporary cognitive psychology.

The importance of affective influences may be especially important with regard to the museum experience. The fact that a museum visit may awaken an interest in a particular area and lead to a state of readiness, or intention, to find out more about a particular topic may be of greater significance than any immediate, measurable information gain. The reaction may be largely affective and not amenable to standard measures of cognitive gain.

Tentative evidence in line with this view can be seen in Sobol's (1980) finding that 'blockbuster' exhibitions seem more successful in attracting a wider audience. Prince (1984) suggest this finding may indicate these types of exhibition 'capture the public's imagination'. Certainly, although this was not explored by Sobol, this would seem to imply a strong affective component.

Similarly, research on Swedish Travelling Exhibitions (Arnell et al, 1976) found that whereas ordinary didactic types of exhibition influenced the knowledge of individual visitors very little, one exhibition - 'Beautiful Moments' - using more emotionally-loaded illustrations and appealing more to feelings, rather than the need for information, did succeed in arousing a greater awareness of the problems portrayed (relating to under-developed countries) amongst visitors not especially interested in the subject, and certain changes in attitude were affected. This effect was still evident on interviewing the visitors four months later. Interviews were used to elicit information regarding visitors' knowledge about, interest in, subjective impression of, and attitudes towards under-developed countries, and more general questions on, for example, politics and defence. As well as examining any long-lasting effects by a follow-up interview, the study also involved interviewing a representative sample of inhabitants of the town where the exhibition was to be staged a month before it was actually shown.
It would appear that the Swedish study encompasses a more complete view of the museum experience, whereas Prince's study focuses on one small aspect of cognition—information-processing. The kind of learning being investigated in the two studies would appear to be very different. An emphasis on purely cognitive aspects of knowledge-gain would appear to be insufficient in providing any meaningful description of the communicational effectiveness of museums.

Similarly, an experimental cognitive perspective ignores the essentially social nature of a museum setting. One reason why people visit a museum is to share time with family and friends. According to Laetsch (1976), family groups constitute the museum's single largest constituency (the museum in question being the Lawrence Hall of Science in Berkeley), and he found that adult-child combinations spent more time at the exhibits than did child-child or adult-adult combinations. Yet there is little research on learning in family groups, although the museum is perhaps the only educational setting where families frequently appear as a unit (Kimche 1978).

A more appropriate perspective than the experimental cognitive approach advocated by Prince might be found by pursuing a social-cognitive approach, given the essentially social nature of the museum experience. Indeed, Jaspers and Fraser (1984) point out that the most recent research on cognitive processing presupposes a social origin of such systems. Thus perhaps, for museum evaluators, the most pertinent point to be drawn from Neisser are his final words in his 1967 book, 'Cognitive Psychology':

"A really satisfactory theory of higher mental processes can only come into being when we also have theories of motivation, personality and social interaction. The study of cognition is only one fraction of psychology, and it cannot stand alone."
Bruner

The work of Bruner (1957, 1973) has had a strong influence in many areas of psychology - concerning perception, concept-formation, and education. His views on perception, formulated in the 1940s, were a radical challenge to the then dominant behaviourist view, seeing the perceiver as one who actively selects information, forms perceptual hypotheses, and, on occasion, distorts the input.

Bruner sees perception as being fundamentally of the same nature as concept attainment and other higher mental processes, thus it can be viewed as an act of categorisation. Similarly, his views on education see the acquisition of knowledge as an active process. As a consequence the most important feature of Bruner's approach to education is to encourage the learner to participate actively in the process of learning and to organise evidence so that s/he is able to go beyond it.

An individual actively constructs knowledge by relating incoming information to a previously acquired psychological frame of reference or cognitive structure (Bruner refers to it as a generic 'coding system). This frame gives meaning and organisation to the regularities in experience, allowing individuals to go beyond the information given.

Bruner's views are widely accepted in formal education and his influence is clearly seen in the modern museum's emphasis on interpretation, organisation and participatory exhibits.

However, Alt and Shaw's (1984) study described above found that if an exhibit involves participation or interaction, this is not necessarily sufficient for it to be close to a visitor's notion of an 'ideal' exhibit. They suggest that for a particular exhibit to be successful the act of participation itself must be informative, and participation merely as a means to obtain information is not good enough. They argue that the notion that a learner should be
actively engaged in the act of discovery may be appropriate for the classroom learner (which is Bruner's main area of concern) but may not be applicable in the case of the casual museum learner.

Bruner's work on education largely focuses on the development of curricula for school learning. In a museum, an individual is already actively engaged in discovery, in a sense, by being able to observe at first hand the topic of interest, rather than having to imagine it from the words in a book. Rather than focusing on Bruner's ideas about formal education, what is perhaps more applicable in relation to museum evaluation is his notion that mental growth is in very considerable measure dependent upon growth from the outside - in mastering techniques that are embodied in the culture and are passed on in a contingent dialogue by agents of the culture (Bruner 1973). Bruner's later work thus attributes some power to the role of culture in shaping cognitive structures in the course of intellectual development, and he examines thought processes from the perspective of phylogenetic, cultural and ontogenetic heritage - an essentially historical and social perspective absent in his earlier work.

His later work is also more dependent on naturalistic observation and ecologically representative situations rather than the artificial experimental conditions of his earlier work on perception and reasoning.

An emphasis on the role of cultural, historical and social elements in shaping the course of learning may be of more importance in the consideration of casual learning in a museum environment, rather than focusing on Bruner's views on formal education. The implication is that researchers need to take into account visitor's preconceptions and expectations regarding particular exhibition topics (science, conservation etc) and assess the exhibition's effectiveness in developing higher levels of awareness or changing deeply-rooted beliefs about such issues.
Piaget

Like Bruner, Piagetian theory implies that in terms of a successful training procedure, the more active a subject is the more successful the subject's learning will be (Inhelder et al 1974). For Piaget, knowledge is not something the organism takes in, but represents the organism's way of coping with (adapting to) different aspects of the environment. This occurs by a process of assimilating what information has been taken in to the pre-existing conceptual framework, or schema, and accommodating new information in accordance with this. Thus for Piaget, what is important is to explore how people become competent at various tasks (Piaget 1970a).

Thier and Linn (1976), in their research on science and technology centres, used the framework of Piagetian theory to evaluate the effectiveness of interactive experiences for teaching important scientific concepts and thinking skills. Involving the learner in what is to be learned is a basic feature of science centres in particular; however, as the discussion relating to Bruner (above) reveals, the notion of what constitutes a participatory exhibit needs qualification. If the role of the visitor is limited to pushing a button which starts an exhibit, this cannot be taken as involving her in discovering information through her own participation in the process (Eason and Linn 1976). Borun (1977), in fact, found push buttons correlated negatively with learning.

It would appear to be important for museum evaluators to look more closely at the central idea of Piagetian theory in order to utilise this perspective in improving museum exhibits. To simply attach gadgets/push buttons neglects the essential point of Piaget's approach, and it may be, for example, that observing a real object and perceiving its intrinsic qualities will involve more of an 'act of discovery' than any amount of interpretive gadgetry can achieve.
As Kimche (1978) points out, neither a tree nor a goat has push buttons; yet you can feel, hold or feed a goat, observe its colouring, and its behaviour, or speculate upon the structure of its anatomy as an adaptation to its natural habitat. Kimche also notes that although the addition of interpretive devices to models representing natural objects and materials may facilitate viewer-learning, it does so at the expense of reducing the viewer's range of discovery.

In terms of a theoretical framework then, Piagetian theory may have some useful suggestions for museum design, but it is necessary not to interpret his notions at too superficial a level.

In terms of techniques for evaluating learning, Piagetian theory may also have something to offer. Many of the early Piagetian techniques for examining the child's cognitive development have been heavily criticised in recent years (eg by Donaldson 1978). However, it may be useful to remember that it is only through Piaget's brilliant use of the interview in his early work that we are today so aware of just how different the world of the child is from that of the adult (Farr 1982). It may be worth considering the usefulness of the interview in assessing a real understanding of people's perceptions of museums (or the area with which the museum is concerned in general, eg science), as a precursor to any more controlled study. The value of the unstructured interview may have been too heavily dismissed by researchers in this area (Miles 1982; Prince 1984).

In addition, Piaget's work does offer a broad framework within which children's understanding of the world can be assessed (ie, in terms of stages of cognitive development, and the kind of skills representative of each stage). This approach has been utilised to explore children's learning in this kind of setting (eg Thier and Linn 1976). (Piaget's theory and the stages of cognitive development are discussed in more depth in Chapter 6).
The influence of these three major cognitive theorists in all areas of education research has been profound. However these theories were, in the main, developed for exploring linguistically-based, formal educational learning mechanisms. In the museum, learning will be primarily visual rather than linguistically-based. In addition, whilst the notion that learners should be encouraged to actively participate in the act of learning may be as valid in the informal as in the formal learning setting, in an informal and essentially social learning environment it may be more useful to examine active participation between individuals rather than between the individual and the learning material. In an informal learning situation, social interaction may be the salient independent variable.

2.3.3. The Phenomenological Model

Kelly's (1955) Personal Construct Theory offers the model of 'the scientist'. Construing an individual 'as if' s/he was a scientist means that individuals are seen as attempting to organise the events with which they are confronted in order to gain control over these events, and in turn be able to predict future events. This process of gaining control over our own lives results from our ability to draw comparisons amongst the various events in our lives, and thus building up a personal construction system by noting that certain events are similar, and thereby different from others (Fransella 1984).

This model sees us coping with our lives on the basis of construct dimensions, which have been erected in the past. Kelly's theory, like the cognitive models outlined above, implies the active constructive nature of learning, and reflects similar ideas to those seen in, for example, Piaget's work, eg. the notion that new information is selectively assimilated and accommodated to existing schema. 'Schema' refers to an individual's compilation of attitudes, beliefs, and conceptual framework. However Kelly's model differs from the cognitive model in that it follows an ideographic,
rather than a nomothetic approach, and sees each of us as unique individuals, who differ in our construing of events, since we each have our own set of personal constructs.

In addition, unlike the other theorists discussed above, Kelly offers a technique of analysis, the Repertory Grid technique, for interpreting construct relationships in mathematical terms. By presenting people with a set of elements (things/people/events to be construed) and requiring them to say in what way certain elements are similar and thereby different to other elements, each individual's personal construct system (or way of perceiving the world) can be elicited. As Kelly originally conceived it, it is not possible to compare people's construct systems since they will be entirely subjective, although an individual's construct system can be looked at over time to see if changes occur, eg as a result of therapy.

Other researchers have compared people's construct systems by providing subjects with both the elements and the constructs to be assessed. It is also possible to elicit constructs from a group of people, enabling the researcher to isolate clusters of shared constructs concerning particular topics (Fransella 1984). As noted above, Lee and Uzzell (1980) used this kind of technique to assess the educational effectiveness of Farm Open Days.

Kelly's theory thus offers not only a clear theoretical framework, but also a valid evaluative tool; however, generally, this kind of approach has not been utilised in museum evaluation research.
The three psychological frameworks outlined above all offer a particular model of human learning, but none offers a very adequate model of a museum visitor. These theoretical approaches are concerned with how individuals process material, and work towards objectives; yet the museum visitor is primarily a member of a group rather than an individual, and the main objective of the average museum visitor may not be "tolearn". There would appear to be a need to search for a theoretical framework within which cultural and contextual influences on learning can be accommodated. A focus on individual information-processing mechanisms obscures wider issues which may be important in relation to learning in an informal setting, such as interpersonal interaction, affective response, and cultural and historical influences.
There would appear to be two major problems in museum evaluation research. Firstly, the absence of a clear theoretical framework within which to explore the experiences people have in a museum setting. Secondly, there is the inadequacy of techniques generally used to measure learning in such settings.

The first problem would seem to arise from the misapplication of theoretical frameworks, which are largely drawn from cognitive psychology and formal education theory, to the examination of learning in a social setting. These theories largely neglect both affective and social influences on learning, two factors which may have particular relevance to the kind of informal learning involved in the museum experience.

Theories which have proved useful in relation to the processes involved in learning in a formal education context are inappropriate because the unique nature of museum learning has not been appreciated. What needs clarification is whether casual learning in a museum is essentially the same process as formal classroom/book learning, or whether it is qualitatively different.

Similarly, theories drawn from mainstream cognitive psychology have been seen as appropriate, since this is the area of psychology primarily concerned with thinking, problem-solving and information processing. However, cognitive psychology focuses on the individual information processor. In a museum setting, the group may be a more appropriate level at which to explore learning.

The second problem arises from this lack of any appropriate theoretical perspective. Learning is measured in terms of how many facts subjects can recall or recognise, and is seen as an individual response. This is quite compatible with a cognitive psychological perspective, although often there is no clear theory
directing the research. Measuring learning in this way produces results which allow the researcher to make quick, quantitative comparisons. However, this kind of procedure ignores the social, cultural and historical influences on learning.

Since the museum is a social experience generally, a more fruitful approach may be to examine what social psychology has to offer in terms of theory and methodology. Although the influence of social psychology can be seen in some museum research, specifically in relation to the investigation of preferences and attitudes, social psychology also offers a vast body of research into group processes, and this has been largely neglected by museum evaluators. They have been concerned with exploring learning, and as a result have been diverted by purely cognitive aspects of theories. What is needed is an approach which sets museum evaluation in its proper social context but can also examine cognitive and affective components.

Besides these theoretical and methodological problems, another issue which arises from a review of the museum evaluation literature relates to whose learning is being investigated. Despite evidence which indicates that children constitute a major part of the visitor population (Laetsch et al. 1980, Kimche 1978), relatively little research has focused on children's learning in a museum setting. (The small amount of research which has been concerned with children visiting museums with school groups and family groups is reviewed in Chapters 3 and 8.)

In attempting to address all these problems, one broad social psychological theory which may be appropriate is the social representations approach (Moscovici 1961; Moscovici and Farr 1984), which offers insight into a wide variety of phenomena and draws together a varied group of researchers. What unites them is an emphasis on the social nature of cognitive processes.
A social representations approach is concerned with the way knowledge is represented in a society and shared by its members; for example, Herzlich (1973) studied the ideas about health and illness which are shared throughout a society. These shared representations are not reducible to a collection of individual representations (Moscovici and Hewstone 1983).

Although the 'social representation' has similarities with the 'attitude', 'opinion' or 'stereotype', it goes beyond these conceptual frameworks in considering knowledge as rooted in history and culture. The social representation also has similarities with Kelly's notion of a construct. Indeed it brings together several aspects of the major cognitive theories outlined above, but with an additional important social and historical perspective.

The social representations approach, according to Doise (1984) attempts to bridge a dichotomy between psychological and sociological explanations, and would seem especially pertinent to the concerns of museum evaluators, who, on the one hand, produce vast amounts of survey data of a sociological nature (Elliot and Loomis 1975) and on the other, seek to explore the individual's cognitive processes (Prince 1984).

In terms of methodology, a wide range of techniques are suggested within this theoretical framework. For example, the Repertory Grid formula has already been discussed as a useful method to apply in museum evaluation, and the grid technique is entirely compatible with a social representations framework, as Fransella (1984) has suggested.

Moscovici (1984) proposes the collection of data which illuminate the transmission of social images we all carry. To achieve this he sees the need for observation in natural settings. It has been recognised that considerable scope exists to investigate aspects of the museum experience using unstructured, open-ended conversation-based interviews associated with naturalistic observation and
participant observation techniques of enquiry, as Prince (1984) has acknowledged, but few evaluations have explored. The social representations approach may offer a theoretical basis for such an exploration. These issues are taken up in later chapters.

Whilst a social representations approach may be useful in exploring the content of people's shared understanding in a museum context, a more rigorous approach may be necessary if we are to understand the processes involved in learning in a museum. In this respect Doise (1978) offers a socio-cognitive approach, which is entirely compatible with a broad social representations framework. Doise's work explores the effects of interpersonal interaction in promoting learning. Learning, from this perspective, is seen in Piagetian terms, involving the development of new cognitive structures. Thus a socio-cognitive approach is particularly relevant for the investigation of children's understanding of a museum, whilst also taking into account the social and interpersonal aspects of learning. The relevance of a socio-cognitive approach to the evaluation of children's learning in an informal setting is examined in detail in Chapter 6.
Summary:

General Problems relating to museum/exhibition evaluation of learning research arising from a review of the literature:

1. No adequate theoretical framework, largely as a result of the missapplication of general experimental-cognitive theories and approaches (developed in relation to formal education) to the informal learning setting of a museum.

2. Methodological problems arising as a result of (1) above.

3. The importance of social factors in relation to museum learning has been largely ignored.

4. The influence of affective factors in relation to learning in an informal setting has been largely ignored.

5. Children - who constitute a major part of the museum population (in both school and family groups) have been neglected in research.

The above five points appear to constitute the main gaps in research on evaluating learning in museum/exhibition contexts, as reflected in the literature. The studies reported here attempt to explore and clarify some of these problems.
PART 2

SCHOOL GROUPS
Museums and other informal educational settings are free-choice learning environments. One of the primary educational functions of the museum is to encourage curiosity, so that visitors are stimulated to explore the knowledge offered to them. Whereas schools provide extensive information through sequential learning, they are sometimes unable to motivate and arouse curiosity (Laetsch et al 1980). There would, therefore, appear to be some considerable potential for providing a beneficial supplement to formal education through the use of informal learning centres.

Many teachers recognise this, and school groups form a substantial part of the visitor population in museums. However, although museums are apparently well-used by primary schools, they would appear to be somewhat under-used by secondary schools (Adams and Miller 1982). This may be because a trip to the museum has been viewed as a "treat" rather than a valuable educational experience.

Very little is known about learning during a school field trip. There are many studies of children in classrooms, but field trips have been ignored by researchers, despite millions of children taking field trips each year to cultural institutions (Laetsch et al 1980). Recently, however, some research has been emerging, particularly in relation to school visits to science centres (eg Gennaro 1981; Feher and Rice 1985) and also historical sites (Pond 1983). Some writers have been particularly keen to advocate the use of such visits for younger children. The physical and tangible experience offered by the museum would appear to be most beneficial for children at that stage of development where they require concrete material (according to Piagetian theory, the influence of which is evident in much of the research).
One reason for the paucity of studies in this area may be the perceived difficulty of assessing attitudes and learning in a school group. Alt (1980) excluded children in organised parties from his survey of visitors to the British Museum (Natural History) because a pilot survey had shown that interviews with children were unproductive - the children had no plans about their visit and maintained they had come "because the school brought them".

The next five chapters explore theoretical and methodological approaches which may allow a more fruitful study of school group learning in informal settings, and describe two studies which attempt to examine whether informal learning centres are successful in promoting learning within school groups. Firstly, the literature on school visits to museums is assessed.
3. A SCHOOL VISIT TO THE MUSEUM - A VALID ACADEMIC ACTIVITY OR JUST A DAY OUT?

This chapter evaluates research which has focused on school visits to museums. The literature is not extensive, and much of it emanates from teachers themselves, in an attempt to find out how the field trip can be used to supplement formal classroom teaching in their particular discipline. As a result, many of the investigations have been approached from the perspective of formal education.

Most of the published research concerns science and history as presented in museums. Research has led to an increasing awareness of the value of the museum visit or field trip in relation to these two areas of study.

The first part of this chapter describes the research which has been undertaken to date, and evaluates the theoretical and methodological perspectives which have directed this research. The second part of the chapter explores an alternative theoretical perspective which may provide a more useful framework within which school visits to museums can be explored.

3.1 LITERATURE REVIEW - RESEARCH ON SCHOOL VISITS TO THE MUSEUM

Education Officers are employed in museums to work with schoolteachers on developing projects, and to advise curators and designers on museum display. They are also involved in training teachers, writing and editing publications, and developing adult education programmes. Unfortunately, few museums have Education Officers. Taking into account museums, art galleries, visitor centres, zoos and planetaria, there were only 300 museum officers in the whole country in 1986 (West 1986).
This means that schoolteachers are often left to plan museum visits on their own, without any guidance or advice. Because of this, many schools may not be making the best use of the museum visit.

Too often, teachers are not selective in the exhibits they visit, and try to take in the whole museum, so that children are bombarded with a surfeit of information.

In addition, the worksheets and question papers used by school groups usually contain lists of fact-finding questions. These can often be answered by simply copying labels. Adams and Millar (1982) have argued that worksheets are probably the least effective learning method employed in museums. Recording information can only be effective as an aid to learning if it directs the child to explore and analyse the evidence available.

Teachers are increasingly aware of these problems, and have themselves undertaken research aimed at achieving a better understanding of the museum, in order to ensure that the school trip to the museum is more than just a day out.

The next two sections evaluate research in this area. Firstly, studies which have focused on school groups visiting science centres is examined; this is followed by an evaluation of research which has focused on the value of the museum trip in relation to history teaching.

3.1.1. Research on school groups visiting science centres

Science centres in the United States attract around 40 million visitors every year, almost half of whom are children (Laetsch et al 1980). Science Centres are now being introduced in Britain, for example, there is the Exploratory in Bristol, Techniquest in Cardiff, and the Launchpad Gallery at the Science Museum in London.
These centres provide a range of demonstrations and experiments which visitors can work for themselves. The aim is to encourage visitors to physically interact with the exhibits, rather than simply observing artefacts in glass cases, as in traditional museums. It is assumed that physical interaction stimulates cognitive interaction - people learn by doing.

This idea derives from Piagetian theory, and is therefore supported by a wide body of research in the formal education sphere. However, being able to manipulate exhibits is also much more entertaining than merely looking at them, and the development of interactive science centres is also based on sound commercial principles - the centres attract a wide audience who come to be entertained as well as to learn.

From an educational viewpoint, however, the experience provided by science centres is important. For Piaget, new knowledge is acquired through acting on objects. This process allows different kinds of knowledge to develop. Two kinds of experience are important from the Piagetian viewpoint - physical experience and logico-mathematical experience, and both arise through interaction with the physical environment. Physical experience provides knowledge of the properties of objects that are acted upon, whilst logico-mathematical experience yields knowledge not of the objects but of the actions themselves, and their results (Piaget 1970b).

For example, we can arrange pebbles in a row and count them to ascertain their number. If we then change the order of the pebbles and count them again, we will find the same number. From this we have learnt that the number of a set of objects is independent of the order in which they are arranged. (Donaldson 1978).

Piaget's main concern was with explaining the normal course of development of human intelligence, which arises through interaction with the physical environment. He saw this development as proceeding through a series of sequential stages. The stages of
cognitive development which he outlined are discussed in a later chapter (Chapter 6).

Whilst Piaget's views on the importance of activity in stimulating cognitive growth has been widely researched in schools, until recently, few investigations have been carried out involving school groups on field trips to a science centre. This is surprising, since the Piagetian model, focusing as it does on physical and logico-mathematical experience as the basis of all knowledge, is particularly relevant to any examination of how children develop an understanding of science concepts. Science centres provide a rich collection of manipulable objects demonstrating natural phenomena and would appear to offer an ideal setting within which his theory could be explored.

Feher and Rice (1985) suggest that the science centre or interactive museum provides a particularly suitable setting for a Piagetian-style investigation not only because of the wide range of material available, but also because it is an informal learning environment, free from the emotional overtones and constraints of the formal educational environment. Their investigation involved exploring children's notions of light and vision.

In this study they used Piaget-style interviews, that is, subjects were questioned about their thought processes as they carried out a series of tasks. They asked children (aged 11 to 13 years), visiting the museum in a school group, a series of questions about two exhibits which can be manipulated to produce surprising visual effects. The aim of the study was to try and discover the conceptual framework with which the naive learner approaches a natural phenomenon.

From these interviews, they identified four kinds of explanations which offered insight into children's notions of light and vision.
Some children believed the effect seen was due to the object alone, others explained the effect in terms of the object and the receptor (that is, the eye). A third type of explanation involved seeing the effect as due to the light source falling on the object. A complete explanation involved taking into account the light, the object and the receptor.

They found that the concept of light as a force acting on an object was common, but the concept of the eye as receptor was often absent. A complete explanation, taking into account all the variables involved, was only obtained after taking the children through different ways of obtaining similar effects while asking them to verbalize their thoughts at each stage.

The majority of school party studies have not been conducted within such a clear theoretical framework however, nor have they used the exhibits themselves as a research tool to examine the learning process itself, as Feher and Rice attempt to do. Most studies have been more concerned with simply examining the effect of background knowledge, and how this influences children's understanding of museum exhibits, by testing school groups before and after visiting a museum.

Usually, paper and pencil tests are used, with questions assessing straightforward information gain. This does not allow any analysis of the thought processes underlying responses.

Borun (1977) used test questions on colour slides of exhibits, with subjects required to give a push-button response. She found that schoolchildren in grades 7-9 obtained higher scores than college students or graduates, which appears to contradict other research which has indicated that visitors with more background knowledge score better on tests evaluating understanding of exhibits (Griggs and Rubenstein 1983).
Gennaro (1981) found that greater learning occurred in a group visiting a museum and given pre-visit instruction. However, this study did not include a control group receiving pre-visit instruction alone. Schneider et al (1979) found that pre-visit experience on astronomy courses did not explain differences in performance between boys and girls on a test given after a visit to an astronomy exhibit, but the differences seen could be accounted for by differential prior experience with telescopes.

None of the studies described above take into account the social dynamics involved in a school visit to a museum, and how this might relate to learning. Researchers have been more concerned with evaluating the interaction of school experience and museum experience, and have ignored the unique quality of the museum experience itself, which is characterised by interpersonal interaction.

One study which has attempted to examine more fully the experience of school groups attending a science centre is Gottfried's (1979) investigation of children's exploratory and social behaviour during school field trips to a science centre's 'biology discovery room'. This study used a variety of data-gathering techniques, including questionnaires (for teachers as well as children), observation, interviews, and analysis of maps of the discovery room drawn by the children two weeks after the visit. The study also involved setting up peer teaching sessions, where children who had visited the centre showed other children what they had discovered during their visit.

Gottfried found that teachers did not see the visit as a continuation of classroom teaching, but as an enrichment activity, with the emphasis on social interaction in a new environment.

He also found that children tended to go round in pairs rather than in larger groupings. Not only was the dyad the most commonly observed subgroup, but it was also the group size in which children
were most involved in verbal and motor exploration.

Gottfried found that there were wide individual differences in learning. This was measured in terms of the discoveries which the children reported. Two hundred children reported 497 discoveries altogether. They preferred manipulative exhibits to static ones, and these made a greater impact on their memories.

Gottfried notes the importance of social factors, such as group size and peer teaching co-operation, in influencing exploratory behaviour and learning. However, the study is primarily concerned with describing exploratory behaviour and no detailed analysis of learning processes is offered.

It would appear that the majority of studies examining learning in school groups visiting science museums have perceived the children as isolated individuals, whereas, as Gottfried's findings suggest, the dyad may be a more meaningful unit of analysis. In addition, assessments of learning have involved simply calculating the number of facts which children can remember from their visit, and these assessments are often made immediately after the visit. Researchers have not looked at the thought processes underlying the responses given, and have failed to consider the role that group dynamics might play in directing behaviour and facilitating learning.

3.1.2. Research on school group visits to history sites/museums

Much of the research on the effectiveness of school visits to museums in relation to history subjects has been undertaken by teachers themselves, and research in this area has been heavily influenced by Piagetian theory. It has been recognised that museums and historic sites offer tangible, physical experience, which, according to Piaget, may be especially important for younger children, who will be at the concrete operational stage of conceptual development. Children under the age of 11 or 12 are not able to form hypotheses or think in the abstract, and they need
concrete experience with real objects in order to learn. (Chapter 6 contains a fuller discussion of Piagetian notions of the stages of development in relation to the understanding of history.)

West (1969) suggested that a visit to Rievaulx or Fountains Abbey can give children a better understanding of monasticism than can be provided by any number of books. Similarly, Thompson (1982) suggested that a visit to HMS Victory could conjure up 'the blood, smoke, fire and thunder of Trafalgar and allow the horrors of sea battles to become a reality' (page 21). These views imply that visiting historical sites provides children with an experience of what the past was really like.

Pond (1983) suggested that this idea may be too simplistic. He argues that offering children concrete experiences to aid understanding may, in fact, make things more difficult. The past is not concrete and cannot be directly perceived, but can only be appreciated by imaginative experience. Pond argues, therefore, that visits to historical museums and sites may be more useful for older children.

He took children, aged 8 to 12 years, on a visit to Norwich Cathedral. The children were prepared for the visit by two formal teaching sessions, and were tested the day after the visit. The testing consisted of two parts. The main test was designed to consider how well the children had been able to visualise the past and imagine the monks carrying out various tasks and roles. Pond used a set of 20 pictures depicting monks engaged in a variety of tasks and another set of 30 photographs showing parts of the Cathedral as they exist today. The children were required to match one of the pictures of monks engaged in a particular task with a photograph depicting the place where this would have occurred. The second test involved writing an essay which required the children to imagine they were monks who had to recount a day in their lives. The essays were assessed for empathetic content.
The children were also given a standard test to assess their
general level of cognitive development. It was found that the
scores on this standard test correlated highly with scores on the
other two tests. This indicated that children at a higher level of
cognitive development benefited most from the visit, and were
better able to perceive and imagine the past.

However, Pond did not include a control group only receiving
classroom instruction, and his study does not say anything about
the effectiveness of the museum visit, only that children at more
advanced stages of cognitive development have a better
understanding of history.

Adams and Millar (1982) suggest that visits to historical sites and
museums can be beneficial for all age and ability groups, since
museums offer visual evidence which is approachable at a variety of
levels. They argue that the teaching/learning method adopted is the
key to the success or otherwise of the visit. They list a variety
of approaches which can be applied to various kinds of evidence in
order to develop a whole range of historical skills.

One teaching method suggested is the use of drama. This approach
has been developed most notably by the Young National Trust
Theatre, a Theatre in Education group attached to the National
Trust's Education Service. Actors stage a historical day in the
life of one of the Trust's properties. Small groups of children are
assigned to an actor and introduced to the realities of the daily
life of various characters, eg the lord and lady of the house, the
housekeeper, steward and chambermaid (Millar and Durston 1982).

Clearly, educators have recognised the great potential offered by
museums and historical sites as an aid to history teaching.
However, few investigations have been undertaken to evaluate how
successful such visit are in terms of learning. Much of the
literature on school visits to history museums is descriptive
rather than analytic.
Where attempts have been made to examine whether children learn during a museum visit, the interpretation of the findings has been heavily influenced by the Piagetian notion of sequential stages of cognitive development. However, Piaget's work was concerned primarily with a child's understanding of physical causality. Research has demonstrated that children reach the highest level of thought (the formal operational level), in relation to an understanding of physical causality, at around 12 to 14 years old. It is by no means clear whether thinking about history follows the same sequential course.

There is evidence, for example, that a proper understanding of history is achieved much later than an understanding of physical causality. Elton (in Ballard 1971) suggests children do not arrive at a proper understanding of history until at least 15 or 16 years old. It would seem, therefore, that a closer examination of the relevance of Piagetian theory in relation to the understanding of history is needed, before its applicability to the assessment of learning about history in museums can be properly assessed. This issue is taken up in Chapter 6.

In addition, the social nature of a museum visit needs to be taken into account. Whilst it is recognised that the museum offers the opportunity for group discussions and role-taking activities, little attention is paid to the role of social interaction in relation to the actual process of learning about history in museums.

At a wider level, the nature of history itself has not been considered. Before an understanding of the processes involved in learning about history can be achieved, an assessment of the content of people's understanding about history must be made. This necessitates taking into account how social and cultural influences shape our contemporary view of the past.
This need for a broader perspective is important not only in relation to assessments of learning in history museums, but in relation to any examination of learning in informal environments. Within formal education theory, learning is viewed as essentially an individual cognitive response. However, learning does not occur in a social vacuum, and in an informal learning environment it is particularly important to recognise this. The interplay between social/cultural influences and contemporary understanding needs to be taken into account before any real understanding of the educational effectiveness of informal learning environments can be achieved.

In the next section, a theoretical perspective which takes into account these factors is described, and its applicability to the examination of learning in museums is discussed.
3.2 A FRAMEWORK FOR EXAMINING THE CONTENT OF CHILDREN'S UNDERSTANDING OF MUSEUMS

The museum can be seen as an environment where two different worlds of understanding come together. There is the academic world, concerned with the presentation of science, history and culture, and there is the everyday world of the general public, which has its own common-sense understanding of science, history and culture. In any attempt to explain the effectiveness of the museum in shaping people's knowledge, it is important to recognise that these two worlds of knowledge exist, and to examine how the one influences the other.

In the next section, a theory which recognises that different worlds of knowledge exist is described. The theory explores how abstract scientific knowledge filters down to become common-sense understanding, shared and shaped by society. The next two sections describe how this theory can be seen as particularly relevant to an examination of knowledge as presented in a museum, and explore methodological implications arising from its application.

3.2.1. The Theory of Social Representations

For traditional behaviourist psychology, the study of learning has been central to the study of all human development. However, although in this respect the environment has been seen as the most important influence on learning (and hence all development) it has not been studied as a social phenomenon. More recently, however, there has arisen an awareness of a need to link studies of learning, and the laws of learning which can be identified, with analyses emerging from social psychology; in other words, to take more account of the social context within which learning occurs. Thus neo-behaviourists, such as Bandura (1977), have studied social processes in an attempt to explain learning.
Within social psychology itself, the central focus has traditionally been the concept of 'attitude'; attitudes have been seen as directing all behaviour, and hence are central to learning (Doob 1947). However, whilst the methodology of attitude measurement has made great advances over the years, the theoretical development of attitude research has not progressed very much since the 1930s, and research attempting to find a correlation between expressed attitudes and overt behaviour has been largely unsuccessful (Wicker 1969).

One possible reason put forward for the failure of attitude research to explain behaviour (and hence learning) is that explanations have centred on the study of the individual and not on the study of collective realities. Fishbein and Ajzen (1975) have suggested, in this respect, that researchers may have been trying to relate the wrong kinds of attitudes to the wrong kinds of behaviour, and that the problem is thus one relating to the level of specificity used. More recently, however, Eiser and van der Pligt (1984) have suggested that it may be more correct to say that researchers have been looking for the wrong kind of relationship. If the focus of interest is individual behaviour, the concept of attitude is superfluous and explanations can be sought in general experimental psychology without recourse to such abstract notions; on the other hand, if the focus of interest is the behaviour of groups, explanations can be found through an examination of cultural, historical and economic factors, which is the domain of sociology, and here again, the attitude may be superfluous. Eiser and van der Pligt suggest that there is a need to find and define explanatory concepts which can "operate in this middle ground between the individual and the aggregate" (Eiser and van der Pligt 1984, p 364).

One theoretical framework which attempts to enter this "middle ground" is Moscovici's theory of Social Representations. Moscovici has argued that the concept of 'social representations' could usefully replace those of 'opinion', 'image', or 'attitude', which
are relatively static and descriptive (Moscovici 1963 p.232).

Moscovici's idea is that we can only interpret information about the world in terms of representations, which are 'superimposed' on objects/persons. He points out that whilst attitudes held about external objects are assumed to be construed in terms of pre-existent and largely factual information (1973 p xii), social representations determine both the object and the related judgments (1973 p xiii). His notion of a social representation is closer, therefore, to Tajfel's concept of social stereotypes (Hewstone et al 1982) and Kelly's notion of personal constructs (Fransella 1984), rather than the traditional conception of attitude.

Social representations are inextricably linked to to our perceptual and conceptual processes. According to Moscovici, there are two ways in which social representations structure reality; i) they conventionalise objects/persons/events; ii) they are prescriptive (they prescribe what we will think and perceive). Thus the notion of social representations can be seen as referring to a way of understanding, and communicating, what we know already. They are a way of linking concepts and percepts - our way of categorising and simplifying the world and of reproducing the world in a meaningful way (Moscovici 1984).

Moscovici uses this kind of framework to examine how abstract scientific/ideological concepts filter through to people in general and become 'common-sense' general knowledge. In his study of psychoanalysis (Moscovici 1961/72) he shows how in our society the term 'neurotic' is associated with the scientific enterprise of psychoanalysis, Freud, and the Oedipus complex, whilst at the same time the word is used freely to refer to a certain type of person (an egocentric pathological person with unresolved parental conflicts) - thus the word evokes science (and also a revolutionary thinker of modern times) and at the same time, for most people, it evokes an image of a type of person with particular characteristics. There is a distinction between the systematic, scientific concepts the word conveys and the reality of how the
word influences our perceptions of, and relationships with, others (and ourselves) in our everyday lives.

This distinction between the 'sacred' sphere of science and the 'profane' sphere of ordinary life is central to Moscovici's perspective. He refers to these different worlds of meaning as the reified and consensual universes.

In the consensual universe, everyone is equal and free, everyone is an observer, an amateur politician, scientist, educator, and so on. "Individuals and groups, far from being passive receptors, think for themselves, produce and ceaselessly communicate their own specific representations and solutions...people analyse, comment, concoct spontaneous unofficial 'philosophies' which have a decisive impact on their social relations, their choices, the way they bring up their children, plan ahead and so forth. Events, sciences and ideologies simply provide them with 'food for thought'." (Moscovici, 1984, p 16).

The reified universe, the domain of science, religion, ideologies, etc. is a more formal world where everyone is not equal. It is a hierarchy reliant on competence, rules and regulations - a world from which the ordinary man is apart.

The sciences are the means by which we understand the reified universe, and social representations deal with the consensual. Moscovici sees this distinction as a relatively modern phenomenon, unique to our culture: "Science was formerly based on common sense and made common sense less common; but now common sense is science made common." (Moscovici 1984, p 29).

Moscovici is not concerned with 'truths' and 'beliefs' which are 'innate' (or survive from primitive times) but rather with the transitory and fluctuating beliefs of our current society. It is the link, in terms of a process of diffusion, between the two universes which is of interest - how the abstract scientific
concept of 'neurotic' comes to have meaning to the general population in terms of a type of relationship with, and feelings towards, a particular person. The knowledge of the reified universe changes in certain ways during the process of filtering down and penetrating everyday reality because the language of abstract sciences needs to be linked to actual, concrete, social life in order for it to be meaningful.

For most people knowledge of the reified universe is constructed from bits of actual scientific/historic/economic knowledge, welded together with experience and hearsay. The process of fitting abstract notions into a more concrete and familiar consensual reality is not necessarily a one-way process but is essentially dynamic and fluctuating. This can be illustrated again with reference to Moscovici's study of psychoanalysis. He argues that trying to understand the nature of a psychoanalytic treatment is at first unfamiliar - it contradicts the conventional view of medical treatment and the doctor-patient relationship. If, however, the psychoanalytic procedure is seen as similar to a confession, it becomes more familiar. Thus the concept is removed from its proper context and compared to the process of confessing to a priest, and here it is rendered less abnormal. In time, as psychoanalysis becomes more accepted in its own right, a confession itself comes to be seen as a form of psychoanalysis.

Moscovici identifies two processes which generate social representations in this way: anchoring and objectification. Anchoring transfers unfamiliar concepts to the familiar by attaching them to everyday categories and images so that they fit in with our own conceptual framework. Objectification reproduces representations - transforming abstract ideas into something more concrete and tangible.

Moscovici (1981) gives the example of a study by Denise Jodelet (1980) to illustrate the anchoring effect. Jodelet found that mental patients brought to live in a community were identified with
tramps and half-wits by the local population, on the basis of traditional ideas. The characteristics associated with tramps and half-wits were attached to the mentally ill.

Since anchoring is a process of classification and naming, language is seen as playing an important role in shaping social representations.

Objectification involves transforming an unfamiliar concept into a more concrete reality - changing "the word of a thing into the thing of the word" (Moscovici 1981, p.199). Firstly, objectification involves comparing an unfamiliar concept with a more familiar image, eg, seeing God as a father. The image conjures up a conceptual structure (strong but caring, just but severe, etc). Moscovici sees this process producing a 'figurative nucleus' - an image structure that reproduces a conceptual structure in a visible manner (1981, p.199). Once a figurative nucleus or model has been acquired, the previously abstract concept becomes easier to talk about. Moscovici suggests that this process will develop so that eventually the abstract quality of a concept disappears and it becomes almost a physical reality; for example, in his work on psychoanalysis, he found that 'repressions' and 'complexes' can be seen and identified in someone, almost in the way that one identifies a person's red hair and freckles.

Anchoring and objectification are both mechanisms which operate on memory, although in slightly different ways. Anchoring sifts through the memory, fitting in new ideas, and objectification takes things from memory and combines and reproduces them to create something new out of what is already known.

Moscovici attempts to show how the representations we develop through the processes of anchoring and objectification are the result of our attempts to make usual that which is unusual, and he argues that in this sense social representations work in opposition to science, which attempts rather to make the usual more unusual.
3.2.2. Applying a Social Representations approach to museum evaluation

In his work Moscovici examines how abstract scientific/ideological concepts filter through to people in general and become 'common-sense' general knowledge. The distinction he makes between the 'sacred' sphere of science (the reified universe) and the 'profane' sphere of ordinary life (the consensual universe) is central to his perspective. Moscovici attempts to show how the representations we develop are the result of our attempts to make usual that which is unusual (i.e. to fit the abstract notions of science and ideology into a more concrete and familiar framework) and he argues that in this sense social representations work in opposition to science, which attempts to make the usual everyday things in life more unusual (i.e. to turn the ordinary world into abstract scientific and ideological concepts). In this process the operation of memory is paramount.

Examining the museum from this kind of perspective, then, is particularly interesting. Firstly, by utilising Moscovici's views on the nature of memory, the essential function and operation of the museum can be identified. Memory is, not only from a social representations perspective but by definition, a term which directs attention not to the past, but to the past-present relationship (Popular Memory Group 1982); knowledge of the past is only meaningful in terms of its relationship with the present, but each society and each age may recreate the past in different ways. The museum can be seen as playing an increasingly important role in linking the past with the present, in today's rapidly changing society. Museums can be seen as the protectors and communicators of the living memory of people (Hodge and D'Souza 1979). The memory which the museum represents and operates on is essentially a public memory, which is shared by society as a whole. Perceiving the museum as public memory allows one to explore the processes of anchoring and objectification, which in the museum are transformed.
from abstract concepts into a concrete reality, reflecting the very essence of the social representation process.

A second, but closely related, point of interest is the juxtaposition of the 'reified' and 'consensual' universes which is represented in the museum. Museums attempt to present the reified universe to the general public - to make the abstract scientific world available to everyone. In this respect museums are unique, since museum directors see them as primarily learning establishments, implying the competence, hierarchy and sacred nature of the reified universe, and as part of the reified universe, their aim would be, in Moscovici's terms, to make the familiar everyday world more unfamiliar. Yet, clearly, most directors of modern thematic museums would argue that they intend rather to make the unfamiliar more familiar. Museums are concerned with transmitting knowledge to the general public in a relaxed and informal manner, thus whilst they may be seen as representing the reified world of science, their influence will be directly on the consensual world of people's social representations.

Thus the museum can be seen as an environment where the reified and consensual universes are brought together, and in addition, the communicator of the shared memories of society. If the museum is perceived in these terms, an examination of people's understanding of exhibitions in terms of social representations would appear to be a more valid exercise than attempting to measure a more formal and individual type of cognitive gain (in terms of the amount of facts and concepts remembered by individuals), which has been the traditional approach in museum evaluation studies.

3.2.3. Methodological considerations

The study of memory and learning has its roots in experimental and cognitive psychology, and attempts to study these processes have generally been aimed at the individual level of analysis. Research
on learning in a museum context has followed this traditional approach. However, if we are to perceive our task as the exploration of the public memory which the museum represents, this general approach, focused on individual cognitive processes, may be inappropriate, since social, cultural and historical influences need to be accommodated.

In addition, visitors come to a museum generally as part of a group and the psychological aspects of group membership itself must not be ignored.

Adopting a social representations framework for research should provide a more fruitful way of examining learning in a museum, and whilst this kind of approach does not necessarily imply a radically different methodology, it does imply a different approach to interpreting and analysing data.

One important implication is that past experience, history and culture are important aspects to be examined, and these have generally been neglected in museum evaluation research. In the social representations literature, many studies have involved in-depth analysis of literature to assess the kinds of images and understanding that society holds about certain topics (e.g., Chombart de Lauwe's (1984) study of representations of children). The first consideration which needs to be taken into account, therefore, is that knowledge must be assessed in a wider cultural and historical context, by examining the kinds of influences which direct people's understanding of particular issues and topics.

A further consideration arising from the social representations approach relates to the kind of knowledge we expect people to gain from a museum visit. Assessing visitors' recall of factual items immediately after they have visited the museum may not be very useful; a wider and longer-term viewpoint must be taken if we are to assess real understanding and knowledge gain. In any case, people apparently do not visit museums primarily to learn facts
(Borun 1977), but to experience new and stimulating phenomena, and thus assessing factual knowledge gain is particularly inappropriate.

A more useful approach may be to assess how visitors' understanding of a familiar/unfamiliar theme or concept may change or be enhanced as a result of a visit; that is, to assess understanding in terms of a more global perspective, rather than in terms of specific facts or exhibits. Most museums nowadays present information not as a series of unrelated 'facts' but as a theme or story. The influence of a museum visit on people's understanding of novel themes or new perspectives on familiar themes could be assessed, for example, through using unstructured interviews, accounts and drawings.

The body of research emerging from the theory of social representations is very diverse, and the range of methodology is very wide, including open-ended interviews (Herlich 1973), observation over a long period of time (Jodelet 1983), content analysis of drawings/maps (Milgram 1984) and experimental intervention (Codol 1984). Moscovici himself advocates a reversion to methods of observation as the most useful kind of approach.

There are, however, several problems associated with research conducted in a social representations framework. Potter and Litton (1985) outline some of the flaws in the approach, arguing that the problems arise directly from fundamental difficulties in the theoretical framework of social representations. One problem they identify relates to the researcher's role in identifying the social categories of interest. In addition, they point out that the notion of consensus across representations fails to take into account intra-group differences which may exist, and the fact that different layers of consensus may be present. Potter and Litton argue that in the empirical studies undertaken, consensus has been presupposed and any internal diversity has been disguised by the kinds of analytic procedures used; for example, in Di Giacomo's
(1980) study of social representations of student protest movements, the results are presented in terms of mean scores over the sample, which Potter and Litton claim obscures the possible appearance of intra-group differences.

One possible way of overcoming these problems of analysis and interpretation is the use of Multidimensional Scaling procedures (MDS), which are essentially descriptive methods of dealing with multivariate data, and are especially useful when dealing with open-ended data. MDS procedures extend the idea of descriptive statistics in that they seek structure and form, either for informal interpretation or as a basis for more sophisticated modelling or analysis (Barnett 1981). Through the provision of geometric representations of data, underlying structures can be identified and important departures from that structure can be traced. Using this kind of technique, no assumptions need to be made about the distribution of the data, and any intra-group differences which exist are allowed to emerge.

The use of descriptive techniques of analysis is particularly relevant to a social representations approach. The essential implication of adopting this kind of theoretical framework is that the focus is primarily upon the content and description of people's representations, rather than the cognitive mechanisms which are assumed to process information. Moscovici points out that social psychology has tended to focus on single and unidimensional mechanisms, taken out of context, in order to explain social behaviour (concepts such as dissonance, attribution, and so on). He advocates a move towards an examination of what people think, since this is likely to prove more revealing than a fruitless search for isolated mechanisms to explain the processes of thought.

In the next two chapters, the validity of adopting a social representations approach to the evaluation of learning in a museum environment is explored further.
4. LEARNING IN SCHOOL GROUPS - PRELIMINARY RESEARCH

Two studies comprise this research into school group learning in museum/exhibition settings, and a primary aim of both studies is to establish a more social psychological approach to museum evaluation, in contrast to the experimental/cognitive psychological framework generally adopted to assess the effectiveness of museums in promoting learning. The approach in this research is to look at inter-individual behaviour and its influence on learning rather than focusing on individual cognitive processes, since in an informal learning setting the social factor may be predominant.

The aim of Study 1 was to examine understanding in terms of the content of the shared knowledge which visitors (in this case children in school parties) bring to a museum and how this might be enhanced or altered by a museum visit. In addition, it was hoped that the nature of the cognitive challenges which the museum presents to visitors could be established in the first study, in order that individual learning might be compared with group learning in the second study.

Study 2 looks at the inter-individual processes by which learning/understanding may be facilitated in this kind of setting. If it can be established that cognitive conflict is likely to be stimulated in individuals visiting the museum, then the influence of the social element on learning can be more clearly assessed, by comparing the performance of groups and individuals on a museum-related task. If cognitive conflict is present in both conditions, any superiority in the performance of groups compared to individuals can be attributed to the social element alone (see Chapters 6 and 7).

The museum used in these investigations is a modern, unconventional museum which presents a theme rather than merely displaying artefacts, and has a particular appeal for children. The Jorvik
Viking Centre in York presents a detailed reconstruction of a Viking settlement and describes the archaeological process; the portrait of the Vikings presented here contrasts sharply with the usual image of the "Viking Villain" found in literature/films. The first study seeks to examine whether there is a generally held image, or social representation (Moscovici 1961/76), of the Vikings in the minds of children today, to explore the nature of this image, and to discover whether a visit to Jorvik can shape or alter the image in any way.

4.1 A SOCIAL REPRESENTATIONS APPROACH APPLIED TO THE JORVIK VIKING CENTRE

The Jorvik Viking Centre in York is a museum which portrays Viking life in York by presenting a reconstruction of a Viking settlement with houses, workshops and a wharf, brought to life not only through the use of life-size models, but also through sounds and smells.

The Centre is divided into three parts:

1. An orientation area.

2. An innovation area (which includes a journey back through time, a reconstruction of a Viking settlement, and a reconstructed archaeological dig).

3. Conventional display cabinets.

Before reaching the Viking town, visitors walk through an orientation area (wall panels using graphics which set the Vikings in their historical context). The visitor then enters a Time Tunnel designed to emphasize the long time span which has elapsed since the Viking age, leading the visitor away from the 20th Century into the 10th. In this way an apparently simple concept, like time,
which may in fact be difficult to grasp, is conveyed more meaningfully (Addyman and Gaynor 1984). In the main part of the display (from the Time Tunnel to the end of the Viking settlement), visitors are transported in four-person battery-driven cars, each with a commentary. Visitors are carried back through time (passing scenes from history on the way) to the 10th Century and a bustling Viking street.

The Time Tunnel leads the visitor into a reconstruction of rows of 10th Century timber buildings with models of Viking figures engaged in everyday activity. Every detail is in fact directly based on excavated evidence, or deduced indirectly from historical or archaeological evidence from elsewhere (Addyman and Gaynor 1984).

The journey through the Viking settlement shows a side of Viking life rarely contemplated - their domestic life (houses, cooking facilities, children and pets) and some aspects of their cultural and working life (jewellery and leather making, fishing and trade). Because visitors are transported through this section the amount of time they spend in this area is carefully controlled - visitors cannot stop at any of the displays.

In addition to the reconstructed settlement, the Jorvik Viking Centre also portrays the archaeological process which led to this reconstruction. This area is set out just as it would appear during the excavation, and the archaeological process is explained with reconstructions of site sheds and laboratories, and photographs. Parts of excavated buildings with pits and hearths exposed are shown in the actual location where they were discovered.

The final part of the museum has artefacts in glass cases, more like a conventional museum. The artefacts displayed relate to their domestic and cultural life rather than their warring, adventurous escapades.
The Jorvik is of particular interest in terms of a social representations perspective, since it presents accurate historical details in a way which will readily be assimilated by the public, by creating an atmosphere of 10th Century life through the use of life-size figures, sounds and smells. In addition it attempts to educate the public in archaeology and, in particular, to demonstrate the role of the Vikings in the history of the city of York and the importance of archaeology in elucidating this. Thus the exhibition links a historical and legendary theme with a scientific activity and attempts to fit this into the social reality of York as people know it today.

In addition, the image of the Viking, as portrayed in this exhibition, is very different to the conventional myth. Although the Vikings are a popular topic for study in primary school, many children and adults retain only a vague notion of how they fit into history. The word 'Viking' conjures up for many an image of a bloodthirsty, brave, but merciless race of seafarers, sporting beards and horned helmets. People have vague recollections of Vikings from history books, but more powerful images will have been gleaned from adventure stories and films.

However, the notoriety of the Viking as the hero of stories, comics and films has waned of late, being replaced by fictional and surreal superstars like Spiderman (although several advertisements nowadays still use the traditional aggressive, horn-helmeted image to advertise such things as Danish lager).

An examination of children's social representations of Vikings, then, hopes to reveal if there is still a strong image of the stereotypical Viking hero/villain, which has filtered down to a new generation, and seeks to assess how effective the Jorvik Centre is in shaping and altering this image.
It is hoped that this assessment of children's understanding of the Vikings will illuminate more general issues in relation to the understanding of history itself.

4.2. THE NATURE OF HISTORY

Any investigation into learning in a museum ought to take into account the public's understanding of the general topic area (e.g., science or history) in order to properly assess their understanding of the specific topic area (in this case, the Vikings). The Jorvik Viking Centre is primarily concerned with history and the investigation of history through archaeology.

Historical constructions can be found everywhere: in films, literature, and in the massive contemporary growth of historical tourism. Thus the general public's understanding of historical themes may be drawn from a variety of sources, and may often be founded more on myth than reality.

History is essentially a dynamic discipline since it is the account of man's activities over a period of time (Jurd, 1978), and in effect, its purpose is to examine the continual changes in society.

A publication issued by Her Majesty's Inspectors of Schools in 1985 on the subject of history teaching in primary and secondary schools states that history "is concerned with explanations and origins and with the contemporary world as much as with the distant past. It demands evidence to support statements about human beings and it depends on skills of reasoning, criticism, and communication." (History in the Primary and Secondary Years, D.E.S. 1985). Above all, it is concerned with making inferences from the facts available and searching for more facts in order to support or reject these inferences. Yet to many people, history simply involves a parrot-like repetition of facts and dates. The HMIS's report was intended to re-establish history as an important and relevant subject in the school curriculum, in the face of general
criticism that the study of history should be replaced by more relevant contemporary disciplines like sociology and economics (Guardian article, 1.10.85).

Perhaps a major problem with history's image is that in many school textbooks it is represented as a series of facts and dates without contemporary relevance. Some museums, like the Jorvik Viking Centre, have attempted to correct this image by presenting history in a more dynamic form, which is more easily assimilated into contemporary understanding.

A view of history which encompasses the ideas expressed in the HMIS's report implies further that any assessment of learning in a history museum must attempt to move beyond the mere measurement of recall/recognition of facts and dates.

Marwick (1970) sees history as providing a memory for present-day society, and from this perspective, it can be seen to perform a vital function, just as our own individual memory is essential to provide us with continuity and stability. Johnson and Dawson (Popular Memory Group, 1982) have distinguished two ways in which a sense of the past retained in our social memory may be produced: through public representation and through private memory (the latter does not refer to a completely individual or idiosyncratic memory, since it may also comprise many collective representations).

The kind of representation produced by the public arena is referred to as 'dominant memory' - representations which are formulated mainly, but not exclusively, by formal academic procedures and which have connections with dominant institutions in society. Historical representations which are produced in academic history-writing are not all 'dominant' however, since within academic history there are often competing constructions of the past; nor are those representations which are successful in gaining public acceptance necessarily truthful - they may be stereotypical
constructions or myth. Johnson and Dawson point out, for example, that images of World War II in Britain have developed into a plethora of fact and fiction influenced more by the traditions of masculine romance inherent in movies and in today's superhero cults than by historical writing.

History in terms of 'private remembrances' is a more 'hidden' history, concerned with private experiences which generate a feeling of past and present in the course of everyday life. Johnson and Dawson point out the importance of recognising this past-present relationship implicit in the term 'memory', and hence in relation to an understanding of history. History is constructed and reconstructed as part of a contemporary consciousness, it is not merely concerned with things in the past.

The Jorvik Centre seems to encapsulate this kind of view in its presentation of history. It does not present abstracted 'facts' and isolated artefacts, but tells a story. The reconstructed Viking settlement attempts to recreate, in modern York, the experience of living there in Viking times. In addition, the historical story is linked more concretely to the present day by showing the archaeological process which led to our knowledge of Viking life in York. Most importantly, the exhibition contradicts the 'dominant' representations of the Vikings - the 'rape and pillage' image generally held, not by arguing that that particular construction is incorrect, but by offering another perspective on Viking life. Thus it appeals to people's 'private remembrances' of the Vikings - early representations of them gleaned from adventure stories and films as well as school, and attempts to change people's understanding by offering a different viewpoint.

A social representations approach examines the social transmission of knowledge and is essentially concerned with past-present relationships, hence this kind of approach can be usefully applied in any investigation into the understanding of history, since it attempts to move beyond the mere recall of facts. A proper
understanding of what the general public learn about the Vikings from a museum visit must take into account what they already know about the topic, and this cannot be properly assessed by the use of simple pre-visit 'tests' of recall or recognition of isolated facts, to be compared with a similar postvisit assessment.

Thus a social representations approach would appear to be a more suitable theoretical perspective for the investigation of historical understanding in general, and in particular, to an appreciation of learning in a modern historical museum like the Jorvik Centre, than the cognitive-experimental approach more usually adopted. The rest of this chapter describes the application of this approach to examine the effectiveness of the Jorvik Centre in encouraging learning in schoolchildren.

4.3 PRELIMINARY RESEARCH

Since a social representations approach necessitates taking into account the understanding which visitors bring to a museum, before one can properly assess how this understanding may be enhanced or altered, the subjects' pre-visit image of the Vikings is compared to their post-visit understanding. In order to explore what today's schoolchildren know about the Vikings, and in particular, whether a common image, or social representation, can be identified, drawings and accounts are used, rather than straightforward tests of factual knowledge.

By using accounts and drawings children can be encouraged to express freely whichever details appear salient to them, and the nature of historical constructions can be more effectively explored. In addition the portrayal of the Viking in literature is examined, to provide indications of the kind of information available to the general public.
The pilot study consists of a largely qualitative examination of the images which can be found in children's books on the Vikings and in the drawings and accounts of a small sample of children between the ages of 9 and 12 years.

### 4.3.1. Analysis of Children's Books on the Vikings

**Method:**

A thematic content analysis was undertaken, using the recording unit of a theme within the context unit of a paragraph, ie each paragraph was considered separately and all the themes contained therein were noted.

**Sample:**

The books examined were:

- A Closer Look at Vikings (Archon Press, 30 pages)
- Great Civilizations: The Vikings (Longman, 44 pages)
- Ladybird Great Civilizations Series: The Vikings (Ladybird, 50 pages).

These books were selected on the basis that they are widely used in classrooms as well as being available in local libraries. They are all factual books, aimed at an age range of 8 - 12 years old.

**Procedure:**

The texts were read firstly in terms of the character of the Viking which emerges, and secondly in terms of the way of life of the Viking. These two main aspects were selected because although history is concerned with presenting 'facts', any account of history is necessarily embellished by contemporary reflections on the motives, feelings and character of historical figures.
Comparing past conditions with present dilemmas in terms of the human qualities we all possess enables a link to be established between the past and the present in the contemporary consciousness. Thus whilst objective facts are clearly of primary importance in history, our impressions of the character of historical figures is necessary to render these facts understandable.

The two main themes (Viking Character and Way of Life) were used to develop two separate coding frames.

The Viking Character

The texts were read with a view to understanding the image of the Viking character which emerges. The various signs and themes were coded and it clearly emerged that many of the statements conveyed attitudes, judgements and situations which went beyond the historical facts which are known. Many statements entailed several meanings.

The portrait of the Viking character presented in the books was examined broadly in terms of Internal factors (ie aspects relating to personal qualities) and External factors (including both external or environmental influences which determine character, and the reactions of others towards the Vikings). Thus three main themes emerged, in terms of Qualities (internal), Influences (external), and Reactions of others (external effects). These main themes emerged after an initial analysis of the manifest content of the whole narratives, taking into account everything which was written about the Viking character itself, and references to character implied in the acts of others.

The creation of a code developed from the initial three main themes.

The code referring to Internal Characteristics (Qualities) was further subdivided into three subcodes, relating to moral aspects
(ie aspects relating to their conduct in terms of law and justice),
social/emotional aspects (ie aspects of character which primarily
effect social relations), and egoistic aspects (aspects of
cracter which primarily effect the Vikings themselves). Each of
these subcodes contained several categories of opposing
caracteristics (positive-negative), as shown below:

Code: Internal Qualities

Subcode: Moral Social/Emotional Egoistic

Categories:

<table>
<thead>
<tr>
<th>Moral</th>
<th>Social/Emotional</th>
<th>Egoistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>just/unjust</td>
<td>kind/cruel</td>
<td>skilled/unskilled</td>
</tr>
<tr>
<td>honest/dishonest</td>
<td>constructive/</td>
<td>strong/weak</td>
</tr>
<tr>
<td></td>
<td>destructive</td>
<td></td>
</tr>
<tr>
<td>obedient/disobedient</td>
<td>civilised/</td>
<td>brave/cowardly</td>
</tr>
<tr>
<td></td>
<td>uncivilised</td>
<td></td>
</tr>
<tr>
<td>good/bad</td>
<td>peaceful/aggressive</td>
<td>appearance(+ve/-ve)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>humility/pride</td>
</tr>
<tr>
<td></td>
<td></td>
<td>adventurous/unadventurous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>enjoyment/displeasure</td>
</tr>
</tbody>
</table>

Each of these categories regrouped a number of items in which the
word itself or its equivalent could be seen as expressing that
particular quality, eg references (explicit or implicit) to Vikings
as unkind, unfriendly, intolerant, ungenerous, selfish, greedy,
merciless etc were all included in the negative pole of the kind-
cruel category.

The two main codes referring to External Factors (influences and
effects) included the following subcodes and categories:

Code: External Influences and Effects

Subcodes: External Influences Effects/Reactions of
Others

Categories: character moulded by
the environment
no fear/fear
welcome/avoid
powerful/powerless

External Influences, manifested in the notion of a character
moulded by the environment, was a strong theme which emerged in all
the texts, with an emphasis on the close relationship between the
Viking and his harsh environment. All references to the influence
of the environment on the development of the Viking character were
included in this code (e.g. "you had to be very tough to survive in a
land like Scandinavia"). The effect of the Vikings on other people
was illustrated in the references in the Effects/Reactions of
Others code. This was subdivided into four categories, with
opposing pairs of reactions being included in order to
differentiate between favourable and unfavourable reactions.
Viking Way of Life

The three books examined in detail were all primarily concerned with conveying actual historical detail and they were further analysed in order that the major categories of information could be noted.

The major information conveyed fell into the following categories:

1) Dates

2) Place of origin

3) The Vikings in Scandinavia - Industry
   - Farming
   - Art/craft
   - Class system
   - Law
   - Religion and superstition

4) Domestic Life -
   - Houses
   - Food
   - Clothes
   - Relaxation

5) The Vikings abroad -
   - Trade
   - Raids
   - Exploration
   - Armour weapons
   - Seamanship/ships
**Results**

**Viking Character**

All three books convey a strong image of the Viking character. A quantitative analysis was necessary in order to identify the major themes. Overall, 172 references to character were made, the greatest number of these references occurring in the Ladybird book (77 references).

In *A Closer Look at Vikings*, 49 references were made to character, the majority of these falling in the Internal Qualities Code (25 positive, 16 negative). Within this Code, most references fell in the Egoistic Subcode (references to skill, strength, courage). Negative references, however, primarily occur in the Social/Emotional Subcode (references to aggression, cruelty etc). External Influences and Effects was not a strong theme in this book; however, the predominance of negative references occurring in the Social/Emotional Subcode indicates an implicit assumption about the effect of the Vikings on other people.

*Great Civilizations: The Vikings* offers a more detailed description of factual historical detail with a less stereotypical view of the Viking. There is more narrative and less pictures than in the other two books. Often the traditional, mythical view is counterposed by a more accurate opposing view. Nevertheless there were 46 total references to the Viking character. Eighteen of these fell in the Egoistic subcode of the Qualities code, referring largely to skill and achievement. There was less emphasis on the *character moulded by the environment* and the categories in the Reactions of Others code, and reference to the Vikings being welcomed as merchants were included, to counterpose their image as fear-provokers.

*Ladybird Great Civilisations Series: Vikings* demonstrated all of the codes and categories most dramatically. Whilst the emphasis is on conveying factual information, the narrative also conveys a
strong image of the Viking character. There was a total of 77 character references throughout this book. Fifty three of these references were concerned with the (internal) qualities possessed by Vikings, 35 positive and 18 negative. There were six references to the character moulded by the environment; however this theme generally pervaded much of the narrative as a whole. The Reactions of Others was referred to a total of 18 times. The most prominent themes here are fear and powerlessness. The only reference to Vikings as welcome was in the context of them as merchants.

**Viking Way of Life**

The purpose of the content analysis with respect to the 'way of life' detail was to establish the main themes emerging in the literature, which could be used to indicate the variety of information available to children in school, and thus form the coding categories for the analysis of the children's accounts. These themes are noted above. The frequency of occurrence of the various themes was not primarily of interest at this stage, and was not noted. Generally, a particular aspect of the Viking way of life (eg Viking food, Viking raids) formed a chapter or sub-section of a chapter, and these themes were used to provide the categories.

What emerged from the analysis was that there was a predominance of factual information (as compared to references to character) covering all aspects of Viking life, with a majority of the information presented in all the books relating to the Viking Abroad category. Whilst all aspects of Viking life are fairly comprehensively covered (see categories above), the Vikings seafaring exploits receive the most attention in all three books.

The Jorvik Centre, of course, is not primarily concerned with covering the whole of Viking history, but with demonstrating life in a Viking settlement in Britain and, more importantly, with educating the public in archaeology's role in discovering these details. The three books examined paid little attention to this
latter aspect. The Ladybird book makes one reference to archaeology and its role in uncovering the evidence of Viking existence, and two of the books refer to the traces of Viking inheritance found in the appearance of people living in the north and east of England and in surnames and place names existing today. Generally, however, the crucial role of the archaeologist is not mentioned; although the role is implied in the many detailed drawings/photographs of artefacts; but apart from occasional references to the places where such artefacts were found, the actual process and the importance of archaeology is not directly referred to.

Discussion:

In all three books there is an emphasis on conveying factual information in an objective manner, and the whole spectrum of Viking existence is fairly comprehensively covered. However, the major emphasis is on the adventurous side of their life, i.e. those aspects relating to their explorations and raids in foreign countries.

This emphasis on the adventurous side of their life is embellished by frequent references to character. On the whole, the Viking's character emerges as positive - relating to aspects such as skill and bravery.

Throughout all three books, a clear dichotomisation of the positive and negative aspects of the Viking character emerges, however, when these are considered in the context of their significance to and influence on others. Positive qualities, like skill, courage, strength (Egoistic subcode) can be distinguished from negative qualities, such as unfriendly, destructive, aggressive, etc (Social/Emotional subcode), in terms of how far these characteristics effect others, or are significant only to the Vikings themselves. The negative aspects are primarily those which impinge on the lives of others. The overall impression is of the
Vikings as destructive, aggressive and cruel in their dealings with others, whilst at the same time, considered as a race on their own, they can be considered as possessing many admirable and worthwhile qualities.

The Viking is seen as a hard, tough warrior largely because of the harsh nature of his homeland, and the difficulties of life in Scandinavia. This influence is responsible both for their harsh nature and their intrusions into other lands. Thus their relentless raids are seen not as a manifestation of their greed for power so much as a necessity forced upon them. In addition the environment is responsible to a large extent for their more admirable qualities - their skill in seamanship, and their achievements in exploration. The overwhelming impression however is of the Vikings as feared by everyone and this theme is linked to and emphasised by the negative characteristics emerging in the Qualities code.

This was not intended to be a comprehensive analysis of children's books on Vikings, but merely to provide indicators of the image of the Viking popularly represented in school books today, and the sorts of factual knowledge that is available. What would appear to emerge from this brief examination is that even high quality historical accounts do not restrict themselves merely to the evidence, but convey the Vikings as personalities who had particular effects on other people. The other important aspect which emerges relates to the absence of explicit references to the role of archaeology in revealing history to us. There is little indication here of an attempt to relate what we know with how we know, yet surely this is important if we are to teach children an objective approach to history?
4.3.2. Children's accounts and drawings on the Vikings

The second stage of this preliminary research involved applying the coding frame derived from the literature to the analysis of children's accounts and drawings. This was done using a small pilot sample in order to establish the comprehensiveness and suitability of the coding categories, so that any modifications or omissions might be corrected at this stage.

Method:

Short accounts and drawings were collected from 33 children on the subject of Vikings. The accounts were content analysed using the coding frame developed for the analysis on the literature. Again, the recording unit of a theme was used within the context unit of a paragraph.

Subjects:

33 children, aged between 9 and 12 years (from two schools, one in London - sample size 15 - and one in the north of Scotland - sample size 18) were used as a pilot sample. Both primary schools are situated in largely working class areas. The two locations were selected in order to see if there were regional variations. The influence of the Vikings was much more permanent in northern and eastern England than elsewhere and the most highly influenced areas were the North of Scotland and in particular Orkney and Shetland, where Norwegian was still spoken until the eighteenth century and Viking festivals are still held. Thus the image of the Viking may be much more potent and salient for those children in Northern Scotland than for those in London, and they may be more aware of the lasting influence of the Vikings on their lives and culture. None of the children had received any recent lessons on the topic of Vikings, although all of them had already covered this subject at school.
Procedure:

Thirty three children were instructed, by their own teacher in class, to produce accounts and drawings on the topic of Vikings. They were asked "What do you think of when you hear the word "Viking"? Write a short essay and do a drawing - just put down whatever the word makes you think of".

Analysis of Accounts - The Viking character:

The major themes and categories which emerged from the analysis of the literature were used to guide the examination of the children's accounts. Using the same coding frame, a picture of the Viking character was built up. All references to aspects of the Viking character were scored in terms of the categories described earlier.

Analysis of Accounts - The Viking way of Life:

Again the analysis was guided by the earlier examination of books on Vikings. The major historical themes emerging in the three books discussed provided a very comprehensive guide to factual detail, and two further books were also used as a guide in this respect: The Vikings by R D Lobban and The Vikings by G L Proctor. These two latter books emphasise the domestic and everyday life of Vikings and give details of sagas.

The accounts were assessed in terms of the four main codes which emerged from the literature analysis:

1) Place of origin - references to Scandinavia (Norway, Denmark, Sweden) were scored as correct assertions. Incorrect assertions were also noted.

2) Dates - Any correct mention of the dates during which the Viking age lasted (8th to 11th Century) were scored, and in addition
references to the time which has elapsed since then (eg "around 1000 years ago"). Incorrect statements were also noted.

3) Vikings at home - references to their daily existence. This code contained 5 subcodes: law/class system, work, relaxation, religion/superstition, domestic life. The domestic life subcode itself contained several categories: houses, food, (daily) clothes, animals & pets. Both correct and incorrect assertions were noted.

4) Vikings at sea/war - references to aspects of Viking life at sea and on raids. This contained subcodes referring to: ships, explorations and raids, weapons and armour and a separate category for horns. Correct and incorrect assertions were noted. Of particular interest with respect to the latter category was whether the popular (but incorrect) image of the Viking sporting a fierce horned helmet would emerge as a powerful impression in the accounts.

5) A final code was included relating to Source. Included in this were any references to the children's source of knowledge regarding Vikings, ie references to archaeology, writings, sagas, films etc.

The two main codes - Viking Way of Life and Vikings at Sea/War - were so designed as to contain subcodes and categories illustrating two contrasting facets of Viking life - the view portrayed in the Jorvik Centre, emphasising domestic life and peaceful existence, and the view emphasised in books and films, emphasising their war-like and adventurous 'other' life at sea and on raids.
Drawings

Drawings were analysed in terms of the different elements which appear. The whole sample of drawings produced the following elements: Helmets (with horns/without horns), weapons, fighting, sea, ships (oars, square sails, figureheads), castle, houses, men, women.

Results:

Accounts - Viking Character

Scottish school

Most of the children had some opinion to offer on the kind of person a Viking was, and the character which emerges is much less favourable than the one presented in the books. Fifty four thematic references were made to character. Indeed some of the accounts confined themselves to a description of the character alone, offering no other information. In contrast to the books, the majority of the attributes were unfavourable (6 positive, 48 negative) and these mostly related to the (internal) Qualities code, with only two references made to the other codes (both in the 'avoid' category of the Reactions of Others code). Most of the children were very definite in their opinion that Vikings, on the whole, were evil people. The following is representative of the general view:

"My image of a Viking is a ruthless bloodthirsty vicious (sic) man who has no pity, gives no mercy and will destroy towns and villages just for something to do. They are proud but have nothing to be proud of" (age 10).

The most frequently occurring theme was aggression (31% of the total character references). In contrast with the books, there is no apparent awareness of the notion of a character moulded by the
environment or governed by situational factors, rather the Vikings are motivated by greed for power and riches, or their actions are ruthless without aim: "just for something to do". The accounts clearly place the Viking, not in the heroic mould, but as the villain.

London School

Thirty seven themes emerged relating to character and only 6 (17%) of these references were favourable (relating to skill, courage and strength). Again, the majority of references fall in the Qualities code, and the Social/Emotional subcode of this, particularly in relation to cruelty (32%) and aggression (19%). Three negative references fall in the Reactions of Others code. As with the Scottish sample the image which emerges is that of the brutal warlike Viking with few good qualities. Again, the motive of greed is seen as directing the Viking behaviour (here however, several children linked this attribute to physical appetite and appearance: "The Vikings were fat and greedy. They ate lots of food and killed lots of people").

Thus the character of the Viking which emerges is similar for both groups. Even though the Viking is an important part of Scottish culture, the Scottish children still perceive the Viking character as primarily negative.

Accounts - Viking Way of Life

Scottish school

The analysis of the Scottish accounts revealed that the children were aware of several historical details about Vikings. Thirty five references (relating to the codes and categories used) were made, 71% of these conveying correct information, and one reference to a source.
The majority of the correct statements were in the ships/sea category (Vikings at Sea/War code). Half the children demonstrated an awareness of the importance of ships and the sea in Viking life, and several offered more detailed information (eg square sails, figureheads etc). The children were also aware of several places visited by the Vikings (mentioned by 39% of the children). The fact that they were aware that the Vikings invaded Britain is not surprising, but several children offered more specific information (eg Orkney, Greenland). The children showed an awareness of the type of clothing worn and the kinds of weapons used, but there was little mention of place of origin and many children were rather confused about the actual time when the Viking age existed (eg "millions of years ago").

The most frequent misconception related to the weapons/armor category. Where helmets were mentioned, these were nearly always described as having horns.

What is striking about the accounts is the predominance of information (both correct and incorrect) offered in the main Vikings at Sea/War code (77%) compared with the Vikings at Home code (14% references).

Only one child made a reference to a source of information, by referring to a comic strip character called Hagar.

London school

Less accurate historical detail emerged in this sample. Only 13 references were made over the 11 accounts (compared with 35 from 18 accounts in the Scottish sample), and half of these were incorrect. Some of these errors emerge partly because the children attempt to offer more precise detail (eg the "Vikings came in 563" - London sample - as opposed to "Around 1000 years ago" - Scottish sample) leaving more room for error. References to ships/sea are the most
frequent observation (36% of the references), although this is much less prominent overall than in the Scottish accounts. Nevertheless, the majority of references do occur in the Vikings at Sea/War code, with only 23% of the references occurring in the code relating to the Vikings at Home. One mention of a (museum/exhibition) source was offered.

Unlike the findings in relation to the Viking character, here there appears to be a difference between the two groups, in that the Scottish sample would appear to have more detailed factual knowledge of the Viking than the London sample.

**Drawings**

**Scottish school**

The most frequently appearing element is the helmet replete with horns or wings. Wherever a drawing included a Viking figure, he was depicted apparently ready for a fight, sporting a fierce-looking horned helmet (depicted in 91% of the drawings) and an array of weapons (77% of the drawings). Another salient feature was the sea and ships (50% of the drawings) and often the drawings depicted a considerable amount of fairly accurate detail on the ships (square sails, oars, dragon-like figureheads). Only one child included a female Viking in the drawing, and no aspects of domestic life are apparent. The only buildings portrayed are castles (appearing in three drawings) — which are apparently under attack.

The image of the Viking which emerges is that of a fierce, bearded and armed seafarer, spoiling for a fight. One drawing depicts a rather sinister horned warrior carrying a three-pronged trident, so that the image of the Viking merges with that of the devil himself, or Neptune coming out of the sea. In many drawings the image appears to be similar to that of a pirate.
London school

The drawings offered by the London school are similar in many respects to the Scottish school, mostly depicting large bearded males in armour, with horned helmets and weapons appearing in all the drawings. The sea/ships is not a salient feature, however, appearing in only one drawing. Aspects of a domestic peaceful existence are again absent, although one child depicted a Viking (albeit very warlike in appearance) standing before some homely-looking cottages (however it is not clear whether this is intended to depict a Viking settlement or whether it is a village about to be attacked!).

The detail in the London drawings is confined to the Viking figure itself (rather than the ships). Vikings appear with intricately drawn apparel, scars, eyepatches, blackened teeth, hooks for hands, and, of course, the obligatory horned helmet. Thus the image of a pirate is even more strongly evoked in this group's drawings.

Discussion:

What is most striking in the accounts is the emphasis on descriptions of the Viking character, especially the negative aspects, as compared to any descriptions of their way of life (91 as opposed to 50 themes respectively over the whole sample). This predominance of inferences about the bad side of the Viking character is emphasised by the location of most of the factual information offered in the Vikings at Sea/War code, and the relative paucity of information occurring in the Vikings at Home code.

The drawings confirm this emphasis on the Viking's warlike and adventurous aspects, portrayed in the sinister facial expressions of the figures depicted and the proliferation of armour and weapons. The fact that the horned helmet appears in almost all the
drawings indicates the importance of this as the definitive Viking symbol; but the horns are also a symbol for evil in our culture, and convey a whole world of meanings (antichrist, aggressor, sinner etc) which thus become associated with the Viking character. Indeed, in several of the drawings the horns appear to come directly from the Viking's head, thereby connoting a satanic image.

The fact that no archaeological evidence has indicated that Viking helmets possessed horns at all becomes irrelevant because the horns have assumed a significance beyond this; they serve to give meaning to our attempts to understand the Viking behaviour in terms of personality, thus structuring our vague understanding of why they did what they did long ago. The image merges (in children's minds especially) with contemporary images of fictional evil doers and the simplistic clear division between good and evil, which obscures the more complex reality of the Viking motivations.

The central focus on character emerges in the drawings and accounts of both samples and the profile presented is very similar in both - the Viking is clearly a villain. Differences emerge between the two samples, however, with respect to the factual detail offered (Way of Life coding frame). The Scottish sample displayed more accurate and extensive knowledge overall, and also emphasised the importance of the sea and ships much more than the London sample. This is not to say that the London children could not have produced more information if specifically asked to do so; however, by allowing the children to give their own accounts, what emerges are the salient details as they perceive them.

Although a precise comparison is not possible here in view of the small sample size, the implications here are important from a social representations viewpoint. The Scottish sample, coming from the north of Scotland (in actual fact, close to a fishing port), have greater experience of the sea than do the London sample; in addition they live near areas where the Viking influence has been most marked. The difference in social/cultural experience between
the two groups therefore may have been an important factor in influencing the kinds of knowledge/information which has significance for them.

In the next chapter, Study 1 is reported. This study uses the results of this pilot research as a basis for examining the content of children's understanding of the Vikings before and after a visit to the Jorvik Viking Centre.
5. STUDY 1 - CHILDREN'S LEARNING IN A MUSEUM ENVIRONMENT - CONTENT

This chapter presents a study which examines the content of children's understanding of a museum theme from a social psychological perspective. The results of the pilot research, reported in Chapter 4, have been used as a basis for this investigation.

5.1. INTRODUCTION

This study explores the images of history which children share, and examines how these images are enhanced and altered as a result of a visit to a museum.

Children visiting the Jorvik Viking Centre in York (in school parties) were asked to produce drawings and accounts of the Vikings before and after their visit. The Jorvik Viking Centre presents a reconstructed model of a Viking settlement, and describes the archaeological process which led to the reconstruction. The museum is described in detail in Chapter 4. This investigation is based on the pilot research reported in that chapter.

The aim of the study is to explore the content of the children's shared knowledge about the Vikings and to evaluate the effectiveness of the museum in shaping this knowledge.

The nature of the cognitive challenges which the museum presents to visitors is also of interest. The Jorvik Centre presents a view of the Vikings which contrasts with the traditionally-held view of warmongering seafarers, and it might therefore be assumed that visitors will experience cognitive conflict resulting from these two contrasting images. Cognitive conflict, according to Piagetian theory, is an essential element in learning. Before this can be explored further, it is necessary to establish that there is a
traditional image of the Viking, shared by children visiting the museum.

5.2. METHOD

Children visiting the Jorvik Viking Centre in school parties produced descriptions of the Vikings before and after their visit. These descriptions were content analysed, and the frequency of themes occurring in the descriptions produced at the two different points in time were compared. The analysis was determined by the findings of the pilot work. A thematic analysis was undertaken, as with the pilot data, using the recording unit of a theme within the context unit of a paragraph.

5.2.1. Setting

The study took place in the Jorvik Viking Centre, which is described fully in Chapter 4 (Section 4.1.)

5.2.2. Subjects

122 children from 4 schools (in Staffordshire, Middlesbrough, Sheffield, and Gloucestershire) took part in the study. The schools were selected from as wide an area as possible from a list of schools which were due to make an educational visit to the Jorvik Viking Centre. The age range was from 7 years 0 months to 11 years 8 months. All the schools were state primary schools with children from primarily working class backgrounds. Two of the schools were from large urban areas (Schools B and D) and two were from rural areas (A and C). Because of the location of Jorvik in the north of England, very few schools visit the Centre from southern England, and the majority of school visits are made by local schools. In this sample two schools are from the north (B and D) and two from the Midlands (A and C), since this was the widest regional variation available.
School A (26 pupils aged 7 yrs 6 mths - 8 yrs 10 mths) and School D (13 pupils aged 7 yrs - 8 yrs 3 mths) both had some briefing lessons on the Vikings between pre-visit and post-visit. School D's lessons had already begun at the pre-visit date. This formal educational input consisted of specific preparation for the Jorvik visit and some background detail on the Vikings.

School B (56 pupils from two classes, 9 yrs 4 mths - 11 yrs 8 mths) also received lessons on the Vikings which had already commenced by the pre-visit date. The content of the formal educational input received by this school was the most extensive and comprehensive of the whole sample, and differed from that received by Schools A and D in that it was geared to an older age group.

School C (27 pupils 9 yrs 3 mths - 10 yrs 10 mths) received only minimal formal educational input on the Vikings which consisted of specific preparation for the visit. This group had not received lessons on the topic at the pre-visit date.

All schools on an educational visit to a museum will provide some formal educational back-up relating to the subject area concerned, although this will be variable according to age and to whether the topic area relates to a subject which is part of the normal curriculum at that time, or is being used as a special project. The main sample reflects this variability.

The table below summarises the details regarding the descriptions received from each school, and indicates the amount of formal educational input received by each school.
**TABLE 5.1 - Schools providing descriptions of the Vikings before and after a visit to the Jorvik Viking Centre**

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<thead>
<tr>
<th>Accounts:</th>
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<tbody>
<tr>
<td>4 weeks pre-visit</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>4 weeks post-visit</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>1 day post-visit</td>
<td>A</td>
<td></td>
<td></td>
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</table>

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<thead>
<tr>
<th>Drawings:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>4 weeks pre-visit</td>
<td>A</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>4 weeks post-visit</td>
<td>A</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>1 day post-visit</td>
<td>A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Formal educational input:**

| 2  | 1  | 3  | 2  |

1 = extensive
2 = moderate
3 = minimal

5.2.3 **Procedure**

Drawings and accounts were elicited from children between the ages of 7 years and 11 years 8 months, on the topic of "Vikings". The children's own teachers were instructed to present this as a topic and ask the children to draw or write about whatever images the word conjured up for them. This was done around 4 weeks prior to a
planned school visit to Jorvik, and the same procedure was followed around 4 weeks after the visit. One school also produced accounts and drawings the day after their visit (School A). School B produced accounts but no drawings, School D produced drawings but no accounts, Schools A and C produced both drawings and accounts. (See Table 1 above.)

Analysis of Accounts and Drawings

109 pre- and 109 post-visit accounts were obtained, along with 66 pre- and 66 post-visit drawings.

Accounts

Following the analysis of the pilot data, the same two main coding frames (Viking Way of Life and Viking Character) were used, although some alterations were made. Factual data was also collected (date, place of origin, and sources of information).

The main Viking Character coding scheme was largely unaltered, although some categories were combined because they covered similar concepts, eg the adventure and enjoyment categories and the destructive and uncivilised categories of the Social/Emotional subcode (Qualities code) were combined and the justice category (in the Moral subcode) was combined with honesty. The weak/powerful category was dropped from the External Effects subcode since none of the pilot sample used this classification. The final codes and subcodes are shown below, for items in each category, see Appendix A.
Main Code: Viking Character

Code: Internal (qualities)

Subcodes: Moral

good/bad
honest/dishonest
obedient/disobedient

Social/Emotional

kind/cruel
peaceful/aggressive
civilised/uncivilised
adventurous/unadventurous

Egoistic

skilful/unskilled
strong/weak
good appearance/bad appearance
humility/pride

Code: External (influences and effects)

Subcodes: Influences Effects

Character moulded by the environment
No fear/fear welcome/avoid
The Viking Way of Life coding scheme was altered more extensively. The final coding frame covers all the themes arising in the data and regroup a number of items to cover aspects of three main areas:

### Main code: Viking Way of Life

<table>
<thead>
<tr>
<th>Subcode: Culture</th>
<th>Domestic</th>
<th>War/Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>law/class</td>
<td>houses</td>
<td>ships/sea</td>
</tr>
<tr>
<td>money</td>
<td>food</td>
<td>raids/explorations</td>
</tr>
<tr>
<td>writing</td>
<td>clothes</td>
<td>armour/weapons</td>
</tr>
<tr>
<td>art/craft</td>
<td>animals</td>
<td>horns</td>
</tr>
<tr>
<td>religion/myth</td>
<td>work</td>
<td>slaves</td>
</tr>
<tr>
<td></td>
<td>leisure</td>
<td></td>
</tr>
</tbody>
</table>

It was decided to avoid looking at items in this coding frame in terms of 'correct' and 'incorrect' assertions since the analysis of the pilot data had shown that because of the open-ended nature of the data this was not feasible or appropriate, although 'correct' and 'incorrect' categories were retained with respect to Place of Origin and Dates.

Each account was coded twice, firstly in terms of the Viking Character coding frame and secondly in terms of the Viking Way of Life coding frame. Each category was marked with either a 1 or a 0 to indicate whether that particular theme was used by the subject, rather than noting the frequency of the same theme in a particular account, as had been the procedure in analysing the pilot data. This was done in order that a clearer view of the pattern over the whole sample might be obtained.

A random sample of 20 accounts were coded independently by another coder, to assess the reliability of the coding system. The level of agreement for the Character coding frame was 86%, and for the Way of Life coding frame, 88%.
Drawings

The drawings were elicited in an attempt to gain another perspective on the preconceptions which children bring to the museum. It was felt that the influence of formal teaching would be less evident in pictorial presentations than with written material, allowing the children to more freely present their own particular image of the Viking, without the constraints of limited language/writing skills. There is also evidence (from research into children's use of figurative language) that children in middle school years (approximately 7-10 years) eschew figurative and imaginative language in favour of mastering the rules of conventional usage (Gardner et al 1978; Gardner and Winner 1982). In other words, as children acquire an understanding of the boundaries and rules of language this may inhibit their freedom to use imaginative/figurative expressions; alternatively, some researchers have tentatively suggested that schooling may be an inhibitor of the imaginative use of language (Pollio and Pickens 1980). If this is so, drawings may provide a more accurate and less didactic view of children's social representations than written material.

Since it was not feasible to use the Viking Character coding frame with drawings, only the Viking Way of Life coding frame was used. Some of the categories were omitted since they could not be applied to drawings, and some new categories were added. The final codes and categories are shown below:
Main Code: Viking Way of Life

Subcodes:

<table>
<thead>
<tr>
<th>Culture</th>
<th>Domestic</th>
<th>Vikings at Sea/War</th>
</tr>
</thead>
<tbody>
<tr>
<td>money</td>
<td>houses</td>
<td>ships/sea</td>
</tr>
<tr>
<td>writing</td>
<td>food</td>
<td>armour/weapons</td>
</tr>
<tr>
<td>art/craft</td>
<td>clothes</td>
<td>horns</td>
</tr>
<tr>
<td>religion/myth</td>
<td>animals</td>
<td>slaves</td>
</tr>
<tr>
<td></td>
<td>work</td>
<td>fighting</td>
</tr>
</tbody>
</table>

Subcodes:

<table>
<thead>
<tr>
<th>Male figures</th>
<th>Female figures/Children</th>
</tr>
</thead>
</table>

The last two categories in the Vikings at Sea/War subcode, and the subcodes for Male Figures and Female Figures/Children, were additional elements which relate only to the drawings. These additions were made because these elements were seen to be salient aspects in the drawings produced by the pilot sample.

A random sample of 20 drawings were coded independently by a second coder. The level of agreement between the two coders was 95%.
5.3 RESULTS

The aim here is to examine, firstly, what kinds of preconceptions visitors bring to the museum, and more specifically, whether there is consensus concerning the set of attributes which best describes the image of the Viking in the pre-visit descriptions. Secondly, the persuasiveness of the message which the museum conveys may be examined by comparing the pre-visit and post-visit descriptions to see whether any specific influences can be identified (e.g., whether domestic/culture themes are more frequently used after the visit than before), or whether the pre-visit image of the Viking persists after the visit. It is important to take into account variations which may exist as a result of the differential formal educational input which the various schools received, and also variations which may be age-related. Thus in order to more clearly identify these aspects, the accounts and drawings are examined separately.

In the first section the accounts are examined, and differences in the frequencies of themes used by the various schools, both at pre-visit and post-visit, are explored; in addition variations in perspective between the younger and older children are examined. References to place of origin, dates/time and sources of information are also examined here.

The next section examines the themes emerging in the drawings produced by the children at the two time periods. Since the influence of formal educational input may be expected to be less marked in drawings than in written material, the drawings are examined mainly in terms of the different elements which are seen as salient by the different age groups.
A third section briefly examines the accounts and drawings of School A. This school produced descriptions the day after the visit in addition to the two other time periods, and this allows the immediate impact of the visit to be compared with the longer-term effect.

The final section of results uses a different technique (a multi-dimensional scaling procedure) to examine more fully the issue of whether a social representation of the Viking can be identified, and to explore more fully the dimensions underlying the descriptions of the children, and how these vary according to age, or change as a result of their visit to Jorvik.

5.3.1. Accounts

Pre-visit and post-visit accounts (4 weeks prior to and 4 weeks following a visit) were produced by three of the schools used in the study - Schools A, B and C (109 subjects in all produced both pre- and post-visit accounts).

The percentage of subjects using themes from each main code for pre-visit and post-visit accounts are given in Table 5.2.
TABLE 5.2 - Percentage of subjects using various themes in accounts of 'Vikings', before and after a visit to the Jorvik Centre.

<table>
<thead>
<tr>
<th>Time</th>
<th>Viking Way Of Life</th>
<th>Viking Character</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Subcodes: Culture 20</td>
<td>60</td>
<td>moral +</td>
</tr>
<tr>
<td>Domestic 51</td>
<td>79</td>
<td>-</td>
</tr>
<tr>
<td>War/Sea 94</td>
<td>71</td>
<td>social +</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ego +</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>[external]</td>
<td></td>
<td>environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>effects +</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

1 = before  
+ = positive attributes  
2 = after  
- = negative attributes  

(For frequencies in each individual category, see Appendix A)
Table 5.3 condenses the Viking Character code (internal) into positive and negative attributes in order that the relationship between the pre-visit and post-visit descriptions emerges more clearly.

**TABLE 5.3 - Percentage of subjects using one or more themes relating to positive or negative qualities of the Viking character in their pre-visit and post-visit accounts.**

<table>
<thead>
<tr>
<th></th>
<th>Pre-visit</th>
<th>Post-visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>81</td>
<td>59</td>
</tr>
<tr>
<td>Positive</td>
<td>19</td>
<td>38</td>
</tr>
</tbody>
</table>

The use of categories from the two main themes (Character and Way of Life) are discussed separately below.

**Character:**

It can be seen from Tables 5.2 and 5.3 that an emphasis on the negative side of the Viking character predominates in both the pre-visit and post-visit accounts. The only area where this is not the case is the Egoistic subcode, where, in the post-visit accounts, references to positive qualities exceed references to negative qualities, which is the reverse of the position seen in the pre-visit accounts. Environmental and situational effects and influences on character (External categories) do not emerge as a major theme in the children's accounts either before or after their visit, in contrast to the findings in the literature analysed as part of the pilot study. However, the majority of negative character references appear in the Social/Emotional subcode and the majority of positive references in the Egoistic subcode (both
before and after the visit), reflecting the findings in the literature. This implies an implicit awareness of the reactions of others, in that qualities which are seen to be negative are primarily those which concern relationships with others, whilst favourable characteristics relate to aspects of life which will not necessarily affect the lives of other people.

The most frequently mentioned bad characteristic in the pre-visit accounts is aggression, mentioned by 75% of the sample. This remains the most frequently mentioned characteristic in the post-visit accounts, but the percentage of subjects mentioning this theme drops to 40%, and this is almost equalled by the number of subjects referring to a positive quality - skill - which was used by 38% of subjects in the post-visit accounts.

Way of Life:

The main theme which predominates in the Viking Way of Life code is Vikings at Sea/War, mentioned by 94% of the subjects overall, and this remains a salient theme in the post-visit accounts (71%) but fails to retain its predominance as the major theme, which in the post-visit accounts is the Domestic subcode (79%). The biggest change between pre-visit and post-visit is seen in the Culture theme however, (moving from 20% pre-visit to 60% post-visit).

The most frequently used category at pre-visit is ships/sea, from the War Code. This was mentioned by 71% of the subjects at pre-visit, but drops to 49% at post-visit. The most frequently occurring category at post-visit is houses, from the Domestic Code, mentioned by 65% of the subjects (40% at pre-visit).

Thus in the pre-visit accounts, warlike and negative aspects of the Viking are predominant and there would appear to be evidence of a fairly strong consensus about the characteristics and life of the Viking, whereas after the visit a much more balanced but less cohesive portrait emerges, and the overall effect of the visit
would appear to involve an increase in positive and peacetime attributes and a corresponding decrease in negative and warlike attributes.

**Differences due to formal educational input**

**TABLE 5.4 - Showing percentage of subjects from each school using themes from Viking Way of Life Code and Viking Character Code (internal subcode only) in their pre-visit and post-visit accounts.**

<table>
<thead>
<tr>
<th>School</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>26</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Way of Life:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culture</td>
<td>4</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td>Domestic</td>
<td>11</td>
<td>23</td>
<td>91</td>
</tr>
<tr>
<td>War</td>
<td>96</td>
<td>38</td>
<td>95</td>
</tr>
<tr>
<td>Character:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>8</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Negative</td>
<td>81</td>
<td>15</td>
<td>88</td>
</tr>
</tbody>
</table>

_Time 1 = 4 weeks prior to visit_
_Time 2 = 4 weeks after visit_
In order to identify the specific influence of the museum in effecting the changes seen, several Chi² analyses were carried out to establish whether any differences existed between the various schools. Of particular interest here is a comparison between School B (which received the most extensive educational input, beginning before the pre-visit time) and School C (with minimal educational input between pre-visit and visit).

Pre-visit:

Chi² analyses of the pre-visit accounts revealed significant differences between schools in relation to the Viking Way of Life Code (see Table 5.4). Pupils from School B refer to the Culture theme much more frequently than the other schools (37% of subjects from School B as compared with only one subject from any other school); $\chi^2 = 21.5$, $p < .001$.

School B also refer more frequently to the Domestic theme ($\chi^2 = 69.49$, $p < .0001$). No differences emerged in the Vikings at Sea/War theme, which is used as a major theme by all the schools.

The Viking Character Code also revealed a difference between School B and the other two schools at pre-visit. No significant differences were found with respect to bad qualities, but in relation to good qualities a comparison between the schools revealed a significant difference ($\chi^2 = 9.11$, $p < .02$), with School B making significantly more references to good qualities than the other two schools.

Post-visit:

In relation to the Viking Character Code, the difference between schools regarding positive qualities is maintained in the post-visit accounts ($\chi^2 = 25.09$, $p < .001$). School B produced twice as many references to good qualities compared to their pre-visit accounts. School C's references to good qualities has also
increased quite dramatically, but School A's references in this category has decreased a little.

The predominant view of the Viking character remains largely negative however, although the consensus which existed between the schools at pre-visit has been reduced, since here a difference between School A and the other two schools emerges ($X^2 = 27.9 \sigma^2 \leq p < .001$). School A's use of negative character references has dropped dramatically, whilst Schools B and C continue to see this as a major part of the Viking image.

Chi$^2$ analyses on the Viking Way of Life Code in the post-visit accounts shows that the pre-visit pattern of differences between schools is maintained with respect to the Culture theme, although the differences are greatly reduced ($X^2 = 9.55 \sigma^2 \leq p < .01$).

However, the relationship between the schools with respect to the Domestic theme shows a different pattern from the pre-visit accounts. There is still a highly significant difference between the various schools in the use of the theme ($X^2 = 65.31 \sigma^2 \leq p < .0001$), but whereas before the visit, School B differed dramatically from the other two schools (with very few subjects from both School A and School C using this theme), after the visit it is School A which shows a different pattern, with the majority of subjects from this school still failing to use domestic themes in their accounts, whilst School C's use of the theme has increased and is, in the post-visit accounts, comparable with that of School B.

This increase in awareness of domestic and culture variables in the post-visit accounts of schools B and C did not lead to a corresponding reduction in their use of categories from the Vikings at Sea/War code however, since very few subjects from these two schools fail to mention categories from this theme in their post-visit accounts. A more dramatic change is seen in the accounts of School A, where the age group is younger (7-8 years). Here, 96% of
pupils mentioned a warlike theme in their pre-visit accounts and this dropped to 38% post-visit. A Chi \( \chi^2 \) analysis on the difference between schools with respect to this theme at post-visit revealed a significant difference \( (\chi^2 = 19.2, \ p < .001) \) which did not exist at pre-visit.

The dramatic rise in the use of culture and domestic variables in School C's accounts appears to indicate the specific influence of the museum, since this school received only minimal formal educational input. A comparison of the accounts from Schools B and C appears to show that whilst children who have had little formal education on the Vikings (School C) may bring to the museum an initially much narrower perspective on the subject than children who have studied the topic more extensively (School B), the museum visit would appear to have the effect of reducing these differences in perspective. On the other hand, consensus does appear to exist before the visit with respect to the salience of the War theme and the emphasis on a negative character, regardless of formal educational input. Consensus regarding the salience of negative and warlike aspects is not maintained at post-visit due to the dramatic decrease in School A's use of these themes. School A also differs from the other two schools in that domestic variables and references to good qualities do not feature so strongly in their post-visit accounts.

The differences between School A and the other two schools would not appear to be related to formal educational input so much as age, since Schools A's pupils are younger than either of the other two schools. This aspect is discussed below.
Age differences

TABLES 5.5 & 5.6 - Showing percentage of subjects in four age groups referring to themes in the Viking Way of Life Code, at pre-visit (table 5) and post-visit (table 6).

TABLE 5.5

Pre-visit Accounts

<table>
<thead>
<tr>
<th>age</th>
<th>7-8yrs</th>
<th>2yrs</th>
<th>10yrs</th>
<th>11yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>25</td>
<td>17</td>
<td>46</td>
<td>20</td>
</tr>
<tr>
<td>culture</td>
<td>4</td>
<td>12</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>domestic</td>
<td>11</td>
<td>35</td>
<td>59</td>
<td>100</td>
</tr>
<tr>
<td>war</td>
<td>96</td>
<td>94</td>
<td>89</td>
<td>100</td>
</tr>
</tbody>
</table>

TABLE 5.6

Post-visit Accounts

<table>
<thead>
<tr>
<th>age</th>
<th>7-8yrs</th>
<th>2yrs</th>
<th>10yrs</th>
<th>11yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>culture</td>
<td>55</td>
<td>53</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>domestic</td>
<td>23</td>
<td>88</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>war</td>
<td>38</td>
<td>71</td>
<td>78</td>
<td>95</td>
</tr>
</tbody>
</table>
TABLES 5.7 & 5.8 - Showing percentage of subjects making one or more references to negative/positive characteristics in the Viking character - pre-visit (Table 7) and post-visit (Table 8) accounts.

TABLE 5.7

Pre-visit Accounts

<table>
<thead>
<tr>
<th>Age</th>
<th>7/8yrs</th>
<th>9yrs</th>
<th>10yrs</th>
<th>11yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>26</td>
<td>17</td>
<td>48</td>
<td>20</td>
</tr>
<tr>
<td>Negative</td>
<td>81</td>
<td>59</td>
<td>87</td>
<td>85</td>
</tr>
<tr>
<td>Positive</td>
<td>8</td>
<td>26</td>
<td>23</td>
<td>20</td>
</tr>
</tbody>
</table>

TABLE 5.8

Post-visit Accounts

<table>
<thead>
<tr>
<th>Age</th>
<th>7/8yrs</th>
<th>9yrs</th>
<th>10yrs</th>
<th>11yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>15</td>
<td>76</td>
<td>67</td>
<td>81</td>
</tr>
<tr>
<td>Positive</td>
<td>4</td>
<td>41</td>
<td>48</td>
<td>57</td>
</tr>
</tbody>
</table>

In the Way of Life Code, the difference between the 7-8 year olds and the older children would appear to be in the variety of themes used. The older children use several themes in their accounts, often covering all three aspects of Viking life and this tendency
increases between pre-visit and post-visit. The younger children tend to concentrate on only one aspect in the pre-visit accounts (war), but by post-visit a more varied picture would appear to be emerging. However, this increase in the variety of themes appearing in the accounts produced after the visit can be explained in terms of a divergence of views within the younger group, since it would appear that they still tend to restrict themselves to only one theme, although for some of the children the theme they see as salient is no longer associated with war.

With respect to Viking Character, it can be seen from Tables 5.7 and 5.8 that whilst the youngest children's perception of bad qualities changes dramatically between pre and post-visit (indeed, references to the Viking character as a whole is no longer a major theme in their post-visit accounts), the older age groups still see the Viking as essentially a bad character. In fact, references to bad qualities increased between pre and post-visit in the case of the 9 year olds. However, at the same time, the older age groups show, in their post-visit accounts, an increased awareness of the many good qualities the Viking possessed, indicating an appreciation of two contrasting sides to the Viking character, which is much less evident in the pre-visit accounts.

Clearly, the younger age group are less able to consider 2 conflicting portraits of the Viking simultaneously, and although it would appear that in the post-visit accounts they are beginning to be able to accommodate more facets of the Viking way of life, it may be that they are simply exchanging one perspective for another. This is accompanied by a dramatic decrease in references to character, leading to a more concrete, less imaginative view of the Vikings. The older children, however, appear to be able to accommodate the contrasting facets of the Viking character and way of life, and this tendency increases after the visit.

There were no significant differences between males and females in
their use of the Codes. The number of girls and boys using any of the three main codes was about equal.

5.3.2 Factual Information - Dates and Origin

The post-visit accounts contained fewer references to dates and places of origin than the pre-visit accounts. 58% of the subjects referred (correctly) to the date/period of the Viking age in the pre-visit accounts, and this dropped to 19% in the post-visit accounts. Six subjects made an incorrect date reference in the pre-visit accounts, but no incorrect references appear after the visit.

Only 12% referred to 'place of origin' in the pre-visit accounts, and this dropped to 5% in the post-visit accounts.

Jorvik is concerned with portraying the daily life of the Viking in York, and the fact that they were invaders from foreign parts is not focused upon, apart from a display panel at the entrance. The idea that certain skills/customs were brought over from Scandinavia is not emphasised. By contrast, in the literature a considerable amount of detail concerning the origin of the Viking, and descriptions of the harsh life in Scandinavia, is given, and these aspects are related to the Viking character and customs in this country.

The children here show little awareness of such situational and cultural determinants of the Viking behaviour, and the lack of emphasis on the origin of the Viking (together with the paucity of references in the external categories of the Character code) indicates that this is not seen as an important aspect either before or after the visit to Jorvik. Hence Viking behaviour is seen in terms of internal traits and motivations of greed and desire for power in the pre-visit accounts. The peaceful picture of domestic life which Jorvik presents modifies this view. However, with little
reference to the influence of the place of origin and the necessity for the Viking to settle new lands, the effect may be to produce two conflicting and disconnected portraits, which, especially for the younger children, it may be difficult to accommodate.

The fact that fewer references to dates appear in the post-visit accounts could indicate that no real appreciation of the passage of time has been impressed upon the school visitor, despite the museum's attempts to do this. Before entering the Viking village the visitor 'goes back in time' from the 20th Century to the 10th, passing various scenes from history, in order to impress upon the visitor the notion of the passage of 10 centuries, and the 'timecar' in which visitors travel is used to emphasise the time period which has elapsed (Addyman and Gaynor 1984). However, the novelty of travelling in a 'timecar' may in itself detract from this effect.

However there is some indication that for a few of the children at least a better understanding of the passage of time was effectively conveyed. Before the visit, some of the children believed the Vikings existed 'millions of years ago' and one even suggested that they came to Britain in 1959. This kind of error does not appear in the post-visit accounts. Thus whilst fewer references to time and dates appear after the visit, misconceptions as to the time period involved would appear to have been reduced.
5.3.3 Sources of information

Sources of information about history were mentioned in the pre-visit accounts by only 2 subjects, both referring to coins found by archaeologists. However, 37% of subjects referred to sources of information in the post-visit accounts, the majority of these references being made in the museums/exhibitions category (see Appendix A), including references to museums other than the Jorvik Viking Centre. Other sources, however, included references to history books, sagas and films. Twelve children made implicit references in this last category by recounting scenes from a 1950s film called 'The Vikings' which was shown on TV during the period between their visit and the post-visit accounts.

Whilst an awareness of museums as a source of information about history did increase a little, an appreciation of the importance of the role of archaeology is not apparent, although this is one of the main aims of the museum, and half the Centre is devoted to portraying the archaeological process. However, the slight increase in the variety of sources referred to in the post-visit accounts may indicate that the visit has stimulated a generalised awareness of sources for some of the children, in that they began to seek out information available in other areas, such as television.
5.3.4 Drawings

Sixty six subjects produced both pre-visit and post-visit drawings (Four weeks prior to, and after, their school visit), from Schools A, C and D. These drawings were analysed using the amended Viking Way of Life Code shown above (5.2.3).

The percentage of subjects using one or more of the elements from each main code is shown in Table 5.9.

**TABLE 5.9 - Percentage of subjects using elements from 5 themes in drawings on the topic of 'Vikings' - before and after a visit to Jorvik**

<table>
<thead>
<tr>
<th>Culture</th>
<th>Domestic</th>
<th>Sea/War</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-visit</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Post-visit</td>
<td>36</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Men</th>
<th>Women/children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-visit</td>
<td>75</td>
</tr>
<tr>
<td>Post-visit</td>
<td>42</td>
</tr>
</tbody>
</table>

In Tables 5.10 and 5.11, the Sea/Wars category (Table 10) and the Culture/Domestic categories (Table 11) are examined in terms of separate age groups, and it can be seen that the biggest change occurs with the younger age groups, especially in relation to the Sea/War theme.
TABLE 5.10 - Percentage of subjects using elements from Sea/War theme in pre and post-visit drawings x age.

<table>
<thead>
<tr>
<th>age</th>
<th>7yrs</th>
<th>8yrs</th>
<th>9yrs</th>
<th>10yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>16</td>
<td>23</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Pre-visit</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Post-visit</td>
<td>12</td>
<td>39</td>
<td>78</td>
<td>77</td>
</tr>
</tbody>
</table>

TABLE 5.11 - Percentage of subjects using elements from Domestic/Culture themes in pre and post-visit drawings x age.

<table>
<thead>
<tr>
<th>age</th>
<th>7yrs</th>
<th>8yrs</th>
<th>9yrs</th>
<th>10yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>16</td>
<td>23</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Pre-visit</td>
<td>18</td>
<td>13</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Post-visit</td>
<td>87</td>
<td>76</td>
<td>43</td>
<td>54</td>
</tr>
</tbody>
</table>

It can be seen from the above tables that the warlike image of the Viking emerges even more strongly in the drawings than it did in the accounts. 100% of all age groups used some elements from the War code in their pre-visit drawings, and very few elements from the Domestic and Culture themes are evident at this stage. However, the post-visit drawings present a much more varied picture.
Various Chi² analyses were used to look at these differences more fully. No differences in the themes used is evident in the pre-visit data; however, analyses of the post-visit drawings revealed highly significant differences between the various age groups in terms of the themes used (no gender differences were found).

Post-visit differences:

The Vikings at Sea/War theme was used by the whole sample prior to the visit. However, after the visit, the younger children have largely dropped this theme, whereas the older children continue to use it quite extensively ($X^2 = 18.54, \text{df} = 1, p < .001$).

There was little difference in the groups with regard to the use of the Culture/Domestic theme (which was largely absent) in the pre-visit drawings, but a significant difference between younger and older children emerges in the post-visit drawings ($X^2 = 5.71, \text{df} = 1, p < .02$. 7/8 year olds - 80%, 9/10 year olds - 48%).

These differences between younger and older children at post-visit reflect the findings in the accounts, in that the younger group appear to focus on only one theme (which changes from 'wartime' at pre-visit to 'peacetime' at post-visit), whereas the older children appear to be able to accommodate elements from both themes in their post-visit drawings.

It is noticeable however that, in contrast to the accounts, very few of the children included any peacetime elements in their pre-visit drawings, and the degree of consensus across the whole sample at pre-visit is much stronger than that seen in the accounts. However, it should be noted that School B, having received much more extensive schooling on the topic than any of the other schools in the sample, was largely responsible for the differences which emerged in the pre-visit accounts, and this school did not produce any drawings. The three schools which did produce drawings received less formal educational input and thus the image which they produce...
may be less constrained by academic considerations. From the degree of consensus which emerges within these groups it would appear that the most potent image held by the children, regardless of age, is that of the warrior. The visit would appear to have the effect of reducing this consensus view and allowing fundamental age differences to be revealed (which will not be unconnected with variations in schooling of course).

One interesting aspect of the drawings which should be noted relates to style. Whereas in the pre-visit drawings of all the children there are no noticeable variations in style, the post-visit drawings are much more varied in style as well as content.

Before the visit the children present scenes of Viking Life (terrifying warriors and battle or sea scenes), but after the visit several of the older children, in particular, produce more abstract designs and images, eg copies of the Jorvik Centre's striking logo (a black and white Viking mask), or isolated elements and artefacts (examples of runes, coins, jewellery and weapons).

The younger children (and a few of the older ones) still produce scenes at post-visit, although many of the scenes now depict a peaceful domestic life. This may indicate that the impression which the visit made on the children was very varied, in that some of them retained an overall impression of 'Viking life' whereas others retained a more specific focus on elements which interested them. In addition, for some of the children the museum visit may have had the effect of stimulating a wider aesthetic appreciation. Thus a museum may influence visitors in ways which extend far beyond the specific content of the subject area.

(See Appendix B for examples of the drawings.)
5.3.5 **Long-term effects of the visit**

School A (26 subjects, 7½-8½ years old) produced accounts and drawings on the day after their trip to Jorvik in addition to the accounts/drawings provided 4 weeks before and after the visit. This enabled a comparison to be made of the immediate effect of the visit with the longer-term effect. Tables 5.12 and 5.13 show the number of subjects from this school referring to the various main themes at three periods of time.

**TABLE 5.12 - Number of subjects from School A using elements from 5 categories (drawings)**

<table>
<thead>
<tr>
<th>Elements: Culture</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>1</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Wars</td>
<td>26</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Men</td>
<td>17</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Women</td>
<td>0</td>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>

1 = 4 weeks before visit  
2 = day after visit  
3 = 4 weeks after visit
TABLE 5.13 - Number of subjects from School A using themes from 5 categories (accounts).

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Themes: Way of Life:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culture</td>
<td>1</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Domestic</td>
<td>3</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Wars</td>
<td>25</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Character:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>21</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Positive</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

1 = 4 weeks before visit
2 = day after visit
3 = 4 weeks after visit

The pattern of change occurring between pre-visit and post-visit (at times 1 and 3 in the above tables) reflects the general pattern of change occurring in the youngest age group, described above, and there is little difference between accounts and drawings for this group. Of interest here is the nature of the change which occurs between the day after the visit (time 2) and 4 weeks after the visit (time 3).

It would appear that the image retained immediately after the visit develops and changes over the 4 week period, so that, for example, a focus on Culture themes increases and Domestic themes decrease
during this period. The decrease in references to Negative aspects of character and War categories evident immediately after the visit remains fairly stable over the period however. In the drawings, the use of figures, both male and female, declines during the 4 week period.

These changes probably reflect the influence of teacher guidance during the period following the visit. The predominant image which the Jorvik presents is of a bustling town, and domestic aspects are most salient (cooking facilities, sanitary arrangements, pets etc). Whilst aspects of culture are present (particularly in the artefacts gallery in the last section of the museum, where archaeological finds are displayed) the model town and lifelike figures clearly have a more immediate impact on the children's minds. This appears to indicate that the archaeological section, and the artefacts revealed through the archaeological process, do not make an immediate impact on the children, and their importance may need to be drawn out through supplementary lessons.

However, an alternative interpretation can be made, in terms of the cognitive processes which may be occurring. A visitor to Jorvik is presented with a view of the Vikings which conflicts with the popular image, and the cognitive conflict which arises will necessitate an alteration in perspective which may involve two related but distinct processes – an awareness of previous misconceptions, and the accommodation of new ideas. Thus the most persistent effect of the visit would appear to be an awareness of misconceptions (seen in the reduction of negative and warlike images, eg horns, which remains stable over the 4 week period). The assimilation of new and contradictory ideas (ie in relation to domestic and cultural aspects) may involve, for the younger visitor at least, a more fluctuating and less stable progress.
5.3.6. Discussion of content analysis

From the analysis of the frequency data it would appear that a change in the image of the Viking does occur after the visit to Jorvik. War themes predominate at pre-visit and although this is also a major theme at post-visit, other aspects of Viking life are being taken into account.

In addition, various misconceptions which were evident before the visit have been corrected. In particular, reference to the Viking's horned helmet, almost universal at pre-visit, has been almost completely eliminated by post-visit. A hologram display of a real Viking helmet in the artefacts gallery at Jorvik may have influenced this change; however, the disappearance of the horns may indicate a more subtle influence at work - the Viking is now seen as an ordinary person, rather than a symbol for evil.

The changes which are apparent here are more dramatically illustrated in the drawing material than in the written accounts, but this is largely because the children who received the most comprehensive background information preceding the visit (School B) contributed to the accounts data but not the drawings data. The differences between the accounts and drawings cannot, therefore, be taken as any support for the view that requiring children to produce written material inhibits their freedom of expression, as Pollio and Pickens (1980) have suggested.
However, because School B was excluded from this sample, the drawings do provide us with a clearer picture of the kind of image which the naïve visitor brings to the museum, and the effect the museum visit may have on altering or enhancing that image. On the other hand, an examination of the accounts data allows a comparison of the influence which varying amounts of formal educational input may exert.

The differences between the schools which are apparent in the pre-visit accounts indicate that variations in formal educational input do influence the perception which the children bring with them to the museum. However, these differences have been greatly reduced by post-visit.

Differences between the schools are still evident after the visit but these can largely be accounted for in terms of age differences; the younger children appear to have changed one perspective for another, whilst the older children are able to accommodate two points of view - the Viking has his warlike and unpleasant side, but also has a peaceful, domestic part to his life. This more balanced view reflects the descriptions found in the literature.

One theme which emerged in the literature but is largely absent from the children's descriptions is that relating to External Influences and Effects. Thus whilst in the post-visit descriptions the subjects' perception of the Viking character is more favourable, this does not appear to arise through any heightened awareness of extraneous factors being responsible for the Viking's harshness. It appears rather that the perception of internal qualities such as skill and craftsmanship has been encouraged. This again suggests the specific influence of Jorvik, since these are aspects which the museum focuses upon.
However, there is little evidence that Jorvik increased an awareness of the relationship between archaeology and history, which is one of the museum's main aims. Although references to a variety of sources of information did increase by post-visit, it is still only a minority of children who make any reference of this sort (37% at post-visit).

However, the fact that references to sources of information after the visit are not simply restricted to museum/exhibition sources suggests that the subjects became more aware of sources of information in general. Whilst some of this awareness would, of course, be related to sources available at school, it also extended beyond this, e.g. the influence of an adventure film seen on TV during the period was evident in several accounts.

With respect to the long-term effects of the visit as compared with the immediate impact, the examination of School A's descriptions at three points in time suggests that the image which pertains immediately after the visit does not remain static, but undergoes further modifications and change. In this respect, it would appear that the correction of misconceptions is the most enduring effect, whereas the adoption of a new image undergoes a less stable progress. This suggests that the museum may have stimulated further information-seeking, but also may indicate that the new image of the Viking is less stereotypical and more fluid.
5.4 MULTI-DIMENSIONAL SCALOGRAM ANALYSIS

The difference in the use of categories for pre-visit and post-visit descriptions indicates that the image of the Viking does undergo change after a visit to Jorvik. The pre-visit descriptions of the whole sample (with the exception of School B) contain a fairly narrow set of variables, whilst in the post-visit descriptions a wider and more diverse range of items are included.

However, examining the data simply in terms of frequency distribution does not allow one to make any informative statements about any systematic individual differences which may exist, in terms of the processes underlying the data. To overcome this problem, a multi-dimensional scaling procedure was used.

Multi-dimensional scaling (MDS) procedures provide geometric representations of relational data and are useful in dealing with open-ended data, such as accounts and drawings. The MDS procedure used here is the Multi-dimensional Scalogram Analysis (MSA) (Shye 1978). This is a non-metric analysis which makes no assumptions about the distribution characteristics in the data and operates entirely on categorical data. A scalogram is a rectangular matrix in which the columns represent items and the rows subjects. The matrix indicates, for each subject, the category to which it belongs in each item.

The MSA-1 computer programme presents the results in a pictorial display which is easily interpreted. It creates a geometrical representation of the multivariate distribution (a scalogram), taking into account the interrelations among the items. No a priori demands on the distribution characteristics of the items or on the relationship between them is made; instead every subject is represented as a point in geometrical space of an appropriate dimensionality, in such a way that for each item there will be a clear partition of the space into several regions according to the
categories of that item. These regions can be called contiguity regions (Zvulum 1978).

MSA does not depend on the concept of statistical significance but attempts to find the spatial solution which minimises the distortion between the pattern embedded in the correlation matrix and its spatial representation, i.e., it produces a 'best fit' solution. The level of distortion is given by a coefficient of contiguity, with a value lying between +1 and -1. Usually a coefficient of .9 is considered satisfactory for a 2-dimensional solution (the MSA-1 programme maximises the fitness of the representation using iterations until a satisfactory coefficient of contiguity is obtained.)

In this case, the categories to which each item could be assigned were 1 (denoting the presence of that attribute/item in the subject's description) and 0 (denoting the absence of the item/attribute).

Each subject is shown as a point in space which represents their position on all the variables - i.e., a profile is built up for each subject on the basis of the presence/absence of each of the variables used in their descriptions. The distance between any pair of points (i.e., subjects) in the space corresponds to the size of the correlation between them, so that the higher the correlation the closer the points are in the space (hence the more similar the profiles).

Each subject was entered into the MSA programme twice, firstly in relation to their pre-visit profile (i.e., all the variables used in descriptions produced before the visit to Jorvik) and secondly in relation to their post-visit profile (all the variables used in descriptions produced after the visit).

The MSA plot was examined in order to establish whether the pre-visit profiles for each age group (the configuration of points
representing subjects' descriptions before the visit) was distinct from the post-visit profiles (the configuration of points representing the same subjects after the visit). Where a clear partition of the space can be identified a line can be drawn to divide off different regions.

In many cases, of course, not all variables will give rise to clear regions within the configuration. However, the MSA programme also provides plots for each variable, or attribute. The configuration of points (subjects) on these plots is identical to the initial profile plot, however, on each attribute plot an indication is given of that particular attribute's presence/absence in each subject's description. These attribute plots can be used to establish whether identifiable regions exist for each variable and whether these regions correspond closely to pre-visit or post-visit regions, indicate other underlying dimensions of difference or similarity between the subjects, or fail to give rise to a clear partitioning of the space.

The aim here is to examine more fully whether a common image can be identified in the children's descriptions, and which attributes contribute to this image. Those attributes which give rise to a partitioning of the space which is identical or very similar to the pre-visit or post-visit profile of a particular age group (ie corresponds to the space representing that age group's complete descriptions before or after the visit) may be seen as contributing strongly to the pre-visit or post-visit image of the Viking which that age group holds.

If several attributes contribute to the pre-visit (or post-visit) image of all the children, this may indicate that these attributes can be seen as constituting a social representation of the Viking.

In addition, any change which occurs between pre-visit and post-visit descriptions can be more clearly identified in terms of sets
of attributes, and the underlying dimensions of conceptualisation can be examined.

The accounts and drawings of each age group (7-8 year olds, 9 year olds, 10 year olds and 11 year olds) were analysed separately. This was necessary because the MSA-1 programme cannot deal with large numbers of subjects; but in any case, it was desirable to make a comparison of any differences between the age groups. A two-dimensional solution provided the closest fit in each case. The regions occupied by the pre-visit and post-visit profiles of the subjects within each group were found to be clearly differentiated, with the exception of the 9 year olds' accounts. Lines were drawn (by hand) to demarcate subjects' pre-visit descriptions from (the same) subjects' post-visit descriptions.

Further plots, showing the attributes used in the descriptions separately, were also produced. These plots indicate which subjects used each of the attributes. The pattern of distribution for each of the attributes can be compared with the 'before' and 'after' profiles.

Several of the variables used in the original coding of the data were used infrequently and these were excluded from the analysis, leaving the following set of attributes to be included in the MSA:
<table>
<thead>
<tr>
<th>Accounts: Way of Life</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture: Law/class</td>
<td>Bad (moral) - disobedient, dishonest</td>
</tr>
<tr>
<td>Writing</td>
<td>Bad (social) - cruel, aggressive, uncivilised</td>
</tr>
<tr>
<td>Art/craft</td>
<td>Good (social) - skill</td>
</tr>
<tr>
<td>Religion/myth</td>
<td>Bad (ego) - appearance</td>
</tr>
<tr>
<td>Domestic: Houses</td>
<td>Good (ego) - strength</td>
</tr>
<tr>
<td>Food</td>
<td>External - fear</td>
</tr>
<tr>
<td>Animals/pets</td>
<td>Work</td>
</tr>
<tr>
<td>War/Sea: Sea/ships</td>
<td></td>
</tr>
<tr>
<td>Raids/explorations</td>
<td></td>
</tr>
<tr>
<td>Armour/weapons</td>
<td></td>
</tr>
<tr>
<td>Horns</td>
<td></td>
</tr>
<tr>
<td>Slaves</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drawings: Culture</th>
<th>Domestic</th>
<th>War/sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money</td>
<td>Houses</td>
<td>Ships/sea</td>
</tr>
<tr>
<td>Writing</td>
<td>Food</td>
<td>Armour/weapons</td>
</tr>
<tr>
<td>Art/craft</td>
<td>Clothes</td>
<td>Horns</td>
</tr>
<tr>
<td>Religion/myth</td>
<td>Animals/pets</td>
<td>Slaves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Fighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male figures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female figures &amp; children</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.4.1 Results of MSA

Figs. 1 - 7 - Profile Plots - Showing each subject, before and after the museum visit, as a point in space which represents their position in terms of all the attributes used in their descriptions.

Fig. 1 7-8 year olds' DRAWINGS (n=39)
Subject nos. 1-17 pre-visit
Subject nos. 18-37 post-visit
Fig. 2 7-8 year olds' ACCOUNTS (n=26)
Subject nos. 1-19 pre-visit
Subject nos. 20-38 post-visit

Fig. 3 9 year olds' DRAWINGS (n=14)
Subject nos. 1-10 pre-visit
Subject nos. 11-18 post-visit
Fig. 4 9 year olds' ACCOUNTS (n=17)
subject nos. 1-17 pre-visit
subject nos. 18-34 post-visit

Fig. 5 10 year olds' DRAWINGS (n=13)
subject nos. 1-7 pre-visit
subject nos. 8-17 post-visit
Fig. 6 10 year olds' ACCOUNTS (n=46)
subject nos. 1-45 pre-visit
subject nos. 46-91 post-visit

Fig. 7 11 year olds' ACCOUNTS (n=20)
subject nos. 1-20 pre-visit
subject nos. 21-40 post-visit
Figures 1 to 7 present the configuration of points derived from 2-dimensional MSAs for each age group, with the drawings and accounts shown separately. The numbers on the plots indicate the individual subject numbers. Each subject is represented twice—the lower range of numbers represent the subjects' descriptions before the visit to the museum, the higher range of numbers represent the same subjects' descriptions after the visit.

In several cases subjects had identical profiles (that is, they used the same attributes in their descriptions) and so several subjects may be represented by a single point. Thus where there are unequal numbers at pre-visit and post-visit, this is because more than one subject is represented by a single subject-number. For example, in the 7/8 year olds' drawings the subject numbers shown are from 1 to 37; however, the actual number of subjects is 78 (39x2). Details of duplicated subjects are given in Appendix C. Duplication occurs mostly in the youngest age group, indicating the greater similarity of their accounts compared with the older groups. In all cases, duplication occurs within one time period only. No descriptions produced after the visit are identical (in terms of the set of attributes used) to descriptions produced before the visit.

A line has been drawn to indicate the separate regions of space occupied by the subjects at pre-visit and post-visit. Deciding where to draw lines to partition space is a problem with the MSA analysis, since this is has to be done by hand. Ideally, lines should be straight, but in reality this is not always possible. In this case the lines have been drawn so that all the subject numbers denoting subjects at pre-visit fall on one side of the line and those denoting the same subjects at post-visit fall on the other side. Great care was taken to obtain an optimum partitioning of the space, but because of the nature of the data here, involving a fairly large number of categories used in the descriptions, this partitioning does not easily fit within straight lines.
However, in each case, the space can be partitioned into two regions distinguishing between pre-visit and post-visit profiles, which indicates that the children used a different set of attributes to describe the Vikings after visiting the museum. The exception to this is the descriptions of the 9 year olds (accounts only), where the distinction between 'before' and 'after' profiles was less clear. Three areas are indicated on the diagram for this age group's accounts (Fig. 4). On the top left is a pre-visit region, at the bottom a post-visit region, and the top right is a region where no clear distinction between before and after profiles could be made. The majority of subjects occupy this latter region.

**Attribute Plots**

The MSA-I programme also produces plots for each variable - here, the attributes used by the subjects in their descriptions. The configuration of points on the attribute plots is identical to the profile plots, that is, each subject is shown as a point in space. However, whereas the profile plot identifies each subject by the subject number entered into the programme, the attribute plots indicate only the presence (denoted by the figure 1) or absence (denoted by the figure 2) of that particular attribute in each subject's description.

Figures 8 and 9 are examples of two original attribute plots from the 7-8 year olds' drawings (the attributes are *animals/pets* and *work*). The presence of these attributes in each subject's description is shown by a figure 1, and its absence by a 2. The area of the space containing the attribute (a cluster of 1s) is marked off by a line. The broken line indicates the separate regions occupied by pre-visit and post-visit subjects. It can be seen that these two attributes only occur in the post-visit region, i.e., the children only used these attributes in their descriptions of Viking life after they had visited the museum.
Fig. 8 Attribute Plot (7/8 year olds' drawings) for the attribute ANIMALS/PETS

Fig. 9 Attribute Plot (7/8 year olds' drawings) for the attribute WORK
In the next section, each age group's descriptions are examined in terms of the particular attributes used. For clearer interpretation, the points representing the presence or absence of the attribute in each subject's description are not shown on the attribute diagrams, but the region of the space occupied by all the subjects using the attribute has been indicated (the hatched area). Not all the attributes could be identified in terms of clearly separate regions and only those attributes which did give rise to a clear partition of the space for that particular age group (clearly identifiable regions indicating presence/absence of the variable) are shown.

In order to illustrate the relationship between the use of a particular attribute and the time of the description (ie, before or after the museum visit), the areas occupied by pre-visit and post-visit descriptions is indicated by a broken line on each diagram (except where it is identical in spatial delimitation to the attribute region). Each profile diagram, with subject numbers shown, is presented again alongside the attribute diagrams.

Where several attributes partition the space in a similar way (ie, show a similar orientation), these attributes can be seen as contributing to the same underlying dimension, or conceptualisation. Ideally, this would be indicated by identical patterns of orientation. Whilst this does not occur here in all cases, several similarities in the general orientation of the attributes used can be identified. In addition, there are clear differences between the attributes (and the underlying dimensions which these attributes indicate) appearing in the descriptions before the visit and those appearing after the visit.
7-8 year olds drawings (Figs. 1 - 1 ix)

Figs. 1i - lix show those attributes in the 7-8 year old's drawings which divide the space into clearly identifiable regions (present/absent).

Two attributes are identical in spatial delimitation with the pre-visit profile - sea/ships and horns (Figs liii and iii). Fighting (Fig. li) also occupies the same region, although covering a much smaller area (ie appearing in the accounts of fewer subjects). None of these attributes occur in the post-visit region of the space. These attributes can be seen to share a warlike connotation, which is only apparent in the children's descriptions before the visit to the museum.

However, armour/weapons (Fig. lixiv) also occupies the pre-visit region, but occurs in the post-visit region as well. This indicates that this attribute is a major part of the image of the Vikings held before the visit to Jorvik, and can be seen as part of the wider underlying dimension of 'War' identified above. Unlike the other warlike attributes, this image also persists after the visit.
The spatial relationship between the 4 attributes shown at Figs lv to lviii (houses, animals/pets, female figures, work) form a separate grouping which contributes strongly to the post-visit profile of the descriptions. Although these attributes do not have identical spatial profiles, they show a similar orientation, and they do not occur in the descriptions produced prior to the museum visit (except houses which appears in the pre-visit drawing of one subject).

These attributes, taken together, contrast sharply with the attributes used in the pre-visit descriptions, and would appear to indicate an opposing underlying dimension of 'Peace'.
The two different spatial orientations identifiable here (Figs. li-iv and lv-lviii) would appear to indicate two separate aspects of Viking Life, the War aspect and the Peace aspect. The War dimension clearly relates primarily to the pre-visit conceptualisation of the Viking, whereas the Peace dimension underlies the post-visit image.

Armour/weapons (Fig.1iv) and male figures (lix) are two further attributes which partition the space into clearly identifiable regions (present/absent). However, their relationship with the two underlying dimensions identified above is not clear. Armour/weapons was seen to be associated with the War dimension, and is an aspect of war which persists after the museum visit, unlike the other attributes of this dimension. Male figures appears to occupy the same region of the pre-visit space, and may therefore also contribute to the War image. However, in the post-visit area, these two variables occupy different regions of space; and whereas male figures corresponds closely with the attributes which constitute the Peace dimension at post-visit, armour/weapons would appear to constitute a separate region.
This suggests that men are perceived as fulfilling different roles in the two sets of descriptions. Before visiting the museum, the children associated male figures with War; after the visit, they come to be associated with scenes of domesticity and peace.

Similarly, armour and weapons are the trappings of war and adventure in the pre-visit descriptions, but appear to be perceived as a separate entity in the descriptions produced after the visit. This may be related to the fact that the only weaponry or armour in Jorvik is found in the final display area, presented as artefacts in glass cases, and not as an integral part of the Viking scene.

The presence of armour and weapons in the post-visit descriptions may indicate that the War image persists for some of the children after the visit; however, it is a much diluted image in comparison to that which exists before the visit, and most of the children have replaced this image with a contrasting image of Peace.

7-8 year olds - accounts (Figs 2 - 2 ix)

A similar pattern of differentiation between 'War' and 'Peace' can be seen in this age group's accounts, with raids, ships/sea (Figs 2i and 2ii) suggesting one underlying dimension of War which relates only to the pre-visit profile. Bad(social/emotional) character (Fig.2iii) is also an aspect of this same dimension, although here there is some overlap with the post-visit profile. This set of attributes, contributing to the pre-visit profile, is again distinct from the set of attributes which best describe the post-visit profile (Figs. 2vi - ix).
Fig. 2 BEFORE AND AFTER
7-8 year olds ACCOUNTS

Fig. 2.1 Raid/explorations

Fig. 2.1.1 Ships/sea

Fig. 2.1.1. Bad (social/emotional) character

Fig. 2.1.4 Armor/weapons

Fig. 2.5 Horns
The two attributes *Armour/weapons* and *horns* (Figs 2iv and v) appear to be related, although the latter appears only in the pre-visit descriptions whilst the former also persists in the post-visit descriptions. Whilst these two attributes overlap with the War dimension identified above, the different orientation here suggests a separate dimension underlying their use.

A different set of attributes are used in the post-visit descriptions. Here, two separate patterns of underlying organisation can be identified — *houses* and *animals/pets* (2vi and vii) can be differentiated from *art/craft* and *clothes* (2viii and ix).
Here the Peace theme appears to encompass two distinct sub-themes, which could be interpreted in terms of a 'Domestic' dimension and an 'Ornamentation' dimension. At post-visit, armour/weapons appears to be related to the Ornamentation dimension (rather than a persistance of the War theme) since it occupies a similar region of space to that occupied by art/craft and clothes. That is, weapons and armour are perceived as objects, related to craft and ornament, rather than as the trappings of war.

Thus, again, a single theme (War) appears to unite the pre-visit descriptions of this age group, whilst a more differentiated, less rigid image is apparent at post-visit. Here, however, the themes which underlie the post-visit accounts would appear to involve slightly different underlying dimensions to those seen in the drawings of this age group.

9 year olds - drawings (Figs 3 - 3 vi)

In comparison with the younger group, the pattern of relationships here is less clear. However, similar underlying dimensions can be identified.

Figs 3 i to 3 iii (horns, male figures, armour/weapons) form one clear grouping of attributes which could be seen as a War dimension. Again, this theme occurs in the pre-visit region (although there is some overlap into the post-visit region also).
A different orientation groups together *houses* and *female figures* (3iv and v), and corresponds most closely to the post-visit region.
Art/craft (vi) also contributes to the post-visit profile, but the different spatial orientation of this attribute indicates a separate underlying dimension.

The two main systems of underlying organisation which appear to emerge can again be seen in terms of 'Peace' and 'War'. However, in this case, an alternative interpretation might be in terms of 'Male' and 'Female' aspects.

The third underlying dimension (relating to art/craft) might be interpreted as an 'Ornamentation dimension', similar to that which emerges in the younger children's accounts. Armour/weapons and male figures, where they appear in the post-visit region, could be seen as contributing to this dimension also.
9 year olds - accounts (Figs 4 - 4 vii)

A more complex picture emerges in the 9 year olds' accounts. Here three separate regions are indicated in Fig. 4. The region on the left represents a pre-visit region, although only three subjects appear here, and they are not closely related. At the bottom is a post-visit region.

The area occupying the top right-hand corner is a region where no clear distinction between 'before' and 'after' descriptions could be made, i.e. both pre-visit and post-visit subjects appear in this region, indicating that many of this group's pre-visit descriptions were similar to the post-visit descriptions.

However, the underlying dimensions of 'War' and 'Peace' can be identified here also. Figs 4i to 4iv (horns, armour/weapons, ships/sea, slaves), form one grouping which could be interpreted as a dimension of 'War'.

![Diagram of pre-visit and post-visit regions](image-url)
Fig. 4v shows the region of space partitioned by the variable relating to bad (moral) character. This is identical to the before/after profile plot in that there are two clear regions (denoting presence and absence of the attribute) corresponding to the pre-visit and post-visit regions, and a third indistinct region. This attribute would appear to be related to the War dimension.
Figs 4vi and vii (religion/myth and work) indicate a further grouping, relating only to the post-visit region, and these attributes may relate to an underlying Peace dimension.

10 year olds - drawings (Figs 5 - 5 vi)

Here the spatial delimitation for the attribute ships/sea (5i) is identical with the pre-visit profile and forms one underlying dimension along with horns (5ii). Armour/weapons (5iii), although extending into the post-visit region, encompasses the same pre-visit area. This could thus be a War dimension.
Female figures and houses (iv,v) form a further though less distinct grouping, and appear only in the post-visit region. This dimension could be interpreted as a Peace dimension.
The relationship between male figures (5vi) and the other attributes is less clear. It appears to constitute a separate underlying dimension which overlaps with both the War dimension (in the pre-visit region) and the Peace dimension (in the post-visit region). This could again indicate that the conceptualisation of male figures changed after the museum visit; before the visit men are associated with war, whereas after the visit they are perceived in a more domestic context.

As with the younger children's descriptions, the two main conceptualisations of War and Peace can be identified here, and a divergence of views is again apparent at post-visit. However, the partitioning of the space into clearly identifiable (and interpretable) regions is less clear than with the younger age group.
10 year olds - accounts (Figs 6 - 6 xiii)

Bad (moral) character, horns, armour/weapons, ships/sea, bad (social) character and raids/explorations (i - vi) suggest one clear underlying dimension which can be interpreted as a War dimension.
A second grouping, shown in Figs vii - xii (food, houses, religion/myth, work, skill, art/craft) suggests a Peace dimension.
Of all the age groups, the 10 year olds describe the two underlying dimensions of 'War' and 'Peace' most comprehensively. However, although the War dimension encompasses the whole of the pre-visit region, whereas the Peace dimension corresponds more closely to the post-visit region, many of the War variables are also present at post-visit, and many of the Peace variables extend into the pre-visit space.

The only variables which show a clear differentiation between pre-visit and post-visit are bad (moral) character and horns (only appearing in the pre-visit accounts), and skill and art/craft (only appearing in the post-visit accounts). This may suggest that a basic shift has occurred in the underlying conceptualisation of the Viking as a result of the visit, from a negative, destructive image towards a more positive and constructive view.

11 year olds - accounts (Figs 7 - 7 ix)

The pre-visit and post-visit profile for the 11 year olds is remarkably similar to that for the 10 year olds' accounts. Here however, the division of the space in relation to the attributes is not so clearly divided into the underlying themes of "War" and "Peace"; instead three groupings emerge.

The first dimension can be see in Figs 7i - iv (fear, horns, bad appearance, raids/explorations) and relates most closely to the pre-visit region (although the latter two attributes also extend into the post-visit region).
A second dimension would appear to link ships/sea, skill, and art/craft (v - vii), and appears to be mainly representative of the post-visit profile.
A third, much looser grouping is religion/myth and clothes (7viii and ix), again relating to the post-visit profile.
The three groupings can be interpreted as representing, firstly, 'Negative', or 'External' aspects ('external' because they relate to aspects of appearance and ways in which the Vikings impinge on the lives of others). The attribute clothes would also appear linked to this dimension in the pre-visit region.

Secondly, 'Positive' aspects would appear to be an underlying feature of the second dimension, relating to skill and achievement, and therefore describing essentially 'Internal' aspects.

The third grouping appears to be related to aspects of Viking life which cannot be regarded in terms of positive or negative (ie the underlying concept is informational rather than judgmental). These two attributes, religion/myth and clothes (where it is represented in the post-visit region only), could be seen as forming part of an 'Ornamentation' dimension which has emerged in the descriptions of the other age groups. In this respect, for some subjects, art/craft may be included here, since it occupies the same region of the post-visit space, although for other subjects it would appear to be more closely related to the 'Positive/Internal' dimension.

Several things are interesting here. Firstly, ships/sea would appear to be seen as a positive aspect relating to skill and achievement, rather than warmongering and intrusion. In addition, this attribute, in contrast to the other groups' descriptions, is here associated more strongly with the post-visit descriptions than with the pre-visit descriptions.

A second point of interest is the differentiation into 'Internal' and 'External' aspects of character, which is apparent here. This kind of conceptualisation, seen in the literature on Vikings discussed earlier, was not explicit in any of the children's accounts. The analysis here indicates however that this way of perceiving the Vikings is beginning to emerge in the oldest age group, implying the development of more abstract modes of thinking in the 11 year olds.
5.4.2 Discussion of MSA

Whilst the frequency data indicates that the Jorvik was successful in influencing the children's knowledge about Vikings, it does not really answer the question as to whether one can see historical themes like this in terms of social representations theory. Although clearly a strong and cohesive image prevailed at pre-visit, differences did exist between the individual schools, as well as between different age groups.

This is not inconsistent with a social representations view, but in fact highlights some of the problems in this approach, as outlined in a critique of the theory by Potter and Litton (1985). They suggest that the notion of consensus across representations fails to take into account intra-group differences and that different layers of consensus may exist. They also point out a problem relating to the researcher's role in identifying the social categories of interest. Thus if a researcher is interested in examining the social representations of 'schoolchildren' the implicit assumption is that this can be regarded as a cohesive group, yet, leaving aside obvious age differences, other broader social dimensions such as class or race may be more influential. In the light of these problems, the MSA analysis of the data may be more useful in identifying the elements which comprise the social representation of the Viking.

Overall, what emerges from the MSA is a differentiation between War and Peace as the underlying conceptualisation of the Vikings. The War theme emerges most clearly and relates closely to the pre-visit descriptions. The Peace theme emerges most strongly in the descriptions produced after the visit to Jorvik, but is less cohesive, and in all age groups the post-visit profile comprises several themes, including some aspects of War which persist from pre-visit, and notably a dimension (which does not appear at all in the pre-visit descriptions) which has been referred to above as the
Ornamentation dimension. This Ornamentation element appears to encompass aspects of Viking life which do not involve judgmental processes (making inferences about the Viking character in terms of positive or negative aspects), but instead relates to more aesthetic observations of Viking life, for example, their culture and craft.

One purpose of the MSA analysis was to examine in more detail the nature of change which occurs between pre-visit and post-visit, and to relate these changes to underlying differences in thinking structure which might be expected at the different age levels.

A clear differentiation between pre-visit and post-visit descriptions is most clearly seen in the youngest age group. As the children get older, the distinction between pre-visit and post-visit becomes less clear, and the underlying conceptualisation of the Viking becomes more sophisticated; for example, the 11 year old group see the sea-faring theme as separate from the war theme. Interestingly, the 10 year olds provide the most comprehensive picture of the differentiation between war and peace in their accounts, but this differentiation is not so clearly influenced by the visit (as it is with the 7-8 year olds) since peace themes are present at pre-visit and war themes persist after the visit.

The 9 year olds present the least clear picture. This may indicate that this age group is undergoing a period of change in the underlying structure of thought. The clearcut division between pre-visit and post-visit perceptions is beginning to break down, and the underlying conceptualisation is less clear. In the drawings the distinction appears to be between 'Male' and 'Female' aspects rather than 'War' and 'Peace'.

By 10 years of age, a more consolidated view has been achieved and a wider range of variables contribute to the underlying organisation of the concepts used; but the perception of the Viking would appear to be less directly influenced by single events, such
as a museum visit. The blurring of the distinction between pre and post-visit themes may indicate that the children are developing the ability to consider both sides of the Viking character simultaneously, which is not the case with the younger children.

The 11 year old group shows the most sophisticated pattern of underlying organisation, and the beginning of more abstract processes of conceptualisation, which emerges in the implicit Internal and External themes which can be identified here.

The variety in the pattern of conceptualisation underlying the post-visit descriptions of all the age groups suggests that intra-group differences, which are not evident at pre-visit, have emerged by post-visit.

In addition to indicating more clearly the nature of the changes which occur, the MSA is also useful in suggesting which perspective on Viking life is shared by all the subjects and where differences emerge, ie which attributes contribute to a social representation of the Viking. The attributes which best describe the pre-visit space for all the groups is horns, and ships/sea; and raids/explorations, armour/weapons, fighting also correspond closely with the pre-visit image. Since these five attributes are common across the majority of the whole sample (above 70%), it would appear that the predominant image of the Viking is that of the warlike adventurer. No similar cohesive correspondence emerges in the post-visit descriptions.

The two variables male figures and armour/weapons are fundamental elements in the warmongering image of the Viking which predominates at pre-visit, but both variables appear to be viewed differently after the visit. For some subjects, they still form part of the warlike image as they did at pre-visit, but for others men are no longer seen always in conjunction with armour and weapons, but are associated with a peaceful domestic scene, whilst armour and weapons would appear to form part of the paraphernalia of Viking
culture and artefacts, rather than being seen as the accoutrement of war.

Interestingly, the image of the Viking which emerges contains few elements from the 'Viking Character' coding scheme. Very few of the character attributes divided the MSA space into clearly identifiable regions, and none were common across the different age groups. The image of the Viking which is shared by all the children is essentially a very concrete and visual image, and the Viking emerges as merely a symbol of war and adventure, rather than a real historical figure with a particular personality, feelings or characteristics.

The indications are that a social representation of the Viking does exist, and children visiting the Jorvik are likely to bring with them a fairly strong impression of the Viking race as a hoard of fierce, seafaring warriors, sporting horns. The contrasting impression which the Jorvik presents would appear to be fairly effective in modifying this impression, in that an awareness of an alternative perspective is evident in many of the post-visit descriptions. However, for many, the warlike image persists. In particular, the emergence of an Ornamentation dimension in many of the children's descriptions indicates that the museum is effective in encouraging some awareness of cultural aspects of Viking life, as well as an appreciation of their domestic lifestyle.
5.5 GENERAL DISCUSSION

The results overall indicate that the museum visit did enhance the children's understanding of the Vikings. At the simplest level, learning can be seen to have occurred in that factual misconceptions have been corrected (eg in relation to 'horns'), but, more importantly, it appears that more complex patterns of conceptualisation underlie the post-visit descriptions. Thus the older children's descriptions suggest an ability to appreciate several contrasting points of view, and the use of more abstract dimensions of categorization; and even in the youngest group, there is evidence of the beginning of more complex thinking structures after the visit.

The data here also suggests that children visiting Jorvik may already have a strong stereotypical image of the Vikings. When thinking about ways of exploring learning in historical museums, clearly one must take into account the pervasiveness of historical representations which may be founded more on myth than truth. Any investigation of learning in a museum must take into account the existing knowledge and misconceptions which visitors bring with them, and this may be most usefully investigated using a social representations perspective.

The social representations approach has generally been used in attempts to investigate how people explain and interpret their social worlds. Thus issues which have been explored have usually involved aspects of social identity and group membership.

Here, a social representations framework has been used to examine learning and images of the past, in order to explore beyond the simple recall of facts, and to examine how knowledge of our cultural and historical past is represented in our contemporary consensual understanding. Knowledge of our past is social knowledge, based on shared cultural belief systems and stereotypes. Any examination of the transmission of such knowledge must take
into account the social-contextual factors involved, and develop methods of investigation which can take this into account.

It was noted in the previous chapter that the Department of Education and Science is critical of the way history is perceived and taught in schools today, since the essentially dynamic nature of the discipline has not been properly recognised. If history is concerned with the contemporary world as much as with the distant past, teaching history must involve an awareness of the variety of perspectives which exist and the social and cultural context from which these perspectives derive: it is not simply a matter of teaching dates and facts.

Similarly, researchers who wish to investigate how the general public understand and learn about history should not perceive the public as passive receivers of information, as an empirical model of human behaviour implies, nor as individual and efficient information processors, as the cognitive model suggests, nor as the unique and isolated individuals perceived by the phenomenological model (see Section 2.3). Instead, the social and cultural nature of human existence must be recognised. An understanding of how we learn about history must take into account the social and cultural past of the learner, and at the same time appreciate the true nature of history. This study has attempted to demonstrate the usefulness of adopting a social representations model of human behaviour in this kind of endeavour.

A secondary aim of this first study was to establish whether cognitive conflict might be experienced by visitors to Jorvik. According to Piaget, learning occurs through the creation of cognitive conflicts whose resolutions result in the construction of higher forms of reasoning (Piaget 1963). However, more recently, researchers have argued that cognitive development cannot be accounted for solely in terms of children's solitary reflections, rather knowledge develops through the coordination of differing perspectives within a social context (this issue is discussed fully
in the next chapter). This study has indicated that Jorvik presents a view of the Vikings which contrasts sharply with the image predominant in the children's minds before their visit, and it may therefore be assumed that some kind of cognitive restructuring will be necessary in order for the new perspective on the Vikings to be accommodated. Thus, having examined the content of children's understanding about the Vikings in this study, the second study aims to explore the processes by which learning may be facilitated in this kind of setting, by comparing individual learning in terms of cognitive conflict processes with inter-individual learning in terms of socio-cognitive conflict (Doise & Mugny 1979).
6. CHILDREN'S LEARNING IN A MUSEUM ENVIRONMENT - PROCESSES

Having examined the CONTENT of children's understanding of a museum theme from a social psychological perspective, the next chapter explores approaches which may be utilised in an attempt to examine the social dynamics involved in the PROCESS of learning in informal settings. The ideas examined here are utilised in the study reported in Chapter 7, which compares individual and group learning in children visiting a museum in a school group, focusing on the historical and archaeological themes presented in the Jorvik Viking Centre.

One major cognitive psychological approach which offers a widely accepted framework for assessing learning processes in children is Piaget's theory of cognitive development. The usefulness of Piaget's model in relation to informal learning settings and with learning material which may involve open-ended thinking structures is assessed. In addition, a social psychological elaboration of the Piagetian approach is explored, in order that the importance of the social dynamics operating in informal learning environments may be examined.

6.1 PIAGET'S THEORY OF COGNITIVE DEVELOPMENT

Piaget's theory of cognitive development enjoys considerable status in contemporary psychology and education and has been very influential in formal learning settings. In addition, there is evidence of a strong Piagetian influence in informal learning settings, for example in modern museum design, with its emphasis on the need for active participation.

Within museum evaluation research, where the concern has been the assessment of the educational benefits of a museum trip, Piagetian theory has also been influential (eg Thier and Linn 1976). Some
writers (eg Wilson 1982) have stressed the usefulness of museum visits for younger children in particular, since it is at this stage of development, according to Piaget, that children require concrete experience (which a museum can offer in abundance) in order to learn.

Piaget's approach to an understanding of cognitive development is a structural view; that is, it is an attempt to find structural characteristics which define various sequential stages of development in the intellectual growth of the child. Intellectual growth is conceived in terms of a series of stages and each stage is marked by qualitatively different emergent structures - some new cognitive skill can be identified at each stage. Much research has centred on what properties characterise each stage and what processes are involved in transforming one stage into another, in an attempt to discover general laws of development.

According to Piaget, the process of learning occurs through an interaction between the child and its environment. Each cognitive encounter with the world has two aspects, assimilation and accommodation. Assimilation refers to the interpretation of the external environment in terms of the individual's existing cognitive system - the fitting in of new information with what the child already knows. Accommodation means taking account of the structure of the external data - adapting the cognitive system to fit in with the environment. By the continuous processes of assimilation and accommodation the individual is constantly striving towards a state of equilibrium.

Piaget's model emphasises the importance of cognitive challenges which help promote the individual from one level of cognitive equilibrium to a more advanced one. Such cognitive challenges expose the subject to the latent contradictions in their initial response to a problem, and thereby cause cognitive restructuring and reorganization to occur (Doise and Mackie 1981). Initially separate items of knowledge (schemas) can in this way be
combined to form co-ordinated knowledge. The notion of cognitive conflict is thus seen as an essential element in the process of learning.

Stages of development

The various stages of cognitive development outlined by Piaget have been exhaustively described elsewhere. For present purposes it is necessary only to briefly summarise the stages, referring to the main properties which characterise each stage and which may be relevant to the present study. The stages are described in terms of different modes of thinking; within each stage a common cognitive structure can be identified, the nature of which is described either in terms of the principle by which they are formed or by means of the algebra of symbolic logic. There are four major stages - sensorimotor, preoperational, concrete operational and formal operational.

The sensorimotor stage (birth to 2 years) is the first stage. At birth the child is only capable of simple reflex responses, and during this stage, these develop through a series of sub-stages into organized behaviour patterns (schemas). Behaviour lacks the representational component of true cognition at this stage, and the infant responds to the stimulus as presented, rather than as represented or interpreted by cognitive activity (Piaget 1947). This lack of representational ability is illustrated in the concept of object permanence, which does not develop until late in the second year, according to Piaget. Children below this age appear to believe that if an object disappears from view it has ceased to exist.

The preoperational stage (2 to 7 years) is characterised by the rapid development of representational processes. Intelligence is no longer manifest by overt acts but increasingly by symbolic manipulation of events. In this stage the child can generate an internal representation which is not tied to perceived events;
however, although the preoperational child does not have to act upon environmental events but can imagine them, the representations generated at this stage are still fairly close to overt concrete actions.

Preoperational behaviour is generally described in terms of the absence of concrete operational abilities, such as classification, seriation, conservation, transitivity and spatial and geometrical concepts. The inability to cope with these kinds of tasks is related to the preoperational child's inability to decentre - to take account of more than one aspect of a situation. This is linked to the notion of irreversibility - the symbolic reversal of a process is not within a preoperational child's capability.

The child's thinking at this stage is largely intuitive. The rules of logical reasoning are not present: Piaget refers to preoperational thinking as transductive - proceeding from the particular to the particular, rather than from the particular to the general (inductive reasoning) or the general to the particular (deductive reasoning).

In the last years of this stage, first signs of decentring and reversibility appear, leading on to the concrete operational stage (7 to 11/14 years) during which the child's thinking becomes more integrated. The more highly organised mental processes which emerge around 7 years are called operations and much of Piaget's work consists of descriptions of the emergence of logical operations such as adding, multiplying, correspondence etc, and the infralogical operations involved in manipulation of quantity, time, space, and so on (Piaget, 1957). The most widely used test of concrete operational thought is the conservation test, involving the conservation of some property (length, volume, mass) between two objects when some transformation occurs to one of them. For example, when water is transferred from a tall, thin glass to a short wide one, the relations 'shorter than' and 'wider than' must be seen to be multiplied together. The concrete operational child
would know that the liquid remains unchanged although its appears
to be less in the shorter glass. The preoperational child would
focus on only one aspect (height) and assume that there was now
less liquid (Piaget 1952).

The formal operational stage begins at around 11 to 14 years of
age and is the final period of intellectual growth, during which
the cognitive processes become detached from concrete material and
hence become 'formalised'. At this stage the child is able to
produce logical thought which is itself about thought (Halford
1978). Formal operations are not restricted to dealing with data
but consist of 'second-order' operations which means the child can
deal with possible events, ie it involves hypothetico-deductive
reasoning.

There is a considerable body of literature which is critical of
Piagetian theory, particularly in relation to post-infancy
development. It has been argued, for example, that Piaget vastly
underestimated the cognitive skills of young children (see
Donaldson 1978).

More serious are the questions which have been raised in relation
to the validation of the theory. For concrete and formal
operational thinking, Piaget presented formal theoretical models
which incorporate logical and mathematical concepts and structures
(these models have been widely described, eg Brown and Desforges
1979). However, there is a growing conclusion that these models may
be incorrect, or at least incomplete or unclear. Flavell (1977,
1985) has outlined the major criticisms.

The main problem is the notion of 'stage' itself, and there are
several aspects to this problem. The structures used to model
concrete and formal operational thinking appear inadequate: Piaget
appears to be suggesting that the structures which make up concrete
and formal intelligence "become a part of the permanent furniture
of our minds or brains" (Halford, 1978, p xvi), and many
developmental psychologists question this assumption (see Flavell 1985).

Questions have also been raised as to whether the stage-to-stage developmental changes are quite so exclusively qualitative as Piaget asserts. Some evidence suggests that being an 'expert' in a particular area means that the quality of one's cognitive functioning in that area will appear very mature, in comparison to that of a 'novice'. Since a 'novice' in any domain is generally a younger child and the 'expert' an older child/adult, it may appear that they are in qualitatively different stages of intellectual development, but the difference is really only due to greater experience and practice - some would propose that this is a quantitative rather than a qualitative difference (Flavell 1985, p82).

A third problem is that the within-stage changes may be more gradual, important, and extended in time than originally believed. Piaget did not suggest that stages ended abruptly, but that there was a period of transition. Flavell goes further in suggesting that the stage itself is all change and transition. If this is so, it also follows that same-stage development may be less concurrent than Piaget's theory seems to require. It is accepted that there will be some horizontal décalage (the existence of acts atypical of the currently prevalent structure) particularly during transition between stages. However, one should still be able to make reasonably confident predictions of predominant modes of cognition displayed by most individuals for most of the time. Yet several studies have reported very low correlations between various measures of a particular operation (eg Schwebel 1975, Pascual-Leone, 1970).

Flavell allows that since it is likely that considerable mental organization does occur, it is still meaningful to talk in terms of cognitive structures, although Piaget's structural model may not accurately describe them. In addition, the major cognitive-
developmental changes which can be identified do appear to be qualitative rather than quantitative, and it is possible to identify concrete and formal operational intelligence, although Flavell prefers to talk in terms of developmental trends and contrasts (1985 p 93). However, cognitive growth should be seen as a much more gradual process, and it is necessary to adopt a much more dynamic concept of a stage if it is to have any utility. Whilst some researchers have suggested alternative, more dynamic conceptualizations of the stage approach (eg Wohlwill 1973), the growing trend has been towards adopting an information-processing approach to cognitive development (see Flavell 1985). Many, however (eg Halford, 1978) still adhere to the Piagetian approach, but with reservations, restricting their arguments to a description of the moment of the child's thinking when s/he is actually engaged in problem solving.

Flavell has suggested that "perhaps what the field needs is another genius like Piaget to show us how, and to what extent, all these cognitive-developmental strands within the growing child are really knotted together" (1977 p 252). In the absence of such, it is proposed that the work reported here will utilise Piaget's concepts of preoperational, concrete operational and formal operational thought. It is recognised, however, that intellectual growth may not be such a stage-like process as Piaget implied. It is reasonable to conclude, however, that one may still be able to identify developmental trends which show evidence of some kind of mental organization.

6.2 PROBLEMS OF APPLYING A PIAGETIAN-TYPE APPROACH TO AN EVALUATION OF LEARNING IN AN INFORMAL SETTING

Piagetian theory rests on a logical operational model of thinking, and researchers have used test material which can be described in terms of logical categories - hence, generally, physical causality, mathematics and science concepts lend themselves most readily to a Piagetian assessment. In closely structured subjects, like
mathematics, operations can be defined, firstly, in terms of the task used, and in addition, in terms of the subject's understanding of the structure of the task. A child's operational level is usually judged by her explanation of the task which can give indications of the structure of her thinking. The task itself is usually designed so as to elicit a particular operational skill, eg conservation tasks are used to assess whether a child is at the pre-operational or concrete operational level, since the ability to conserve is one of the major characteristics which distinguishes between these two stages.

Whilst a Piagetian framework can be applied in relation to an assessment of children's learning of science concepts in a museum setting (eg Thier and Linn 1976), the model is less easily applied in the case of more open-ended material, for example, where the theme of a museum is a historical one. In history the emphasis is on changes which occur over time, and this presents problems in any attempt to apply a Piagetian framework to an investigation of the learning processes involved in history-type material. The problems of attempting to apply a logical operational model of thinking to open-ended history-type material is discussed in more detail in Section 6.4.1.

A further problem needs to be considered. Piaget's theory of cognitive development offers a widely accepted framework within which children's understanding can be assessed. However, generally, the model has been applied in relation to individual learning, and is most often utilised in a formal educational setting. In an informal setting, such as a museum, learning may not be a matter of individual cognitive deliberations, but may be heavily influenced by social interaction processes. Most people visit museums in groups, and the psychological aspects of group membership itself should not be neglected. In view of this, it is necessary to examine an elaboration of Piaget's theory, which takes into account the social factor, and may thus be more applicable in a museum setting than a strictly Piagetian approach.
6.3 DOISE'S THEORY OF SOCIO-COGNITIVE CONFLICT

To social psychologists it has long been obvious that social factors intervene in cognitive development, but traditionally such factors have been seen as secondary to individual cognitive processes. Even within the study of social cognition, the dominant paradigm focuses on information-processing models to explain social judgments; and few studies have explored the impact of social factors on the nature of cognition, or examined the mechanisms by which social interaction intervenes in cognitive functioning.

Although Piaget acknowledged (in his study of moral development, 1932) that social interaction was a necessary condition for the development of individual thought, he was primarily concerned with how individual cognitive structures develop in the non-social environment. Piaget emphasised the importance of the child's interaction with the physical world; however, as Doise and Mackie (1981) point out, the most interesting objects which children actively explore are other social beings. Doise and his colleagues, operating within a Piagetian framework, believe that the importance of social interaction in relation to learning must be recognised, and have suggested that such interaction might play a causal role in cognitive development.

Whereas Piaget's equilibration model emphasises the importance of cognitive challenges, or conflict, which lead to cognitive restructuring and reorganization in the individual, Doise's socio-cognitive conflict model extends the concept of conflict to encompass social factors as well as cognitive ones. Doise's approach demands that both the social and cognitive nature of any conflict arising in an interactive situation be recognised, since any cognitive conflict present in a situation will be translated through the respective social behaviours of the participants. If, in Piagetian terms, cognition is seen as the co-ordination of actions within an individual, Doise sees this process made possible by co-ordinations between individuals.
Doise's basic hypothesis, then, is that social interaction exercises a causal effect on cognitive development, and more specifically, individual cognitive co-ordinations are preceded and made possible by the inter-individual co-ordinations that occur during social interaction. In order to test this hypothesis, Doise saw the need to develop new models and research paradigms in which social interaction would feature as an independent variable. (Doise et al 1975, Mugny and Doise 1978).

In their research, Doise and his colleagues wanted to show, firstly, that at certain ages children perform at a more advanced level when interacting than when working alone, i.e., new cognitive capacities are developed in social interaction (Doise and Mackie 1981). This is a different perspective to that of, for example, Zajonc (1965), who suggested that superior performance in collective situations is due to 'social facilitation' — the presence of others leads to arousal, which in turn leads to the production of dominant responses. 'Dominant' responses are capabilities which have already been learned, so Zajonc does not allow the emergence of 'new' cognitive capabilities in collective situations.

A further aspect which Doise attempts to demonstrate relates to the consequences of social interaction processes for individual cognitive development. He attempts to show not only that inter-individual co-ordinations precede the appearance of the same co-ordinations in individuals, but that they actually promote such cognitive development in the individual child. This idea is not new, of course, and has been explored within Social Learning theory (Rosenthal and Zimmerman 1972). However, from a Social Learning perspective, the transmission of new skills during social interaction results from modelling and imitation, and this implies that for progress to occur in an interaction situation, one of the participants must already possess cognitive abilities which the other participants can imitate.
The Social Learning view implies that in any situation where two children are working together, only the less advanced child can make progress, and if both children are at the same stage of development, no progress would be possible. The socio-cognitive conflict thesis, however, suggests that progress can result from experience with solutions equally or less advanced than that of the subject. The criterion for progress is that conflict, or opposition, should be socially present, not that presented solutions be superior to that of the subject. Where two subjects at the same cognitive level progress through interaction (or where progress is made by a child after interaction with a less advanced child) this would support a socio-cognitive rather than a modelling explanation, and several studies have demonstrated support for this view (Carugati et al 1978, Mugny, Doise and Perret-Clermont 1975).

However, the socio-cognitive conflict view does not imply that cognitive progress automatically arises from social interaction. Mugny et al (1984) suggest several necessary prerequisites for progress to occur:

1) When response systems of participants differ, i.e. between individuals with different cognitive levels (Mugny and Doise 1978);
2) in encounters between individuals at the same cognitive level who make opposing centrations (Mugny et al 1975);
3) between participants at the same cognitive level but occupying positions/points of view that generate divergent responses despite the application of the same schema (Carugati et al 1978).

Much experimental evidence confirms that socio-cognitive conflict arises given the above conditions. However, Mugny et al point out that, even when these conditions exist, several factors may prevent constructive socio-cognitive conflict arising, and these factors operate at several levels.

At the individual level, conflictual social interaction will be most effective in inducing cognitive progress at the point where
the child is ready for the combining of initially isolated schemas into the first outline of a co-ordination. Once the beginnings of this elaboration have been socially established, social interaction ceases to be so effective – the child can achieve equilibration of her co-ordinations by working alone. Thus social interaction is more likely to promote progress in children at an intermediate stage of development.

At the situational level, inter-individual dynamics may hinder progress. In some experimental situations designed to stimulate socio-cognitive conflict it appears there has been a compliance effect, i.e. the subjects have not attempted to co-ordinate their actions/views but have simply juxtaposed them, so that one participant becomes dominant and solves the problem alone (Mugny et al 1984). This is particularly a problem with child-adult interactions.

In addition, at a wider level, more general social determinants may intervene in the situation, relating to the social position and social identity of the participants. Again, this relates particularly to child-adult interactions.

**Empirical research demonstrating socio-cognitive conflict processes**

Most of the socio-cognitive conflict studies reported in the literature are drawn from a traditional Piagetian testing framework, and almost all the studies are to do with conservation attainment, and take the form of experiments in laboratory settings. A few studies have focused on the co-ordination of spatial perspectives, drawing on Piaget’s three-mountain problem (Piaget and Inhelder 1956). This consisted of a papier-mache model of a landscape with three different-sized mountains. Subjects were asked to identify the visual perspective of a doll placed in various locations around the landscape. Doise's study (Doise et al 1975) is a variation on this original idea.
Doise used three houses made of 'Lego' pieces. Each house was different and had an opening marking the front of the house. The houses were placed on a cardboard base, with a coloured mark (a 'lake') as a point of reference for the orientation of the base. The position of this mark was varied in different conditions.

The subjects were asked to reconstruct each village on another base on a table placed at an angle of 90 degrees to the left of the subjects. Subjects were told that they were allowed to go round the models but that the copy had to be made while they remained at the other table and without turning the base around.

The subjects performed this task either individually or in pairs. The main experimental measure consisted of the number of houses correctly placed in respect of both localisation and orientation to the opening. Four test situations were used, two simple and two complex, according to the nature of the transformations the subjects were required to make. It was found that group performance was significantly superior to individual performance.

Further studies showed that the group is superior to the individual only at a certain age level (the difference between individual and group performance being more marked at 7-8 years than at 9-10 years old) indicating that socio-cognitive conflict is mainly effective for children at intermediate stages of development. The younger children, according to Piaget's theory, would be in a transitional phase between the preoperational and concrete operational levels, whereas children of 9-10 years should have reached full concrete operational status.

Carugati et al (1978) introduced various modifications of this task, in order to isolate the social dimension and lend support to a socio-cognitive over a modelling explanation. Thus they had one subject in an 'easy' position (ie an identical orientation of the bases relative to the subject's view of them) and a partner in a
'difficult' position (where the orientation of the bases was reversed requiring left/right, front/back transformations).

Thus the 'easy' position should not give rise to any cognitive conflict whereas the 'difficult' position should. This resulted in substantial progress for subjects in the 'easy' position (when tested later on an individual task) - which could only be due to social conflict brought about by comparing their responses with the incorrect responses of the partner.

Other studies have utilised the Piagetian conservation of liquid task to compare individual and group performance, and the focus here has been particularly on the effects of interaction on later individual performance. Perret-Clermont (1980) found that such interaction, especially with a more advanced peer, produced significant, lasting and generalizable progress.

The substantial body of literature emerging in relation to socio-cognitive conflict indicates that cognitive development cannot be adequately explained solely in terms of children's solitary reflections upon hypothetical problems. Nor can the superiority of group over individual performance be attributed to modelling effects alone. The work of Doise and his colleagues would appear to support Vygotsky's suggestion, that "the true direction of the development of thinking is not from the individual to the socialized, but from the social to the individual." (1962, p29).
6.4 APPLYING A SOCIO-COGNITIVE DEVELOPMENTAL APPROACH TO THE ASSESSMENT OF LEARNING IN A MUSEUM SETTING

A museum/exhibition environment would appear to be the kind of setting where socio-cognitive conflict would be likely to arise, since it is an informal learning environment, and is essentially a social setting where inter-individual interaction and discussion may be an essential part of the learning process. However, it may be that museum design and interpretive practices may be failing to tap this potential for increasing knowledge by encouraging socio-cognitive conflict. In the modern museum the emphasis is primarily on interaction between the visitor and the object, rather than encouraging discussion between visitors, and it may be that distracting gadgets or overinterpretation in fact inhibit discussion.

The issue of interpretive practices and interactive exhibits is addressed in a later chapter (see Section 8.3). The problem to be addressed here is whether the psychosocial processes used to explain the acquisition of operational competence in laboratory settings can aid our understanding of the socio-cognitive dynamic which may exist in a natural (and informal) learning setting. Perret-Clermont has demonstrated convincingly that such processes can be examined in formal educational settings, and has argued that social interactions and their cultural contexts play a crucial role in the elaboration of thinking, for example, in relation to understanding mathematics in the classroom (Perret-Clermont et al, 1984). However, although Perret-Clermont's study has shown that socio-cognitive conflict processes can be demonstrated away from the experimental laboratory in a real-life setting, her work focuses on very closely structured thinking skills which are characterised by a set of logical operations and by concepts which incorporate these operations, in much the same way as both traditional Piagetian studies and the more recent experimental studies of Doise and his colleagues.
This study aims to examine socio-cognitive conflict processes in a museum setting, where the subject matter will not necessarily involve closely-structured thinking skills, but will often require a more open-ended thinking structure, especially where one is concerned to assess visitors' understanding of a particular museum theme, rather than a specific exhibit, and in addition, where that theme is a historical one.

The problem which arises in relation to this kind of study, therefore, relates to whether a task, or measure of some kind, can be devised which may allow the assessment of more open-ended thinking, and how this can be conceived and interpreted in socio-cognitive-developmental terms.

Since the socio-cognitive conflict hypothesis derives from the Piagetian concept of development, it is necessary firstly to examine research on the understanding of more open-ended material which has been conducted within a broadly Piagetian framework.

6.4.1. Research on the understanding of history using a Piagetian approach

Investigations looking into children's understanding of history using a model of thinking based on the Piagetian concept of logical operations encounter a major problem in that history-type material, looking at changes over time and offering explanations which must be seen in relation to present-day structures and interpretations, necessarily retains an open structure, in contrast to the closed structures involved in explanations of maths or physical causality, where Piagetian theory has normally been applied. Jurd (1978) has reviewed much of the research which has attempted to overcome this problem and her analysis of the relevance of a logical operational model of thinking to history-type material is drawn on here.
Jurd suggests that aspects of history which have the most immediate relevance to logical operations are the use of concepts and generalisations and the achievement of objectivity - both of which are also present in the physical sciences. However, in history-type material these will have a slightly different form and implications.

**Generalisations**

With regard to generalisations, Jurd considers two kinds: 1) generalisations found in law-giving hypotheses, and 2) generalisations in concept formation/identification.

The ability to formulate and test law-giving hypotheses is seen as a characteristic of formal operational thought. In the physical sciences it is generally possible to isolate the relevant variables and induce generalisations which can be verified by controlled experimentation, eg Inhelder and Piaget (1958) asked questions like 'Why do some objects float and others not?' and it is a fairly straightforward procedure to test this out by trial and error - weight alone and size alone can be discounted and the combination of weight and size together may be inferred and tested, so that a general rule can be formulated.

However, a problem relating to causes of events in history is less clear-cut, and variables involved may be numerous and complex and impossible to isolate, or even define. Even if variables can be identified, verification is difficult because controlled manipulation is not possible.

Jurd suggests two ways of overcoming this problem. Firstly, using Dray's (1957) argument, she suggests that historians can ask 'What would have happened if x were not so?', ie examine what might have happened if a particular suggested cause had not occurred. A second method, also drawn from Dray, involves altering the
scientists' qualifying phrase 'all other things being equal' to the more relevant 'the situation being as it was'. By doing this the historian is suggesting that the outcome might be different if the situation was changed, in the absence of being able to consider the effect of each variable separately. For the student of history an understanding of this kind of modification in thinking about history might enable a more critical evaluation of historical 'truths'; however, it would appear that it is still not clear how a student might be able to test out hypotheses about history for herself.

Generalisations as concepts or classifications is a skill which can be assessed at the concrete operational level. Jurd suggests that in history-type material it is useful to consider colligatory concepts (Walsh 1967) which may be seen as similar to a conservation concept, as it 'corresponds to the property that is left unchanged across various transformations of the object' (Elkind and Flavell 1969, p187). An example of a colligatory concept is 'the growth of democratic government', which might differ widely across countries and periods, but nevertheless has a wide generality.

Jurd reviews research into both these kinds of generalisations using open-structured material. With regard to generalisations as hypothesis testing, most of the studies involve presenting evidence and then analysing the subject's explanations of events presented, eg Peel's (1965) study which involved presenting short stories and analysing the subject's explanations in terms of Piagetian-type stages. Hallam (1967) gave history passages to children between 11-16 years with material which offered conflicting evidence. Children's answers to questions and reasons for these were elicited and categorised in terms of criteria largely based on Piagetian concepts, eg the preoperational stage is characterised by irreversibility of thought, centring on one feature only, etc; formal operational thinking is characterised by the formulation of
hypotheses which are then confirmed or refuted by the data, holding some factors constant and varying others systematically, abstract reasoning, and seeing possibilities of interrelationships and links. Hallam found formal operational thinking in history did not usually emerge before 16 years. Rhys (1972) studied the understanding of geography using maps and pictures as well as verbal material, and analysed the results in terms of Piagetian stages of development.

With regard to generalisations as concepts, Jurd examines studies which have examined understanding of historical terms. There is a problem in history in that many of the terms used change over time, and in addition, words may have a different meaning in other more familiar contexts, eg 'party', 'ruler', 'subject'. The tendency to use more usual contexts to interpret words has been demonstrated by Milburn (1972) in relation to children's understanding of geography. Coltham (in Peel 1967) asked junior school children to explain and draw words such as 'king', 'ruler', 'trade' etc, and found that only a few older children recognised the important time dimension in relation to 'king' eg 'kings used to have power, but not now'. The indication was that there is a progression by age from understanding in relation to position or place to understanding in relation to function or process.

De Silva (1972) attempted to measure the use of vocabulary in line with Piagetian stages. He gave subjects historical passages in which a key word or idea (eg 'depression') was replaced by a nonsense word, which subjects were required to define. He found no differences in explanations between 12, 13 and 14 year olds but significant differences between 14, 15 and 16 years. Younger age groups showed evidence of isolated centring on single pieces of evidence and their responses were logically limited.

The evidence indicates that the development of understanding of historical concepts is compatible with Piagetian theory; however,
whilst all these studies indicate a pattern of development similar to that identified by Piaget, eg hypothetico-deductive reasoning is not evident until about 15½ years and is preceded by the use of concepts as generalisations (a concrete operational skill), a major difference between these findings and Piaget's results is the late age at which formal operations occurs. This may be because the material is more abstract and remote from the child's experience.

Objectivity

Establishing objectivity - what really occurred - is necessary in both science and history, and will involve some interpretation. Objectivity involves consensus of opinion and adequacy of explanation. Consensus is often not achieved in history-writing, and many authors will maintain an individual stance often dictated by a particular political perspective. In order to avoid an uncritical acceptance of a view which may be distorted or biased in some way, the audience must have the ability to decentre - to appreciate that things can be seen from another point of view. Piaget sees decentring as the process by which objectivity is achieved, eg in his famous 'three mountains' study, children are required to appreciate that a scene they can see from one position may appear differently from another position. This is a difference of perspective in the literal sense, but it also applies in relation to social and affective perspectives.

Jurd identifies research on role-taking as most relevant in relation to decentring and history material. Piaget and Wiel (1951), in a study of nationality, found that preoperational children, being unable to see things from another's point of view, could not understand that they would be a foreigner in another country, or that their own country was not 'best'. Middleton, Tajfel and Johnson (1970) found evidence to suggest that school children (Between 7 and 11 years) learnt most easily about foreign countries which were regarded as 'liked', indicating evidence of an
inability to decentre, since the implicit assumption is that 'liked' countries will have the same motivations, values, and so on — thus a different point of view is not necessary, and knowledge about these countries is easier to assimilate. However, in order to achieve true objectivity, a person needs to decentre even with respect to apparently similar countries, since various aspects of events in different countries at different periods of time may not always indicate a similar viewpoint to one's own. Thus it is necessary, for true objectivity in relation to history material, to be able to think of multiple interacting systems — an aspect of formal operational thought.

Jurd points to another aspect of history which demonstrates the necessity of highly developed thinking — the need to be able to 'think about X thinking about Y thinking', i.e. a student must be able to think about the historian (X) thinking about a historical personage (Y) who is thinking about his future actions (Z) (Jurd, p 307) to properly be objective about the history which is presented in books and the classroom.

**Time**

One important aspect of thinking about history is the notion of time. Jurd includes this aspect in her discussion of generalisations as concepts; however it would appear that time is a concept which merits particular and separate attention when considering history material, since time would appear to be the very essence of history.

Jurd notes three important aspects of time in relation to Piagetian theory:
1) ordering of events — comparable to seriation;
2) grouping events which are concurrent — comparable to class formation;
3) establishing a sense of continuity in time between past and present.

Although these would appear to be concrete operational skills, Oakden, Sturt and Bradley (in Jahoda, 1963) found that children could not order three dated events until 11 years of age, and it appears that children's understanding of time is not comparable with adult comprehension until at least 16 years of age.

Piaget argues that children cannot properly understand the passage of time until they have attained transitivity. Transitivity involves the ability to group events which are concurrent, reversibility, and seriation skills. According to Piaget, transitivity in relation to concepts of time involves an understanding of succession and duration.

In his early study, The Child's Conception of Time, first published in 1927, he focuses on the child's grasp of succession and duration. He argues that operational time is constructed as soon as the order of successions is deduced from the colligation of durations and vice versa (Piaget 1969 p 261). He sees succession as 'qualitative seriation' - an additive grouping of asymmetrical ('before' and 'after') relations. The order of events corresponds to the duration of the interval between the events, ie the order of events A, B, C, D etc corresponds to the inclusion (colligation) of the partial duration a(A-B) in the longer duration b(A-C) and to the inclusion of b in c(A-D) and so on (p 35).

Piaget sees durations as constituting an independent grouping from successions however, and a child may have grasped succession but not duration, and vice versa (although this is less common).

Piaget assessed children's understanding of succession and duration in relation to physical time, using various concrete materials. For example, one study involved presenting the child with two flasks or
jars, one on top of the other. The upper flask could be filled through a hole in the top and emptied into the lower container through a glass tap. The subject has to indicate on drawings of the flasks how the level of water changes, as they observe the lower flask being filled from the upper one. The series of drawings are then shuffled and the child has to rearrange them in order, and answer a series of questions about their decisions.

Piaget also assessed the understanding of succession and duration in relation to the more abstract concept of age by questioning children about their families and the order of births amongst their siblings. He found evidence that in some children the grasp of succession preceded that of duration, eg the child was able to order births but failed to deduce the permanence of age differences (Type I); whilst in others, duration preceded succession, eg the child perceived that age differences persist, but fails to deduce the order of succession of births (Type II). The co-ordination of the concepts of succession and duration was achieved around 8-9 years old.

Piaget's evidence conflicts somewhat with the more recent research described above, where a proper understanding of time in relation to history material did not emerge until much later.

Summary

The studies described by Jurd, and the findings generated from them, indicate that a Piagetian perspective can be useful in identifying the capabilities which can be expected of various age groups in relation to an understanding of history. Younger students can be expected to learn the process of ordering events into sequences and grouping events into meaningful patterns, which might involve colligatory concepts. For a proper understanding, however, the student must also learn to decentre in order to achieve
objectivity, and in addition to appreciating that events may have multiple causes, also identify multiple points of view.

Whilst the evidence suggests that characteristic developmental trends can be identified in relation to children's understanding of history, and these can be described in terms of Piaget's three stages of representation (preoperational, concrete operational and formal operational intelligence), the age at which formal operations is reached is much later than Piaget suggested. As noted above, this difference can be explained in terms of the difference between the open-ended nature of history problems and the closed structure of the physical causality and mathematical problems generally used in Piagetian studies. However, this finding lends some support to Flavell's (1977, 1985) assertion that stage development must be seen as a very gradual process, and same-stage developments may be less concurrent than traditional Piagetian theory has suggested.

A proper understanding of history, then is a complex process which requires quite advanced structures of thinking. In fact, Elton (in Ballard 1971) has argued that true history cannot be taught to the very young. Hallam (in Ballard 1971) suggests that since formal operational thinking does not occur till mid-adolescence with history material, the use of concrete learning materials (eg pictures, artifacts) may be particularly appropriate before this age. This suggests that museums may have a more central role to play in teaching history to children than is evident at present. Adams and Millar (1982), in an article on the usefulness of museums in history teaching, point out that "museums give an opportunity for research and allows pupils of all ages, abilities and backgrounds to 'work as historians'", yet more often than not, a museum visit is seen merely as a means of occupying spare time.
6.4.2. Understanding history from a socio-cognitive conflict perspective

The museum is a naturally social context where one is able to discuss and explore the information presented in the company of others, and a child visiting the museum is freed from the individualistic and usually competitive constraints of the schoolroom, where, often, discussion is limited.

The substantial body of evidence on socio-cognitive conflict processes produced by Doise and others (Doise et al 1975; Perret-Clermont 1980; Mugny and Doise 1978) indicates that, especially for children who are at the transitional phase between stages of development, social interaction can be an important factor in facilitating intellectual progress. In view of the evidence which indicates that understanding history requires quite advanced thinking processes, and may thus lag behind other aspects of cognitive development, the socio-cognitive dynamic which may exist in a museum setting could be especially helpful in promoting progress with respect to this kind of material.

However, although Doise's approach may be more useful than a strictly Piagetian approach in this kind of setting, research using a socio-cognitive perspective has generally been restricted to very controlled laboratory conditions, or formal education settings, and none of the research reported has involved an assessment of the usefulness of interaction in relation to open-ended material.

The study reported in the next chapter is an attempt to assess the utility of the socio-cognitive conflict model in an informal setting, using learning material which requires a more flexible, open-ended thinking structure.
7. STUDY 2 - A COMPARISON OF INDIVIDUAL AND GROUP LEARNING IN A MUSEUM SETTING

This study examines learning in school groups during a visit to a museum. Children in school parties were presented with a task to perform during a visit to the Jorvik Viking Centre. It was hypothesised that children working in pairs would perform the task better than children working alone, in line with the socio-cognitive conflict hypothesis (Doise 1978), which argues that cognitive development cannot always be fully explained in terms of a child's solitary cognitive strategies, but should be viewed in an interpersonal context. The findings lend support to the socio-cognitive conflict view.

7.1 INTRODUCTION

The purpose of this study is to assess the effect of social interaction on cognitive development in the context of an informal learning setting. The theoretical framework used here is drawn from social psychology rather than cognitive-experimental psychology, which is the usual approach in investigations into learning in museum settings. Doise's socio-cognitive conflict model of learning (Doise 1978) extends Piaget's equilibration model of cognitive development, which stresses the importance of cognitive challenges in aiding the individual to move from one cognitive equilibrium to a more advanced one. Doise's approach demands that, in an interactive situation, both the social as well as the cognitive nature of any conflict arising be recognised.

Doise's model has previously been used primarily in laboratory settings, using tasks which involve operatory skills such as conservation of length and spatial perspective; a few studies have been conducted in formal educational settings, eg investigating
mathematical skills (Perret-Clermont et al, 1984). Whilst some attempts have been made to use a Piagetian-type analysis in the investigation of more 'open-ended' subject matter, such as history (Jurd 1978), no research has yet attempted to utilise Doise's socio-cognitive conflict model with this kind of material in an informal learning setting.

The present study is concerned with comparing the effects of cognitive conflict with the effects of socio-cognitive conflict on the performance of a museum-related task. The theme of the museum focuses on history (the Vikings) and archaeology (the source of information about the Vikings). Children between the ages of 8 and 12 years who were visiting the Jorvik Museum in York (in school parties) were given tasks to perform during their visit, either alone or in pairs, and their performance on these tasks was compared. In addition, their level of understanding about history, and sources of information about history, was assessed prior to their visit, using a Piagetian-type grading system, and again assessed several weeks after the visit. It was hypothesised that children working in pairs would perform the task better than children working alone.

7.2 METHOD

Following the general design of Doisian experimental investigations comparing individual with collective performances, a three-step paradigm was used, ie an individual pre-test, a test condition, involving the subjects performing under either a collective or individual condition, and an individual post-test.

The pre-test and post-test involved interviews to assess the developmental level of the child in terms of Piagetian stages.

A partial repeated measures design was used for the test condition. Subjects performed under either an individual or a collective
condition, but all the subjects were required to complete the same three tasks.

Thus the independent variables here include condition (collective or individual), task (which varied in terms of cognitive difficulty), and the cognitive developmental level of the child or pair of children (assessed by the pre-test). The dependent variable is performance on the three tasks. Any progress made between pre-test and post-test was also assessed.

7.2.1. Setting:

A socio-cognitive conflict perspective on the Jorvik Viking Centre

The study was undertaken in the Jorvik Viking Centre, York, a modern and popular museum which presents a historical theme (the Vikings in York) linked to a modern-day scientific theme (archaeology). The museum attempts to portray Viking life in York as it was lived, and by reconstructing a Viking settlement showing a bustling market, houses and a wharf, visitors experience in sight, sound and smell what it was like to live in Viking-age York. After experiencing the 10th Century Viking settlement, the visitor is presented with a view of the archaeological process, and in the final part of the museum, some of the artefacts discovered by archaeologists. (A fuller description of the Jorvik Viking Centre is given in Chapter 4.)

The museum is particularly interesting in relation to the cognitive conflict view of learning, firstly because the Vikings are presented in a way which conflicts with the traditional stereotypical image of the Viking as villain and interloper, an image which was demonstrated forcibly in Study 1.

Secondly, Jorvik presents what may be seen as two conflicting aspects of history: a life-size model of a Viking settlement -
which gives a concrete representation of the past; and the presentation of the archaeological process - which indicates that this view of the Vikings is not necessarily authentic, but rather a modern-day reconstruction, which is rooted in contemporary consciousness.

7.2.2. Subjects

101 children from four schools (located in Merseyside, South Humberside, and two in Kent) took part in the study. Twenty four children were used as a control group, leaving 77 children to form the experimental sample. The sample was divided equally into males and females. Fifty four children took part in the collective condition (27 pairs) and twenty three children form the individual condition. In the collective condition, children were paired with a same sex child from the same class. The age range was from 8 years 7 months to 11 years 8 months (at the initial pre-test time).

The schools were selected from a list of schools booked to visit Jorvik. Schools were selected from as wide an area as possible, although because of the location of Jorvik in the north of England, the choice of schools elsewhere was very limited. One school was a private fee-paying school, whilst the others were state schools, albeit primarily middle-class.

7.2.3. Materials

The subjects were given worksheets during the museum visit; these are reproduced in Appendix D and Appendix E. Two variations of the worksheet were used, one developed for the pairs of children working together (Appendix D) and the other for individual children (Appendix E).

The left-hand section of the worksheet (Part 1) is marked by a blue dot and relates to the Town section of the museum. There is a short
explanation of the task at the top of the page, and space for answers denoted by the letters A to G. The right-hand section of the worksheet (Part 2) is marked by a red dot and relates to the Archaeology section and the Artefacts Gallery. Here the instructions are followed by a space for answers and the letters H to N. These two sections of the worksheet are identical for both the individual and group conditions.

A third section (Part 3) instructs the child, or pair of children, to co-ordinate their responses in Parts 1 and 2.

Two sets of seven black and white photographs showing scenes from the museum were used in addition to the worksheets. These are shown at Appendix F. The photographs were presented in easy-to-handle flip-over packs, and each photograph has either a red or a blue dot in the top right hand corner, denoting which section of the museum they relate to. The Blue set of photographs relates to the Town section of the museum and each photograph is also marked by a letter (A to G). The Red set (marked by the letters H to N) refers to the Archaeology/Artefacts section. Each photograph in the Red set can be matched with a photograph in the Blue set; eg photograph H (Red set) shows the excavated remains of a fireplace as it was uncovered during the archaeological dig. This can be matched with photograph C (Blue set) which shows the reconstructed hearth with a meal being prepared, as shown in the Town Section.

The wording on the individual and group worksheets was kept identical as far as possible and where differences were unavoidable (eg in Section 3 of the worksheet, where the instructions are directed at either an individual child or a pair of children) care was taken to use the same number of words and comparable wordlengths in each case. The worksheet had to be read by and also written to by children aged 8 years to 12 years, thus great care was taken to reserve a suitable space for the children to write, and to select a type size and line spacing which would both be
clearly legible and balance the reserved writing area. Optima was chosen as the typeface for its visual clarity (this is a popular typeface with children's publications). Use of the various type fonts was carefully considered in order to present not only visual clarity, but also to emphasise clarity of meaning, eg using bold italic was restricted to references to the Blue/Red set of photos. Equal significance was given to visual clarity and clarity of meaning in both the wording and presentation.

The choice of photographs was determined by the availability of corresponding items illustrating the two thematic elements of the museum. It was intended to encourage the subjects to relate the concrete picture of Viking life presented in the Town section to the more objective view of the reconstructive process involved in building up this picture (seen in the Archaeology section, and also in the artefacts presented in the final part of the museum). Thus it was necessary to select photographs showing aspects of each theme which could be linked in some way, and this restricted the choice of items available.

The final set of items selected were as follows:

<table>
<thead>
<tr>
<th>Blue set (town)</th>
<th>Red set (archaeology &amp; artefacts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Wall of reconstructed house</td>
<td>K Wall exposed during excavation</td>
</tr>
<tr>
<td>B Leather-maker's table</td>
<td>M Pair of leather shoes</td>
</tr>
<tr>
<td>C Fireplace in house</td>
<td>H Excavated fireplace</td>
</tr>
<tr>
<td>D Pottery stall</td>
<td>I Pieces of pottery</td>
</tr>
<tr>
<td>E Herrings in basket</td>
<td>N Herring bones</td>
</tr>
<tr>
<td>F Loom</td>
<td>L Piece of cloth</td>
</tr>
<tr>
<td>G Toilet</td>
<td>J Excavated toilet</td>
</tr>
</tbody>
</table>
7.2.4 Pre-test and Post-test: Design considerations

Clearly, unlike previous investigations into socio-cognitive conflict processes, here there was no standard Piagetian-type measure of developmental level, such as can be used in assessing operatory skills like conservation. Therefore a measure had to be devised, relating to the particular themes of interest, but also with a more general relevance.

A problem here was that we were not dealing with 'closed' problems (such as those involving operatory skills or mathematical problems) but more 'open-ended' concepts, relating to the notion of the passage of time and the process of finding out about history. Thus 'time' was used as the primary focus of the pre-test and post-test, since this most clearly allowed an investigation of thinking skills in line with Piagetian stages and, in addition, the notion of the passage of time appears to be crucial to an understanding of the relationship between history and archaeology.

If a child does not perceive the differences between 10 years ago, 100 years ago and 1000 years ago, s/he will not be able to grasp the meaning of the relationship between archaeology and history properly. For example, we can find out about events 10 years ago by simply asking people who were present at those events; for 100 years ago this will probably not be possible, but there are written records, drawings, houses and objects still in use which can tell us how people lived. For 1000 years ago we may need to rely mostly on archaeological evidence since this is all that is available; what written evidence is available may be largely unreliable (as is the case with written evidence relating to the Vikings).

The most appropriate evaluative measure for assessing notions of 'time' was felt to be the interview. The interview procedure was based on Piaget's clinical approach and was partially standardised, in that the subjects were asked a number of identical questions
relating to identical situations. On occasions original questions were reworded if it was felt that the child's responses indicated a lack of verbal comprehension, and some novel or ambiguous responses were followed up by additional questions. This kind of procedure is outlined by Opper (1977), where it is described as "an attempt to combine the more structured approach of standardised testing with the flexibility of the clinical method and hence satisfy both the requirements of systematic observation and those of conducting research with young children" (Opper, 1977, p95).

Using this approach allowed the researcher to look for evidence of skills in Piagetian terms, eg concrete operational abilities could be seen in evidence of the ability to seriate events (eg knowing that 100 years ago is longer ago than 10 years ago, but no so long ago as 1000 years ago). Similarly the ability to suggest different sources of information at different periods can be seen to involve classification skills. The interviews also allowed for some characteristically formal operational skills to be displayed, eg the ability to conjecture on all possible events by generating hypotheses about possible sources of information, using compensation and cancellation in relating different variables, and so on. The interview format is given in Section 7.3.1.

7.2.5 Task: Design Considerations

The task itself was designed to help promote changes in thinking across the levels of operational thought. Using the worksheet and photographs described above, the children were required to identify and interpret different scenes from the exhibition, and then to match parts of the Town scene with objects shown in the Archaeology/Artefacts section. This draws attention to the relationship between actual knowledge of the past (the incomplete picture gleaned from archaeological finds) and reconstructed knowledge (our modern-day interpretation of these remnants of the past, presented as a complete town). The aim was to encourage an
understanding of the relationship between history and archaeology, and also to highlight the interpretive aspects of the process of understanding about history - in other words to aid objectivity. Objectivity involves the ability to think about multiple interacting systems - a formal operational skill (see 6.4).

However, because of the simplicity of the task and the use of photographs rather than purely written material, the concrete operational child can use and display skills already in her possession (eg classification skills etc), and the preoperational child can be encouraged to demonstrate these concrete operational skills. Thus the worksheet can be seen as a tool for eliciting primarily concrete operational skills, particularly in relation to the completion of Parts 1 and 2 (identifying the photographs). In addition, although all three parts can be successfully completed at the concrete operational level, formal operational thinking may be encouraged in the completion of Part 3 (correctly linking two independent systems - history and archaeology).

The same three tasks were presented to the children either individually or in pairs. The children working collectively were given different perspectives on the theme of the museum by being asked to complete only Part 1 or Part 2 of the worksheet and then working together to co-ordinate these different perspectives in Part 3. The children in the individual condition needed to co-ordinate these perspectives alone. In this way it was hoped that cognitive conflict would be created in both conditions, and the influence of social conflict, created only in the group condition, could thus be assessed.

7.2.6 Control Measures

Task (Worksheet and photographs)
The wording and layout of the worksheet and the photographs to be used were tested out on children of comparable age range with the
experimental sample at various stages during the whole process of production.

In addition, a control group of 15 children between the ages of 8 and 12 years attempted to complete the worksheet using the photographs but without having visited the museum.

This indicated that the three tasks (Parts 1, 2 and 3) were not comparable in terms of cognitive difficulty - Some of the control group could correctly identify several photographs from the Blue Set (the Town), but the majority could not identify those in the Red Set (Archaeology), nor match up the pairs of photographs from each set. When the task was presented to children who had visited the museum some weeks previously the performance on Parts 2 and 3 was found to be better, although not so high as for Part 1.

This meant that, in the collective condition, one child would have an 'easy' task initially whilst his/her partner would have a 'difficult' task. This was advantageous, since it might more clearly separate out the cognitive and social elements involved. The strategy of having a child perform an easy task (i.e. posing no cognitive conflict) paired with a child with a more difficult task was used by Carugati et al. (1978) in an experimental study involving spatial perspective, in order to more clearly identify the social dimension involved in an interaction situation. Thus if the subject in the easy position shows cognitive progress as a result of the interaction, this could only be due to the social conflict brought about by a comparison with the incorrect responses of their partner. Since in a naturalistic environment the researcher's control over the variables present in a situation is considerably more tenuous, it was decided that a similar strategy would be advantageous here in order to ensure a social opposition factor being present.


Pre/post test (interviews)

A further control group of 24 children who were from the same classes as the experimental sample and visited the museum on the same occasion, were given the pre-visit and post-visit interviews but were not required to complete a worksheet. This was done in order to assess the reliability of the interview procedure.

The interview procedure used in the pre-test and post-test was developed over several months, being tested out on two samples (each sample comprising 15 children) visiting the Natural History Museum on two separate occasions. After the first testing, extensive revisions of the interview procedure were made. Further minor revisions were made after the second testing.

7.3 PROCEDURE

The children in the experimental sample were interviewed four weeks prior to visiting the Jorvik Viking Centre on a school trip. During the visit, the children were required to complete a worksheet, either individually or in pairs. The same children were interviewed again four weeks after the visit. The control group were interviewed in the same way, but were not required to perform the task during their visit.

7.3.1 Pre-test and Post-test Interviews

101 children (including 24 who formed a control group) were interviewed individually at their schools between 3 and 4 weeks prior to their visit to Jorvik. The interviews lasted approximately 10 minutes each and were tape-recorded. The same children were interviewed in the same way 4 weeks after their visit.

Before starting the interviews the researcher attempted to establish good rapport with the child by asking personal questions
(name, age, about the school etc) until the child began to relax and talk freely. At this point a series of standard questions was introduced:

1) If you want to find out about 10 years ago, what sort of things can you do?

1a) Is it easy or difficult to find out about 10 years ago?

2) If you want to find out about 100 years ago, what can you do?

2a) Is it easy/difficult to find out about 100 years ago?

2b) (If a different source has been suggested for the two time periods)
Can you use (eg. books) to find out about 10/100 years ago too?

3) If you want to find out about 1000 years ago, what can you do?

3a) Is it easy or difficult to find out about 1000 years ago?

3b) (If a different source has been suggested)
Can you use (eg books) to find out about 10/100/1000 years ago too?

4) If people in 10 years time want to find out about now (1986) what sorts of things do you think they will do?

4a) Will it be easy or difficult for them, do you think?
4aa) Will it be easier/more difficult than it is for us to find out about 10 years ago?

5) What if people in 100 years time want to find out about now. What sorts of things do you think they will do?

5a) and 5aa) As above, in relation to 100 years in the future.

5b) (If a different source has been suggested)
Will they use ((eg books)) to find out in 10/100 years time too?

6), 6a), 6aa), and 6b) As above, in relation to 1000 years in the future.

7) Think of what it's like now and think what it must have been like 10 years ago. Is it very different? Did many things change during that time? What kind of things?

8) If it was different/same 10 years ago, what about 100 years ago? Did many things change between 10 years ago and 100 years ago do you think? What kind of things? Did more things change between now and 10 years ago, or less things, or would it be the same amount of change?

9) What about the changes between 100 years ago and 1000 years ago?

Did more things change then or did more things change between 10 years ago and 100 years ago? What kind of things?
10) Think of the time between now and 10 years ago, then think of the time between 10 years ago and 100 years ago. Is one longer or are they the same? Think of the time between 100 years ago and 1000 years ago. Is that longer or the same? Which is longest?

These questions served as a guidance only. Extra questions were included, for example, where it appeared that a child's answers might be a result of a response set; thus if a child suggested the same source of information for all time periods (eg "look in books"), s/he was encouraged to suggest further possibilities. Where the child seemed unclear as to the meaning of the question, it was reworded. Additional items were introduced in this way where any doubts arose over the ambiguity of a particular response or where the child might have only a partial grasp of the concept. This kind of approach is fully outlined by Opper (1977) and allows the researcher to adjust to the level of each particular child.

7.3.2 Analysis of interview data

The post-visit assessments were made independently of the pre-visit assessments, ie without sight of the subjects' pre-visit grading.

The protocols were analysed using criteria based on Piagetian theory, following the guidelines used by Hallam (1967) in an investigation into children's understanding of history using a Piagetian framework. Hallam analysed children's responses to questions about history in terms of 5 stages, as shown below:
<table>
<thead>
<tr>
<th>Stage</th>
<th>Some of the criteria used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperational</td>
<td>1. Not relating the question to the information provided. Not looking for possible contradictions in the thought processes. Isolated centring on one feature only. Irreversibility of thought Transductive and syncretic thinking.</td>
</tr>
<tr>
<td>Between preoperational and concrete operational</td>
<td>2. More than one feature of the situation considered but the attempt to relate differing facts not too successful. Uncertainty of judgments; attempts at reversibility end in failure.</td>
</tr>
<tr>
<td>Concrete operational</td>
<td>3. Able to give an organized answer but limited to what is apparent in the text; able to forecast a result from the evidence available; compensates one statement by another or negates a statement, but not able to coordinate negation and reciprocity.</td>
</tr>
<tr>
<td>Between concrete and formal operational</td>
<td>4. Going outside the known data to form hypotheses, but not too successfully; beginning to relate different variables.</td>
</tr>
</tbody>
</table>
Formal operational

Holds certain factors constant and varies others systematically in order to discover which explanations are true; hypotheses are postulated and then confirmed or not by the data; reasoning by implication at an abstract level; realizing a multiplicity of possible links.

(Hallam 1967)

In addition, Piaget's own investigation into the child's conception of time (Piaget 1969) influenced some of the criteria used, in particular, the concepts of succession and duration (See Section 6.4.1).

Evidence of seriation, succession, duration and reversibility were taken as evidence of concrete operational thought (Stage 3). Absence of one or more of these concrete skills was taken to be evidence of intermediate between pre-operational and concrete operational thinking (Stage 2). If none of these 4 skills was evident in a child's responses, he/she was graded at stage 1 (pre-operational).

Additional skills (hypothesis formation, relating different variables through a process of compensation and cancellation, abstract reasoning and objectivity) were taken as indications of stage 4 (intermediate between concrete operational and formal operational thought), if more than one of these higher skills was evident, the subject was graded at Stage 5.
A coding frame using these criteria in relation to the specific questions outlined above was developed, and this is outlined below:

1. **Seriation**: Evidence that the subject perceives that 10<100<1000 - assessed by an examination of the transcript as a whole.

2. **Succession**: Assessed by questions on difficulty/ease of finding out about each time period (questions 1a, 2a, 3a, 4a, 4aa, 5a, 5aa, 6a, 6aa). Also, since an understanding of succession involves reversibility, questions on same/different sources of information available at each time period (2b, 3b etc.) were also relevant.

Succession involves the reconstruction in the mind of the correct succession (seriation of events) plus correct perception of differences (eg in relation to the difficulty of finding out about 100 years ago as opposed to 10 years ago).

Evidence of Stage 2 thinking would be where no differences are perceived in the ease of finding out about different time periods; 1000 years ago is as easy/difficult to find out about as 10 years ago, and no justification for this is offered.

No difference in perceived difficulty can be evidence of Stage 3 (concrete) where this is justified (eg "1000 years ago is just as easy because there are books") and the child also shows an awareness that 1000>100>10. This is concrete thinking because the child focuses on 'books' as being a reliable source of information but fails to modify the response by also taking into account the fact that the information may be less accurate because of the longer period of time which has elapsed.

A child seeing difficulty as increasing as time increases but adhering to the same source of information for each time period may also be demonstrating concrete thinking since this would indicate a primary focus on time rather than source. Completely different
sources for each time period (e.g., museums for 1000 years ago, books for 100 years ago, TV for 10 years ago) can also be taken as evidence of stage 3 thinking.

The child must begin to coordinate these various aspects in order to achieve Stage 4 thinking (relating different variables). This would require difficulty not necessarily being related to source or time period in themselves, through a process of cancellation and compensation, e.g., it may be easier to gain information (more books/museums) on 1000 years ago than on 10 years ago, but easier to ask people about 10 years ago, although there may be fewer books/museums covering this period. Where this awareness is linked to objectivity, for example, understanding that books may be available for all the periods, but the information may not be so accurate for 1000 years ago because the books we have now will have been written from the perspective of a later period, this is evidence of Stage 5.

3. Duration: Assessed by questions on the length of the time periods and changes which may have occurred (questions 7 to 10).

Duration relates to the knowledge that the period 0-10 is smaller than the period 10-100 and that 100-1000 is longest. An understanding of duration can be assessed by questions relating to the length of each period, therefore. In addition, the child's perception of the changes which might occur during each period is relevant, since correct answers to the 'length' question may simply reflect an understanding that 1000 is greater than 100 and 100 is greater than 10, and not the actual duration of each period.

Perceiving that most change occurs between 100 and 1000 years reflects a grasp of duration and is evidence of Stage 3 thinking. No awareness of difference in the amount of change between the three time periods reflects Stage 2 thinking, since a proper understanding of duration has not been achieved.
An awareness that the longest period is not necessarily where most change occurred (eg, more change may have occurred between 10 and 100 years ago than between 100 and 1000 years ago, although the latter is longer) can be taken as evidence of Stage 4 (beginning to relate different variables). Where this is coupled with an awareness of differences in the qualitative nature of the changes which occur at different time periods, this may be taken as Stage 5 thinking (abstract reasoning).

4. **Reversibility**: Assessed by questions relating to *same/different* sources of information (questions 2b, 3b etc), and also through a comparison of answers in relation to sources of information about the past (questions 1-3) and the future (questions 4-6).

Succession and duration are related to skills of reversibility - the freedom to pass from one relation to another by a process of complete decentration.

In relation to the questions here, understanding that a source of information for 10 years ago (eg photographs) will probably also be available for 100 years ago, but not for 1000 years ago; a source available for 1000 years ago (eg museums) may not necessarily be available for 10 years ago however.

This relates to the assessment of succession (as described above) in that responses in relation to *same* or *different* sources of information at each time period can be used to assess both succession and reversibility. The same source suggested for each time period can be seen as Stage 3 thinking only if this emerges in conjunction with an awareness of differences in difficulty (an understanding of succession) - otherwise it is Stage 2. Different sources at each time period can also be taken as Stage 3 (if this emerges in conjunction with a concrete justification in terms of time eg "books wouldn't last for 1000 years").
Reversibility is best assessed by comparing past-future answers - an awareness that what applies to the past may also apply to the future. Lack of coordination between past and future (eg where it is asserted that people in 1000 years time will not be able to find out about today although it is also asserted that we know about 1000 years ago - unless this is justified) is evidence of Stage 2, since it demonstrates a lack of reversibility.

Comparing past-future answers is also useful in identifying Stage 4/5, eg where children assert that it may be easier to find out in the future through new technology, this may involve hypothesis formation. Where this is qualified by an assertion that it may still be more difficult in 1000 years time than in 100 years time because of the distortions which may occur over so many years, this can also be taken as evidence of formal thought (relating different variables).

Where a child demonstrates an understanding that it may be easier in the future to find out about history than it is now, but maintains that in 1000 years time it will be easier than in 100/10 years time, this is evidence of concrete thinking, since although this would demonstrate an ability to forecast a result from the evidence available (reversibility), the child is unable to coordinate the various factors involved and go beyond the information to form hypotheses.

The transcript of each interview was assessed in terms of the above criteria, thus questions on difficulty of finding out about the past were examined in relation to succession, questions on length/changes were used to assess duration, and the coordination of views in relation to past/future was used to assess reversibility. The ability to seriate events was assessed by an examination of each child's responses over all the questions, and the additional formal operational skills were assessed by an examination of the quality of the child's responses overall.
Each subject was given a score of 1 for each skill which emerged. Thus a score of 4 was necessary for the child to be graded at Stage 3 (indicating seriation, succession, duration and reversibility skills), and a score of 2/3 was graded at Stage 2. A score of 5/6 was graded at Stage 4; and a score of 7/8 at Stage 5. A score of 0/1 was graded Stage 1. (Examples of interview protocols are shown at Appendix G).

Of course, seriation, succession, duration and reversibility are not independent skills: succession involves seriation, and reversibility is necessary for succession and duration skills to emerge. Similarly, forming hypotheses and relating different variables are often interrelated and may involve abstract reasoning and objectivity. Thus where a child's responses did not clearly indicate the stage s/he had attained, a global view of the transcript was taken, to assess whether the responses overall reflected preoperational/concrete/formal thinking (eg was there evidence of egocentricity, did the subject focus on one aspect only, is the reasoning illogical, is there a coordination of ideas, and so on ?).

A random sample of 20 interview protocols were graded independently by an additional judge. The interjudge agreement obtained was 84%.

Out of 101 children interviewed (including 24 forming the control group), 48 were graded at stage 3, 43 at stage 2, 1 at stage 1 and 9 at stage 4. None were graded at stage 5.
7.3.3. Task

Collective Condition:

Children were paired on the basis of their pre-visit interview grades. Two kinds of combination were used for the dyads: children with the same pre-test grade (eg two grade 2s, two grade 3s), and children with different but adjacent grades (2 + 3, 3 + 4). Where pairs consisted of children with unequal grades, eg 2 + 3, half the grade 2s were assigned the 'simple' task (Part 1) and half the 'difficult' task (Part 2), in order to counterbalance the effects of task difficulty. (For subject numbers in each group see Appendix H.)

Each pair were given two sets of photographs and a joint worksheet. They were told which Part (1 or 2) they were to complete, and which set of photographs they needed to identify (whether they were a 'blue' or a 'red'). The worksheet was read through with them to establish that they fully understood the three tasks. It was stressed that they were to complete Parts 1 and 2 individually. This entailed identifying the photographs in their set, showing things which could all be seen in the museum, against the relevant letter on the worksheet. They then had to collaborate on Part 3 and come to a joint decision before matching the two sets of photographs, by drawing a line between the letters on Parts 1 and 2 which related to two matching photographs. An example was given (photo A from the blue set goes with photo K from the red set) and they were told to draw a line connecting these two.

The children then proceeded with their visit and handed in the worksheets as they left.
Individual Condition

This is the same as the collective condition except that each child had to perform the whole task alone, using both sets of photographs.

Since the task was relatively simple, the children in the individual condition did not have any difficulty in completing it during their visit and in fact generally took less time than the dyads to complete the whole task.

7.3.4. Scoring of Task

Each child or pair of children obtained a score of 1 for each photograph correctly identified and for each pair of photos correctly matched. For Parts 1 and 2 the maximum score was 6, for Part 3 the maximum score was 5, since the final pair of photographs could be correctly matched through elimination. For the purposes of statistical analysis this last score was adjusted in line with the other two scores, by dividing each score by 5 and multiplying by 6 (hence 5=6, 4=4.8, 3=3.6, 2=2.4, 1=1.2).
7.4 RESULTS

The mean performance scores for Part 1 (identifying the blue/town set of photographs), Part 2 (identifying the red/archaeology set of photographs), and Part 3 (Matching task), for both the individual and collective conditions are reported in Table 7.1. As expected, subjects did better on Part 1 compared to Parts 2 and 3, although this difference is not so great as that between Part 3 (the matching task) and the other two scores. The difference between the tasks is most noticeable at the individual level, whereas at the group level performance was high on all three tasks. (Raw data and fuller details of analyses performed on the data are given in Appendix H.)

<table>
<thead>
<tr>
<th>Condition (n)</th>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collective (27 pairs)</td>
<td>5.70</td>
<td>5.26</td>
<td>5.02</td>
</tr>
<tr>
<td>Individual (22)</td>
<td>4.78</td>
<td>4.17</td>
<td>2.71</td>
</tr>
</tbody>
</table>

A 2-way partial-repeated measures analysis of variance test (Winer 1971), examining condition x task (2 x 3) was applied to the data. (For the purposes of analysis, dyads constituted one subject, producing three scores, for Parts 1, 2 and 3.) This showed a significant main effect of task ($F_{2,96} = 14.93$, $p < .001$).
There was also a main effect of condition. As predicted, subjects working collectively achieved significantly higher scores. ($F(1,49) = 15.54, p<.001.$)

The analysis of variance also showed that there was a significant interaction effect of condition x task ($F(2,96) = 4.46, p<.05.$). Fig. 10 shows this interaction:

Fig. 10 - Showing interaction of condition x task
From Fig. 10 it can be seen that in the collective condition performance is fairly high on all three tasks, and declines slightly as subjects progress through Parts 1, 2 and 3. In the individual condition, performance is consistently lower on all tasks, but follows a pattern of decline similar to that seen in the collective condition as subjects move from Part 1 to Part 2. However, there is a dramatic decline in performance on Part 3, the matching task. This lends strong support to a socio-cognitive conflict explanation for the superiority of group over individual performance, since the matching task involved a social opposition factor in the collective condition, which was absent in the individual condition. Cognitive conflict was generated in both conditions, through the presentation of different perspectives on history provided by the tasks in Parts 1 and 2. Thus the superiority of performance seen in the collective condition cannot be accounted for solely in terms of cognitive conflict processes, which would be present in both conditions.

In addition to the gross comparisons between individual and collective conditions, the scores were also analysed for specific groups of subjects (based on their pre-test grades). Dyads consisting of subjects each with a pre-test grade of 2 were compared to individuals with pre-test grades of 2; dyads comprising subjects each with pre-test grades of 3 were compared to individuals with pre-test grades of 3; dyads consisting of subjects with pre-test grades of 2 paired with subjects with grades of 3 were compared with individuals with pre-test grades of 3; dyads comprising subjects with pre-test grades of 4 paired with subjects with pre-test grades of 3 were compared with individuals with grades of 3.

The mean scores of these groups are shown in Table 7.2.
Each comparison was analysed using a partial repeated measures analysis of variance. The only significant main effect for condition (individual v collective) was on the comparison of individuals with pre-test grades of 2 with dyads comprising subjects who both had pre-test grades of 2. \( F(1, 15) = 6.87, p<.01. \)

For the dyads where a grade 2 subject was paired with a grade 3, a comparison was made between pairs where the grade 2 subject was assigned the 'easy' task and pairs where the grade 2 subject was assigned the 'difficult' task. No significant difference was found, indicating that the social conflict factor may have eliminated any differences which might have been expected due to differences in cognitive difficulty.

**TABLE 7.2**
Mean performance scores of subjects in particular collective and individual conditions.

<table>
<thead>
<tr>
<th>Condition by pre-test grade</th>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (n=11)</td>
<td>4.36</td>
<td>3.18</td>
<td>1.20</td>
</tr>
<tr>
<td>2x2 (n=6)</td>
<td>5.50</td>
<td>4.67</td>
<td>4.00</td>
</tr>
<tr>
<td>2x3 (n=9)</td>
<td>5.50</td>
<td>5.37</td>
<td>5.40</td>
</tr>
<tr>
<td>3 (n=10)</td>
<td>5.10</td>
<td>5.30</td>
<td>4.48</td>
</tr>
<tr>
<td>3x3 (n=7)</td>
<td>5.86</td>
<td>5.43</td>
<td>5.66</td>
</tr>
<tr>
<td>3x4 (n=5)</td>
<td>5.80</td>
<td>5.40</td>
<td>4.56</td>
</tr>
</tbody>
</table>
The significant overall difference between subjects in the collective and individual conditions supports Doise's general findings. However, the results do not support the evidence of Mugny & Doise (1978) which indicated that more progress occurs where children with different initial levels of ability are paired. Here, subjects with the same initial levels of ability showed more progress.

Children with the same initial levels of ability progressed better than children with differing levels in a study by Bearison (1983), using a modification of Doise's spatial perspectives task. As he points out (p 214), although inconsistent with Mugny & Doise's results, this does provide evidence against a social learning (ie modelling) type of explanation.

A further 3-way analysis of variance (partial repeated measures) looked at individual v collective performance when the subjects are divided into age groups instead of in terms of their pre-test grades (age x task x condition, 3 x 3 x 2). There was no significant difference between the various age groups, and the comparison of individual and collective performance just failed to reach significance (F (1,44) = 3.84, p< .06).

This was not a surprising finding since the variety of pre-test grades across all the age groups had indicated that there was not a very clearly demarcated age range within which certain skills could be identified in relation to an understanding of history material. Research using Piagetian-type grading systems with this kind of open-ended material supports this view (Jurd 1978).

The mean scores for collective and individual conditions by age are shown in Table 7.3. On the whole 10 year olds performed slightly better than 11 year olds, especially at the individual level for Part 3.
TABLE 7.3
Mean scores of subjects: age x condition x task

<table>
<thead>
<tr>
<th>AGE</th>
<th>8.6-10.0</th>
<th>10.0-11.0</th>
<th>11.6-12.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collective</td>
<td>n=12 (6 gpa)</td>
<td>n=20 (10 gpa)</td>
</tr>
<tr>
<td>Part1</td>
<td>5.67</td>
<td>5.70</td>
<td>5.64</td>
</tr>
<tr>
<td>Part2</td>
<td>4.33</td>
<td>5.60</td>
<td>5.45</td>
</tr>
<tr>
<td>Part3</td>
<td>3.80</td>
<td>5.40</td>
<td>5.35</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>n=6</td>
<td>n=12</td>
</tr>
<tr>
<td>Part1</td>
<td>4.20</td>
<td>6.00</td>
<td>4.42</td>
</tr>
<tr>
<td>Part2</td>
<td>3.00</td>
<td>4.50</td>
<td>4.50</td>
</tr>
<tr>
<td>Part3</td>
<td>1.44</td>
<td>4.20</td>
<td>2.53</td>
</tr>
</tbody>
</table>

Effect of social interaction on individual development

In addition to considering how social interaction influenced the task performance, the effect of social interaction on individual development was also of interest. This was assessed by comparing subjects' pre-visit interview grades with their post-visit grades.

Nineteen children showed evidence of a progression, from Stage 2 to Stage 3 (13 subjects) and Stage 3 to Stage 4 (6 subjects). Of these 19, 3 were from the individual condition, whereas 16 were from the collective condition.

Of those in the collective condition who showed progress, there were only 9 cases where this progress could be attributed to socio-cognitive conflict (since in the other 7 cases, modelling effects could account for the progress seen).
In 3 dyads, both subjects showed progress. In two of these dyads where both partners progressed, the subjects were at the same level initially, thus lending support to the view that such progress cannot be attributed to modelling effects. The third pair progressed from 2+3 to 3+4, thus again, a modelling explanation can be discounted, since the partner operating at an initially higher level also showed progress.

In those cases where only one partner progressed, generally this was where subjects with initially different pre-test scores were paired, and the subject with a lower grade progressed to the level of his/her partner. This could, of course, be explained in terms of modelling effects. However in three cases, the subjects were at the same level initially: thus again, this lends credence to a socio-cognitive explanation over a social learning type of explanation.

When a statistical analysis of this data was undertaken, it was found that the difference between the collective and individual conditions was not significant (using a chi² test of association), hence there is no conclusive evidence here that social interaction influenced individual cognitive development.

However, it does not appear that any progress seen can be attributed solely to maturation, since none of the control group sample (24 children) showed any evidence of progress between pre-visit and post-visit.
7.5 DISCUSSION

Whilst previous studies on children's learning in museums have utilised traditional Piagetian research paradigms and interpretations, the results here indicate the need for a shift towards a different model, which can better accommodate the social element. Knowledge is not constructed independently of the social context but develops through interactions with others. Focusing on children's individual cognitive deliberations may not be sufficient to explain the process of learning, particularly in an informal learning environment.

The findings from this study indicate that social interaction can significantly influence the performance of children on a learning task, and this can be explained in terms of socio-cognitive conflict processes. The superiority of group over individual performance was most marked in relation to the matching task (Part 3), which required the pairs of children to co-ordinate their different viewpoints, and therefore generated social opposition, in addition to the cognitive conflict generated by the two perspectives presented to them in the first two tasks (Parts 1 and 2). In the individual condition, the children experienced the same cognitive conflict, since they were required to coordinate two different perspectives in the same way, but did not experience any social opposition.

Whilst the results here lend support to a socio-cognitive conflict model of cognitive development, it should be remembered that not all socio-cognitive conflict necessarily results in cognitive progress. Some regulations of a social nature can stimulate progress, but others may inhibit it. In this study it was found that collective performance on the three tasks was superior to individual performance overall; however, when the subjects' pre-test developmental level is taken into account, it can be seen that a significant superiority of group over individual performance
emerges only where individuals graded at Stage 2 (intermediate between preoperational and concrete operational) are compared with pairs of subjects at the same level of development.

This finding supports the assertion that social interaction is most effective for children at intermediate stages of development, i.e., at the point where the child is ready for the combining of initially isolated schemas into a more coordinated understanding of a problem. However, Mugny and Doise (1978) found that more progress took place when children with different initial levels of task ability worked together than when children with the same initial levels worked together; this was explained by the fact that more cognitive conflict is likely to arise with children who have different abilities.

This was not found to be the case in this study, although the findings here are consistent with the results found by Bearison (1983), using a spatial perspective problem similar to that used by Mugny and Doise in their study. Bearison points out that, whilst his findings are inconsistent with Mugny and Doise's results, where children of similar abilities do show progress after interaction, this can be taken as evidence in favour of a socio-cognitive explanation in preference to a social learning type of explanation, since progress cannot be explained in terms of imitation and modelling.

It is also the case in this study that the pairs of children were given different perspectives on the problem (by being assigned to either an 'easy' or a 'difficult' initial task). Mugny et al. (1984) cite this as one of the situations where socio-cognitive conflict may be particularly effective (see Section 6.3). Thus, in this case, presenting different points of view, which may generate divergent responses, appears to be more effective in promoting progress through socio-cognitive conflict than encounters where the
response system of the participants differ (ie in individuals with
different cognitive levels).

It should be noted, however, that in the comparison between pairs
where a grade 2 subject (paired with a grade 3) was assigned the
easy task and those where the grade 2 subject (also paired with a
grade 3) was assigned the difficult task, no significant
differences in performance were found. Thus the effects of
different perspective may have been cancelled out by the effects of
different cognitive levels, and this may explain why the results
here do not reflect the findings of Mugny and Doise.

The results here indicate that a clear age progression in relation
to children's understanding of history material is difficult to
establish. This emerges in both the interview data, and in relation
to the children's performance on the tasks. This is quite
consistent with other research findings (Jurd 1978).

Despite this difficulty in defining a clearly demarcated age range
for the understanding of history concepts, the attempt to assess
children's understanding of history using a Piagetian framework
would appear to be generally quite successful. The reliability of
the grading system was established by the finding that the 24
control group subjects maintained a consistent level over the two
month period. In addition, by comparing the pre and post-visit
grades, it can be seen that the majority of children who progressed
to a higher level of cognitive ability at the post-visit stage were
those initially identified as being at an intermediate stage
between preoperational and concrete operational ability, which
lends support to the validity of the initial assessment, since it
might be expected that children at an intermediate level (ie at a
point where they are about to progress to a higher level) would be
most likely to be operating at a higher level after a 2 month
period (whether this is as a result of an interactive experience or
simply maturation).
The long-term effects of the interaction dynamic on the individual are somewhat unclear however. Although more children from the collective condition showed progress, generally this progress occurred where subjects with initially different pre-test grades were paired. This could be evidence in favour of a social learning explanation rather than a socio-cognitive conflict explanation. Thus although the finding that subjects graded at the same level initially benefited most from social interaction during the performance of the task (and this cannot be explained in terms of modelling effects), this finding is not satisfactorily supported by the findings from the individual post-test assessments. The number of subjects (9) whose performance at post-visit indicated a progression which could only be accounted for in terms of socio-cognitive conflict was too small for any firm conclusions to be drawn as to the implications of social interaction for individual cognitive development. In addition, one cannot rule out the effects of maturation entirely, although this is unlikely to be the main explanation for any progress seen at post-visit, since none of the control group (including those at intermediate levels of development) showed evidence of advancement.

In conclusion, this study has shown, firstly, that it is possible to apply a Piagetian-type approach to the assessment of children's understanding of history. Although this kind of approach has been used before, the interview procedure and grading system developed here provides a more standardised method of assessment which is not confined to any specific historical theme or particular developmental level.

Secondly, the study has shown that a socio-cognitive conflict model of learning can be usefully applied in an informal learning environment and need not necessarily be confined to laboratory settings or logical-operatory material and skills.
Another conclusion to be drawn from this study has important implications for museum designers and for schools. It would appear that social interaction is an important aspect of learning which has largely been neglected in museum design, and in the teacher's approach to field trips.

Schools should encourage collaborative problem-solving and discussion during museum visits. Although this study used worksheets in order to establish a way of providing concrete and quantifiable evidence of the importance of the interaction dynamic, generally it must be concluded that discussion and argument may be more effective in promoting learning in a museum setting. The use of individual (and individualistic) worksheets, containing questions which require responses which might just as easily be gleaned from books, may actually inhibit learning.

Museum designers should design exhibits which provoke discussion and argument. Instead of trying to encourage the individual to interact with the exhibit, it may be more useful to provide an opportunity for people to interact with each other. Although socio-cognitive conflict would appear to be primarily beneficial for children at particular stages of development, these children form a major part of the visitor population, and in any case, encouraging the communication of ideas must surely be beneficial for everyone who visits a museum.
PART 3

FAMILY GROUPS
In order to improve the effectiveness of museums, zoos, and other visitor attractions, a considerable amount of research is undertaken assessing the needs and interests of various visitor groups. Typically, visitor groups are broken down into coach parties, specialist interest groups, school parties, day trip visitors and holiday visitors.

One social group which is rarely recognised as a group in its own right is the family group. Day trip and holiday visitors are seen to comprise families, but they are not generally conceptualised as such, and the specific interests, needs and perceptions of family groups are not taken into account. Whilst little research has been done on school group learning in free-choice environments, even less has focused on the family group. Yet Rosenfeld (1980) found that child-adult groups spent more time together at the zoo than either child-child or adult-adult groups, and a similar finding emerged in a study at a natural history exhibition (Lakota 1975).

Whilst for school groups the museum or zoo may be perceived primarily as a learning environment, this may not be so for family groups. Two thirds of the reasons given by family groups for visiting a zoo focused on aspects unrelated to specific educational goals (Rosenfeld, 1980). Thus having an enjoyable and entertaining time may be the basic objective of family groups visiting informal learning centres.

Whilst very little has been reported about the behaviour of child-adult groups in informal learning environments, it has been recognised that social interaction is an important element. The museum or zoo is a place where families can be together, and it has been suggested that one function of family group visits is to strengthen family ties (Laetsch et al 1980, Rosenfeld 1980). However, researchers have neglected the role that social interaction may play in promoting learning.
Chapters 8, 9 and 10 explore the research which has emerged in relation to family groups in museum environments, and describe two studies which examine the importance of the social interaction dynamic in promoting learning in child-adult groups.
A FAMILY VISIT TO THE MUSEUM - LEARNING EXPERIENCE OR SOCIAL EVENT?

The first section of this chapter examines research findings which have emerged concerning the experience of family groups in museums, firstly in terms of family interaction patterns, and secondly in terms of learning.

The following section examines ways of investigating family behaviour and learning in free-choice environments, using social psychological theory and methodology. Firstly, a technique for assessing intergroup behaviour, drawn from mainstream social psychology, is described, and its applicability to the investigation of family behaviour in a museum setting is discussed. Following this, the usefulness of applying Doise's socio-cognitive conflict model of cognitive development to assess learning in child-adult groups is examined, in the hope that this may provide a more structured framework to explore the importance of social interaction in promoting learning in family groups.

The final section of this chapter addresses the question of the nature of the exhibit, and examines the role of interactive exhibits and interpretive devices in stimulating social interaction between visitors.
8.1 LITERATURE REVIEW - RESEARCH ON FAMILY GROUPS AT THE MUSEUM

There are two different lines of research into family groups in informal learning environments. The majority of the studies have been observational and have focused mainly on the behaviour patterns of family groups visiting museums and zoos. For example, do family members interact differently depending on their generation or gender?

A second area of research comprises studies which have focused on learning within family groups in museum environments, using interviews or paper and pencil tests to assess knowledge gain. However few reported studies have attempted to address this question of whether children (and their parents) do benefit educationally from a museum trip.

8.1.1. Family interaction patterns in a museum environment

Most observational studies of family interaction patterns in museums also involve some interviewing of visitors, in order to gain information regarding motivations, expectations, and attitudes. However the primary focus of this area of research has been the actual behaviour patterns which can be observed, and traditional museum evaluation techniques are generally employed, eg assessing the attracting and holding power of exhibits. Thus the attention has been primarily on the nature of the exhibit, rather than the dynamics of family behaviour.

However, one study conducted by Cone and Kendall (1978) suggests distinct variations in the behaviour of family members according to their position in the family, and also according to gender. The study was conducted in the Anthropology Hall of the Science Museum of Minnesota. Observations were made of family interaction in front of the four exhibits determined by earlier research to be the most popular. Interactions were recorded in terms of the following
categories: reads aloud, explains, questions, points, disciplines, separates, rejoins, leads. The predominant mode of verbal interaction was explanation.

The most interesting finding to emerge from this study, however, was the considerable gender role differentiation which was observed. It was found that mothers addressed almost all their interactions to children, and their attention was divided fairly equally between sons and daughters. Fathers engaged in much less verbal behaviour altogether, and most of this was directed at sons. Daughters were the least likely to engage in verbal interaction and rarely addressed fathers, although sons directed verbal behaviour equally to both parents.

Cone and Kendall's finding that the most frequent kind of verbal interaction was explanation (in the case of the parents) and questioning (in the case of the children) would appear to indicate that learning may be a major goal of the family visit; however, this contrasts with the evidence from interviews which indicates that families do not go to the museum specifically to learn.

Rosenfeld (1980) found that families had a variety of reasons for visiting a zoo, other than observing or learning from the animals. These included: to watch other people, to walk in a safe place, to have fun, and to eat food not eaten at home. For many of the adults it appeared that the zoo enabled them to 'act like children'. Another important aspect of family visits was their function in strengthening family ties. Thus learning does not appear to be a conscious goal of families visiting museums and zoos.

Rosenfeld and Terkel (1982), in their naturalistic study of visitors to a mini-zoo concentrated primarily on observing behaviour patterns, but also attempted some evaluation of informal learning. They graphed the frequency and duration of visits to various exhibits and in addition they recorded the spontaneous
comments of visitors. They compared the number of social comments and the number of exhibit-related comments produced by visitors, and found over four times as many social comments, which led them to conclude that visitors lacked in-depth curiosity about the animals.

The majority of studies show that most family groups spend very little time actually observing exhibits. Cone and Kendall found that the average time which a family spent in the Anthropology Hall was slightly less than 10 minutes, with an average time of only 30 seconds spent in front of an exhibit. Rosenfeld's study of family groups visiting a zoo (1980) found that people actually spent less than half their time observing animals and only 8% of the exhibits induced reading by visitors. Most adult-child groups do not read exhibit instructions or look at graphics in science centres either (Laetsch et al 1980).

It would appear from these studies which focus on family interaction patterns that learning is not the only or even the primary aim of the visit by a family group to a museum or zoo. This may be one reason why research into learning in such groups has been so neglected.

Observational and interview research like this has produced some interesting findings which warrant further investigation. For example, Cone and Kendall's finding that girls receive much less attention and instruction than boys has wide implications not only for museums but for society in general. However, on the whole, the techniques for measuring and coding behaviour are inadequate, and tend to be drawn from traditional museum evaluation research which focuses on the exhibit rather than the visitor. The actual dynamics of intergroup behaviour have not been explored in any depth. In addition, the paradoxes which arise have not been explored. If the majority of family groups engage in questioning and explaining, why is it that they don't see learning as a primary objective of their
visit? The fact that families say they are visiting a museum for purely social reasons does not mean that they don't learn anything while they are there.

8.1.2. Learning during a family visit to a museum

Very few reported studies have addressed the question of whether a family visit to a museum is successful in terms of learning.

Rosenfeld and Terkel did include some evaluation of learning in their largely observational study of families visiting a mini-zoo. This evaluation took the form of an analysis of the spontaneous comments of visitors, and in addition they used projective techniques (picture stimulus questions).

Although it was found that the comments made were generally social rather than exhibit-related, where the comments referred to a series of interactive zoo-games (as opposed to ordinary animal exhibits), visitors tended to make more interpretive statements. About 15% of the interpretive comments involved discovery or awareness of a concept. An example of an incident observed, which the authors suggest illustrates this, is where an 11 year old was examining a poster which asked 'How fast does your heart beat?' and gave the heartbeat rates of animals of various sizes. This poster was accompanied by a stethoscope, so that the visitor could measure his/her own heartbeat. The boy observed by Rosenfeld and Terkel commented 'the bigger the animal, the less the heart beats'.

The authors concluded that the zoo-game exhibits stimulated a more focused and convergent style of discussion than the ordinary exhibits, largely because they involved interactive activities, such as the one described. However, whilst the interactive exhibits were successful in engaging visitors in exploratory behaviour, it
was only rarely that they attempted to search for the concept behind the activity.

Whilst Rosenfeld and Terkel acknowledge that social interaction is often a dominant element of casual visits to many free-choice settings, they do not attempt to relate this to learning, but conclude instead that the important aspect is interaction between the visitor and the exhibit. It is clear that interactive exhibits may hold visitor attention better than non-interactive exhibits (Parsons 1968, Fazzini 1972), and that using interpretive techniques which involve, for example, asking questions and encouraging comparisons (as in the zoo-game described above) may encourage the exploration of ideas. However the important point may be that good interactive exhibits and interpretative devices stimulate more productive social exchanges between visitors, and it is the nature of the social exchanges, especially between child and adult, which should be examined. The role of interactive devices and interpretive techniques in stimulating social interaction is discussed further in the final section of this chapter.

Diamond's (1980) study of the behaviour of adult-child groups in the Lawrence Hall of Science Exploratorium has attempted to examine how social interactions may result in learning. He looked at how social interactions affect the ways people interact within an environment - how visitors point out things to each other and teach each other. He concluded that exhibit design and activities can influence social interaction in a way which may be important for the learning process, but the actual mechanisms involved in this are not explored.

Other studies have looked at more structured educational programmes offered by museums to parents and children. Gennaro, Bullock and Alden (1980) studied families attending a course in animal behaviour which was held at the Minnesota Zoological Gardens. Adults and children attended classroom discussions and film
viewing. Other demonstrations and activities were held in the zoo itself.

The families participating (over five weekends) were tested using multiple-choice questions administered on the first and last days of the class, and the pretest and posttest scores were compared. The conclusion was that learning, as measured by the test, did occur in both adults and children. However, since this was a formal course and participation involved a considerable degree of commitment and motivation to learn, it is questionable whether this can be fairly compared to a casual family visit to a museum or zoo.

Generally, there is little reported evidence on the learning which occurs in family groups in free-choice settings, and on the whole the evidence which is offered is not guided by any clear theoretical framework within which the actual processes involved and the role played by social interaction might be explored.

8.2. A SOCIAL PSYCHOLOGICAL APPROACH TO THE STUDY OF FAMILY GROUPS VISITING A MUSEUM

Research into family behaviour and learning in museums is not extensive. It has been delimited by the adherence of researchers to traditional museum evaluation techniques, such as measuring attracting and holding power, and assessing learning through paper and pencil tests of factual knowledge. Whilst some investigations, eg Rosenfeld and Terkel's study noted above, have utilised alternative techniques (eg projective tests) the interpretation of results has been difficult since the research has generally been conducted in a theoretical vacuum. The usefulness of innovatory techniques of assessment cannot be properly assessed unless they can be linked to a clear theoretical framework for interpretation.
It has been argued throughout that a major problem in museum evaluation research is that informal learning has been perceived as an individual rather than a social experience. Social psychology may offer a more fruitful approach, in terms of theory and related methodologies, by which understanding of learning in a free-choice environment can be explored.

The applicability of Doise's model of socio-cognitive conflict processes has already been demonstrated in relation to school groups visiting a museum. In section 8.2.2. the problems and advantages of using a socio-cognitive conflict framework to look at learning in child-adult groups are examined.

Firstly, a more systematic approach to the observation and recording of group behaviour is examined.

8.2.1. Using Interactive Process Analysis to study family group behaviour

Researchers engaged in studying the behavioural patterns of family groups in museums have generally adopted traditional museum evaluation techniques originally devised for examining the behaviour of the individual museum visitor (for example, the measurement of the attracting and holding power of exhibits) in order that those exhibits most attractive to family groups can be identified.

However, most researchers have recognised that this is insufficient for a full explanation of the family experience in the museum, and in addition it has been necessary to observe and categorise different elements of behaviour exhibited by different members of the family group - who speaks to whom, what is the nature of the interaction, and so on. In this way one can gain some insight into the way different members of the group experience the museum, and
how differences in generation and gender may influence that experience.

Generally, researchers devise their own categories for coding visitor interaction, and those categories used will inevitably reflect the researcher's own perception of the salient aspects of the situation. For example, Rosenfeld and Terkel (1982) noted the spontaneous comments of visitors to a zoo, and classified these into 21 categories which were established after a close reading of all the comments recorded. These categories were in turn subsumed into 4 major headings: conversations relating to exhibits, technical comments, interpretive comments, and social comments. The subcodes used included, for example: emotion, naming animal, wanting to do activity, fear of being bitten (all these are taken from the 'conversations relating to exhibits' category). The categories are not mutually exclusive, so that a statement could be classified in as many as three different ways.

Cone and Kendall (1978) used a very different kind of coding system in classifying the interactions of family visitors to the Anthropology Hall of the Science Museum of Minnesota. They included both verbal (reads aloud, explains etc.) and non-verbal (separates, rejoins etc) interactions. (See section 7.1.1. for a complete list of the categories used.)

Whereas Rosenfeld and Terkel's categorising scheme is very specific to the particular exhibition being studied, Cone and Kendall's coding frame is much more generalisable and could be used in other settings. This latter kind of approach would appear to be more useful, since it allows comparisons to be made across different settings and focuses attention away from the exhibit and on to the visitors themselves. However it is not clear whether the categories used by Cone and Kendall cover all possible relevant aspects, and the general nature of the categories does not really allow very powerful inferences to be made.
It would appear that clearer guidelines are needed for directing researchers interested in gaining a better understanding of family behaviour in museums, so that more systematic observations can be made which will strengthen our powers of inference and enable comparisons to be made.

Within social psychology, the study of intergroup behaviour has been a major area of research for several decades. One well-established method for the study of small groups is called Interaction Process Analysis (IPA). IPA is part of a general approach to the understanding of personalities and groups in their natural settings, and the method offers simple guidelines by which researchers can train themselves to observe and record interactions.

Firstly, the procedure for coding who speaks to whom must be perfected. A symbol is chosen in advance for each group member (e.g., a number or letter - 1 for father, 2 for mother, etc). In this way who speaks to whom can be recorded fairly quickly and efficiently by noting down just two numbers - the initiator of the interaction followed by the person spoken to (e.g., 1-2). If the whole group is being addressed, a zero is used to denote this. Once this procedure has been refined through practice, the observer can go on to simultaneously classify the interactions which occur. A scoring pad is arranged with a list of categories down the left-hand side, followed by a number of cells (each column of cells being allocated to one group of subjects). Pairs of numbers denoting who speaks to whom can be noted in the appropriate cell.

IPA uses 12 categories which can be grouped into 4 subsets: Positive, Answers, Questions, and Negative (PAQN). The categories are shown below, with a brief description of each. Detailed descriptions of the categories are given in Bales (1970). Those aspects which might be particularly relevant to the observation of family groups in free-choice environments have been underlined.
Positive

1) Seems Friendly
Includes all socially positive attitudes, eg expressions of sympathy, greetings, leave-takings, acts promoting solidarity of group, mediating, conciliating, moderating, protective and nurturing attitudes, praising, encouragement, gratitude, shows of admiration. This category includes aspects of social discipline and direction. Not task oriented.

2) Dramatises
Includes fantasy statements, anecdotes, silly remarks. Joking and laughing. Not task oriented.

3) Agrees
Includes specific signs of attention to what the other is saying ('I see', 'I think you're right', etc.). This category can be confused with 1) above, however, agreement relates to specific tasks or statements made. If overtly friendly, should be coded in 1).
4) Gives 
Suggestion

Taking the lead in directing attention, control of communication ('watch closely now'), persuasion and preparation for activity. Should be neutral, ie not overtly friendly or unfriendly (otherwise it should be scored in those categories). Task oriented.

5) Gives 
Opinion

Includes affirmations of belief, indications or verbalizations of the process of thought, reasoning, inference, interpretation; distinguished from 6) (gives information) in that this category involves inference or interpretation rather than simply reporting. Task oriented.

6) Gives 
Information

Neutral, factual, objective statements. Non-inferential (if too vague, it should be coded as opinion). For example, reading labels.
Questions

7) Asks Information

Questions requesting factual, descriptive, objective answers (eg 'what does the label say'). (If answers require guessing or conjecture, these should be coded as Asks Opinion.) Task oriented.

8) Asks Opinion

Questions encouraging statements of opinion, eg 'what do you think'. NOT 'don't you think so' - this is giving suggestion. Can include indirect requests for opinion, eg 'I can't figure out what that means'. Task oriented.

9) Asks Suggestion

Neutral and task oriented but also submissive - turning initiative to another, eg 'where do we go now', 'I don't know what to do', 'what do you think we should do'. Can be confused with Giving Suggestion, eg 'what else do you think we can do' - which implies the power to decide. Asking suggestions which have an emotional tone should be classified in Shows Tension; irritation may be better classified in Unfriendly (eg 'well what do you suggest then'). Can also be Friendly (eg 'well, what would you like to do now').
Negative

10) Disagrees 'No...I don't think so', 'Well...but...'. If too negative should be classified in 12). Disagreement may be by omission.

11) Shows Tension Not clearly negative. Confusion, anxiety evading requests, fear, worry, even laughter if it conveys unease.

12) Seems Unfriendly Aspects of social control, direction, supervision, which limit the choice of another: eg 'stop that', 'hurry up', 'Get out'. Disapproval. Insistence on interfering with what another says/does. Implications of inferiority, incompetence, complaining. Aspects of Dramatizes (2) can be included here only if overtly unfriendly.

Interaction Process Analysis is built on a very simple common sense base and Bales provides simple exercises and extensive instructions on the use of the method.

Bales points out that ambiguities will arise but puts forward several simple rules to help reduce these. For example, priority should be given to a scoring in Category 2 (Dramatises) and Category 11 (Shows Tension) over a scoring in any other category. This rule is particularly relevant to acts that would otherwise be placed in Category 6 (Gives Information). Priority should also be given to scoring in Category 1 (Seems Friendly) if an element of
interpersonal feeling is present. This rule is particularly relevant to acts that would otherwise be categorised as Giving Opinion or Giving Suggestion (simple acts of agreement and disagreement are exempt from this rule). Priority should also be given to a scoring in Category 4 (Gives Suggestion) or Category 9 (Asks Suggestion) over a scoring in Category 5 (Gives Opinion). A final rule is that after an initial act of disagreement, or of agreement, the scoring reverts to the neutral categories based upon the interaction form of the act. This rule is necessary to prevent Categories 10 and 3 from being a 'sink' into which all interactions are drawn.

The general effect of these rules is to divert the classification of acts that tend to be most frequent, in the form of giving opinion and information, into less frequently used categories which depend upon more subtle cues and are of greater diagnostic interest. (Bales 1970, p 135.)

From the point of view of museum evaluation, IPA can be seen to have several advantages. Firstly, the method offers a standardised format with detailed instructions and training exercises which can aid the researcher in becoming competent at recording observations.

Secondly the method is flexible and thus is not tied to any particular setting. This flexibility also means that the method can be used at several levels. If, for example, a researcher is simply interested in distinguishing between positive and negative interactions, questions and answers, these four broad categories alone can be used. However, a more detailed and subtle analysis is also possible through the use of all twelve categories; for example, one can determine whether a particular exhibit stimulates visitors to offer suggestions rather than simply give information.

Most importantly, IPA effectively diverts attention away from the specific exhibit towards a focus on the actual intergroup dynamics.
In addition, instead of simply recording the behavioural aspects of the group (for example, how often members of the group separate or rejoin) the method enables one to make some assessment of the affective experience of visitors. Bales' analysis allows one to distinguish between explanations which are truly exhibit-oriented and those which are only superficially to do with explanation and in fact relate more to positive or negative aspects of social control or feeling.

Using Interaction Process Analysis to observe and interpret the behaviour of family groups in free-choice environments will allow researchers to gain a better understanding of the social and affective nature of the family's experience at the museum. It will also help researchers to distinguish between various exhibits in terms of their success in stimulating different kinds of interaction. It is argued here that the nature of those interactions may indicate which kinds of exhibit may be most effective in stimulating learning.

It has been demonstrated (see Chapters 6 and 7) that group learning in children may be facilitated by the stimulation of socio-cognitive conflict processes, wherein participants with different points of view or levels of understanding are encouraged to co-ordinate their perspectives. Thus one would expect that exhibits which stimulate argument and suggestions, rather than acceptance and information giving, would be more likely to lead to learning. This is explored further in the two studies described in Chapters 9 and 10.

Firstly, the question of whether socio-cognitive conflict processes can be effective in child-adult groups must be addressed.
8.2.2. Socio-cognitive conflict in child-adult interaction

The substantial body of evidence on socio-cognitive conflict processes produced by Doise and others is discussed fully in Chapter 6. This model was successfully applied to the investigation of children's learning during a school trip to a historical museum, described in Chapter 7. Briefly, Doise's hypothesis is based on the Piagetian view that learning involves the resolution of contradictions or conflicts between new and old knowledge. Doise's contention is that it is not sufficient to explain learning only in terms of the co-ordination of cognitive conflicts within an individual, but that the process is facilitated by the co-ordination and resolution of cognitive conflicts between individuals. In other words, if children can work together on a problem they will be more successful than working alone, and this success is not dependent on one partner being more able than the other and thus providing a model to imitate, but is related to the social and cognitive conflict involved in the interactive situation.

Mugny et al (1984) outlined several necessary conditions for social interaction to lead to cognitive progress (see 6.3). One of these conditions is where the response systems of participants differ. Mugny and Doise (1978) have shown that socio-cognitive conflict can result in cognitive progress for the participants in this kind of situation, that is, between individuals with different cognitive levels. This would imply that child-adult interaction would be likely to lead naturally to socio-cognitive conflict, since the child and adult would be likely to have different levels of understanding in relation to a particular problem, giving rise to socio-cognitive conflict and necessitating a co-ordination of views.

However, Mugny et al also point out that even where favourable conditions exist, constructive socio-cognitive conflict may be
prevented; for example, inter-individual dynamics may hinder progress by creating a compliance effect - where one participant becomes dominant and simply solves the problem alone. At a more general level, the social position/identity of participants may also lead to a compliance effect. This kind of problem is particularly acute in situations involving children and adults, since the child may assume an adult's response is more likely to be correct; or may simply defer because of the adult's superior status as an authority figure.

The compliance effect has been demonstrated in experimental situations involving children and adults (Mugny et al 1984). However it has been shown that compliance can be avoided by the adoption of a particular style of interaction on the part of the adult. The adult must not be too explicit in responses as this will inhibit any active construction of another solution by the child, and continual expressions of doubt may be effective in counteracting the compliance effect. In this way an adult may provoke cognitive progression in the child, even when the adult's own response is incorrect.

Whilst it would appear that the essential inequality of the relationship between child and adult may inhibit socio-cognitive conflict, social regulation factors can also facilitate progress. In many socio-cognitive conflict situations there will be a relationship between responses of a cognitive order and other relevant social regulations, or regulations made salient in the situation. Such situations are characterised by a social marking of cognitive responses.

One experiment which illustrates what is meant by social marking was conducted by Doise, Dionnet and Mugny (1978). Non-conservers were engaged on a task involving conservation of unequal length which involved having to judge the length of bracelets and then divide them between a fat and a thin cylinder (the circumference of
these corresponded to the length of the bracelets), or between self and adult. Cognitive conflict was identical in each situation, but progress was only substantial in the latter case. This is interpreted in terms of the superiority deriving from the necessity of social sharing - the social order accentuates the contradiction resulting from the child's initially non-conserving judgments. Thus certain forms of correspondence will favour cognitive progress - where conflict is both cognitive and social, and the correct response corresponds to the social necessity.

In another experiment De Paolis et al (1984) used a variation on the houses and lake spatial transformation task used earlier by Mugny and Doise (1978) and described in Section 6.3. Instead of using houses and a lake, De Paolis used a teacher's and a pupil's desk, thus the social marking was accentuated. It was found that performance using the socially-marked situation was superior to the house/lake control.

In another variation of the houses/lake spatial relations task Carugati et al (1978) used a child in an 'easy' position opposing an adult in a 'difficult' position (See Section 6.3). Children who opposed the adult progressed, but children who acquiesced to the adult's incorrect responses did not (a compliance effect). Using child-adult combinations to compare results between the houses/lake task and the socially-marked schoolroom adaptation of this indicated that the socially-marked situation led to more progress. The coincidence of cognitive evidence with the social rule symbolized in the task enabled the children to escape the 'social weight' of the adult.

The limited research on the effects of socio-cognitive conflict processes in child-adult interaction has been restricted to experimental situations. No attempt has been made to assess natural interactions with familiar adults. In addition, because Doise's hypothesis derives from a Piagetian framework which focuses on
sequential stages of cognitive development in the child, no attempt has made to assess the effects of socio-cognitive conflict on the adult; indeed from Doise's perspective this would be irrelevant since socio-cognitive conflict is seen to be effective only for children at certain transitional stages of the developmental sequence: it is, of course, assumed that adults have completed their cognitive development.

However, since social interaction is a two-way process, it must be allowed that adults may benefit from such encounters. Whilst these benefits may be primarily in terms of such factors as the strengthening of family relationships, it may also be possible that in some situations some kind of cognitive progression is provoked in the adult.

The study reported in Chapter 10 attempts to fill these gaps in the research. Whilst the main focus of interest is the effect of social interaction on the child, attention is also paid to the adult's understanding of the problems presented, in a tentative attempt to set the notion of cognitive progress in a wider context.
8.3. THE NATURE OF THE EXHIBIT

The ways in which people interact and share information can greatly facilitate learning. Although attention is given to the design of the physical aspects of museum exhibits, researchers have paid little attention to the explicit design of rules or conventions that will determine the relationships between people and information (Chase, 1975). Chase suggests that there is a need for the conventions that govern a museum environment to be changed, so that visitors can become much more involved in sharing and experimenting with knowledge. He suggests, for example, that an exhibit dealing with mechanics could include an activity area in which teams work collaboratively on the design of simple machines. The activity area could have a gallery of spectators who might be asked to provide criticisms of the performance, or act as a jury to decide on the problem-solving and design efforts they are observing.

In many modern museums and science centres, activity areas are now provided, and interaction between the visitor and the exhibit is encouraged. Research shows that visitors prefer multisensory exhibits as opposed to static non-participatory exhibits (Thier and Linn 1976). Whilst the average time spent at non-interactive exhibits is between 40 and 90 seconds (Fazzini 1972), interactive exhibits hold the visitor's attention for much longer (Rosenfeld and Terkel 1982).

However, it is still assumed that the visitor learns from the object - although learning is now assumed to involve active participation on the part of the visitor rather than a passive acceptance of information. The sharing of information amongst groups of visitors is not generally considered, however.

There is some indirect evidence that interactive exhibits may be more successful than static exhibits in stimulating information
sharing. Gottfried (1980) found that students who had visited a laboratory at the Lawrence Hall of Science where they handled real animals and designed and ran their own experiments were able to successfully teach other students who had not visited the laboratory.

Data relating to the effectiveness of interactive exhibits in facilitating learning generally is unclear. In fact, Borun (1977) found a negative correlation between learning and interactive devices. However, these negative effects were related to simple push-button devices. Alt and Shaw (1984) have pointed out that to be properly interactive the act of participation itself must be informative: participation merely as a means to obtain information is insufficient.

Unfortunately, many modern exhibits presented as 'interactive' are simply exhibits with push buttons or gadgets which simply light up the display (Kimche, 1978, refers to this as a first order interaction). Whilst pushing a button might increase the attractiveness of an exhibit, it does not engage the visitor intellectually in any way. It is necessary for participation to involve the visitor through a second order interaction (for example by controlling the exhibit, or deciding between alternatives) if learning is to be enhanced (Lucas 1983).

Kimche (1978) suggests that simply providing experience with a real object (a third order interaction) will lead to learning. Seeing, touching and smelling a real animal can enhance your knowledge of it better than any carefully structured interactive display. However, as Lucas (1983) points out, simply providing first hand experience with an object is unlikely to lead to learning; it may be necessary to direct attention to the important aspects, and to help provide the relevant cognitive structures, in order for a proper understanding to be gained.
This point of view implies that careful interpretation may be especially important in the case of static exhibits, if they are to stimulate learning. Labels can be used to provoke cognitive interaction with an exhibit, by posing questions, or encouraging comparisons.

However, providing cognitive direction in this way may be as necessary for interactive exhibits as it is for static ones. It is a mistake to assume that an exhibit which can be physically manipulated will automatically stimulate intellectual activity; it is the intellect itself which needs to be manipulated. The interaction involved in the 'How fast does your heart beat' zoogame exhibit described above (7.1.2) is actually intellectual interaction, stimulated by the question posed and the comparisons offered. The physical act of lifting the stethoscope and listening to your own heart would be meaningless if the proper context of enquiry had not first been created.

The principles behind the development of interactive exhibits in museums have been drawn largely from Piagetian psychology (see Chapters 2 and 6). They are based on the assumption that interaction with the environment will lead to an awareness of the contradictions between what one assumed to be true and what one observes and experiences. The resolution of these contradictions is learning. It has been argued here that, particularly in a free-choice learning environment, the process of learning does not occur in a vacuum, but is influenced by social factors. If the museum is to properly fulfil its role as educator, these social factors should be taken into account, and the museum should aim to facilitate information-sharing amongst visitors. Since family groups constitute a large majority of the visitor population, it is especially important to encourage the sharing of knowledge between adult and child.
It has been pointed out in the previous section that attempting to facilitate learning in child-adult groups through the process of socio-cognitive conflict is problematic, and can only be achieved through a very careful style of interaction on the part of the adult. Adults must not be too explicit in their responses, and must engage in frequent expressions of doubt, in order to counteract a compliance effect - where the child simply acquiesces to the adult's view. It is not, of course, possible (or desirable) to control the way families talk to each other in museums, but it may be possible to direct their conversations through careful interpretational devices - using demonstrators, or simply employing careful labelling which encourages debate.

Another factor which emerged from the discussion on socio-cognitive conflict in child-adult groups could also be taken into account. It was found that the social marking of cognitive responses was effective in producing greater intellectual progress in children engaged in problem-solving interaction with adults. Again, interpretive devices could be used to accentuate these social regulation factors. Where a correspondence exists between a cognitive response required by a particular exhibit and a social response, social analogies could be drawn which could encourage the correct cognitive response.

Recognising the importance of encouraging families to share their knowledge could have profound and beneficial consequences for the effectiveness of the museum as a learning environment. Whilst developing new and interesting exhibits which can bring about a cognitive gain is an admirable development in modern museums; designers should become more aware of the potential of museums for facilitating social and affective gains amongst visitors.
In the next two chapters, two studies are described which explore some of the questions raised here. A comparison is made between exhibits requiring different levels of physical and mental interaction, and the amount and nature of the family interaction and learning which each of these exhibits stimulates is explored.
9. **STUDY 3**

**AN OBSERVATIONAL STUDY OF FAMILY INTERACTION AT THREE EXHIBITS IN THE SCIENCE MUSEUM**

The findings from Study 2 (see Chapter 7) suggest that socio-cognitive conflict processes may facilitate learning in a museum setting, but may be effective only under certain conditions, i.e., for children at a certain stage of cognitive development. Study 3 and Study 4 (described in this chapter and Chapter 10) explore further the kinds of conditions which may encourage useful social exchange (i.e., interactions which may lead to learning through a process of socio-cognitive conflict) in a museum setting. Firstly, the kinds of interactions which are stimulated by different types of exhibit are examined (Study 3), and secondly, the kinds of understanding gained by visitors at the same exhibits, with interpersonal interaction either encouraged or discouraged, are explored (Study 4).

Whereas Studies 1 and 2 were concerned with school groups visiting a museum with a historical theme, Studies 3 and 4 both focus on family groups visiting the Science Museum in London.

9.1 **INTRODUCTION**

This study explores the nature of the interactions which occur between members of family groups visiting a museum, using observational techniques.

A family visit to a museum is a much less structured event than a school visit. Children on a school trip to an exhibition may perceive their visit as being educational, in the sense that they will be aware that they may be expected to demonstrate some knowledge gain after the visit, and they will usually arrive with some background knowledge and pre-determined tasks to undertake. Children who visit with their families may not have the same
motivations and expectations, and probably have little background knowledge. A school group will have a specific goal in mind, whereas a family group may not have any goal, except, perhaps, a social goal.

The study to be described in this chapter involves a comparison of family behaviour at three different kinds of exhibit. These exhibits include one interactive exhibit (ie requiring active participation since information is transmitted only if the visitor interacts both physically and mentally with the exhibit); one push-button exhibit (ie requiring participation only to the extent that a button is pressed to activate the exhibit); and one static exhibit (a non-participatory exhibit requiring only observation and/or reading of labels).

The aim is to identify whether

i) different kinds of interpersonal interaction are stimulated by the different types of exhibit;

ii) certain kinds of exhibit can promote more useful social exchanges between family members than others;

iii) the exhibits stimulate social exchanges which could be interpreted in terms of socio-cognitive conflict processes, and hence may lead to learning.

Whilst there have been some naturalistic and ethological studies of learning in museums which have involved a comparison of static and interactive exhibits (Rosenfeld and Terkel, 1982, Diamond 1980), assessments of the educational effectiveness of exhibits (Shettel 1973), investigations of the instructional modes of various exhibits (Screven (1974), discussion papers on the role of interactive exhibits as teaching devices (Semper, Diamond and St John 1982), and studies which have used interactive exhibits as a research tool (Feher and Rice 1985), no reported studies have
compared interactive exhibits with static and push-button exhibits, in terms of their effectiveness in stimulating discussion and learning.

9.2. METHOD

Family groups visiting one of three different kinds of exhibit (interactive, pushbutton and static) at the Science Museum in London were observed, and the nature of the social exchanges stimulated by the three exhibits were compared, using Interaction Process Analysis (see 8.2.1).

9.2.1. Setting

Since the aim of this study is to explore the nature of social interaction in family groups visiting a museum, and its influence on learning, one variable which must be taken into account is the degree of interaction (both physical and social) demanded by various exhibits, so that the degree to which various kinds of exhibit encourage or discourage family interaction can be more clearly examined. However the different exhibits also need to convey the same basic concept or process in order for their effectiveness in terms of learning to be properly compared (this is explored further in Study 4). With these considerations in mind the Science Museum in London was selected as a suitable site.

The Science Museum has its origins in the Great Exhibition of 1851, which led to the opening of the South Kensington Museum's scientific and educational collections in 1857. The South Kensington Museum eventually became the Victoria and Albert Museum, and the science collections were separately housed in nearby buildings. The present Science Museum was built in 1913, and consists of five floors housing an impressive collection of galleries showing various aspects of science and technology.
In the Science Museum, several exhibits demonstrate the same identifiable scientific or technological concept in different ways, and in addition the Science Museum offers a wide range of design and interpretive modes. Whereas many of the exhibits have not altered much over the years, some very modern interactive exhibits are also on offer.

Launchpad

One gallery in the Science Museum is of particular interest in relation to family interaction. Launchpad is a new gallery which opened in the summer of 1986. It consists of over 100 separate exhibits in an area of nearly 1000 m². The exhibits are all fully interactive and consist of experiments and demonstrations which visitors can touch and handle in order to explore and discover the fundamental ideas in technology and science. Visitors are encouraged to not only interact physically and mentally with the exhibits, but also to interact with each other. Many of the exhibits necessitate the collaboration of two or more people in order for them to be assembled or used.

The gallery is staffed at all times by trained assistants whose role is to explain the exhibits to visitors, and to encourage them to experiment with the exhibits. The assistants also give demonstrations.

Most of the exhibits are intended for people with no specialist technical knowledge, and many are accessible to very young visitors.

The emphasis in Launchpad is on technology rather than science, and the exhibition demonstrates many fundamental and long-established technologies relating to basic structures and materials which surround us in our daily lives, as well as introducing newer information technology ideas.
In addition, many of the principles and phenomena which the exhibition demonstrates are presented elsewhere in the Science Museum, in more traditional, non-interactive displays.

The Launchpad Gallery is an ideal place in which to explore family behaviour since it is specifically aimed at family groups. It was decided that an exhibit should be selected from this gallery which could be compared with two other exhibits elsewhere in the Science Museum, demonstrating the same concept but demanding a different level of interaction from the visitor.

Two other galleries in the Science Museum were used in addition to the Launchpad Gallery, the Agriculture Hall and the Transport Gallery. These are described in Section 9.2.2. below.

9.2.2. The Search for Exhibits

The first stage of the research involved a search for suitable exhibits. Since it was proposed that the study would involve contrasting different levels of participation with an exhibit, but that all exhibits selected should demonstrate the same basic concept/process, a review of several galleries in the Science Museum was made, in an attempt to link various exhibits elsewhere with the exhibits in Launchpad.

The main galleries reviewed were the Children's Gallery, the Optics Gallery, the Agriculture Hall, the Transport Gallery, and the Bridges Exhibition. These galleries were selected since they all had exhibits which communicated concepts or processes which were also demonstrated in Launchpad. The advice of staff at the Launchpad Gallery was helpful in deciding on the relevant galleries and exhibits.

Finally, it was decided that exhibits demonstrating the principles involved in gear wheels should be selected. This principle is conveyed in a variety of ways throughout the Science Museum.
Exhibits from the Transport and Agriculture displays, in addition to one from the Launchpad Gallery, were chosen.

The Transport Gallery is located on the ground floor of the Science Museum. It is a very busy gallery since it has to be passed through in order to enter other galleries, and entry to the Natural History Museum, which is located next door to the Science Museum, can be gained from the centre of the gallery. There are several large displays, including a train, tube train, cars, fire engines, and so on, and also smaller exhibits showing models, engines, etc in glass cases. The exhibition is very traditional, and most of the displays are static. However, there is the opportunity to activate some exhibits by using pushbuttons or handles.

The Agriculture Hall is a quieter gallery on the first floor. It is also a traditional gallery, with some large displays of agricultural machinery and life-size models of animals. However, most of the exhibits are in the form of dioramic scenes portraying farming practices over the years. There are no interactive exhibits, although some of the exhibits can be activated by pushbuttons.

The Launchpad Gallery has been described above. It differs quite dramatically from the other two galleries, firstly because it is housed in a separate section, and has its own entrance, just inside the main entrance to the Museum. Secondly, it differs from the other galleries in that the exhibits are all interactive, and visitors are encouraged to manipulate them. It is a very popular and noisy gallery and attracts mainly family groups.
**Gear Wheels**

Gear wheels are fixed in machines to make different parts move at different speeds or in different directions. They have toothed edges and when two gear wheels are fitted together, one wheel turns one way, the other turns the other way. If one wheel has half the number of teeth of the other, it turns twice to every one rotation of the bigger wheel. So whilst the speed of the whole operation can be increased/decreased, the ratio of speed for all the wheels remains the same. The invention of gear wheels was a great technological advance which helped to produce powerful machines such as windmills, waterwheels and capstans. Examples of gear wheels can be found in all manner of objects, eg in clocks and bicycles.

In terms of Piagetian theory, an understanding of how gear wheels function would appear to necessitate formal operational thought, since it involves problems of proportionality and relative speed, which necessitate taking into account several different variables through a process of compensation.

According to Piaget, formal thought is characterised by the child's appreciation of 'possibilities' as opposed to 'realities' in approaching a problem. At the concrete stage (8-11 years) the child is limited by the 'reality' of a situation, but the formal thinker (over 11 years) can consider a variety of possibilities and is capable of generating several hypotheses in order to determine the relationship amongst variables.

Thus whilst the thinking of a child between 8 and 11 years of age is characterised by concrete operations and relates directly to objects and groups of objects, when the child reaches 11 or 12 years of age, new operatory schemes are beginning to be established, which liberate the child from the concrete and locate reality within a group of possible transformations (Inhelder and Piaget, 1958). The thinking structures of concrete operations are
reconstructed onto a new level of representation, thus these new schemes involve some kind of combinatorial system (the separate schemes of concrete operations become integrated into superordinate schemes). So, for example, the child can now isolate relevant variables and conceive of the compensation of two opposing factors based on possible combinations.

This is best illustrated by some examples from the Piagetian literature. For example, in explaining why a heavy ball released from a low position travels as far as a light ball released from a high position, Inhelder and Piaget (1958) showed that children at the beginning of concrete operations cannot appreciate the compensation of variables involved here but generally explain the result in terms of one or other of the variables (height or weight) instead of combining them. Only when the child has reached the stage of formal thought can the understanding of compensation involving 3 or more factors be achieved.

The understanding of proportion and relative speed, which is fundamental to an understanding of gear wheels, involves the operation of compensations and according to Piaget appears at around 11/12 years of age, i.e. at the beginning of formal operations.

Piaget has investigated the phenomenon of proportion by using the relationship between the weights and lengths of the arms of a balance, where the child has to discover that when you begin with two equal weights at equal distances from the centre, you maintain equilibrium by decreasing one weight but moving it farther away or increasing the other weight and moving it closer to the centre (Piaget and Inhelder 1958).

Other researchers have investigated the development of proportional reasoning using matching lengths constructed of Cuisenaire rods, a pantograph, balance beams, sets of number pairs with missing numbers, and similar items (Lunzer and Pumfrey 1966, Lunzer 1965,
Lovell and Butterworth (1966). They found that proportional reasoning unaccompanied by physical actions rarely appeared in subjects under the age of fifteen. Children younger than this solved some of the problems by using successive addition, and the authors concluded that subjects had learned multiplication and division but did not really appreciate the inverse relationship between them.

Wollman and Karplus (1974) found that many students attempted to solve problems which required the application of proportional reasoning by using incorrect additive strategies, estimation or pure guesswork. They also found that some students applied proportional reasoning on some tasks but not on others in an unpredictable way. This could be interpreted, in line with Piaget's theory, by arguing that the students were transitional between concrete and formal operations. Another interpretation, however, is that there is not a definite stage of formal thought. Rather, there are formal operations, such as proportional reasoning and propositional logic, which are used by individuals when they are suitably motivated, have certain cues that suggest a formal rather than an intuitive approach, and/or are pressed to justify their conclusions (Wollman and Karplus op. cit. p 609).

The notion of proportionality in turn relates to the problem of relative speed, i.e., the coordination of two speeds into one single apparent speed. The composition of two speeds implies formal thinking and this has also been investigated by Piaget (1970), in an experiment involving the child being shown a framework fitted with an endless moveable belt on which are fixed 8 card cyclists. The speed is regulated by a handle. Parallel to the belt is a string carrying a doll (the observer). The child has to forecast how many cyclists the doll will see in 15 seconds when travelling in the same direction (at a constant but slower speed) as the cyclists, and decide whether the doll will see as many cyclists passing by when it is moving in this way as it sees when it is stationary. Piaget found that it was not until around 11 years of
age that children could produce correct deductions and explanations of the relativity of speed.

In relation to the operation of gear wheels, the child must appreciate that not only are the different sized wheels moving at different speeds (with a constant ratio) but also that the initial impetus or speed of operation of the whole can be varied. Thus whilst the speed of the whole operation can be increased/decreased, the ratio of speed for all the wheels remains the same.

Thus, from a Piagetian viewpoint, a proper understanding of this apparently simple and fundamental technological principle actually involves quite complex thinking structures.

The Three Exhibits

The gear wheels exhibit in Launchpad consists of several wheels of various sizes with serrated edges or teeth (the teeth being the same size on all the wheels). Coloured portions mark off an equal number of teeth on each wheel, so that the ratio of teeth per wheel and hence the ratio of one wheel to another can be easily assessed. For example, one wheel has six coloured portions and a smaller wheel three, thus the large wheel is twice as big as the small wheel since it has twice as many teeth (the ratio of teeth on the two wheels being 2:1). The largest wheel in the exhibit has a handle attached in order to move it round, and when all the wheels are fitted together so that their teeth engage, the visitor can turn the handle to activate all the wheels. The smallest wheel is fixed, but the others can all be moved around so that the visitor can experiment by trying different sized wheels together.

A label attached to the exhibit poses the question "Which wheel turns most slowly?".

The exhibit in the Transport Gallery is a push-button exhibit of a Brown-Boveri Axel Driver. The scale of the exhibit is 1:5. It is a
demonstration model showing the method of connecting the armature shaft and the driving wheels of an electrically-driven locomotive with individual axel-drive, dated c1916/17. The gearing is a large spur wheel mounted on an outside frame and concentric with the driving wheel. The large gear wheel fits into a much smaller wheel. When visitors press a button the gear wheels move to operate the motor. A label above the exhibit gives very detailed technical information (the ratio of the gear wheels is not given however).

The exhibit in the Agriculture Hall is a static exhibit which consists of a large (life-size) model of a horse attached to a 19th Century Horsewheel which was used for churning butter. The Horsewheel has four gear wheels. The main wheel has 240 teeth and the succeeding gears have 40, 48 and 24 respectively. The overall ratio of 12:1 gave a horse going round 4 times a minute (2 mph) a speed of around 50 rpm for the 60 gallon churns. In 1½ to 2 hours about 250 lbs of butter could be made. (This information is given on a small label attached to the front of the exhibit, together with some additional information on the horse's harness).

The three different exhibits all demonstrate the operation of gear wheels. However, clearly the Launchpad exhibit is more amenable to children at concrete operations since the child's judgment of what is happening can be directly related to the objects themselves. The child can manipulate the wheels and see that some wheels go round faster than others. In addition, attention is drawn, by the use of different coloured portions, to the proportionality aspect of the operation, and by observing the number of teeth marked off by each coloured portion the child is directed to the relevance of this aspect.
9.2.3. Subjects

150 family groups were observed, 50 families for each of the three exhibits. A family group was defined as a minimum of one adult plus one child. Non-English speaking groups were excluded from the observations. Family groups with very young children were also excluded, and only families with children between the ages of 7/8 to 13/14 years of ages were included. This age group was selected since it encompasses the period during which, according to Piagetian research, children move from concrete operational thought to formal operational thought, and is thus an age group where understanding of the principles involved in the operation of gear wheels is developing.

Although this study is not specifically concerned with assessing learning but rather with examining the social conditions under which learning might be facilitated, it is necessary to create the relevant cognitive context in order for these conditions to be examined. In addition, the next study (see Chapter 10), using the same exhibits, goes on to assess whether learning actually occurs, and the observational data produced here was used to help structure this subsequent investigation. The age of the children was assessed by observation only, since none of the subjects were approached.

The composition of the family groups observed at each exhibit is shown in Table 9.1:
Table 9.1: Composition of family groups observed at three exhibits

<table>
<thead>
<tr>
<th>Parents</th>
<th>Children</th>
<th>LP</th>
<th>T</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother &amp; Father</td>
<td>Son(s) &amp; Daughter(s)</td>
<td>6</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Son(s)</td>
<td>7</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Daughter(s)</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>One Parent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>Son(s) &amp; Daughter(s)</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Father</td>
<td>Son(s) &amp; Daughter(s)</td>
<td>0</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Mother</td>
<td>Son(s)</td>
<td>4</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Father</td>
<td>Son(s)</td>
<td>13</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Mother</td>
<td>Daughter(s)</td>
<td>11</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Father</td>
<td>Daughter(s)</td>
<td>5</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

LP = Launchpad  T = Transport  A = Agriculture

(See Appendix J for more detailed breakdown of family groups)

9.2.4 Materials

The only materials needed were a scoring sheet and pencil. The scoring sheet was arranged with the twelve categories used in Bales Interaction Process Analysis (see Section 8.2.1) listed down the left hand side. Cells divided off the area to the right of each category and each cell was used for the recording of one family unit (see Appendix I).

9.2.5 Pilot Research

Since classifying interaction in an unobtrusive manner requires some skill, the procedure was practised for four weekends prior to conducting the study. The guidelines laid down by Bales (1970) for the observation and recording of small group behaviour using Interaction Process Analysis were strictly followed.
The observer tried out various positions to ascertain the best place to observe unobtrusively and at the same time be able to record the interactions which took place. Around 20 families were observed at each exhibit.

The most difficult part of the process was in deciding quickly the type of interaction, and great care was taken to distinguish between the various units of communication and to identify complete units of meaningful communication.

After 4 weeks the observer was able to record interactions with ease, and had become acquainted with the various categories of interaction.

9.2.6 Procedure

The observations took place over several weekends during December and January. The observer positioned herself unobtrusively near to the exhibit, so that all interactions could be clearly seen and heard. When a family group approached, all the interactions which took place were noted. As soon as a family group approached, a number was assigned to each member, e.g. 1 - male adult, 2 - female adult, 3 - oldest male child etc. The same notations were used, as far as possible, for each family group, to denote who spoke to whom. To record an act the two numbers representing who speaks to whom were placed in the space following the category most appropriate to the act. (See Section 8.2.1. for a fuller description of the method.)

The interactions noted here refer specifically to verbal behaviour, although where, for example, agreement or disagreement was clearly indicated by a gesture, this was coded also.

After one family had left the exhibit, the procedure was repeated with the next suitable group which approached. Fifty families were observed at each exhibit.
9.3 RESULTS

The analysis of the data falls into three major areas.

Firstly, the composition of the families visiting the three exhibits is examined, to see if differences arise, for example, in relation to the gender of the parents and the children attracted to each of the exhibits.

Secondly, the data is analysed in terms of who speaks to whom. In the light of Cone and Kendall's finding that girls delivered and received considerably less verbal interaction than boys, and that mothers adopted the main teaching and social control role during a family visit to a museum, the data here was examined to see if this held true with regard to the three different types of exhibit investigated here.

Finally, the data is examined in relation to the amount and nature of the interactions stimulated by the three exhibits.

9.3.1 Composition of families

Table 9.1 (see Section 9.2.3) indicates that the composition of families differed at the three exhibits. Table 9.2 below shows the composition of families in terms of the sex of the children. The data here is given in percentages:
TABLE 9.2 - showing the percentage of boys and girls in family groups visiting the three exhibits

<table>
<thead>
<tr>
<th></th>
<th>Launchpad</th>
<th>Transport</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups with boys only</td>
<td>44</td>
<td>56</td>
<td>46</td>
</tr>
<tr>
<td>Groups with girls only</td>
<td>38</td>
<td>14</td>
<td>38</td>
</tr>
<tr>
<td>Groups with both sexes</td>
<td>18</td>
<td>30</td>
<td>16</td>
</tr>
</tbody>
</table>

Of the 50 families visiting Launchpad, there was a fairly equal number of boys and girls. 31 groups contained boys, and 28 groups contained girls (the total number here exceeds 50 because groups containing both sexes are also included). The Agriculture Hall also attracted a fairly equal number of both sexes (31 groups with boys, 27 groups with girls).

At the Transport Gallery, however, only 7 of the total family groups observed did not contain boys. Clearly the Transport Gallery exhibit was seen to be particularly interesting to boys and of little interest to girls; no such distinction would appear to arise with respect to the two other exhibits.

A Chi² test of association indicated that this difference was significant ($X^2 = 9.94$, $df = 4$, $p < .05$).

Below, the percentage of adult males and females visiting each exhibit are shown.
TABLE 9.3 - showing percentage of male and female adults in groups visiting the three exhibits

<table>
<thead>
<tr>
<th></th>
<th>Launchpad</th>
<th>Transport</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family groups with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male adults only</td>
<td>40</td>
<td>56</td>
<td>46</td>
</tr>
<tr>
<td>Family groups with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>female adults only</td>
<td>32</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Family groups with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male and female adults</td>
<td>28</td>
<td>22</td>
<td>30</td>
</tr>
</tbody>
</table>

What is most noticeable about these figures is the much higher percentage of fathers than mothers visiting all three galleries.

A Chi² test of association showed that there was no significant difference between the three galleries in terms of the sex of adult members of the family groups observed.

Overall, there was a higher percentage of males than females visiting the three exhibits. 74% of the groups contained male adults compared to 53% containing female adults, and 70% of the groups contained boys compared to 51% containing girls (these figures exceed 100% because some groups contained both males and females).

9.3.2 Who speaks to whom

In observing who speaks to whom, useful inferences can be made concerning the effectiveness of the exhibits in stimulating discussion between the various members of the groups.
Of particular interest here is the issue of gender and generation role differentiation. Cone and Kendall (1978 - see 8.1.1) have suggested that fathers initiate much less verbal behaviour than mothers during a family visit to a museum, and most of their communications are directed at sons. They also found that girls rarely initiated interactions. In the light of these findings, the data was examined in order to assess whether similar patterns of differentiation could be identified here.

**TABLE 9.4 - showing pattern of interactions and actor ratios for family members visiting three exhibits.**

<table>
<thead>
<tr>
<th>Actor</th>
<th>No. To mother</th>
<th>To father</th>
<th>To daughter</th>
<th>To son</th>
<th>total</th>
<th>AR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#  %</td>
<td>#  %</td>
<td>#  %</td>
<td>#  %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Launchpad)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>30 9 (8)</td>
<td>64 (55)</td>
<td>43 (37)</td>
<td>116</td>
<td>387</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>34 12 (9)</td>
<td>47 (34)</td>
<td>79 (57)</td>
<td>138</td>
<td>406</td>
<td></td>
</tr>
<tr>
<td>Daughter</td>
<td>33 33 (45)</td>
<td>26 (35)</td>
<td>5 (7)</td>
<td>10 (13)</td>
<td>74</td>
<td>224</td>
</tr>
<tr>
<td>Son</td>
<td>37 15 (21)</td>
<td>45 (62)</td>
<td>8 (11)</td>
<td>4 (6)</td>
<td>72</td>
<td>194</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(Transport)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>22 4 (15)</td>
<td>5 (19)</td>
<td>17 (65)</td>
<td>26</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>39 3 (6)</td>
<td>24 (46)</td>
<td>25 (48)</td>
<td>52</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>Daughter</td>
<td>24 4 (17)</td>
<td>7 (30)</td>
<td>5 (22)</td>
<td>7 (30)</td>
<td>23</td>
<td>96</td>
</tr>
<tr>
<td>Son</td>
<td>49 10 (24)</td>
<td>20 (49)</td>
<td>7 (17)</td>
<td>4 (9)</td>
<td>41</td>
<td>84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(Agriculture)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>27 7 (22)</td>
<td>12 (37)</td>
<td>13 (41)</td>
<td>32</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>38 7 (12)</td>
<td>24 (43)</td>
<td>25 (45)</td>
<td>56</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>Daughter</td>
<td>35 11 (34)</td>
<td>10 (31)</td>
<td>10 (31)</td>
<td>1 (3)</td>
<td>32</td>
<td>91</td>
</tr>
<tr>
<td>Son</td>
<td>38 5 (22)</td>
<td>14 (61)</td>
<td>0 (0)</td>
<td>4 (17)</td>
<td>23</td>
<td>60</td>
</tr>
</tbody>
</table>

AR = Actor ratio = no. of acts X 100
no. of persons
In view of the fact that a breakdown of the data into subunits of parent-child pairs or family-type gives rise to fairly small samples, it was not appropriate to apply statistical tests to the data. Instead, the data is presented descriptively throughout, using actor ratios (see Cone and Kendall, 1978, p255). The actor ratio is a means of providing a common unit of measurement for comparative purposes. The ratio of acts to persons is multiplied by 100 to give a standardised measure.

In Table 9.4, the pattern of verbal interactions, in terms of who speaks to whom at each exhibit, is shown. It can be seen from these figures that the Launchpad exhibit stimulated more interaction between parents and children than the other two exhibits combined.

It also emerges here that fathers have a higher actor ratio than mothers. This contrasts with Cone and Kendall's findings which suggest that mothers initiate verbal interaction far more often than fathers (Cone and Kendall report an actor ratio of 160 for mothers and 64 for fathers). In addition, daughters initiated more verbal interaction than sons at all three galleries. Cone and Kendall had found that girls were the least likely to initiate interaction.

Nevertheless, as in Cone and Kendall's study, some striking differences in patterns of interaction can be discerned here. However, it would appear that the distribution amongst generation and gender categories must be taken into account before these differences can be properly interpreted.

The distribution of gender and generation categories varied quite widely at all three exhibits; in particular, groups visiting the Transport exhibit contained many more males than females. Thus the data here suggests, for example, that mothers are biased in favour of sons and fathers give equal attention to sons and daughters, but this interpretation may be misleading because of the unequal numbers here.
Cone and Kendall, in their analysis, only made gross comparisons, that is, they included all the subgroups of families in a single tabulation, as in Table 9.4. However, it would appear that the pattern of interactions must be further broken down before any real gender and generation variations can be identified.

In Table 9.5, the actor ratios for separate subgroups of parent-child are given. The actor ratio here is calculated in the same way, but the number of persons is based on the absolute number of persons in a category. If a group contains one father and two sons, for analytical purposes there are, in effect, two fathers. For example, at the Launchpad gallery, 26 groups contained both fathers and sons, but five of these groups contained two sons (i.e., a total of 31), thus the absolute number of fathers was 31. Since 79 observations were made of fathers speaking to sons (see table 9.5), the actor ratio of fathers to sons is $\frac{79 \times 100}{31}$.

(See Appendix J for full data.)

From an examination of the actor ratios shown in Table 9.5, it appears that the gender and generation role differentiation which was apparent in the first assessment (Table 9.4) is, in fact, much less dramatic when the data is broken down in this way. However, some differentiation can still be discerned. At the interactive Launchpad exhibit, parents initiated far more verbal behaviour than children, and there was a tendency for both fathers and mothers to favour girls rather than boys. A more dramatic difference emerges in relation to children's interactions with parents at this exhibit: both boys and girls paid more attention to fathers than mothers. This bias is more apparent in boys than girls.

At the pushbutton (Transport) exhibit fathers also interacted more with daughters than sons, but mothers communicated more with sons than daughters. However, no differentiation is apparent in relation to children's interactions with parents at this exhibit.
Very little differentiation occurred at the static (Agriculture) exhibit: parents divided their attention fairly equally between sons and daughters. There was a tendency for boys to interact more with fathers than mothers, however boys initiated very few interactions at this exhibit generally.

### TABLE 9.5 - showing actor ratios for separate subgroups (parent/child) visiting three exhibits

<table>
<thead>
<tr>
<th>Exhibit</th>
<th>Actor</th>
<th>To mother</th>
<th>To father</th>
<th>To daughter</th>
<th>To son</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launchpad</td>
<td>Mother</td>
<td>-</td>
<td>-</td>
<td>246</td>
<td>215</td>
</tr>
<tr>
<td></td>
<td>Father</td>
<td>-</td>
<td>-</td>
<td>313</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>Daughter</td>
<td>127</td>
<td>173</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Son</td>
<td>75</td>
<td>145</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transport</td>
<td>Mother</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Father</td>
<td>-</td>
<td>-</td>
<td>133</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Daughter</td>
<td>36</td>
<td>39</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Son</td>
<td>48</td>
<td>51</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Mother</td>
<td>-</td>
<td>-</td>
<td>63</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Father</td>
<td>-</td>
<td>-</td>
<td>96</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Daughter</td>
<td>58</td>
<td>40</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Son</td>
<td>25</td>
<td>47</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

No. per subgroup: LP T N

- Fathers and sons: 31 32 30
- Fathers and daughters: 15 16 25
- Mothers and sons: 20 21 20
- Mothers and daughters: 26 11 19

In order to further assess the nature of the differentiation which occurred at the interactive and pushbutton exhibits, a separate assessment was made for those groups containing both male and female adults and children at these two exhibits. This data is shown in Table 9.6. (For other groupings, see Appendix J.)
Table 9.6 - showing number of interactions and actor ratios for groups containing male and female adults and male and female children visiting the Launchpad and Transport exhibits

<table>
<thead>
<tr>
<th>Actor</th>
<th>No.</th>
<th>To mother</th>
<th>To father</th>
<th>To daughter</th>
<th>To son</th>
<th>total</th>
<th>AR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>#</td>
<td>#%</td>
<td>#</td>
<td>#%</td>
<td>#</td>
<td>#%</td>
</tr>
<tr>
<td>(Launchpad)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>6</td>
<td>5</td>
<td>(18)</td>
<td>12</td>
<td>(43)</td>
<td>11</td>
<td>(39)</td>
</tr>
<tr>
<td>Father</td>
<td>6</td>
<td>3</td>
<td>(14)</td>
<td>11</td>
<td>(50)</td>
<td>8</td>
<td>(36)</td>
</tr>
<tr>
<td>Daughter</td>
<td>6</td>
<td>5</td>
<td>(24)</td>
<td>8</td>
<td>(38)</td>
<td>8</td>
<td>(38)</td>
</tr>
<tr>
<td>Son</td>
<td>6</td>
<td>1</td>
<td>(12)</td>
<td>3</td>
<td>(37)</td>
<td>4</td>
<td>(50)</td>
</tr>
<tr>
<td>(Transport)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>5</td>
<td>3</td>
<td>(33)</td>
<td>3</td>
<td>(33)</td>
<td>3</td>
<td>(33)</td>
</tr>
<tr>
<td>Father</td>
<td>5</td>
<td>3</td>
<td>(27)</td>
<td>4</td>
<td>(36)</td>
<td>4</td>
<td>(36)</td>
</tr>
<tr>
<td>Daughter</td>
<td>5</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td>3</td>
<td>(100)</td>
</tr>
<tr>
<td>Son</td>
<td>5</td>
<td>3</td>
<td>(30)</td>
<td>4</td>
<td>(40)</td>
<td>3</td>
<td>(30)</td>
</tr>
</tbody>
</table>

AR = Actor Ratio = \( \frac{\text{no. of acts}}{\text{no. of persons}} \times 100 \)

Here, it emerges that, at the Launchpad exhibit, mothers initiated more verbal interactions than fathers, when both parents are present. This does not occur at the Transport exhibit. In addition, fathers tended to interact more with daughters than sons at Launchpad, although mothers divided their attention equally between boys and girls, as did both parents at the Transport exhibit. Daughters communicated as frequently as parents at Launchpad, but sons were much less likely to initiate verbal behaviour at this exhibit. The reverse occurs at the Transport exhibit, where girls rarely communicated, and only addressed their brothers.

The sample sizes here are too small to draw any firm conclusions, but clearly the nature of the exhibit can greatly influence the pattern of gender and generation role differentiation which occurs.
### 9.3.3 What was said

**TABLE 9.7 - Showing the number and type of interactions stimulated by the three exhibits, \( n \) (number of families observed) = 150**

<table>
<thead>
<tr>
<th>Exhibit:</th>
<th>Launchpad</th>
<th>Transport</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 50 )</td>
<td>( n = 50 )</td>
<td>( n = 50 )</td>
</tr>
</tbody>
</table>

**Categories:**

**Positive:**

1. Seems friendly  
2. Dramatizes/jokes  
3. Agrees

<table>
<thead>
<tr>
<th>Answers:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Gives suggestions     | 120                  | 25       | 21          |
5. Gives opinion         | 69                   | 8        | 12          |
6. Gives information     | 24                   | 23       | 29          |

**Questions:**

7. Asks information      | 5                    | 10       | 8           |
8. Asks opinion          | 16                   | 1        | 2           |
9. Asks suggestion       | 12                   | 6        | 0           |

**Negative:**

10. Disagrees            | 15                   | 1        | 1           |
11. Shows tension        | 8                    | 8        | 2           |
12. Seems unfriendly     | 3                    | 2        | 0           |

**Total** 373 116 112  
\( \chi^2 \) 7.46 2.32 2.24
The Launchpad exhibit stimulated much more verbal interaction than either of the other two exhibits. The total number of interactions (made by adults and children) stimulated by the three exhibits, and the nature of these interactions are shown above.

For all three galleries, the most frequently used group of categories was Answers (categories 4-6). The percentage of the total interactions falling in these three categories for the Launchpad, Transport and Agriculture exhibits respectively was 57%, 48% and 55%. The second most frequently occurring group was Positive (categories 1-3). The percentage of interactions falling in these categories was 27% (Launchpad), 28% (Transport) and 33% (Agriculture). Questions constituted 9% of the interactions at both the Launchpad and Agriculture exhibits, and 15% at the Transport exhibit. Negative interactions were uncommon at all three exhibits (Launchpad - 7%, Transport - 9%, Agriculture - 3%).

Thus although the Launchpad exhibit stimulated much more interaction overall (an average of 7.46 exchanges per family, compared to 2.32 and 2.24 at the Transport and Agriculture exhibits respectively), the general pattern of the interactions would appear to be similar for all three exhibits. However, several differences do emerge when the nature of the interactions are considered in more detail.

In the next table, the different categories of interaction initiated by adults are compared to those initiated by children at each of the three galleries. (These figures are given in percentages to aid comparison.)
TABLE 9.8. - Showing the percentage of total interactions falling in each of four categories (Positive, Answers, Questions, Negative)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Launchpad</th>
<th>Transport</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adult</td>
<td>child</td>
<td>adult</td>
</tr>
<tr>
<td>P</td>
<td>23%</td>
<td>33%</td>
<td>34%</td>
</tr>
<tr>
<td>A</td>
<td>65%</td>
<td>44%</td>
<td>49%</td>
</tr>
<tr>
<td>Q</td>
<td>6%</td>
<td>14%</td>
<td>11%</td>
</tr>
<tr>
<td>N</td>
<td>6%</td>
<td>9%</td>
<td>6%</td>
</tr>
</tbody>
</table>

The figures above indicate that although Answers is the largest category overall, there are some generation differences in the use of this category. Children at the Transport exhibit used Answers as frequently as adults, whereas children at the other two galleries did not produce as many Answers as their parents. Parents produced fewer Answers at the Transport exhibit than at either of the other two exhibits, however. At the Agriculture exhibit, children produced more Positive responses than Answers. Children produced more Questions than adults at all three exhibits.

More differences between the three exhibits emerge when the data is considered in terms of the individual categories, and in order to properly examine these differences, a geometric approach for the analysis of frequency data was employed. This is described below.
Correspondence Analysis

Correspondence analysis is useful for studying the dependence of two qualitative variables, and is primarily a technique for displaying the rows and columns of a two-way contingency table as points in corresponding low-dimensional vector spaces. These spaces may be superimposed to obtain a joint display. It may be described as similar to canonical correlation analysis - the study of linear relationships between two sets of variables which involves finding the linear combinations of the variables which have maximum correlation. Correspondence analysis may be described as a special case of this problem (Greenacre 1981).

The method of correspondence analysis has been used in France since the early 1960's (Benzécri 1973). The French approach has involved defining, describing and interpreting the analysis in a geometric framework, which has widened the field of application of correspondence analysis to other types of data matrices apart from contingency tables.

The geometry of correspondence analysis may be compared to Pearson's description of principal components analysis, where he posed the problem of finding the lines and planes of closest fit to a cloud of points in multidimensional Euclidean space (Greenacre 1981). Correspondence analysis defines a cloud of points in a multidimensional vector space, the metric structure of this space, and the fit of this cloud of points to a variable low-dimensional subspace onto which the points are projected for display and interpretation.

The data here was analysed using this technique. In this case, rows represent the interaction categories (PAQN) and columns represent the exhibits. The point vector representing a row can be defined as the row vector divided by the sum of its elements. This is termed a profile. Correspondence analysis attempts to fit each profile into three-dimensional space, so that the similarities or differences
between each exhibit (in terms of the frequency and type of interaction occurring at each exhibit) can be clearly seen. The same process applies to the columns in the data matrix, ie the column profiles are fitted into subspaces of closest fit.

Here, the closest fit is one dimensional, ie the profiles can be viewed as points along a single line. The closest fit solution here (referred to as maximum inertia) corresponds to both rows and columns and explains 72% of the total inertia (or variance) (see Appendix K for further details).

The results of the correspondence analysis are shown in Figs 11, 12 and 13, where C1 = Launchpad, C2 = Transport, C3 = Agriculture. R1 to R12 refer to the PAQN categories 1 to 12 of Bales' Interaction Process Analysis (Bales 1970, See Table 9.8 above).

It can be seen from Figure 11 that the three exhibits occupy clearly separate subspaces, ie they stimulate distinctly different sets of communications.

Figure 12 shows the different categories of communication, and here it can be seen that several different clusters can be identified. Two distinct groupings emerge. R3, R4, R5, R8 and R10 form one cluster, which is separate from the cluster comprising R1, R9, R11 and R12. A third, much less distinct grouping comprises R2, R6, and R7.
Fig. 11 - Showing the plot of the column variates, from correspondence analysis.

C1 = Launchpad exhibit; C2 = Transport exhibit; C3 = Agriculture exhibit.
Fig 12 - Showing plot of row variates from correspondence analysis
R1 - R12 = Interaction Process Analysis Categories 1 - 12 as
described in Table 9.8.
Fig. 13 - Showing the plot of row variates superimposed on the plot of column variates.

The three exhibits (C1, C2, C3) are shown together with the categories of interaction (R1 - R12).
In Fig. 13, those categories nearest to each exhibit represent those interactions which emerged most strongly at that exhibit. Thus five categories of interaction can be clearly identified as strongly related to the Launchpad (C1) exhibit. The Transport exhibit (C2) and the Agriculture exhibit (C3) both have a weaker relationship with specific categories of interaction.

It can be seen that the INTERACTIVE exhibit (C1 - Launchpad) stimulated five categories of communication most strongly: R3, R4, R5, R8 and R10. These are, respectively:

AGREES (P)
GIVES SUGGESTION (A)
GIVES OPINION (A)
ASKS OPINION (Q)
DISAGREES (N)

The PUSHBUTTON exhibit (C2 - Transport) is more closely related to five different categories, although this relationship is much weaker. The categories here are R1, R7, R9, R11 and R12:

SEEMS FRIENDLY (P)
ASKS INFORMATION (Q)
ASKS SUGGESTION (Q)
SHOWS TENSION (N)
SEEMS UNFRIENDLY (N)

Of these categories, only R11 (Shows Tension) appears to have a very strong relationship with C2. In addition, it should be noted that R9 (Asks Suggestion) is almost midway between C1 and C2 and therefore is almost as closely related to the Launchpad exhibit as it is to the Transport exhibit.

The STATIC (C3 - Agriculture) most clearly relates to R2:

DRAMATIZES/JOKES (P)

There is also a weak relationship with R6 and R7:

GIVES INFORMATION (A)
ASKS INFORMATION (A)
What this analysis indicates is that the Launchpad exhibit stimulated the most clearly defined set of interactions, and these differ from the kinds of interactions stimulated by the other two exhibits.

If the nature of the interactions stimulated by the three exhibits is examined, several interesting features emerge.

Launchpad is more closely related to Questions and Answers categories than the other two exhibits, and the nature of these questions and answers is not a didactic transmission of information, but focuses on opinions and suggestions. A straightforward giving and receiving of information (Asks Information – R7 – and Gives Information – R6) is more closely related to the Agriculture and Transport exhibits.

In addition, the Launchpad exhibit is related to communications involving Agreement and Disagreement, which suggests that discussion and debate were stimulated at this exhibit.

Aspects of social control or general socializing behaviour do not emerge as strong factors in relation to the Launchpad exhibit. In contrast, the other two exhibits are most closely related to aspects of social control/socializing behaviour. The Agriculture exhibit was most likely to induce Dramatization/Joking (R2), and the Transport exhibit was most likely to induce Shows Tension (R11).

It would appear, then, that the interactions stimulated by the Launchpad exhibit are those which are more likely to involve socio-cognitive conflict, that is, debate and disagreement are common, and a passive giving/receiving of information is less evident.
9.4 DISCUSSION

The results of this study indicate that the three types of exhibit differed quite dramatically in terms of the amount and type of family interaction which each stimulated. In addition, different patterns of gender and generation role differentiation were observed.

Family groups containing boys were much more likely to be attracted to the Transport exhibit than family groups without boys. At the Launchpad and Agriculture exhibits no significant difference in the number of boys and girls observed at the exhibits is apparent however, although there were more male adults than female adults in the observed family groups at all three exhibits.

In relation to who spoke to whom, the results here contrast sharply with the earlier research conducted by Cone and Kendall (see 8.1.1.) They had found that mothers were much more likely to initiate interaction than fathers, fathers neglected daughters in favour of sons, and girls initiated interaction much less often than boys. The findings here suggest the reverse, with fathers initiating more interaction than mothers overall, attention being directed mainly at daughters, and boys being the least likely to initiate any interaction.

The differences between Cone and Kendall's findings and the findings reported here may be due to the fact that the sample of children used in Cone and Kendall's study were much younger (2 - 9 years old). In addition, they had a much higher percentage of 2-parent families in their sample, and they did not assess actor ratios for separate subgroups of actors.

Nevertheless, the apparent neglect of girls which Cone and Kendall observed does not emerge here, in spite of the fact that the exhibits in this study could be seen as being primarily of interest
to boys. Indeed, generally, girls received more attention from their fathers than boys.

However, the patterns of differentiation occurring here appear to be dependent on the nature of the exhibit. Little gender and generation role differentiation was apparent at the static (Agriculture) exhibit. Mothers and fathers engaged in an equal amount of verbal interaction with sons and daughters, and there was only a slight tendency for boys to interact more with fathers than mothers.

The pattern of interactions between parents and children is different at the interactive (Launchpad) and pushbutton (Transport) exhibits, however. At the Launchpad exhibit, parents initiated interaction far more often than children, and both fathers and mothers interacted more frequently with daughters than with sons. Children were more likely to communicate with fathers rather than mothers, and this tendency was more marked in boys than girls.

Fathers at the Transport exhibit also interacted more often with girls than they did with boys; however, here, mothers paid more attention to sons than daughters. Children at this exhibit divided their attention fairly equally between fathers and mothers.

When 2-parent groups with both male and female children are considered alone, it emerges that, for these groups at least, mothers did initiate more interactions than fathers at the Launchpad exhibit, which is in line with Cone and Kendall's findings. This does not occur at the Transport exhibit however. In addition, girls at the Transport exhibit were much less likely to initiate interaction than boys, although the reverse of this pattern occurred at Launchpad. The sample size here was too small for any firm conclusions to be drawn; however the findings do suggest that the presence of an opposite sex sibling may be an inhibiting factor, but how this factor operates is dependent to a large extent on the nature of the exhibit.
The nature of the gender and generation role differentiation which emerges here may have significant implications in terms of learning. If group learning in children is facilitated by the stimulation of social as well as cognitive conflict, that is, through the process of socio-cognitive conflict, it is necessary to create an optimal social, as well as cognitive, context in order for cognitive progress to occur. In child-adult interaction, socially-marked situations (see 8.2.2) — where social regulations interact with cognitive responses — may be particularly important. The gender and generation variations observed at the Launchpad and Transport exhibits may be indicative of some kind of social marking effect.

Social marking can be beneficial in terms of aiding cognitive progress, because the social order may accentuate cognitive contradictions resulting from a child's initial incorrect response to a problem. However, social marking may sometimes have an inhibiting effect.

At the Launchpad Gallery, the technological nature of the exhibit may enhance an awareness of perceived differences in ability between the sexes, in terms of technical ability. This may explain why daughters received more attention than sons, since parents may have felt that girls would need more help in understanding the exhibit. It could also explain why children communicated more with fathers than with mothers, since it might be assumed that fathers possess greater knowledge about such things than mothers. This would appear to suggest that social marking, in this case, had a negative rather than a positive effect — it would not appear to be desirable to reinforce sexual stereotypes, if that is what is going on here.

However, although this exhibit seems to have created the greatest amount of differentiation across the various actor categories, the factors operating here appear to be very complex. When both mothers and fathers were present, mothers had a higher actor ratio than fathers. Girls also had a higher actor ratio than boys, when
both were present. Visitors can actually manipulate the Launchpad exhibit, and there is the opportunity for people to co-operate, and help each other to fit the various gear wheels together. This may have had the effect of counteracting the inhibitions created by the technological nature of the exhibit.

At the Transport exhibit, the social marking effect appears to be operating in a different way. Here fathers were again encouraged to attend to daughters rather than sons, but mothers said very little altogether, and directed more attention to sons. When both boys and girls were present, girls had a much lower actor ratio than their brothers. This exhibit was the most overtly technological of the three, and the technological nature of the exhibit may have been enhanced by the fact that the exhibit is a working exhibit. Unlike the Launchpad exhibit, however, it cannot be directly manipulated, and there is no opportunity for collaboration, since only one person at a time can press the button to activate the gear wheels. Thus, here, family interaction is not encouraged, and the stereotyped responses stimulated by the technological nature of the exhibit may actually be reinforced because of the limitations on family interaction.

Clearly, the amount of physical interaction allowed creates a different cognitive context for each exhibit. Whereas the Launchpad exhibit invites experimentation and can be controlled by the visitor, at the Transport exhibit visitors are restricted to simply watching the gear wheels in operation. At the Agriculture exhibit, the gear wheels can be observed, but little can be learned about the way they operate.

In addition, however, different social contexts are created. This not only affects the way visitors interact with each other, but may also influence their perception of the exhibit, and of themselves. The social context created by an exhibit may thus have an important influence on the effectiveness of the cognitive context which an exhibit stimulates.
Clearly the Launchpad exhibit stimulated a much greater amount of verbal interaction overall – an average of 7.46 interactions per family, compared to 2.32 and 2.24 respectively at the Transport and Agriculture exhibits. The majority of these interactions, for all three exhibits, fell in the Answers category (giving information, suggestions, opinions). Cone and Kendall report similar findings, although in their study, whilst parents engaged in 'explanations', 'questioning' constituted the most frequent verbal behaviour of children. In this study, both children and parents engaged in Answers more frequently than any other kind of verbal behaviour, except at the Agriculture exhibit, where the most frequent type of verbal behaviour produced by children fell in the Positive category (that is, involved social comments rather than exhibit-related comments). This may have occurred because the life-size model horse which formed part of the Agriculture exhibit stimulated a lot of amusement amongst children and diverted attention away from the gear wheels to which the horse was attached.

It can be argued that the findings here are, to some extent, compatible with Rosenfeld and Terkel's (1982 – see 8.1.2.) finding that visitors to a zoo engaged primarily in social comments rather than exhibit-related comments, except where the comments related to interactive zoo-games, which stimulated a much more focused and convergent style of discussion. Both the push-button and interactive exhibits observed in this study stimulated more exhibit-related comments than social comments amongst children, whereas the static exhibit (which involved a model animal, and could be compared to an ordinary animal exhibit at a zoo) was much more likely to stimulate social comments in children.

The Correspondence Analysis reveals that the Launchpad exhibit stimulated a very distinct kind of discussion, and the categories of communication most closely related with this exhibit (agrees, disagrees, gives suggestions, asks suggestions, gives opinions, asks opinions) would appear to be aspects of communication which
might be conducive to the stimulation of socio-cognitive conflict processes.

It was noted earlier (Sections 6.3 and 8.2.2) that in child-adult interaction, adults could offset compliance effects (that is, where the child simply acquiesces to the adult point of view and does not attempt to properly understand a problem) by engaging in a certain style of communication which includes raising uncertainties and doubts as to the correctness of their own solution to a problem. Hence, any didactic conveying of information (in this case, for example, simply stating what an exhibit shows by reading the label aloud to the child) would be unlikely to lead to socio-cognitive conflict, whereas offering suggestions and opinions allows the child to present their own point of view and to compare that point of view with the adult's. The data here indicates that, whilst simply giving and receiving information is associated with both the Agriculture and the Transport exhibits, a much less didactic style of communication was stimulated at the Launchpad exhibit, involving suggestions and opinions.

In addition, the finding that agreement and disagreement are also closely related to the Launchpad exhibit adds more force to the argument that socio-cognitive conflict is likely to be stimulated at this exhibit, since this indicates that opinions and suggestions were not simply accepted, but led to debate and argument, hence the cognitive opposition was enhanced.

Furthermore, the absence of any aspects of social control (categories P and N) as main features of the verbal behaviour observed at the Launchpad exhibit can be seen to support the view that this exhibit is more likely to lead to socio-cognitive conflict. If adult-child interaction focuses primarily on aspects of social control, this would be likely to militate against the production of socio-cognitive conflict processes. The social status and authority of the adult would be emphasised, and this could lead to acquiescence on the part of the child.
The correspondence analysis shows that aspects of social control and general socializing behaviour are related to both the pushbutton (Transport) and static (Agriculture) exhibits. However, these effects are mainly positive in the case of the Agriculture exhibit, and negative in the case of the Transport exhibit.

The Agriculture exhibit is most closely related to 'dramatization/joking'. As noted above, this can be explained in terms of the amusement generated by the life-size model horse. Whilst the exhibit clearly amused children, it also stimulated parents to 'give information' and 'ask information'. It does not appear to have stimulated much discussion or argument, however.

The Transport exhibit is also related to a didactic transmission of information, but is most likely to stimulate 'shows tension'. This would appear to be related to the pushbutton on this exhibit. The negative effects of pushbuttons on exhibits have been noted by Alt and Shaw (1977) and Borun (1977) (See 8.3).

Kimche (1978) argues that first order interactions, such as are experienced with pushbutton exhibits, do not engage the visitor intellectually in any way, although they might increase the attractiveness of an exhibit (See 8.3).

Clearly, neither the pushbutton exhibit nor the static exhibit stimulated a style of discussion which could be seen as conducive to the production of socio-cognitive conflict processes. In contrast, the fully interactive exhibit in the Launchpad Gallery - an exhibit requiring what Kimche (1978) calls a 2nd order interaction (see 8.3) - did stimulate the kind of interaction which might be especially useful in the creation of a suitable social and cognitive context in which learning might occur. The study reported in the next chapter examines the question of learning in more depth.
10. STUDY 4 - SOCIAL INTERACTION AND LEARNING IN FAMILY GROUPS VISITING A MUSEUM

The results from the third study, reported in Chapter 9, indicate that different types of museum exhibit (static, pushbutton and interactive) stimulate different kinds of interaction between family group members. The study reported here examines the effects of the same three exhibits in the Science Museum (the Launchpad exhibit, the Agriculture exhibit, and the Transport exhibit) on visitors' understanding of the concept being conveyed by the exhibits (i.e., the principles underlying gear wheels). This study involves exploring further the three different levels of participation represented by the three exhibits, but of primary interest here is the interaction of a further fundamental factor - the social interaction element.

10.1 INTRODUCTION

It was found (Study 3) that much more social interaction was stimulated amongst family groups at the fully interactive exhibit than at either the pushbutton or static exhibits. Groups visiting the interactive Launchpad exhibit were also more likely to engage in argument and debate; the majority of their interactions were exhibit-related, and involved offering opinions and suggestions rather than a straightforward exchange of information.

The static and pushbutton exhibits, on the other hand, were more likely to induce social comments, and communications which were exhibit-related primarily involved a more didactic exchange of information.

These results indicate that the Launchpad exhibit would appear to provide the optimum conditions for promoting a constructive group discussion. It now remains to be shown whether these conditions can facilitate the learning process.
It has been argued throughout that in a museum setting social interaction must be considered as an important element in the learning process, and in Study 2 it was shown that encouraging individual children to work together on a museum-related task led to an enhanced performance when compared with children working alone at the same task (although this only occurred where children were at a certain stage of cognitive development). This finding lends support to Doise's (1978) view that socio-cognitive conflict processes generated in interpersonal exchanges are an important element in learning, especially when children are at certain stages of cognitive development (See Chapters 6 and 7).

Doise has demonstrated that children working in groups may be more successful than individual children in the performance of certain cognitive tasks, and this superiority cannot be attributed to modelling effects alone. He argues that the process which underlies the superiority of group over individual performance is both social and cognitive in nature.

In a group situation, having to co-ordinate different viewpoints in order to solve a problem is not an individual cognitive problem, but an interpersonal one. In other words, learning cannot be explained simply in terms of individual cognitive conflict - the contradiction between what one believed to be true and what one observes, leading to a restructuring of knowledge within the individual - but must be viewed in terms of interpersonal conflict, which may be both cognitive and social. When groups are required to discuss a problem and reach a group decision, the group has to achieve a real cognitive organisation which may override individual judgments. Thus social interaction can lead to a form of cognitive structure which the individual would not have achieved alone.

Whilst a formal educational setting may provide little opportunity for the emergence of socio-cognitive conflict processes, an informal learning environment, such as a museum, would appear to be the kind of environment where such processes might be encouraged,
since people usually visit a museum in groups, and can engage in free discussion.

Whilst Study 2 (Chapter 7) lends support to the socio-cognitive conflict hypothesis in relation to child-child interaction, this study aims to examine these processes in child-adult interaction. Pairs comprising one adult and one child were asked to observe one of three exhibits on gear wheels and answer a series of questions designed to elicit their level of understanding about the operation of gear wheels.

The investigation reported in Chapter 9 (Study 3) indicated that the fully interactive exhibit in the Launchpad Gallery stimulated the kinds of exchanges which might be likely to encourage socio-cognitive conflict. This study aims to examine whether this exhibit leads to a greater understanding of the principles underlying the exhibit than more traditional exhibits demonstrating the same principle (in the Agriculture and Transport Galleries). The findings from Study 3 indicated that the nature of the exchanges between family members at these two exhibits were not compatible with a socio-cognitive conflict explanation.

However, in order to separate out the effects of social and cognitive conflict, half the adult-child pairs are encouraged to discuss the exhibit and help each other to understand what it is demonstrating, whilst half are asked to study the exhibit individually, without discussion. In this way, the effects of the social interaction element can be distinguished from the influence of the exhibit itself. Also of interest are any gender differences which might emerge.
10.2. METHOD

The main investigation involved a $3 \times 2$ independent groups design.

The Dependent Variable was understanding of the principles underlying the operation of gear wheels, measured by the subjects' responses to a series of questions.

There were three levels of the first Independent Variable, the type of exhibit (i.e., in terms of the level of participation demanded by the exhibit - interactive, pushbutton, and static), and two levels of the second Independent Variable, the amount of interpersonal interaction allowed (i.e., an individual condition allowing no discussion, and a social condition, where discussion was encouraged).

A further Independent Variable, the gender of the subjects, was also examined, in order to establish whether males and females differed in their ability to understand and describe the principles underlying the operation of gear wheels.

10.2.1. Setting and Exhibits

Study 4 extends the investigation reported in Chapter 9 (Study 3) and the setting is the same as for that study, that is, the Launchpad, Agriculture and Transport Galleries of the Science Museum in London. The three exhibits used in the study were all concerned with demonstrating gear wheels. A fully interactive exhibit from the Launchpad Gallery was compared to a pushbutton exhibit (Transport Gallery) and a static exhibit (Agriculture Hall).

The setting and exhibits are described in Sections 9.2.1 and 9.2.2.
10.2.2 Subjects

Adults accompanied by children between the ages of 9 and 12 years of age, visiting the Launchpad, Transport and Agriculture Galleries at the Science Museum on Saturdays and Sundays during January and February were asked to participate in the study.

Twenty four pairs (comprising one adult, one child) were interviewed at each of the three exhibits. Half were male and half were female, forming four different combinations of dyad; that is, adult male + boy, adult male + girl, adult female + boy, adult female + girl (giving six pairs in each combination).

The age group of the children was set at 9 to 12 years because this covers the period during which children should be, according to the Piagetian literature, in transition between concrete and formal operational thought. Since a proper and co-ordinated understanding of the principles underlying the operation of gear wheels requires thinking at the formal operational level (see 9.2.2), this should be the period during which children would be most likely to experience cognitive conflict, and hence benefit, in terms of enhanced understanding, from the exhibits being investigated here.

10.2.3 Preliminary Research

Literature on the technology of gear wheels was examined, and several discussions were held with staff at the Science Museum, in order to develop a set of questions which would elicit peoples' understanding of gear wheels. Care was taken to make the questions accessible to a fairly wide age range and applicable to all three exhibits.

A selection of questions was made on the basis of the discussions, and a pilot sample of 10 pairs of subjects were interviewed at each exhibit. A further pilot study, involving 36 adults was conducted
in order to ascertain whether visitors to each of the three
galleries differed in terms of their technological understanding.

Pilot study I

Subjects were approached on entering the galleries and asked to
take part in the study. 30 Subject pairs (one adult and one child)
were taken to a target exhibit and two other exhibits in each
gallery (each subject pair visited only one of the three target
galleries, i.e., 10 subject pairs per gallery). The two other
exhibits in each gallery were used in order to ensure that the
subjects would not be alerted to the specific aim of the study, and
these exhibits were not concerned with gear wheels. The order in
which they visited the three exhibits was randomized.

The subjects were asked to look at the exhibits (either alone or
with their partner). After the subjects had observed three exhibits
they were taken back to the target exhibit and asked a series of
questions about gear wheels. Their responses to the questions and
also their discussions (social condition) were tape recorded. The
preliminary set of questions is shown in Appendix L.

On the basis of these pilot interviews, several modifications were
made to the questions, mainly relating to alterations in word
choice in order to reduce ambiguity. Several adjustments needed to
be made to take into account the differences between the three
exhibits. The development of the questionnaire is discussed in more
detail below.

As well as indicating where modifications were needed in relation
to the questions to be asked, several other revisions were found to
be necessary.

It was found to be impractical to expect subjects to look at three
exhibits in detail, because of the time this entailed. In addition,
it was found that they always paid most attention to the first
exhibit they were taken to. It was decided therefore to take subjects to the target exhibit only.

Because of the general level of noise (particularly in the Launchpad Gallery), it was not possible to tape record the discussions which took place between the subjects in the social condition without being obtrusive. The subjects' responses to the questions could be recorded, by removing individual subjects to a quieter corner before questioning them.

It also emerged that great care needed to be taken over the instructions given to subjects. In the individual condition it was necessary to emphasise that subjects should not discuss the exhibit with their partner.

A major finding from the pilot study was the importance of questioning the adults as well as the children. Originally it had been intended to question only the child in each pair, since socio-cognitive conflict processes have been found to be effective only for children at certain stages of cognitive development and it was therefore felt to be inappropriate to assess parents' understanding using the same procedure. However, it became apparent that parents had widely differing levels of knowledge on the subject, and also that some parents actually showed less understanding than their children about the workings of gear wheels. Thus it appeared to be necessary to investigate parents understanding of the exhibit also, using the same set of questions.

**Pilot Study 2**

The second pilot study involved 36 adults who were presented with the (revised) set of questions without seeing the target exhibits. Only adults accompanied by children between the ages of around 8 to 12 years were approached. Twelve subjects (6 male and 6 female) were intercepted on entering each of the three galleries (Launchpad, Transport and Agriculture) at the Science Museum, and
were shown photographs of three different types of wheel exhibit (see Appendix M). The wheel exhibits were all from the Launchpad gallery, and included the gear wheels exhibit. They were asked to identify the different types of wheel and if the gear wheels were correctly identified, they were then asked to answer a series of questions (see Appendix N).

This was done to ascertain whether the visitors to each gallery differed in their background knowledge, since it was possible that the different galleries attracted people with different interests and this might effect the results.

It was found that no differences existed between the three groups, and all scored fairly well on the questions (a mean score of 7 out of 8 questions correct). There were also no differences between males and females.

10.2.4. Materials

On the basis of the pilot research, the final set of questions used at the Launchpad exhibit is shown below.

1. Can you describe what is happening in this exhibit?
2. Do all the gear wheels go round at the same speed?
3. Which gear wheel turns most slowly?
4. Why?
5. If the big gear wheel was turned round very fast, would it (still) go more slowly than the small one, or will it go at the same speed, or faster?
6. The big gear wheel is twice as big as this smaller wheel. If it goes round at 4 rounds per minute (rpm) can you say how many rpm the small wheel will do?
7. If we made the big wheel go faster, say at 8 rpm, how fast will the small wheel go then?
8. Say we don't know how much bigger the big gear wheel is, but we know that the small wheel goes at 6 rpm when the big wheel is going round at 2 rpm. How many rpm would the small wheel do, if the big wheel is going at 3 rpm?

As far as possible, the wording was kept the same for each condition, but some modifications were necessary to take into account the different exhibits. The Launchpad exhibit consists of gear wheels alone, whereas the other two exhibits have several other features. Thus in the case of the Agriculture and Transport exhibits, the subjects' attention had to be drawn specifically to the gears. The questions asked at the Transport and Agriculture exhibits are shown in Appendices O and P.

The final set of questions were designed to adhere to a hierarchical order, that is, subjects who cannot answer question 2 for example, would not be expected to answer any subsequent questions; subjects who correctly answer question 8 should be able to answer all preceding questions. The questions were designed in this way in an attempt to identify guesses, for example if a subject correctly answers question 8 after failing to answer questions 2-7, then it could be assumed that the subject does not fully understand notions of proportionality and relative speed.

The questions were also designed to elicit specific kinds of knowledge in a cumulative manner:

1: Identification of variables involved (number of teeth, size of wheels).

2,3,4: Judgments of speed and perception of relevant variables. Can the subject perceive from the exhibit (when it is not in operation) that the big wheel will go round more slowly, and explain why.
5. Understanding of constant ratio of speed and relativity of speed.

6, 7, 8: Understanding of proportions (ratios of 2:1 and 3:1). Questions 7 and 8 are included to ensure that subjects do not achieve a correct answer to question 6 through guessing, or simply through an understanding of addition or multiplication (see Section 9.2.2).

Correct responses to all questions indicates that the subject is operating at a formal operational level, ie demonstrates an understanding of relative speed and proportional reasoning. Correct responses up to question 4 indicates a concrete operational level of thought; if a subject fails to get beyond question 1, this would indicate a pre-operational level.

10.2.5 Procedure

Child-adult pairs entering the three galleries were intercepted and asked to take part in the study. The age of the child and other background information was obtained.

The subjects were then taken to the target exhibit and were given a set of instructions:
Social condition: "I would like you to look at this exhibit on gear wheels (and try it out) together. You can read the label if you like. I'd like you to work out together how the gear wheels work. You can ask each other questions to make sure you both understand how it works."

Individual condition: "I'd like you each to look at this exhibit on gear wheels (and try it out in turn). You can read the label if you like. Try to work out how the gear wheels work. I'd like you to do this on your own, one at a time, and not to discuss it."

(Subjects were only invited to 'try it out' at the Launchpad and Transport exhibits - this was not applicable to the Agriculture exhibit which is a static exhibit).

The subjects were then required to answer the series of questions individually. The questions were read out in the order shown. However, depending on the answers given, slight variations were made, since some of the questions depend on a correct answer being offered for the previous question. If any subject appeared not to fully understand a question, it was repeated once. Their responses were tape-recorded, and also scored on a sheet. A score of 1 was given for each correct response; subjects could score a maximum of 8 correct.
10.3 RESULTS

A quantitative analysis of the data was undertaken, examining the subjects' performance in terms of the number of questions answered correctly.

Using the tape recordings of subjects' responses, a qualitative analysis was also undertaken.

10.3.1 Quantitative analysis

Table 10.1 shows the mean scores of adults and children under each condition at the three exhibits.

<table>
<thead>
<tr>
<th></th>
<th>SOCIAL</th>
<th></th>
<th>INDIVIDUAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Child</td>
<td>Adult</td>
<td>Child</td>
<td>Adult</td>
</tr>
<tr>
<td>Launchpad</td>
<td>5.3</td>
<td>7.0</td>
<td>3.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Transport</td>
<td>4.2</td>
<td>6.2</td>
<td>4.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3.2</td>
<td>6.8</td>
<td>3.9</td>
<td>5.0</td>
</tr>
</tbody>
</table>

*TABLE 10.1 - Mean scores - subjects' responses to questions on gear wheels at the Launchpad, Transport and Agriculture exhibits*
Performance was best overall at the Launchpad exhibit (social condition) for both adults and children. The performance of the children in the individual condition is much lower than that of the children in the social condition at this exhibit, whereas at both the Transport and Agriculture exhibits there appears to be little difference between the performance of children under the two conditions (in fact children in the individual condition performed marginally better at these two exhibits). Adults performed better under the social condition at all three exhibits, although the difference in performance between the two conditions is negligible in the case of the Launchpad and Transport exhibits.

In order to investigate these differences further, several statistical analyses were performed, taking the adults' and childrens' scores separately. (For further details of analyses, see Appendix Q.)

**Children's performance**

A 2-way analysis of variance looking at Exhibit x Condition (3 x 2) revealed that there was no significant difference in performance at the three exhibits, and no overall difference between the social and individual condition. However, there was a trend towards an interaction effect ($F = 2.64, p = .06$). This indicates that the influence of social interaction on performance depends on the nature of the exhibit.

The interaction effect is shown in Fig. 14. This shows that performance is best under the social condition at the interactive exhibit (Launchpad), and decreases quite dramatically under the individual condition at this exhibit; this contrasts with performance at the other two exhibits, which is superior under the individual condition.
Taking the three exhibits separately, three t-tests were performed in order to compare the children's performance under the social and individual conditions.

No significant difference between the two conditions emerges with respect to both the Transport and Agriculture exhibits; however at the Launchpad exhibit there was a significant difference between the social and individual conditions ($t = 2.29$ or $z = 2$, $p = .05$). Thus the children in the social condition performed significantly better than the children in the individual condition at this exhibit only.
Differences in performance relating to the gender of the child were also examined. Table 10.2 shows the mean scores of boys and girls in each condition.

TABLE 10.2 - Mean scores of boys and girls under social and individual conditions at the three exhibits. (Maximum score = 8)

<table>
<thead>
<tr>
<th></th>
<th>SOCIAL</th>
<th>INDIVIDUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Launchpad</td>
<td>6.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Transport</td>
<td>4.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3.2</td>
<td>3.2</td>
</tr>
</tbody>
</table>

M = male child
F = female child

Whilst boys performed better than girls generally, at the Launchpad exhibit this superiority is only apparent under the social condition. At the Transport exhibit, boys performed better than girls under both conditions, but a greater difference appears under the individual condition. At the Agriculture exhibit, no real differences emerge.

A 3-way analysis of variance (Exhibition x Condition x Gender - 3 x 2 x 2) was used on this data to ascertain whether these gender differences were significant, revealing that there was a significant effect of gender ($F = 3.79 (1, 69)$, $p = .05$). Thus boys performed significantly better than girls overall.

Another variable which might have affected the children's performance was, of course, age. A 3-way analysis of variance (Age x Exhibit x Condition - 2 x 3 x 2) was performed to examine any differences between the younger and older children, younger
children being those of 9 and 10 years old, and older children being those of 11 and 12 years old. This division was made since it might be assumed that the older group might be transitional between concrete and formal operations, whereas the 9 and 10 year olds would still be operating at the concrete operational level. However, the analysis revealed that there was no significant difference between the performance of the younger and older children. The mean scores of the two age groups are given in the table below.

**TABLE 10.3 - Mean scores of children at the three exhibits, by age**

<table>
<thead>
<tr>
<th></th>
<th>SOCIAL 1</th>
<th>SOCIAL 2</th>
<th>INDIVIDUAL 1</th>
<th>INDIVIDUAL 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launchpad</td>
<td>5.7</td>
<td>4.0</td>
<td>4.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Transport</td>
<td>3.3</td>
<td>5.4</td>
<td>4.9</td>
<td>4.0</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3.0</td>
<td>3.4</td>
<td>3.4</td>
<td>5.0</td>
</tr>
</tbody>
</table>

1 = 9/10 year olds  
2 = 11/12 year olds

Although these differences are not statistically significant, some unexpected trends are apparent. For example, at the Launchpad exhibit, the younger children performed better than the older children in both conditions. At the Transport exhibit, the older children performed better than the younger group under the social condition, but slightly worse under the individual condition. At the Agriculture exhibit, there is little difference between the younger and older children in the social condition, but the older group performed much better under the individual condition.

A further analysis examined the effects of group type on performance. Since the above analysis indicates that there is no
clear progression of understanding which can be accounted for in terms of age differences, it may be that the variability seen can be explained by a further factor, that is, group composition. Boys performed significantly better than girls overall, and performance may have been further influenced by the gender of the parent accompanying the child. Table 10.4 gives the mean scores of the children in relation to group type. This data is not broken down in terms of the individual exhibits, since the sample size would be too small (dividing the sample into two conditions, four group types, and three exhibits) for any meaningful comparisons to be made.

**TABLE 10.4 - Mean scores of children in each condition, by group type**

<table>
<thead>
<tr>
<th>Group Type:</th>
<th>Mm</th>
<th>Mf</th>
<th>Fm</th>
<th>Ff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>4.4</td>
<td>2.9</td>
<td>4.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Individual</td>
<td>3.7</td>
<td>3.6</td>
<td>5.3</td>
<td>3.6</td>
</tr>
</tbody>
</table>

M = Adult male  
π = boy  
F = Adult female  
f = girl

A 2-way analysis of variance (4 x 2 - Group Type x Condition) was performed on this data. This revealed an effect of group type which approached significance ($F = 2.6, p = .06$).

Overall, children visiting the exhibits with mothers performed better than children visiting the exhibit with fathers. Boys visiting with mothers produced the best performance, particularly in the individual condition, i.e. when they were not allowed to
interact whilst viewing the exhibit. Conversely, girls visiting with their fathers in the social condition, (ie with interaction allowed) scored lowest.

Adults' performance

The scores of the adults visiting the exhibits with their children were also examined. A 3-way analysis of variance was performed to examine if any differences existed between the adults (males and females) at each exhibit, under the two conditions (Exhibit x Condition x Gender).

There was a slight trend towards an effect of exhibit \( (p = .10) \) and condition \( (p = .10) \). Males performed significantly better than females \( (F = 5.25 \ < .001, \ p = .02) \).

Table 10.5 gives the mean scores of the adult males and females at each exhibit.
TABLE 10.5 - Mean scores of adults visiting each exhibit

<table>
<thead>
<tr>
<th></th>
<th>SOCIAL</th>
<th></th>
<th>INDIVIDUAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Launchpad</td>
<td>7.3</td>
<td>6.7</td>
<td>7.7</td>
<td>6.2</td>
</tr>
<tr>
<td>Transport</td>
<td>6.5</td>
<td>5.8</td>
<td>7.3</td>
<td>4.2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6.8</td>
<td>6.7</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

M = Adult Male  
F = Adult Female

The mean scores indicate that males were superior to females only with respect to the Launchpad and Transport exhibits - there is little difference in performance at the Agriculture exhibit.

A Spearman's Rank Correlation was performed to examine whether the children's performances were related to the performance of their partner. However, there appears to be little relationship (a correlation coefficient of -.1).
10.3.2 Qualitative analysis

The responses of all the subjects were tape recorded in order that the answers given could be examined qualitatively. This kind of approach is useful in illustrating whether a gradual progression towards an understanding of proportionality and relative speed can be identified in subjects' responses. It is not suggested that well-defined 'stages' can be identified, nor that these stages show a gradual progression by age. Indeed, many of the adults in the sample showed less understanding than the children they accompanied. However it is useful to look at the responses of the subjects using a Piagetian viewpoint, that is, in terms of different stages of thinking, in order to illustrate differences in the reasoning processes exhibited by the various subjects.

Below, various examples of subjects' responses are given, and these are categorized in line with a Piagetian description of thinking processes.

*Preoperational level*

None of the subjects showed an inability to describe the exhibit and most identified the important variables (the teeth, the size of the wheels etc). Thus no-one responded at a preoperational level of understanding, although some children appeared to be in a transitional phase between preoperational and concrete operational thinking.

*Preoperational/concrete operational level*

Some subjects (adults as well as children) believed that all the wheels moved round at the same speed, regardless of the size of the wheel. However adults who made this mistake tended to change their minds as the series of questions progressed.
One (female) adult at the Transport Gallery responded with 'I think they do' to question 2 (do all the gear wheels go round at the same speed?), but in response to question 6 (the big gear wheel is twice as big as the smaller wheel. If it goes round at 4 rounds per minute can you say how many rounds per minute the small wheel will do?) she responded with:

'Oh no - it should go round more - if its smaller - that should go round more often'. When question 2 was then repeated, she replied 'Well no!'

It would appear that this subject needed to have the difference in size pointed out before she could make the connection between this and its effect on the speed of the wheels.

However, children who made this initial mistake with question 2 did not later adjust their answers. This inability to identify the relationship between the relevant variables (speed varying with size) indicates that the children were at a transitional stage between preoperational and concrete operational thought.

**Concrete level**

Another misconception which occurred was that having correctly acknowledged that the wheels do not move round at the same speed (question 2) a subject failed to identify correctly which wheel moved most slowly (question 3).

One 11 year old girl at the Launchpad Gallery responded thus to question 3:

'When you turn the little one, the big one goes slower, when you turn the big one, the little one goes slower'.

Several children at the Launchpad Gallery made this kind of mistake which would appear to indicate an inability to appreciate the
relativity of speed. Here one must understand the combination of two speeds - that is the speed of the overall operation, which the operator controls, together with the constant ratio of speed of the different sized wheels. Children answering in this way made the assumption that the operator controlled the speed and this could alter the relative speed of the wheels. This could be taken as evidence that a child was operating at concrete level of understanding.

Several children also had problems with identifying the reason why the biggest wheel was the slowest, although they recognised that the wheels moved at different speeds and this difference was maintained irrespective of the overall speed of the operation. Having correctly identified the biggest wheel as the one which moves most slowly, they assumed that this was so for the wrong reason.

One 10 year old girl (at the Launchpad Gallery), in response to question 4 (why does the big wheel move more slowly?) replied 'because it's heaviest'. Again, this would seem to indicate concrete thinking. The biggest wheel is undoubtedly the heaviest, but the child has not deduced that it is the circumference of the wheel which is related to its speed.

All the subjects who exhibited problems with answering the first 5 questions failed to correctly answer the last three. However most of the subjects answered correctly up to question 5, indicating an understanding of relative speed.

Concrete/formal operational level

Several subjects appeared to be at a transitional stage between concrete and formal operations. Thus they could answer the first 7 questions (questions 6 and 7 requiring an understanding of a ratio of 2:1) but failed to correctly answer the final question. The
following is the complete protocol of a girl (aged 10) visiting the Launchpad Gallery.

1. (Can you describe what is happening in this exhibit?)

The notches around the outside of the cogs go together and while one moves one way the other moves the other so they all move together.

2. (Do all the gear wheels go round at the same speed?)

No.

3. (Which gear wheel turns most slowly?)

The big one.

4. (Why?)

Because its larger, it takes more time to go all the way round.

5. (If the big gear wheel was turned round very fast, would it still go more slowly than the small one, or will it go at the same speed, or faster?)

The same speed of course.

6. (The big gear wheel is twice as big as this smaller wheel. If it goes round at 4 rpm can you say how many rpm the small wheel will do?)

8 rounds per minute.
7. (If we made the big wheel go faster, say at 8 rpm, how fast will the small wheel go then?)

16 rounds per minute.

8. (Say we don't know how much bigger the big gear wheel is, but we know that the small wheel goes at 6 rpm when the big wheel is going at 2 rpm. How many rpm would the small wheel do then, when the big wheel goes at 3 rpm?)

6 rounds per minute.
(correct answer = 9)

It can be seen from this protocol that the child shows an understanding of the relevant variables and can appreciate the idea of relative speed. She also apparently understands a ratio of 2:1. This would indicate thinking at the formal operational level. However she makes a mistake on question 8, which suggests that in answering the ratio questions she is not properly using proportional logic but may be using an additive strategy (see 9.2.2). Several adult subjects also made this kind of mistake.

The following is the protocol of boy aged 10 visiting the Transport Gallery. This particular protocol is interesting since his answers appear to illustrate how he is thinking through the problems and finally reaches the correct solutions. (For questions in full, see protocol given above.)

1. Well the small one is going round and turning the big one which is turning another one which is slightly bigger which is underneath, and then it goes up and down.

2. No (they don't all move at the same speed).

3. The little one (moves more slowly). (Pause) No! I tell a lie, its the big one!
4. (Why?) Because the little one's turning the big one - the revolutions - if you put paint on the wheel and you made it go along the floor, one revolution would be about that long, (gestures) - for one turn of that (smaller) wheel, and its not as long as it would be for the big wheel, so..

From this point, he goes on to answer all the questions correctly.

This child is able to relate the problem he is posed to a concrete example and using this strategy enables him to eventually reach the right conclusions.

**Formal operational level**

Most adults and several of the children correctly answered all the questions without exhibiting any doubt as to the correctness of their replies, and this can be taken as evidence of thinking at the formal operational level.

Whilst, as noted above, many of the subjects were successful in answering the first 5 questions, indicating an understanding of relative speed, this cannot be taken as evidence that these subjects were thinking at the formal level. At the Launchpad and Transport exhibits the subjects were able to actually observe the wheels moving and this means their judgments could be made at a concrete level of thought. At the Agriculture exhibit (the static exhibit) the majority of children did not get as far as question 5 (the average score of the children here was 3.2 in the social condition and 3.9 in the individual condition). However, overall, an understanding of relative speed was exhibited by more subjects than was the use of proportional reasoning (assessed by questions 6-8). This seems to indicate some support for Wollman and Karplus' contention that formal thought is not a unitary stage but that various formal operations may be selectively used by individuals.
10.4 DISCUSSION

The results of this study confirm the findings from Study 3 (reported in Chapter 9). That study suggested that the interactive (Launchpad exhibit) differed from the two more traditional (pushbutton and static) exhibits in that it stimulated discussion between family members which might be particularly conducive to the production of socio-cognitive conflict, and hence might be more successful in enhancing understanding.

The suggestion that interactive exhibits may be more successful than static exhibits in enhancing understanding has emerged in earlier research. However, the evidence has been rather tentative; for example, Rosenfeld and Terkel's (1982) finding that interactive exhibits held the visitor's attention for longer.

This investigation found that both adults and children at the interactive exhibit demonstrated more understanding of the concepts being demonstrated (proportional reasoning and relative speed) than subjects at the pushbutton and static exhibits.

Although this difference in performance at the three exhibits was not statistically significant overall, there was a trend towards an interaction effect (in relation to the children's performance only) between condition (social or individual) and type of exhibit. This indicated that the children's performance at the three exhibits was to some extent dependent on whether interpersonal interaction was encouraged or not, and the effect of interpersonal interaction was not the same for each exhibit.

A comparison of the children's scores under the social and individual conditions, when each exhibit is considered separately, did reveal that children performing under the social condition at the Launchpad exhibit demonstrated significantly superior understanding than children under the individual condition, thus lending support to the socio-cognitive conflict hypothesis.
This difference between social and individual conditions did not emerge at either of the two other exhibits. This indicates that the nature of a museum exhibit can strongly influence the effectiveness of group learning. An exhibit must create a context which encourages a particular kind of interpersonal interaction in order for group dynamics to influence individual cognitions. The fact that encouraging social interaction did not enhance performance at the pushbutton and static exhibits indicates that these exhibits are not conducive to group learning, as the findings from Study 3 suggested.

A further significant finding in this study was that females (both adults and children) demonstrated less understanding of the concepts presented, which seems to suggest that the traditional view of male superiority in science and maths subjects (Maccoby and Jacklin 1974) is supported by this study. Since schools nowadays are attempting to encourage girls to take a greater interest in these subjects, this finding is particularly surprising with respect to the children.

However, when these gender differences are examined in more depth, it would appear that a variety of factors may have influenced this result. Certainly, the gender differences are not the same for each exhibit, or under each condition. Whereas little difference between boys and girls is apparent at the static exhibit, regardless of whether the children were performing under social or individual conditions, a more dramatic difference can be seen at the other two exhibits, depending on the condition under which the children viewed the exhibit.

At the interactive exhibit, the boys' performance was superior to the girls' in the social condition, whilst there was little difference in the individual condition (in fact, girls performed slightly better than boys). Conversely, at the push-button exhibit, a greater differentiation between boys and girls emerges under the individual condition.
These findings are further complicated when one considers the performance of the children in terms of group type. Here it emerges that children accompanied by mothers performed better overall than children accompanied by fathers, supporting earlier research (Cone and Kendall, 1978 - see Section 8.1.1.) which suggests that mothers rather than fathers adopt a teaching role during museum visits.

However, the best performance was produced by boys accompanied by mothers in the individual condition, that is, when they did not discuss the exhibit with the accompanying adult. This contrasts sharply with the worst performance, which was produced by girls accompanied by fathers in the social condition. Cone and Kendall found that fathers neglected their daughters during museum visits; the findings here suggest that even when fathers are encouraged to interact with daughters it may not be very successful.

These findings are somewhat difficult to interpret, but may indicate some kind of social marking effect (see Section 8.2.2.) similar to that which emerged in Study 3 (See Section 9.4). Since the exhibits here are technological exhibits and could be seen as primarily appealing to males, an awareness of perceived differences between male and female competence may have been emphasized, resulting in the reinforcement of social roles and stereotypical responses.

The absence of any difference in the performance of boys and girls at the static Agriculture exhibit, the least overtly technological of the three, lends support to the view that social marking influences can explain the male-female differences which emerged at the other two exhibits. However, the male-female differences which occurred at the interactive and pushbutton exhibits were not the same, and this indicates that social marking effects may be very complex. The social marking of a situation may be beneficial for learning only under some circumstances; here it appears to be dependent on the type of exhibit, the composition of the family group, and whether interpersonal interaction is encouraged or not.
Further support for the view that the differences observed may be due to social and cultural influences (representations of male-female differences) is reinforced by the finding that the performance of the children was not related in any way to the performance of their parents. Thus, although encouraging interaction between parent and child does appear to have enhanced the performance of some of the children, this cannot be explained in terms of the parents' competence. This also lends credence to a socio-cognitive conflict explanation for the superior performance of children in the social condition, since this cannot be explained in terms of modelling effects.

As in Study 2 (Chapter 7), no clear progression by age is apparent in these results. Wollman and Karplus (1974 - see 9.2.2) whilst finding some progression by age in relation to the understanding of proportional reasoning, found that generally students applied proportional reasoning on some tasks but not on others in an unpredictable way. Their conclusion was that it may be necessary to view Piaget's 'formal' stage not as a unitary stage but rather as a collection of piecemeal operations, which may be used selectively. The absence of any clear progression by age in this study, and the fact that many adults as well as children in the sample appeared to be using additive strategies rather than proportional reasoning, is compatible with this conclusion.

In addition, an understanding of relative speed but not proportional reasoning was apparent in many of the protocols - which further supports the contention that formal thought may be a selective strategy, and lends credence to Flavell's (1977) suggestion that it may be better to look for developmental trends rather than clearly defined stages of intellectual growth. Piaget himself (1972) was well aware that there were problems about the universality of formal operational thinking as a developmental outcome, and suggested that most adults, whilst capable of thinking at this level, may only do so in problem areas in which they are most experienced or interested.
Much previous research indicates that a proper understanding of proportional reasoning is rare before the age of 15 (see 9.2.2), unless physical actions accompany the reasoning task. Many of the children here, aged 9 to 12 years, demonstrated an understanding of proportional reasoning. Whilst children visiting the Launchpad exhibit could physically interact with the exhibit, no physical manipulation was involved in the two other exhibits, yet several children here demonstrated an appreciation of proportionality. This is in accord with Piaget's findings, that these skills emerge at around 11/12 years old, but is not compatible with more recent research on proportional reasoning.

The emergence of proportional reasoning and an understanding of relative speed at such an early age in this study may be accounted for by the fact that the children in this study did have concrete material to observe even if in some cases they could not actually manipulate the exhibit. Relative speed was more easily observed, especially in the case of the Launchpad and Transport exhibits, since these are working exhibits, and children showed more evidence of an understanding of relative speed at these two exhibits than at the static Agriculture exhibit.

It could, however, be argued that the tasks here did not really assess proportional reasoning, in that problems requiring an understanding of ratios of 2:1 and 3:1 are easily solved using additive strategies. However, the qualitative analysis revealed that where additive strategies were being used, this led to an incorrect response in relation to the question demanding an understanding of a 3:1 ratio, which indicates that those subjects who did correctly answer this question were using proportional reasoning and not some other strategy.

The qualitative analysis indicated that the questions were valid, in that typical errors like this could be detected, and different levels of thinking strategy could be identified.
There is a problem in attempting to compare exhibits where, although the concepts being conveyed are the same, other design and interpretive aspects differ greatly. Although the intention of the study was to compare exhibits which differed in the level of participation required, there were other features of these exhibits which may have threatened the validity of a proper comparison, e.g., the location of the exhibits, and the extra features attached to the Transport and Agriculture exhibits. However it was felt that these problems were largely overcome by directing the subjects' attention specifically to the gear wheels during the interview.

The labels attached to the exhibits were extra features which could not be controlled. However, whilst the labels attached to the Transport and Agriculture exhibits conveyed a lot more information than did the Launchpad label (in the case of the Agriculture exhibit, directing attention specifically to the ratio of the wheels) this did not appear to have aided subjects in answering the questions.

The label at the Transport exhibit was, in any case, too high for many of the children to read, and too dense to be easily understood. The Launchpad exhibit was labelled most simply, and probably most effectively, by posing a question ('which wheel moves most slowly?'). Everyone in the sample read this label and in the social condition many used the question as a basis for their discussion. At the other exhibits reading the label was rare.

In conclusion, the major finding here was that children demonstrated significantly better understanding of the interactive exhibit under a social condition as compared with an individual condition, lending support for the socio-cognitive conflict hypothesis.

Here, socio-cognitive conflict processes have been demonstrated in a natural setting involving child-adult interaction. This is an important finding since little research on socio-cognitive conflict
has been undertaken in natural settings, nor has previous research been concerned with examining the effects of such processes in family groups. However the fact that no differences between the social and individual conditions are apparent with respect to the Transport and Agriculture exhibits indicates that the nature of the exhibit needs to be taken into account if family learning is to be enhanced. A fully interactive exhibit would appear to be more effective in creating a context within which family collaboration may enhance a child's understanding.

Interpersonal interaction did not appear to significantly effect the performance of the adults. However, it was apparent, from the interviews, that directing the subjects' attention to specific aspects of the exhibit by asking them questions did lead them to restructure their thoughts to some extent. Thus exhibits which stimulate interpersonal interaction may therefore be beneficial to adults simply because they encourage discussion. This effect could be facilitated by thoughtful labelling which poses questions and encourages debate.

The male-female differences which emerged in this investigation are also important. It has been suggested here that social and cultural expectations of male/female competence may have influenced the performance of both adults and children in this study. Although this conclusion can only be tentative, this is an area which warrants further research. A considerable amount of research has indicated the prevalence of gender stereotyping in formal education (Hartnett, 1978; Mackie and Pattullo 1977), but no research has considered the perpetuation of these stereotypes in informal educational environments.
PART 4
SUMMARY AND CONCLUSIONS
11. LEARNING AS A SOCIAL EXPERIENCE

The research undertaken for this thesis has explored new methodological and theoretical approaches to the investigation of learning in informal settings, focusing on the museum. Traditionally, research on learning in such settings has been influenced by theoretical and methodological approaches drawn from cognitive-experimental psychology and formal educational theory. Whilst these approaches may be relevant to the study of classroom learning, they may not be so appropriate when considering learning in informal environments.

The research reported here has drawn on social psychological theory and methods, since the museum is essentially a social setting. People visit museums in groups, and learning in such a setting will be influenced by group dynamics. The social and recreational nature of the setting implies that learning may be better understood by taking into account social, cultural and interpersonal processes, rather than simply focusing on individual cognitive processes.

Four studies were conducted to investigate learning as a social experience. All the studies focused specifically on children, since children form a significant proportion of the museum visitor population, although the child as museum visitor has been largely neglected in research. Children visiting a museum in school groups were examined in the first two studies, a further two investigations involved studying children visiting a museum in family groups. The latter two studies also involved some examination of the influence of the museum visit on adults in family groups.
11.1 SUMMARY OF RESEARCH

The major hypotheses being tested were:

(i) Do children visiting a museum in a school group learn anything as a result of their visit?

This was examined by comparing children's drawings and accounts of a historical topic (the Vikings) before and after a visit to the Jorvik Viking Centre in York (see Chapter 5).

(ii) Can learning in a museum be facilitated for children in school groups by encouraging social interaction?

This was examined by comparing individual with group performance on a museum-related task, and took place in the same museum (see Chapter 7).

(iii) Do different types of exhibit stimulate different kinds of interaction amongst family groups at a museum?

This was examined through a comparison of family interaction at three different kinds of exhibit (interactive, pushbutton and static), all demonstrating the same technological process, in the Science Museum, London (see Chapter 9).

(iv) Are some kinds of exhibit more effective than others in stimulating learning in family groups, and what is the role of social interaction in this?

This was examined by comparing visitors' understanding of the concepts underlying the same three exhibits in the Science Museum, under individual and social conditions (ie interaction was prevented or encouraged). The subjects were child-adult pairs (see Chapter 10).
The major theoretical influences in this research include Piaget's (1950) theory of cognitive development, which has been a major influence in formal education and also in museum design; and Doise's (1978) elaboration of the Piagetian paradigm, the socio-cognitive conflict hypothesis.

In addition, Moscovici's theory of Social Representations (1961/76) provided a broad framework within which social psychological methodology and interpretational approaches could be developed.

A Social Representations approach is useful in exploring the content of people's understanding in a museum context, taking into account cultural and historical influences on perception. A more rigorous approach was necessary in order to understand the processes involved in learning in museums, and this was provided by Doise's theory, which is compatible with a broad Social Representations framework and explores the effects of interpersonal interaction in promoting learning. Learning, from this perspective, is seen in Piagetian terms, involving the development of new cognitive structures and the notion of cognitive conflict as essential in the process. Doise sees it as more useful to consider social as well as cognitive conflict as being important.

The methodology used in this research was guided by these theoretical frameworks and is compatible with a broad social psychological approach. In the past, museum evaluation research has been constrained by an adherence to techniques of investigation devised primarily to investigate individual behaviour and learning processes. If the museum visit is to be perceived as a social experience these kinds of techniques, relying heavily on behavioural measures and recall and recognition processes in the individual, are not adequate.

Content analysis was used in the first study, in order to explore children's representations of a museum topic through drawings and accounts. This also included some analysis of children's literature.
A worksheet was devised for the second study, for use by children individually or in pairs, in order that an experimental examination of individual versus group performance could be undertaken.

The second study also involved developing a partially standardised interview technique, in order to ascertain the cognitive level of the children involved. This necessitated the development of a new method of categorizing children's understanding of history, in line with a Piagetian view of intellectual development.

The third study was an observational study which utilised Bales' Interaction Process Analysis, a method used in social psychology for examining interaction in small groups, which takes into account affective as well as behavioural aspects of interactions.

The fourth study was an experimental investigation, which involved the development of a questionnaire to elicit subjects' understanding of the technological process underlying three museum exhibits, based on Piaget's (and more recent) research on proportional reasoning and relative speed.

In the next section, the findings from each study will be considered separately and the major conclusions discussed.
11.2 MAJOR CONCLUSIONS

11.2.1. Study 1

By comparing the drawings and accounts produced by children after visiting the Jorvik Viking Centre (in school groups) with descriptions produced before the visit, it was apparent that a change in the children's perception of the Vikings resulted from the museum visit. Thus it could be argued that learning had occurred.

It is important to note that 'learning' here is not perceived in terms of the recall of 'facts' but is seen in a much broader social context. There was not much evidence that the children had learned factual knowledge, such as dates and places, although certainly they made less errors in this respect after the museum visit. Any facts the children learned are likely to have been gleaned from books or formal teaching, however. This kind of learning can easily be measured by pencil and paper tests. This is the usual approach of studies investigating learning in museum settings (see Chapters 2 and 3). What the Jorvik presents is not facts, however.

The museum offers a reconstruction of history, based on fragments of evidence and put together to form an affective and sensory experience, which gives visitors a 'feel' for how the Vikings lived. Using accounts and drawings instead of the more traditional pencil and paper tests allowed an examination of the ways in which this experience influenced the image of the Viking in the children's minds - and this is much more illuminating than simply examining how many accurate facts they learned.

Although all the children in the sample received some formal educational input on the Vikings during the period before and after their visit, the nature of their representations of the Vikings after the visit to the museum could clearly be related to the image the museum presented.
In addition to the indication that learning had occurred, another important finding was that children visiting the museum already had a very strong (and in several respects, incorrect) representation of the Viking before their visit, and this contrasted sharply with the view the museum presented.

An examination of this representation, using Multidimensional Scalogram Analysis, revealed the stereotypical Viking villain - a fierce seafaring warrior in a horned helmet. Here reality is combined with myth, for whilst it is true that the Vikings were seafarers and probably very fierce on occasions, there is no evidence that they wore horned helmets at all. The horns are a major part of the Viking image in contemporary culture however - they appear in advertisements for Danish lager, in cartoons, and in films. From the children's accounts, it was clear that these contemporary mis-representations had influenced the children's perceptions. There were references to a popular cartoon character and an adventure film; both of these portray the Vikings in this way.

In all the descriptions provided after the museum visit, the mythical elements had largely disappeared - the Viking no longer sported horns. For the older children, many of the more accurate details of the warlike image persisted after the visit however, alongside a new and different image which corresponded to the image of peace and domesticity projected by the museum. Thus it appeared that the children had begun to appreciate that two conflicting views on the Vikings could be held at the same time - an indication that the museum had succeeded in helping them towards a more objective view of history.

The study has provided evidence for the view that a museum visit can be a fruitful learning experience for schoolchildren. However, whilst the Jorvik Centre appears to have succeeded in enhancing the children's understanding of the historical theme presented, it should be noted that little indication of an enhanced awareness of archaeology and its role in elucidating history emerged. This is
another major theme of the museum, alongside the Viking theme, but few of the children appeared to have fully understood the archaeological message.

A final point to be noted about this first study was the striking differences in artistic style which emerged in the drawings produced after the museum visit, in comparison to those which were done before the visit. The importance of the museum as a visual and aesthetic learning experience is an aspect which has not been fully appreciated, and warrants further research.

11.2.2. Study 2

The emergence of evidence for the existence of a strong stereotypical image of the Viking, which conflicted with the image the museum presented, provided the basis for the second investigation. The museum presents a view of the Viking which conflicts with the traditional view, and this suggests that cognitive conflict may be experienced by visitors (what they see conflicts with what they know).

The notion of cognitive conflict is crucial to Piaget's conception of learning. Cognitive development occurs when new knowledge, or ways of thinking about a problem, conflict with what a child already knows, necessitating the development of new thinking strategies. Since Piaget has been such a major influence in education generally, and also in museum design, this perspective was an appropriate starting point for an exploration of the processes involved in children's learning in a museum.

Piaget has been criticised for his apparent neglect of the influence of social variables in the process of cognitive development: the child is seen in social isolation, constructing logico-mathematical knowledge through solitary deliberations and manipulations. Clearly children do not develop in social isolation, and they need to confirm, share and use their knowledge in the context of social interaction.
Doise has extended the Piagetian view to include an important social element. He recognises that the process of cognitive change, whilst involving cognitive conflict, may be better understood by examining the ways in which social interaction influences cognitive progress. His work has demonstrated that children working together solve cognitive problems at a more advanced level than children working individually on the same problems. Doise states that "conflicts of cognitive centraions embedded in a social situation are a more powerful factor in cognitive development than a conflict of individual centraisons alone" (Doise and Mugny, 1975, p105). In assessing learning in an informal, as opposed to a formal, educational environment it is particularly essential to recognise that social interaction may play an important role.

Doise is suggesting that social interaction, in conjunction with cognitive conflict, can facilitate learning. Simply interacting with another will not lead to learning. In order to test out Doise's hypothesis, then, it was necessary to ensure that cognitive conflict was present in addition to social conflict.

Having established, in Study 1, that children visiting the museum already had a strong image of the Vikings, which differed from that presented in the museum, it could be assumed that some kind of cognitive restructuring would be necessary in order to accommodate this new perspective.

In addition, the museum presents two sides of history - a concrete reconstruction of a Viking village (a complete picture of the past) is shown alongside the demonstration of the archaeological process (an incomplete picture of the past). Thus cognitive conflict could be established by drawing the children's attention to these these two different aspects of history and requiring them to coordinate the two perspectives.

Children working alone to coordinate the two different viewpoints were compared to children working in pairs, in order to assess the
influence of the social element.

They were presented with the two perspectives through the use of the specially designed worksheet, which consisted of three parts. In the collective condition, one child in each pair was directed to concentrate on the complete, but reconstructed, view of history (the Viking town), whilst the other child focused on the incomplete but more objective view (the archaeological process). The children then had to coordinate these two perspectives in order to complete the third part of the worksheet. In the individual condition, each child had to complete all three tasks. Thus cognitive conflict was experienced by all the children, but those in the collective condition also experienced social conflict, through having to coordinate their own perspective with that of their partner.

Children were paired together on the basis of pre-visit interviews assessing their level of cognitive development in relation to an understanding of history. Children at the same developmental level were paired together, and, in addition, some children with initially different cognitive levels were paired together to perform the task. For this latter group socio-cognitive conflict may arise because individuals will make different responses to the same problem, as a result of their different cognitive abilities.

The worksheet appears to have been quite successful. It was not too time-consuming, and it required the children to actually look at and think about the exhibits - all too often school worksheets can be completed by simply noting down facts from exhibit labels or guidebooks. Most importantly, it effectively drew a link between the different aspects of the museum (the reconstructed town and the archaeological section). From the first study it was evident that children did not, on their own, make the necessary associations between the different parts of the display.

The major finding from this study was that group performance was significantly superior to individual performance, supporting the view
that socio-cognitive conflict is an important factor in learning. This superiority could not be accounted for in modelling terms alone.

However, social interaction was effective in enhancing performance mainly for children at a certain (transitional) stage of development (intermediate between preoperational and concrete operational thought).

This finding is compatible with Doise's socio-cognitive conflict hypothesis, since he also found that social interaction was most beneficial for children at intermediate levels of cognitive development, i.e. at the point where the child is ready for the combining of initially isolated schemas into a more coordinated understanding of a problem.

Here, superiority of group over individual performance emerged most strongly where children with the same initial cognitive levels, rather than different cognitive levels, were paired together. Thus it appears to be the different perspectives presented to the children which was most effective in generating socio-cognitive conflict.

Another important aspect of this study was the development of the interview procedure and grading system for the assessment of children's understanding of history in terms of Piagetian developmental stages. Unlike previous attempts to apply a Piagetian framework in relation to history material, the system developed here provides a method of assessment which is not confined to any specific historical theme.

No clear age progression in relation to an understanding of history was evident in this study. Although this contradicts Piaget's view of sequential stages, it is not inconsistent with research where Piagetian-type grading systems have been used with this kind of open-ended material (Jurd 1978). Indeed, as noted in Section 6.1, the notion of clearly defined sequential stages is even under attack from researchers investigating cognitive development with the more
traditional Piagetian material involving operatory skills and logico-mathematical problems (Flavell, 1977/85; Brown and Desforges 1979). The findings from this study lend some support for the view that the notion of age-related sequential stages in the development of thought needs to be reassessed.

Another issue addressed by this study relates to the effect of social interaction on individual cognitive development. Of the 77 children who formed the experimental sample, only 19 showed evidence, in the post-visit interviews, of a progression from one developmental stage to another. However, none of the control sample showed any change, and of the 19 children who did progress, the majority were from the collective condition. This difference was not statistically significant, however, and some of these progressions may have been due to maturation alone. Thus this finding can only provide tentative support for the view that socio-cognitive conflict processes can facilitate individual cognitive development.

The study has demonstrated that a socio-cognitive conflict model of learning can be usefully applied in a natural setting, as opposed to the laboratory setting which characterises Doise's own research. Perhaps more importantly, the model has been utilised in the investigation of children's understanding of history. Previous research has focused exclusively on logical-operatory material and skills, following the traditional Piagetian paradigm. This study has indicated that Doise's model may have a much wider application.

11.2.3. Study 3

Studies 3 and 4 looked at the family group at the museum, and attempted to explore further the issues raised by the first two studies.

One issue of interest relates to the nature of the museum and how this influences learning. The first study indicated that the Jorvik Centre museum was successful in stimulating learning in children, and the
The second study showed that socio-cognitive conflict may be an important element in the process of learning in such settings. However, it is not clear whether such processes occur naturally in museum environments, nor what role the museum itself, and its exhibits, play in facilitating the emergence of constructive socio-cognitive conflict processes.

Mugny et al (1984) have pointed out that inter-individual dynamics can have an inhibiting rather than a facilitating effect on cognitive progress (See 8.2.2.). The nature of the interactions between people visiting a museum — whether they are constructive or inhibiting — may to a large extent depend on the nature of the museum and its exhibits. The Jorvik Centre is an unusual and modern museum. More traditional museums and exhibits may not be so effective in stimulating learning.

The third and fourth studies were undertaken in an attempt to address these issues, by examining natural family interactions in a more traditional museum, and exploring the role of the exhibit in stimulating useful inter-individual interactions.

A further aspect considered in these studies was the nature of child-adult interactions and how these could be explored in terms of socio-cognitive conflict processes. This is an area which has largely been neglected by researchers in the socio-cognitive conflict field; yet it is suggested that a situation where two individuals are operating at different cognitive levels, and hence have different perspectives on a problem, is one of the optimal conditions which gives rise to socio-cognitive conflict. Since children will generally have different cognitive abilities to adults, one would expect socio-cognitive conflict to be a major feature of child-adult exchanges.

Studies 3 and 4 were located in the Science Museum, London. This museum is very different to the Jorvik Centre, being a much larger and more traditional museum. It was chosen as a suitable setting for this investigation because it offers a wide variety of design and interpretive modes, and several exhibits demonstrate the same
technological or scientific concept in different ways. It was possible, therefore, to examine three different kinds of exhibit (static, pushbutton, and fully interactive), all demonstrating the same technological process (gear wheels).

Study 3 showed that the fully interactive exhibit stimulated much more social interaction amongst family members than either a static or a pushbutton exhibit, and this interaction was qualitatively different to that stimulated by the other two exhibits.

Bales' Interaction Process Analysis was used to code family interaction at the three exhibits. Although this technique requires some practice before it can be efficiently used, it was found to be quite successful. This technique has generally been applied within social psychology for the analysis of interactions in small decision-making groups, and has not been utilised in a museum setting before. However it is especially suited to the observation of family groups in a museum environment, since it takes into account affective and social aspects of group interactions, rather than focusing on behavioural aspects alone. In addition, the technique focuses attention on the group itself, rather than the exhibit. Previous observational studies of families in museums have tended to use coding procedures which are either very specific to the particular exhibit being studied, or which concentrate only on very general behavioural aspects.

On examination, through Correspondence Analysis, of the kinds of interaction produced, it was found that the interactive exhibit encouraged exchanges which would be likely to lead to socio-cognitive conflict (primarily, debate and argument, which was exhibit-related) whereas the other two exhibits did not.

A further finding was that some gender and generation role differentiation occurred. At the interactive exhibit, fathers and mothers spoke more frequently to daughters than to sons, and children were more likely to speak to fathers than mothers. Parents were much more likely to initiate interactions than children. At the pushbutton
exhibit, fathers also paid greater attention to daughters than they did to sons, but mothers were more likely to address sons. No great differences emerged at the static exhibit.

These differences appear to indicate some kind of social marking effect (see 8.2.2.) - that is, where the social order accentuates the cognitive contradictions posed by a particular problem. Socially-marked situations, according to Mugny et al (1984), may be beneficial in terms of enhancing cognitive contradictions and hence facilitating learning; however, they may also have an inhibiting effect. Here, the technological nature of the interactive exhibit may have emphasised an awareness of perceived differences between the sexes, in terms of scientific/technical ability. However, these effects may have been counteracted to some extent, because the exhibit could be manipulated. At the pushbutton exhibit, the different effects which were observed could still be a result of social marking: the difference may be due to the fact that this exhibit, although a working exhibit, could not be physically manipulated, but only observed. The static exhibit was the least overtly technological, and did not stimulate any social marking effects. It is not clear whether the social marking here aided or inhibited cognitive progress. Clearly, it would not be desirable to reinforce sexual stereotypes, if this is what is occurring here. This issue was pursued further in Study 4.

11.2.4. Study 4

The fourth study indicated that the influence of social interaction on visitors' understanding of the concepts underlying the three exhibits was dependent on the type of exhibit. Overall, visitors demonstrated better understanding at the interactive exhibit; but this was only true under the social condition, that is, where interaction with their partner was encouraged.

When the social and individual conditions were compared, taking each exhibit separately, it was found that children at the interactive exhibit performed significantly better under the social condition.
This confirms the findings from Study 3, which suggested that the interpersonal interactions stimulated by the interactive exhibit would be conducive to the emergence of socio-cognitive conflict processes in groups visiting the exhibit, and hence would be likely to facilitate learning in a group context. No differences between social and individual conditions emerged at the other two exhibits, or for adults at any of the exhibits.

It may be concluded from this that certain types of museum exhibit may create a better social context than others for facilitating learning in children.

The subjects' knowledge of the exhibit concept was not assessed prior to their viewing the exhibit. In order to be able to say conclusively that 'learning' had occurred, it could be argued that this should have been done. However, using a pre-test interview/questionnaire could have influenced the subjects' perception of the exhibits, their discussion, and their subsequent responses, and was therefore inappropriate. A control group did indicate that visitors to the three galleries did not differ in terms of their background knowledge.

In any case, what is of interest here is how the visitors perceive the message of the exhibit, and assimilate what they see with their existing knowledge. The social representations approach adopted throughout this research assumes that people do not approach a learning situation with a blank mind. Knowledge is constructed and reconstructed throughout our daily lives and within a social and cultural context.

The questionnaire used here to assess visitors' understanding of the exhibits appears to have been effective in tapping the subjects' understanding of the concepts underlying the exhibits. However, a quantitative analysis of the results provides only a crude assessment of the subjects' understanding. A more useful indicator of the thought processes underlying subjects' responses was provided by the qualitative analysis of the kinds of errors which were made. For
example, it emerged that some subjects used additive strategies when answering questions which necessitated an understanding of proportional reasoning.

Most studies investigating learning in museums have relied on paper and pencil tests of knowledge, which can only show how many questions people can answer correctly, and are of limited value. Using an interview approach and taping subjects' responses, although it is more time-consuming, provides a much more useful perspective on learning processes.

As with Study 2, no clear progression in understanding by age is apparent in this study. Several adults, as well as children, appeared to be using additive strategies to solve problems which necessitated proportional reasoning. In addition, many of the subjects demonstrated an understanding of relative speed, but not proportional reasoning. This again indicates that it may be necessary to review Piaget's notion of sequential 'stages'. The 'formal stage', for example, may not be a unitary stage, but rather a collection of operations, which may be employed by individuals on some occasions but not on others.

Significant gender differences were also apparent here, with males (both adults and children) performing significantly better overall than females. It would be easy to assume from this that the traditional view of male superiority in the field of science and technology has been confirmed by these findings.

However, this explanation may be too simplistic. Firstly, because the gender differences were not the same at each exhibit nor under each condition, especially in relation to the children. At the static exhibit there was little difference between boys and girls, irrespective of the condition under which they viewed the exhibit. At the interactive exhibit, boys performed better than girls only in the social condition; whereas at the pushbutton exhibit, a greater differentiation between boys and girls emerges under the individual condition.
Secondly, there were differences related to group type. The lowest performance was produced by girls accompanied by their fathers in the social condition, whereas the best performance was produced by boys accompanied by their mothers in the individual condition.

The benefits of social interaction in relation to learning in a museum must be qualified, therefore. The indication here is that whilst encouraging social interaction between parent and child was found to be beneficial at the interactive exhibit, it was much more beneficial for boys than for girls. In addition, at the pushbutton exhibit, social interaction did not enhance the girls' performance, and in fact had a detrimental effect on the boys' performance.

These findings could be interpreted in terms of a social marking effect. The observations made in Study 3 indicated that some exhibits may be more socially marked than others, and this may lead to differences in the group dynamics which each exhibit stimulates.

Overall, the technological nature of the exhibits may reinforce social roles and lead to an enhanced awareness of differences between males and females in terms of perceived competence, which results in stereotyped responses. This was less marked at the static exhibit, since it was the least overtly technological of the three.

Although this interpretation is merely speculative, it would appear to be the most plausible explanation of the differences observed here. The influence of cultural expectations and social marking on learning, especially in an informal learning context, is an area which warrants further research.

The general conclusion from this study, however, is that support for the socio-cognitive conflict hypothesis has been demonstrated. These findings supplement those from Study 2, by demonstrating the applicability of this model in a natural setting. In addition, the influence of such processes in child-adult interaction, within the context of the family group, have been explored. The indications are
that the influence of socio-cognitive conflict in child-adult interactions is complex, and needs to be viewed within a broad social and cultural context.

11.3 GENERAL CONCLUSIONS AND INDICATIONS FOR FURTHER RESEARCH

This research as a whole has implications for a variety areas, including social psychology, education, museum design and museum evaluation.

11.3.1. Implications for social psychology

Firstly, the findings here suggest that learning may be investigated within a broad social representations framework. The social representations approach has previously been used primarily to investigate people's understanding of social phenomena. However, all learning takes place in a social context, and the social representations approach can provide a wide perspective within which all learning can be explored. Thus the approach need not be restricted to the investigation of social knowledge, but should be concerned with the social development of all knowledge.

One implication of this is that more attention needs to be directed at children, and the developmental progression of social representations. Knowledge, and ways of thinking, are shaped and developed gradually as we progress from childhood to adulthood. An examination of children's representations of the world, and how these change and develop, can give us insight into the foundations of adult representations.

Secondly, the results here suggest a much wider application of Doise's socio-cognitive conflict hypothesis than has previously emerged. Research in this area has been almost exclusively restricted to laboratory settings and logico-mathematical material. The studies here indicate that the model can be usefully employed in natural settings, and with open-ended material, such as history.
In addition, Doise's hypothesis may be particularly helpful in the investigation of child-adult learning. Little research has been done on how learning occurs within family groups; the results here indicate that a socio-cognitive conflict approach may provide useful insights into family learning processes.

Doise's theory may provide the link between a social representations perspective and a developmental perspective, bringing together two levels of analysis, the social and the cognitive, to examine both the content and the process of knowledge.

In order for this to be achieved, the socio-cognitive conflict approach needs to be applied outside the laboratory in real-life settings, and this necessitates taking into account broader social and cultural influences on learning. The social representations approach needs to take into account interpersonal dynamics and cognitive-developmental issues, in order to better understand the wider social and cultural influences. In this way, a better understanding of the content and process of knowledge may be gained.
11.3.2. Implications for Education

The findings here suggest that a visit to the museum can be a useful learning experience, and clearly, better use could be made of the museum visit by schools. Teachers have tended to regard a museum visit as an entertaining 'day out' rather than an important educational facility.

Since learning can be facilitated by encouraging social interaction, teachers should try to avoid providing individual worksheets for children during museum visits, and, instead, should encourage group discussion and debate.

Providing worksheets which require the individual child to find out 'facts' is normal practice for school visits to the museum. However, this may simply encourage the children to compete with one another, instead of sharing and comparing their views.

In any case, the kind of learning experience offered by a museum is different to the kind of learning which occurs in school or from books. Museums, on the whole, do not offer 'facts', but rather they invite the visitor to explore and investigate new ideas, or to pursue ideas which interest them. 'Facts' can be gleaned from labels or guidebooks, but if this is all that children are required to do, they may as well stay at school and gather information from books.

The major implication for educators is that they need to be aware of alternative models of learning. They need to free themselves from the dominance of a strictly Piagetian approach, with its emphasis on individual cognitions and sequential stages of development. The social psychological approach suggested here offers a more sophisticated and more fruitful framework for the exploration and facilitation of learning.
11.3.3. Implications for museum design

Museum designers need to take more account of psychological theory which can be used to help guide design and interpretation. Although the influence of Piaget can be seen in the development of interactive exhibits, and cognitive theory has guided interpretive practices, there is little evidence of social psychological influences in museum design.

As a result, the importance of social factors in influencing the effectiveness of an exhibit has not been appreciated. Yet it would appear that some exhibits create a social context which is particularly conducive to learning.

In the first study, the sensory and affective experience offered by the Jorvik Centre was effective in stimulating learning in the children visiting the museum. Physical interaction, i.e., the ability to actually manipulate exhibits, is not a feature of this museum. However, the museum engages the visitor cognitively and emotionally.

The Science Museum offers a different kind of experience. Here, the ability to physically manipulate and experiment with an exhibit was effective in stimulating learning. The interactive exhibit stimulated much more conversation amongst family members than the other, more traditional exhibits, and the kind of discussion which was stimulated would appear to be particularly conducive to learning.

Clearly, it helps if visitors can manipulate and investigate exhibits. Interaction with exhibits need not necessarily be physical however; emotional or cognitive interaction may be just as important. This has, of course, been recognised by museum designers, and most modern museum exhibits are designed to encourage participation from visitors, both physical, emotional and cognitive. However, the findings here indicate that interaction between visitors, in addition to interaction between the visitor and the exhibit, may be important.
It should also be noted that labelling of exhibits may be an important factor. It is well-known that visitors do not read labels, and it is pointless having labels which are too long or too dense. However, the use of labels to encourage visitors to question and discuss an exhibit with other people is not so widely recognised.

Clearly, there is a need for more evaluation to guide museum design. This should be conducted within a psychological framework which takes into account the social as well as the cognitive elements involved in learning.

11.3.4. Implications for museum evaluation

The research here challenges the general findings of museum evaluation research, which indicates that on the whole visitors to museums do not learn very much (see Chapters 1 and 2).

Previous research evaluating learning in museums has attempted to investigate and interpret visitors responses in terms of individual cognitive factors, using theory and methodology largely drawn from cognitive psychology and formal education theory to investigate learning and interpret behaviour.

Clearly, a museum visit is an informal and social experience, and any learning which occurs may be different to the kind of learning which occurs in a formal and individual context. Any useful insight into the effectiveness of museums will only be gained by the adoption of new techniques of investigation and new theoretical perspectives, which recognise the social and affective aspects of the museum visit.

One important aspect to emerge from this research was the gender and generation differentiation which was apparent in families visiting the museum. This is an area which needs to be further explored by museum evaluators. This has implications not only for museum designers and educators, but for society in general.
These four studies have attempted to explore these issues, and have demonstrated that social psychology can offer theoretical frameworks and methods of investigation which may provide more fruitful insights into the museum learning experience.
APPENDICES
APPENDIX A

Study 1, Chapter 5
Coding frames used for content analysis (Viking Character and Viking Way of Life) showing number of subjects using themes relating to each category at pre-visit [1] and post-visit [2] (drawings and accounts - n = 175).

ACCOUNTS ONLY (n=109)

MAIN CODE: VIKING CHARACTER

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<td></td>
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<td>0</td>
</tr>
<tr>
<td>bad (evil, nasty, horrible)</td>
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<td>0</td>
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<td>0</td>
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<tr>
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<td>14</td>
</tr>
<tr>
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<td>cruel (unfriendly, greedy, selfish, torture)</td>
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<tr>
<td>peaceful (mild, calm)</td>
</tr>
<tr>
<td>aggressive (fighting, killing, violent, fierce, attacking, invading)</td>
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<tr>
<td>civilised (cultured, constructive)</td>
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<tr>
<td>uncivilised (brutish, savage, pirates, destructive)</td>
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<tr>
<td>adventurous (love of danger, enjoy)</td>
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<tr>
<td>unadventurous (cautious, miserable, dull)</td>
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<tr>
<td>Subcode</td>
</tr>
<tr>
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</tr>
<tr>
<td>Egoistic</td>
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*External influences and Effects*

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<td></td>
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FACTUAL DETAILS

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   " - incorrect 6 0

subcode: Place of origin - correct (eg Scandinavia Denmark, Norway, Sweden) 13 5
   " - incorrect 6 0

subcode: Source

museum/exhibitions 0 12
history books 0 1
sagas 0 5
films/TV 0 12
fiction/cartoons 0 0
archeology (including refs. to items found etc) 2 10
### DRAWINGS AND ACCOUNTS (n=175)

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**subcode: Culture**

**categories:** law/class (system of law/punishment, jarls, 'Thing', etc)

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<td>fighting (drawings only)</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

**subcode: men (drawings only)**

<table>
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<tr>
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<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>50</td>
<td>28</td>
</tr>
</tbody>
</table>

**subcode: women/children (drawings only)**

<table>
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<th>Category</th>
<th>Count</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
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<td>5</td>
<td>16</td>
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</tbody>
</table>
APPENDIX B

Study 1, Chapter 5
APPENDIX B  Study 1 Chapter 5

Examples of drawings of 'Vikings' produced by children before and after a visit to the Jorvik Viking Centre

Pre-visit Drawings:
Post-visit Drawings:
APPENDIX C

Study 1, Chapter 5
APPENDIX C  Study I Chapter 5

MUTIDIMENSIONAL SCALOGRAM ANALYSIS

MSA on drawings - 7/8 year olds

2 Dimensional Solution: coefficient of contiguity = .913 for 3 iterations
No. of variables = 17
No. of subjects = 78 (2x39)

Duplicated subjects:

Pre-visit:

Subject 14 identical to subject 1
|   | 4 | 10 | 19 | 21 | 23 | 12 | 12 | 9 | 13 | 15 | 16 | 20 | 24 | 36 | 29 | 25 | 32 | 27 | 30 |
|---|---|----|----|----|----|----|----|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
|   |   | 2  |    |    |    |    |    |   |   |    |    |    |    |    |    |    |    |    |    |    |

-367-
Post-visit:

43 .................... 42
68 .................... 44
67 .................... 48
53 .................... 51
60 .................... 51
65 .................... 51
66 .................... 51
56 .................... 52
58 .................... 52
69 .................... 52
71 .................... 52
62 .................... 55
64 .................... 55
70 .................... 55
59 .................... 57
72 .................... 57
73 .................... 57
74 .................... 61
75 .................... 61
76 .................... 61
77 .................... 62
78 .................... 62

Subjects renumbered 1 - 37
MSA on Accounts - 7/8 year olds

2 Dimensional solution: coefficient of contiguity = .932 for 3 iterations.

No. of variables: 22

No. of subjects: 52 (2x26)

Duplicated subjects:

Pre-visit:
Subject 4 identical to subject 1
15 .................... 1
9 .................... 5
21 .................... 2
24 .................... 4
18 .................... 14
19 .................... 14

Post-visit:
32 .................... 27
42 .................... 27
35 .................... 34
52 .................... 34
40 .................... 38
50 .................... 38
47 .................... 45

Subjects renumbered 1-38.
MSA on drawings - 9 year olds

2 Dimensional Solution: coefficient of contiguity = .95 for 1 iterations.

No. of variables 17

No. of subjects 28 (2x14)

Duplicated subjects:

Pre-visit:
Subject 5 identical to subject 2
10 .................... 2
11 .................... 2
12 .................... 2

Post-visit:
22 .................... 17
23 .................... 17
26 .................... 17
20 .................... 15
19 .................... 15

Subjects renumbered 1 - 18

MSA on accounts - 9 year olds

2 Dimensional Solution: coefficient of contiguity = .95 for 2 iterations.

No. of variables 22

No. of subjects 34 (2x17)

No subjects duplicated.
MSA on 10 year olds - drawings

2 Dimensional Solution: coefficient of contiguity = .97 for 1 iteration.

No. of variables 17

No. of subjects 26 (2x13)

Duplicated subjects:

Pre-visit:
Subject 5 identical to subject 3

8 .................... 3
11 .................... 3
12 .................... 3
10 .................... 6
13 .................... 7

Post-visit:
22 .................... 14
23 .................... 14
19 .................... 18

Subjects renumbered 1 - 26.
MSA on 10 year olds - accounts

2 Dimensional Solution: coefficient of contiguity = .90 for 3 iterations.

No. of variables 22

No. of subjects 92 (2x46)

Duplicated subjects:

Pre-visit:

Subject 46 identical to subject 45

Subjects renumbered 1 - 91.

MSA on 11 year olds - accounts

2 Dimensional Solution: coefficient of contiguity = .94 for 8 iterations.

No. of variables = 22

No. of subjects = 40 (20x2)

No subjects duplicated.
APPENDIX D

Study 2, Chapter 7

JORVIK CENTRE WORKSHEET

Collective condition

(Original size: 16%" x 12")
APPENDIX E

Study 2, Chapter 7

JORVIK CENTRE WORKSHEET

Individual Condition

(Original size: 16½" x 12")
APPENDIX F

Study 2, Chapter 7

Two sets of photographs
(red set and blue set)
used with Jorvik Centre
Worksheet (SEE REAR POCKET)
APPENDIX G

Study 2, Chapter 7

EXAMPLES OF INTERVIEW PROTOCOLS
POST VISIT

SCHOOL: Seal
SNO: 10.
DATE: 11/6/86

CLASS: 3rd
AGE: 10,1
NAME: A Worsell

10 YEARS AGO:

Go in - time car,
(else?) Look in books
Maps,

(easy/difficult?) Easy,

100 YEARS AGO:

Same

(easy/difficult?) Just the same really,

1000 YEARS AGO:

Think about Jesus
(why?)cos he's seen on the television
(books?) Yes

(easy/difficult?) Same really

GRADE: 2
10 YEARS FUTURE:

Ask me!

(easy/difficult?) Not easy, The school could be still here in 10 years
((Not easy?)No

100 YEARS FUTURE:

I don't know cos I'll be dead,
(Will they be able to find out?) Yes
(How?):-

(easy/difficult?)

1000 YEARS FUTURE:

Be even harder, The school most probably be gone down,

(How will they find out?)Yes - Mexico, Think of Mexico 86
(How?)Don't know
(Easy/difficult?)

CHANGE:

0-10: Yes it changed my life Its just been my birthday, I want to be a goalie, I could be a goalie in 10 years

10-100: I'll grow older

100-1000: More cos its a longer time isn't it

(More change?) most between 100-1000,
(Length) 100-1000 is longer

*** [ends] ***
Find out about it on TV and on cine films and look at a tape from 10 years ago, and books
(easy/difficult?) Easy,

Watch the TV about it and look in museums and sometimes on the radio about it.
(Museums for 10?) Yes,

(easy/difficult?) Bit more difficult,

You'd use, certainly museums and books

(easy/difficult?) Much more difficult

GRADE: 3
10 YEARS FUTURE:

Same as we do

(easy/difficult?) Easy

100 YEARS FUTURE:

Kind of computers, tapes,
books, museums? I don't think they'll use books but I think they'll use museums

(easy/difficult?) Easier than it is for us
(easier than it is for 10 yrs) A bit

1000 YEARS FUTURE:

More computers, museums probably and old houses which they found

(Easy/difficult?) Easier than in 100 yrs time, easier than it is for us

CHANGE:

0-10: No it's the same,

10-100: Lot more, the clothes they wore and aircraft and transport

100-1000: All the clothes and the weapons and transport

(More change?) Er, most between 100-1000,
(Length) 100-1000 is longer

*** [ends] ***
SCHOOL: Woodlands   SNO: 7   DATE: 17/6/86
CLASS: 8   AGE: 11.1   NAME: S Carter

10 YEARS AGO:

There are history books and could ask your relatives.

(easy/difficult?) Easy

100 YEARS AGO:

Well history books I suppose, and television.

(television for 10?) Well it doesn't really tell you, but you can see what it was like.

(easy/difficult?) It's quite easy but you can't get the exact dates of things - can't know exactly.

1000 YEARS AGO:

That's even harder cos they've only got books which don't give you the exact dates, just give you round about.

(else?) Well they do sometimes have programmes.

(easy/difficult?) Even more difficult.

GRADE: 4
I suppose the same as we do
(easy/difficult) Easy,

Might do the same but they might have new machines, computers, to keep records on
(easy/difficult?) Well maybe they'll have better records,
(computers for 10?) I don't expect so, it'll be same as today

Well then I expect it'll be harder, Can't imagine what it'll be like but I don't expect they'll find it all that easy
(computers?) Probably get rid of them well before that and have new things
(easy/difficult?) Well its a longer time

Yes quite the same

A lot different, There wasn't television, lots of things like microwave stuff like that

Even more, The way they dressed and speak, most change
(Length?) 100-1000 is longest

*** [ends] ***
APPENDIX H

Study 2, Chapter 7
APPENDIX H  Study 2 Chapter 7

Details of analyses

1. Number of subjects in each condition:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Individual</th>
<th>Collective</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroups of subjects: Stage 1</td>
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<tr>
<td>2</td>
<td>11</td>
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<tr>
<td>Total:</td>
<td>23</td>
<td>54 (27 pairs)</td>
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</table>
2. **Scores on task:**

Scores for each section of the worksheet are shown. P1 indicates pre-visit grade, as assessed by interview. P2 indicates post-visit grade.

**Individual condition:**

<table>
<thead>
<tr>
<th>Subject No</th>
<th>Age group</th>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
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<th>P2</th>
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Collective condition:

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<th>Part 3</th>
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<th>P2</th>
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2x3:
(Grade 2 allocated Part 1)

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### 4x3:
*(Grade 3 allocated Part 2)*

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### 3x4:
*(Grade 3 allocated Part 1)*

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3. ANALYSIS OF VARIANCE - significant results:

CONDITION (Collective v individual) X TASK (Part 1, Part2, Part3)

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INDIVIDUALS GRADED 2 v DYADS BOTH GRADED 2: CONDITION X TASK

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APPENDIX I

Study 3, Chapter 9
APPENDIX I  Study 3 Chapter 9

INTERACTION PROCESS ANALYSIS

Form for interaction scoring pad

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Percent 0 10 20 30 40
(For profile display)
APPENDIX J

Study 3, Chapter 9
APPENDIX J Study 3 Chapter 9

### Number of family group types visiting 3 exhibits

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M = Adult Male (Father)
F = Adult Female (Mother)
m = Male Child (Son)
f = Female Child (Daughter)
Absolute numbers for pairs (adult/child):

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<td>39</td>
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<td>Fathers and Daughters</td>
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<td>19</td>
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\[
\text{ACTOR RATIO} = \frac{\text{No. of Acts}}{100} \times \frac{\text{No. of Persons}}{\text{No. of Persons}}
\]

**Actor Ratios: Launchpad**

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<tr>
<td>Father to Daughter</td>
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Actor Ratios: Transport

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Actor Ratios: Agriculture

Father to Son \[ \frac{25}{30} \times 100 = 83 \]

Father to Daughter \[ \frac{24}{25} \times 100 = 96 \]

Mother to Son \[ \frac{13}{20} \times 100 = 65 \]

Mother to Daughter \[ \frac{12}{19} \times 100 = 63 \]

Son to Father \[ \frac{14}{30} \times 100 = 47 \]

Son to Mother \[ \frac{5}{20} \times 100 = 25 \]

Daughter to Father \[ \frac{10}{25} \times 100 = 40 \]

Daughter to Mother \[ \frac{11}{19} \times 100 = 58 \]
Number of Interactions for Specific Groupings

(AR = Actor Ratio)

One parent (father) plus male AND female children:

Transport:

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Agriculture:

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One parent (mother) plus male and female children:

Launchpad:

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<th>To Daughter</th>
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<td>4</td>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>Son</td>
<td>3</td>
<td>3</td>
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<td>2</td>
<td>167</td>
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<tr>
<td>Daughter</td>
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<td>2</td>
<td>3</td>
<td>-</td>
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Transport:

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Two parents plus boy(s) only:

**Launchpad:**

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<td>6</td>
<td>8</td>
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**Transport:**

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<th>To Son</th>
<th>AR</th>
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**Agriculture:**

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Two parents plus girl(s) only:

**Agriculture:**

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<tbody>
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Father plus girl OR boy

**Launchpad:**

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### Agriculture:

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### Mother plus boy OR girl:

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(NB : Only groupings containing 3 or more subject groups are shown)
APPENDIX K

Study 3, Chapter 9
APPENDIX K Study 3 Chapter 9

CORRESPONDENCE ANALYSIS

Input details:

No. of rows in the matrix = 3
No. of columns in the matrix = 12

Labels for plotting columns are:
Launchpad........C1
Transport........C2
Agriculture......C3

Labels for plotting rows are:
P1..............R1
P2..............R2
P3..............R3
A1..............R4
A2..............R5
A3..............R6
Q1..............R7
Q2..............R8
Q3..............R9
N1..............R10
N2..............R11
N3..............R12

P - Positive
A - Answers
Q - Questions
N - Negative
Matrix of row by column probabilities:

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<th>C3</th>
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Output details:

No. of Principal Inertias: 1

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Column and Row Coordinates:

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</table>
APPENDIX L

Study 4, Chapter 10
Preliminary set of questions - Gear Wheels Exhibits

1) How do you make the small wheel go round? Describe what happens when it turns.

2) Do all the wheels go round at the same speed?

3) Which wheel turns most slowly

4) Why?

5) If the big wheel is turned very fast, will it still be going more slowly than the small wheel, or will it go as fast, or faster?

6) The big wheel is twice as big as the small wheel - if it goes round at 2 mph, can you say how fast the small wheel will go round?

7) If the big wheel goes even faster, say 4 mph, how fast will the small wheel go then?

8) If the big wheel is 3 times as big as the small wheel and goes round at 2 mph, how much faster will the small wheel go then?
APPENDIX M

Study 4, Chapter 10
APPENDIX M Study 4 Chapter 10

Photographs used with pilot sample questionnaire

Question 1
Question 1

Question 2
APPENDIX N

Study 4, Chapter 10
APPENDIX N  Study 4 Chapter 10

Pilot sample questionnaire
Subject No: Gallery:

(Show three photos of wheels)

1. These are photographs of 3 different kinds of wheels you can find in the new Launchpad Gallery. You can also find examples of all three in other parts of the museum. The three kinds of wheels are GEAR WHEELS, PULLEY WHEELS AND TRAIN WHEELS. Do you know which is which?

Gear wheels ..........
Pulley wheels ........
Train wheels ........

(Show second photo of gear wheels)

2. Look at the gear wheels from the LP exhibit on this photo. If you turn the handle on the big wheel what happens?

..............................(all the wheels move round)

3. When the wheels are going round, do they all move at the same speed?

...........................................................(No)

4. Which wheel moves most slowly?

...........................................................(The big one)

5. Why?

...........................................................(Bigger diameter)

6. If you turned the handle so that the big wheel goes very fast, will it always go faster/slower than the others?

...........................................................(Yes - always slower)

7. The big wheels is twice as big as the smallest wheel. If the big wheel was going round at a speed of 4 rounds per minute, can you say how fast the small wheel would go round?

...........................................................(@ rpm/twice as fast)

8. If the big wheel goes faster, say at 8 rpm, how fast will the small wheel go then?

...........................................................(@ rpm - still twice as fast)
9. Say we don't know how much bigger the large wheel is but we know that when it does 2 rpm, the smallest wheel does 6 rpm. Can you say then how fast the small wheel would go if the big wheel was doing 3 rpm?

..............................3 rpm = 3 times as fast)

Family size:

First visit  Return visit  Launchpad visited

Interest in technology?

Occupation

Sample: Adults accompanied by kids (1 adult and 1 child minimum). Children should be school age.
APPENDIX O

Study 4, Chapter 10
Questions for Transport Exhibit

1. Can you describe what is happening in this exhibit? Describe how the gear wheels work.

2. Do both gear wheels go round at the same speed?

3. Which gear wheel turns most slowly?

4. Why?

5. If the big gear wheel was turned round very fast, would it (still) go more slowly than the small one or will it go at the same speed, or faster?

6. If the big gear wheel was twice as big as the smaller wheel and it goes round at 4 rounds per minute (rpm) can you say how many rpm the small wheel will do?

7. If we made the big wheel go faster, say at 8 rpm, how fast will the small wheel go then?

8. Say we don't know how much bigger the big gear wheel is, but we know that the small wheel goes at 6 rpm when the big wheel is going at 2 rpm. How many rpm would the small wheel do if the big wheel is going at 3 rpm?
APPENDIX P

Study 4, Chapter 10
APPENDIX P Study 4 Chapter 10

Questions for Agriculture Exhibit

1. Can you describe what is happening in this exhibit? Describe how the gear wheels work.

2. Do all the gear wheels go round at the same speed?

3. Which gear wheel turns most slowly?

4. Why?

5. If the big gear wheel was turned round very fast, would it (still) go more slowly than the small one or will it go at the same speed, or faster?

6. If the big gear wheel was twice as big as this smaller wheel and it goes round at 4 rounds per minute (rpm) can you say how many rpm the small wheel will do?

7. If we made the big wheel go faster, say at 8 rpm, how fast will the small wheel go then?

8. Say we don't know how much bigger the big gear wheel is, but we know that the small wheel goes at 6 rpm when the big wheel is going at 2 rpm. How many rpm would the small wheel do if the big wheel is going at 3 rpm?
APPENDIX Q

Study 4, Chapter 10
APPENDIX Q Chapter 10 Study 4

ANALYSIS OF VARIANCE - significant results:

Children's scores:

EXHIBIT (interactive, pushbutton, static) X CONDITION (Social v individual)

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<th>MS</th>
<th>F</th>
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EXHIBIT X CONDITION X GENDER

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GROUP TYPE (Male/male, Male/female, Female/male, Female/female) X CONDITION

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Parent's Scores:

EXHIBIT X CONDITION X GENDER

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T-TESTS

Children's Scores:

Launchpad Exhibit: Social v Individual condition

Scores

Social:  Individual:

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<td>24</td>
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</tbody>
</table>

\[
\begin{align*}
\text{Social:} & \quad 63 \\
\text{Individual:} & \quad 43 \\
\end{align*}
\]

\[
\text{Social} \times 5.25 \quad \text{Individual} \times 3.58
\]

Independent t-test (one-tailed) \( t = 2.29, df = 22, p > .05 \)
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