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**Conceptual and Lexical Functioning in Blind, Severely
Visually Impaired and Sighted Infants**

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Declaration

The work contained in this thesis has been carried out entirely by the author. None of the material has been submitted for a degree or similar purpose before.

Summary

This thesis examines the role of vision in language development by focusing on: first, the understanding blind infants have of objects, actions/events and the way they start to talk about these aspects of their environment; and, second, the ways visual information contributes to conceptual and lexical development in sighted infants. Until recently, research has predominantly focused on infants' understanding of objects and their understanding of actions/events has been neglected. Since individuals who are blind predominantly have access to temporal, rather than spatial information and so are better able to process information about actions and events rather than objects, this bias seems to have led to the conclusion that an absence of visual information results in a cognitive deficit.

Six blind/severely visually impaired infants and their sighted controls were studied for around a year using a range of quasi-experimental, parental report and observational techniques. The studies found little difference between the blind and sighted infants in the age of onset or rate at which first words are produced. However, blind infants were found to be delayed in the age at which they were able to comprehend and produce labels for objects and they produced few words for concrete, discrete objects. The finding that the blind infants were able to categorize objects/actions as well as generalise and extend their words calls into question Dunlea's (1989) claim that an absence of visual information leads to a cognitive deficit. It is argued that blind infants can make their way into language using a route which is merely one end of a spectrum of routes used by sighted infants. Implications are discussed for theories of lexical development (multiroute model, developmental lexical principles framework and the social-pragmatic framework) as well as for possible strategies^{to} facilitate conceptual and lexical development in blind/SVI and sighted infants.

Chapter One

Introduction

The purpose of this thesis is to further understanding into the extent to which visual information influences aspects of language functioning. The notion that these two factors may relate to each other became a topic for discussion in the seventeenth century, when empiricist philosophers considered what sense congenitally blind individuals with recovered sight would make of the world. In his 1690 *Essay Concerning Human Understanding* Locke commented on whether such individuals would continue to rely on touch to make sense of their environment. He speculated that their understanding of the world would be limited because the concepts which words encoded could only be accessed through vision. This implied that visual experience was a pre-condition for the recognition and labelling of objects visually. Furthermore, Locke proposed that visual experience was necessary for an understanding of visually related words like *look* and *light*.

Unlike philosophers, linguists largely disregarded consideration of the relationship between visual information and language functioning until the 1960's. A number of researchers interpreted this disregard as implying that linguists assumed there to be only limited negative consequences of blindness on language functioning (McGinnis 1981; Kekelis and Andersen, 1984; Dunlea, 1989). This interpretation supports the position adopted by Miller (1963) who approached the study of the relationship between visual information and language functioning by commenting on the role of visual information in the acquisition of language. In particular, Miller predicted that an absence of visual information would result in faster language learning on the grounds that blind children depend on language as a form of communication. Seventeen years later, Chomsky (1980) reiterated this view by proposing a significant rate advantage for language development in blind children. In contrast however, Piaget's theory suggests that a lack of vision would "slow down"

sensorimotor functioning, and so subsequently influence language functioning (Cromer, 1991).

Clinicians and educators were drawn to the study of language acquisition in blind children between 1940 and 1954, when there was an increase in the number of babies who were born prematurely and subsequently blinded by an overexposure to oxygen (Stone and Church, 1957). A number of clinicians studied patterns of development in these infants (e.g. Burlingham, 1961; Gessell and Amatruda, 1947; Cole and Tabaroff, 1955; Fraiberg, 1977), and it was around this time that the first clinical accounts of language usage in blind infants appeared (e.g. Wilson and Halverson, 1947; Norris, Spaulding and Brodie, 1957; Keeler, 1958; Burlingham 1961, 1965; Haspiel, 1965; Fraiberg, 1977). The most influential, widely cited of these was completed by Fraiberg (1977) who undertook a longitudinal investigation of the emergence of language alongside the development of attachment, prehension, motor skills, communication and representation of the self in play in 10 blind children.

Whereas previous discussions largely centered on the examination of how the absence of visual information influenced any *one* aspect of language functioning, Fraiberg's study was notable as she systematically described how an absence of visual information influenced a number of aspects of language functioning. For instance, she established that the majority of blind infants in her study attained language milestones within ranges expected for sighted infants although she observed that their ability to use pronouns was delayed. Moreover, she provided extensive notes on qualitative aspects of language functioning.

Fraiberg's studies paved the way for developmental linguists to examine different facets of language functioning in blind infants. These included studies of phonological development (Mills, 1983), syntactical development (Peters, 1994; Wilson, 1985), morphological development (Dunlea and Andersen, 1992; Miecznikowski and Andersen, 1986), lexical

development (Bigelow, 1983; McConachie and Moore, 1994), semantic development (Dunlea, 1989) and pragmatic development (Dunlea, 1989; Klincans, 1991; Perez-Pereira and Castro, 1992). In line with recent studies, the present thesis approaches the relationship between visual information and language functioning by examining conceptual and lexical development in blind children.

1.1. Aims of thesis

The goal of the thesis, to examine the relationship between visual information and early conceptual and lexical functioning, is supported by three aims. The first is to examine how an absence of visual information influences early conceptual and lexical functioning in blind infants. More specifically, it is to examine the understanding blind infants have of actions, objects and events and the way they start to talk about these aspects of their environment.

The second aim is to gain insight into the ways in which visual information contributes to conceptual and lexical functioning in sighted infants. Consideration of the nature of language development in blind infants has previously informed the kinds of theoretical questions that are being posed about language development in sighted infants. For instance, blind infants were considered a suitable test case at the time when theorizing in developmental psychology was particularly concerned with examining whether abilities were innate, learned or the result of an interaction of both factors (e.g. Junefelt, 1987). The rationale was that if the language ability was innate then a visual deficit would not interfere with the process and that the converse would be true if language was learned. It is now recognized that such dichotomies between nature and nurture are not helpful in explaining development (Oyama, 1985). However, intermediate interactionist positions have also received criticism by those who argue that 'interaction' is treated as nothing more than a term for representing the unexplained (Hyland, 1984; Johnston, 1987). In the light of these views, the study of blind infants has been used to inform theories of language development in new ways. Several researchers have pointed out that recent accounts of

aspects of language development assume vision to be intimately involved in the process but that these accounts fail to specify how (Mulford, 1988). One goal of studies of language functioning in blind infants has been to examine the extent to which vision necessarily or sufficiently contributes to the process of language development (Mills, 1983; Prizant, 1984; Urwin, 1984; Mulford, 1988; Tager-Flusberg, 1994). In line with this position, this thesis provides further data relevant to the extent to which vision is necessary or sufficient for the emergence of various aspects of early conceptual and lexical development.

New theoretical advances in understanding how sighted infants begin to learn and understand words can also offer also scope for understanding lexical development in blind infants. As explained above, observations of blind infants can help to inform such theories about sighted infants, thus there is a mutual exchange of information between these two areas of enquiry. Sighted infants are included in the empirical studies reported in this thesis so that the extent to which the lexical strategies of blind infants and sighted infants are similar can be evaluated. Furthermore, the inclusion of sighted infants enables new findings on lexical functioning to be established where no immediate point of reference exists in the literature. However, there is also a danger that, by consistently applying ideas and techniques used with sighted infants to the study of blind infants, any special features of lexical functioning in blind infants may be missed. For example, if Fraiberg (1977) had driven her research solely based on techniques used with sighted infants, then she might have missed observations of the special hand communication made by blind infants. In light of this concern, this thesis attempts to study lexical development in blind infants without uncritically adhering to techniques used with sighted infants.

The outcomes from the first two aims of the thesis contribute to the third aim, which is to suggest strategies for aiding conceptual and lexical development in blind infants. Identification of strategies for intervention with blind infants is especially important since it has been suggested that blind infants rely much more on language as a means of

exchanging information with others than sighted peers (Urwin, 1984; Perez-Periera and Castro, 1992). Thus any problems arising in the domain of language development may exacerbate more general aspects of social and psychological functioning caused by blindness. The aim of identifying conditions in which blind infant's conceptual and lexical development may be promoted does not necessarily imply that their conceptual and lexical development is different from that of sighted infants. Rather, it implies that language is a far more important tool for communicative exchange for those who live in a world organized for the needs of sighted individuals.

1.2. Blindness and severe visual impairment (SVI)

So far, the word 'blind' has been used to describe individuals who have a visual deficit, although, there are, of course, different degrees of impairment. Theoretically, an infant who exhibits no visual response is the ideal case to study since an absolute deficit creates the opportunity for determining the role of vision in conceptual and lexical development. This outlook is reflected in much of the literature, where most studies aim to establish a sample which include infants with as little vision as possible. This obviously raises questions about the extent to which findings can be generalised to the rest of the blind population. Parents, clinicians, teachers and other individuals who work with blind infants require information relevant to infants who have a wide range of visual impairments. Recent studies of language development in these infants have taken this into account by involving groups of infants and children who are classified as either 'blind ' or 'severely visually impaired' (SVI) (Moore and McConachie, 1994; Dunlea, 1989). In these studies, 'blind' is defined as either having no vision or vision which is limited to light perception. SVI is defined a minimal amount of form vision such that the infants can usually detect movement and might be able to use their residual vision to help them move around their environment. Support for separating groups with different degrees of visual impairment comes from studies which detect a difference in language functioning between groups

(Dunlea, 1989; McConachie and Moore, 1994). This thesis seeks to examine how a limited amount of vision influences conceptual and lexical functioning by establishing a sample of both blind and SVI infants. Thus each of the three aims presented above also applies to SVI infants.

1.3. Organisation of thesis.

The theoretical basis for the thesis is presented in **Chapters Two and Three**. **Chapter Two** provides an account of conceptual and lexical functioning in sighted infants, by considering both quantitative and qualitative aspects of lexical functioning and identifying the phenomena which theories of lexical development need to account for. It reviews several theoretical explanations of lexical development and considers the extent to which vision has been incorporated into each theory. **Chapter Three** reviews conceptual and lexical functioning in blind infants, through questioning some of the assumptions upon which previous studies of conceptual-lexical development have been based (e.g. Mulford, 1988; Dunlea, 1989) as well as using their findings to identify the objectives supporting the aims of the thesis.

Information about the infants participating in the studies and the methodological techniques to be used in the thesis is presented in **Chapter Four**. The studies reported in **Chapters Five to Eight** each examine different aspects of conceptual and lexical functioning in blind, SVI and sighted infants, the results from each study being carried forward to inform the findings from later studies in the thesis. **Chapter Five** presents findings about the status of developmental functioning and general trends of conceptual and lexical functioning of infants participating in the studies. The study reported in **Chapter Six** explores the extent to which blind/SVI and sighted infants are able to sort a set of objects into classes and discusses whether or not this is an appropriate indicator of their level of conceptual functioning. It uses the findings reported in **Chapter Five** to understand whether abilities in comprehending labels for objects may be related to abilities in sorting

objects. In addition, it makes comparisons between different techniques used to assess sorting strategies. The study reported in **Chapter Seven** focuses on the age at which blind/SVI and sighted infants acquire their first words as well as examining the content of their early vocabularies. The study reported in **Chapter Eight** uses a naturalistic approach to examine the extent to which blind infants gain experience with objects, routines and rhymes and what they talk about in their second year. The study also addresses the extent to which blind/SVI infants are able to initiate appropriate self-action during nursery rhymes. Findings on how infants act on objects in this study are compared with the findings of the way infants played with objects in the study reported in **Chapter Six**. In **Chapter Nine**, conclusions are drawn for each aim of the thesis: to further understanding about the nature of conceptual and lexical functioning in blind / SVI infants; to further understanding about the role of vision in the conceptual and lexical development of sighted infants and finally, to identify strategies which may promote conceptual and lexical development in blind, SVI and sighted infants.

Chapter Two

Lexical Development in Sighted Infants

2.1. Introduction

The study of lexical development is considered here in terms of how it relates to the more general question of how language is acquired, as well as to aspects of conceptual functioning and other developments during infancy. It is argued that previous studies of conceptual-lexical development have been biased in several ways and that these have subsequently influenced the nature of theoretical explanations proposed to account for lexical development. Descriptions of lexical development are presented by reporting findings from studies using quantitative approaches focusing on the age at which particular milestones are attained as well as the rate at which words are acquired. Qualitative aspects of lexical functioning are described here in terms of the emergence of several phenomena: the vocabulary explosion, context-bound word usage and word extension. The way infants use words in different ways when they first start to talk and the importance of explaining variation in lexical functioning between infants is also discussed.

The nature of conceptual development is addressed here in terms of what infants understand about objects, as well as what they understand about actions and events, in the period before the onset of speech and in the first months of language learning. Early lexical development is related to the possible influence of general environmental factors such as birth-order, gender and socio-economic status as well as to non-verbal and verbal aspects of the environment.

Several theoretical explanations of lexical development are presented and evaluated with respect to the extent to which they successfully explain various phenomena of lexical development as well as the different developmental profiles of words, the acquisition of

different word types and variation between infants. Crucially, the extent to which each account involves visual information in lexical development is discussed. Finally, those theoretical explanations judged to offer the most scope for understanding the relationship between visual information and lexical functioning are identified.

2.2. The study of lexical development: its relationship with language acquisition and other developments

The pool of 50,000-250,000 words adults use and understand constitutes their lexicon (Aitchison, 1987). The question of how this pool is created lies at the heart of research into lexical development. It involves an examination of how infants and children come to use word forms and produce and understand the conventional meanings of words (Nelson, 1991). The study of lexical development needs to be considered as an integral part of the general question about how language develops. In particular, it needs to be viewed as developing alongside phonological, syntactical and pragmatic aspects of language development. After all, words are pronounced, combined with other words and used in particular situations for a variety of different purposes. On this basis, observations of developments in other aspects of language functioning as may be used as evidence to aid the interpretation of developments in lexical functioning where relevant.

Language is not an isolated 'thing' to be obtained, it needs to be seen more as a form of action into which the child grows because it is part of the developmental system itself (Lieven and McShane, 1978; Studdert-Kennedy, 1991; Thelen and Smith, 1994). The question of how lexical development proceeds cannot be studied entirely separately from other developments during infancy and this thesis attempts to consider lexical development as a skill to be acquired which is related to other domains of development. In this vein, early lexical functioning is considered alongside conceptual development, in particular, the kind of understanding and experience infants gain with objects, actions and events prior to, and in the early months of speech.

Recently, Johnston (1995) has drawn attention to the idea that we need to consider relationships between domains of development that seem, *prima facie* to be quite separate from each other. For example, we might consider how lexical development relates to motor development: an infant who has started to walk is likely to have a greater opportunity to access new objects or parts of objects (e.g. drawers and their contents, doors etc). This, in turn, may result in conversations between infants and their parents about these new objects, which may lead to an increase in the infant's vocabulary size. In addition, new opportunities for action with these objects by the infant may arise, resulting in word-like forms being used in new ways. This thesis considers lexical development within the broader context of infant development itself. Although there is no systematic study of these other areas, reference will be made to them when considered beneficial to the interpretation of results in lexical functioning presented in the empirical chapters.

2.3. Biases in the study of lexical development

To date, studies of lexical development have largely been preoccupied both with infants' *production* of words and with their use of words for *objects* (e.g. Clark, 1973; Reich, 1976; Anglin, 1977, 1983, 1986; Gruendel, 1977; Barrett, 1978, 1982; Bowerman, 1978; Rescorla, 1980; Dromi, 1987; Golinkoff, Mervis, Hirsh-Pasek, 1994; Shore, Dixon, Bauer, 1995; Yoder and Munson, 1995). It is argued that those preoccupations lead to an unbalanced view of the nature of lexical development (Shipley, Smith and Gleitman, 1969; Shore, 1995; Tomasello and Merriman, 1995), and moreover, that the development of some theoretical explanations of lexical functioning have been misguided.

One reason why studies have been concerned with production at the expense of comprehension may be because methodologically it is far easier to look at the range and variety of words in studies of production. Comprehension has been studied when fine details of understanding are required, for example in the study of the comprehension of cognitive mental terms (e.g. Astington, 1986; Hill, 1995). However, since the

comprehension of these terms does not emerge until around 36 months, this research bias towards studies of production persists in studies of lexical functioning during infancy.

The research bias on production has inevitably lead to an underestimation of infant's lexical repertoires. For example, Fenson, Dale, Reznick, Bates, Hartung, Pethick and Reilly (1993) demonstrated that infants who were able to produce 10 words had corresponding receptive vocabularies of, on average, 110 words. One implication of this study is that more attention needs to be paid to infant's lexical repertoires in comprehension as well as those in production. Caution is required before making assumptions about infants' overall level of lexical sophistication in the absence of many studies which investigate abilities of comprehension.

The second bias concerns the way that words for objects are studied in preference to words from any other kind of category. Merriman and Tomasello (1995) were particularly interested in studying how infants and children learned words for actions and considered several reasons why objects have been focused on, to the virtual exclusion of verbs. They argue that the preoccupation with object naming may date back to the 1970's and 1980's when object labels were particularly well suited to the comparison of competing theories of lexical development. At that time, Clark's (1973) semantic feature theory was being pitched against Nelson's (1974) functional core theory. Whereas semantic feature theory proposed how children might learn all types of words, functional core theory was concerned with how children learned words for objects. Given that the lowest common denominator between the two theories was how infants learn words for objects, this was the basis upon which empirical studies were conducted and the two theories subsequently compared.

A further focus for research in the 1970's which heightened the bias towards objects was the study of natural categories. In brief, the core idea was that some objects are better examples of some categories than others e.g. an apple is a more prototypical version of a fruit than an elderberry is. This approach set the context for a series of empirical studies

focused on the development of word production for these basic level category words for objects. Action words did not receive much attention in this approach, because, as has been recognized, no-one had set up equivalents to the basic level object category in the action domain (Clark, 1993; Merriman and Tomasello, 1995).

Another reason why object labels were considered particularly well suited to the study of lexical development was that studies of conceptual functioning focused on objects rather than actions. Such studies examined infants' abilities to sort objects to the exclusion of actions / events. Tomasello and Merriman (1995) admit that it is difficult to design a suitable task to examine the way infants categorize actions / events since, unless actions are represented on cards they cannot be sorted into piles. Moreover, sorting actions using cards into piles does not do justice to the dynamic quality of action, thus interest in the conceptual basis for word learning was dominated by the examination of the relationship between words and objects rather than between words and actions / events, which further contributed to the imbalance within the literature (Merriman and Tomasello, 1995).

In sum, the focus on the production of names for objects has directly influenced the nature of theories of lexical development. Tomasello (1995) argues that the conceptualisation of lexical development would be different if object label acquisition had not been the paradigmatic case. In support of this view, recent theorizing argues for consideration of general acquisitional principles (Golinkoff, Mervis and Hirsh-Pasek, 1994). Moreover, when studying the lexical acquisition of blind / SVI infants, it is particularly important to avoid an exclusive focus on object related words, since these infants' access to percepts (and possible concepts) of objects is questionable (see **Chapter Three**).

2.4. What do theoretical explanations of lexical development need to account for?

This section examines the issues of when infants start to understand and produce words and what they talk about. Several phenomena of lexical development are introduced: the vocabulary explosion, context-bound word usage and word extension. There is also discussion of the way infants use words and word-like forms when they first start to speak and the importance of considering individual differences between infants.

2.4.1. Quantitative aspects of lexical development: age of onset of first words, rate of word learning and the vocabulary explosion.

It is difficult to draw a clear distinction between the pre-lexical and the lexical period since, during the transition phase, infants use both phonetically consistent and inconsistent forms. However, for convenience, it is practical to view the onset of lexical development as being the time when infants start to produce consistent forms which approximate the forms used in speech directed towards them. As discussed earlier, studies of production are more common, though the few available studies of the onset of word comprehension suggest that this begins between eight to ten months of age (e.g. Reynell, 1979; Bates, Dale and Thal, 1995). A study of productive vocabulary by Nelson (1973) demonstrated that the 18 infants she studied produced 10 words between 13 and 19 months (mean 15 months) and that 50 words were achieved between 14 and 24 months (mean 20 months). Whereas Nelson used the parental diary method, a recent study by Fenson (1993) on a sample of 1,789 infants and children required parents to check words off an established list. The results of this study showed that 10 words were attained between 8 to 16 months (mean 13 months) and that 50 words were achieved between 10 to 24 months (mean 17 months). Thus for both 10 and 50 word milestones, the larger range of age was found in Fenson's study. The difference between the two studies is representative of how early studies (e.g.

Nelson, 1973) tended to underestimate the range of individual differences because they were based on small numbers of infants.

Studies of the rate of acquisition show that, during the second year, there is an increase in the rate of vocabulary growth (Nelson, 1973; McCune-Nicholich, 1981; Dromi, 1987; Gopnik and Meltzoff, 1987; Goldfield and Reznick, 1990), usually occurring after a 50 word vocabulary has been attained (Bates, O'Connell and Shore, 1987). One reason why infants' vocabularies undergo a sudden increase in acquisition rate may concern the extent to which nouns feature in their vocabularies. Horgan (1977) reports that the children making the fastest language growth are those who engage in object naming. This finding is supported by Snyder, Bates and Bretherton (1981) who found a correlation of 0.51 between the percentage of common nouns and total vocabulary size. Other researchers have commented that the vocabulary burst may be linked with general shift in cognitive abilities. For example, Gopnik and Meltzoff (1987) studied 12 infants longitudinally from 15 to 20 months and observed that the vocabulary explosion was related to their ability to sort objects into groups spatially. This ability is thought to signify that children understand that objects can be alike and that they can exist in categories (see **Section 2.5**).

Recently, the existence of the vocabulary explosion has been questioned by researchers on several grounds. Lieven and Pine (1990) dispute the finding that the children making the fastest vocabulary growth are those who engage in object naming, on the grounds that the proportion of nouns in early vocabularies tends to increase regardless of whether children rely on nouns or not. Others have questioned Gopnik and Meltzoff's (1987) claim that towards the end of the second year, some cognitive shift occurs, on the grounds that some children produce words that are used referentially within their first 10 words (Harris, Barrett, Jones and Brooke, 1988). Reasonably then, for some infants, insight is gained into the naming process before they acquire any words or, at least, from very early on in their lexical careers.

Another criticism concerns the extent to which the vocabulary explosion is a universal phenomenon (Bates, Dale and Thal, 1995). Bates *et al.* argue that although evidence suggests the existence of a period of acceleration during the second year, there is actually no single "take-off" point of the kind assumed by most studies. In support of this, Goldfield and Reznick (1990) report that the vocabularies of five out of the 18 children they studied did not manifest any notable change in rate. Instead, others noted that individual vocabulary growth curves are fitted best by a smooth exponential function or non-linear functions like the quadratic or the logistic (Van Geert, 1991; Bates and Carnevale, 1993).

In sum, the literature suggests that the phenomenon of the vocabulary burst is not automatically part of lexical development in all infants and, furthermore, that any change in rate may represent itself more as a gentle acceleration than a 'burst'. As noted earlier, there have been substantially more studies of development in production than comprehension; findings about quantitative aspects of lexical development may therefore underestimate the age at which infants' lexical capacities emerge as well as the rate at which they acquire words.

2.4.2. What do sighted infants talk about?

Many of the types of words infants first start to produce are often concerned with the 'here and now', they talk about things happening in front of them, rather than absent objects, actions and events. Studies of the composition of early vocabularies show that around 50% of an infant's early vocabulary is based on general nominals - words referring to things (e.g. names for animals, food and clothing) in the environments (Nelson, 1973). Specific nominals - words referring to people, or pets, as well as words for actions, are also produced frequently. Finally, modifiers - words referring to properties or qualities of things or events are less common in early vocabulary. Likewise, function words, those serving a purely grammatical function (e.g. *where*, *for*), are also relatively infrequent. Researchers have reported individual differences between infants in the composition of

their vocabularies, especially the proportion of nominals and personal-social words in their early vocabularies - those words expressing affective states and social relations (e.g. *don't do that, good-night*). Whereas some infants are observed to use a large proportion of general nominals and few social expressions, for other infants, the converse seems to be the case. The significance of such individual differences is discussed further in **Section 2.4.6.**

2.4.3. Context-bound word usage

Infants are often thought to first use words in a context-bound way by constraining their use to highly specific situations and producing them in response to the occurrence of well defined contexts (Barrett, 1986; Bloom, 1973; Harris, Barrett, Jones and Brookes, 1988; Nelson, 1985; Tomasello, 1992). For example, Tomasello (1992) demonstrated the way one child used the word 'brush' when grooming their own hair with a particular brush. Subsequently, brush was used to refer to different types of brushes. Thus the word 'brush' was initially used in just one particular context and thereafter decontextualised for use in a wider range of situations.

The view that words are first used in a context-bound way and subsequently used in a variety of circumstances is viewed by some to suggest a cognitive shift signifying that infants have gained insight into the way words can be used flexibly (Gopnik and Meltzoff, 1987). However, evidence suggests that some words are used in a variety of circumstances as soon as they start to be produced whereas others are context-bound to start with (Harris, Barrett, Jones and Brookes, 1988). In line with this position, Ninio (1993) regards it as inappropriate to view context-bound speech as a response to a situation. Rather, she argues that the criterion for viewing a word as context-bound involves making assumptions about which aspects of a context stay the same or change. Ninio also argues that so called context-bound words are communicative and that, if they held no communicative intent, then they would not be produced in the first place.

In sum, recent approaches to lexical development suggest that words may be context-bound at different points in development and that a substantial number of words may never be used in a context-bound way at all. In addition, the idea that context-bound speech is developmentally inferior to other kinds of speech has been questioned.

2.4.4. Extensions

When infants use words referentially to refer to new referents in their environment, their speech often contains errors, in the form of underextensions and overextensions. Underextension refers to the way in which infants use a referential word in a range of different situations to refer to only a portion of the full range of objects, states, actions and properties typical of standard adult usage. For instance, an infant might use the word 'dog' to refer to poodles and not other kinds of dogs. Overextension refers to the way in which infants use a referential word for the appropriate adult standard usage as well as for additional objects and entities which would normally be referred to by another word in adult usage. For instance, an infant might say 'watering-can' to refer to objects that carry water and distribute water in spray form for watering vegetation, as well as to refer to fountains.

Anglin (1977) observed that most studies suggest that sighted infants underextend between 12 and 29% of their object names. Similarly, Barrett (1995) estimated that infants overextend between 7 and 33% of their total vocabulary (e.g. Anglin, 1977; Greundel, 1977; Barrett, 1978; Rescorla, 1980; Nelson, 1982). The bias referred to in **Section 2.3** above has resulted in most studies being focused on the phenomena of overextension and underextension in relation to the use of labels of objects rather labels for actions, or other classes of words.

2.4.5. Differences in developmental histories of words

The frequency with which such phenomena as context-bound word usage and errors of extension are reported give the impression that these phenomena are common to all words used by infants. However, evidence suggests that different words produced by the same child can show different developmental profiles over time. For example, Dromi (1987) described the patterns in word use produced by one infant between 10 and 18 months of age, observing that context-bound usage and underextension tended to feature early on in the developmental history of words whereas overextensions occurred later. Furthermore, Dromi reported that around half of the child's words showed no change in usage across the period of study. Similarly, Tomasello (1992) reported that some of the words used by his daughter were decontextualised whereas others were restricted to use within the original context. A study of four children, aged 6 to 24 months, by Harris, Barrett, Jones and Brooke (1988), showed that although many of the very first words these children used were context-bound, a significant number of early words were referential. Such studies challenge the notion that the very first words children use are not used referentially and that infants are not able to understand that labels stand for things until they have reached some critical cognitive benchmark. Overall, these findings expose a critical weakness in theoretical explanations of lexical development and show a need to account for how different words produced by a child can show different developmental profiles over time.

2.4.6 Individual differences and lexical development

The idea that infant development is characterized by variation is hardly new. However, the status of individual differences in relation to theories of development has changed considerably over the last 30 years. Shore (1995) observed that, up until the 1970's, the only individual differences to be acknowledged were quantitative differences since both

nativistic and empiricist accounts implied a single route into language development and largely ignored the qualitative aspects of individual differences in the course of acquisition.

What is now a widely held view is summarized by Plomin (1995), who stated that any developmental theory must account for both quantitative and qualitative individual differences. He argued that differences must not be seen as noise in average developmental trends but rather as one of the phenomena to be explained, since explanations of normative development bear no necessary relationship to those of an individual's development. In support of this position, Bates, Dale and Thal (1995) argued that explanations of quantitative and qualitative variation within and between different aspects of language are crucial for understanding the mechanisms of language development. This thesis endeavours to handle diversity in lexical development by considering variations as data which need explaining rather than as noise that gets in the way.

Probably the first most influential study of qualitative variation in lexical development was completed by Nelson (1973) who based her conclusions largely on the study of the acquisition of the first 50 words produced by 18 infants between 12 to 24 months. Nelson distinguished between 'referential' infants for whom over 50% of their first 50 words were object names, and 'expressive' infants whose vocabularies contained words from a variety of classes, but which were often characterized by social expressions like "stop it" or "oopsadaisy". From observations of the content of early vocabularies, inferences were made about explanations of early language. Referential infants with higher proportions of nouns were judged to be demonstrating an interest in language as a way of talking about objects and categorizing them. In contrast, expressive infants with relatively low proportions of nouns were regarded as more socially oriented and demonstrating an interest in language as a tool to communicate about themselves and others. In line with Nelson's (1973) study, a number of subsequent studies have supported the finding that there is

variation in noun use across infants (e.g. Bloom, 1973; Dore, 1974; Starr, 1975; Peters, 1977; Horgan, 1977, 1978, 1981).

On the basis of a number of studies carried out during the 1980's, several claims were made for the existence of two strands in language development. At the time, the pair of terms "analytic" and "holistic" were used to describe these two different strands, terms which became an extension of the terms "referential" and "expressive" derived from Nelson's study (1973). A summary of the claims made in the literature about different characteristics of "analytic" and "holistic" styles for language development made by Bates, Bretherton and Snyder, (1988) is produced in Table 2.1. As can be seen from the table, the analytic style is considered developmentally superior to the holistic style. Furthermore, evidence suggests that an analytic style is associated with good comprehension, particularly of words for objects (Snyder, Bates, Bretherton, 1981; Bates, Bretherton and Snyder, 1988).

A number of serious empirical, methodological and conceptual criticisms have been made of the two route model. The summary of claims compiled by Bates *et al.* (1988) derived from literature about individual differences in language development turned out not to be consistent with the findings produced from their own longitudinal study of 27 children studied from 10 through to 28 months. Bates *et al.* (1988) concluded that the two factor theory was inappropriate to account for their data, and instead, argued that three distinct kinds of language acquisition mechanism play a different role at different age levels. Between 10 to 13 months and again at 28 months the two strand theory fitted the data, however, at 20 months there was a basic division between receptive and expressive language and that expressive language dissociated further into analysed output or rote output. In sum, Bates *et al.* (1988) argued that children differ not in whether they do or do not use a particular strategy but rather in the extent to which they use different modes of learning. An infant who relies on one mechanism more than another will result in a

Table 2.1. Summary of claims made about individual differences in language development (Bates, Bretherton and Snyder, 1988).

"Analytic" style		"Holistic" style
	<i>Semantics</i>	
High proportion of nouns in first 50 words		Low proportion of nouns in first 50 words
Single words in early speech		Formulae in early speech
Imitates object names		Unselective imitation
Greater variety within lexical categories		Less variety within lexical categories
Meaningful elements only		Use of "dummy" words
High adjective use		Low adjective use
Context-flexible use of names		Context-bound use of names
Rapid vocabulary growth		Slower vocabulary growth
	<i>Grammar</i>	
Telegraphic in Stage I		Inflections and function words in Stage I
Refers to self and others by name in Stage I		Refers to self and others by pronoun in Stage I
Noun-phrase expansion		Verb phrase extension
Morphological extension		Morphological undergeneralization
Consistent application of rules		Inconsistent application of rules
Novel combinations		Frozen forms
Imitation is behind spontaneous speech		Imitation is ahead of spontaneous speech
Fast learner		Slow learner
	<i>Pragmatics</i>	
Object oriented		Person oriented
Declarative		Imperative
Low variety in speech acts		High variety in speech acts
	<i>Phonology</i>	
Word oriented		Intonation oriented
High intelligibility		Low intelligibility
Segmental emphasis		Suprasegmental emphasis
Consistent pronunciation across word tokens		Variable pronunciation across word tokens
	<i>Demographic variables</i>	
Female		Male
Firstborn		Laterborn
Higher SES		Lower SES

qualitatively different picture from an infant relying on a different mechanism, although, ultimately, each of the three mechanisms are thought to be necessary to get into language.

Another criticism of the two strand theory, targeted at a methodological level, concerns the degree to which an evaluation of a theory of individual differences requires a large number of children. Bates, Marchman, Thal, Fenson, Dale, Reznick, Reilly and Hartung (1994) noted that most studies of stylistic variation have only been carried out on small numbers of children. They argue that, such studies may point to certain kinds of variation, but that these studies are insufficient to establish the incidence and prevalence of variation in the population as a whole.

A further criticism has been made of the finding of significantly higher rates of vocabulary acquisition in children following a referential-analytic approach to language development (Bates *et al.*, 1988). Pine and Lieven (1990) argue that this rate difference reflects developmental changes rather than stylistic differences, and that it is inappropriate for Bates *et al.* (1988) to use cross-sectional measures based on age to study strategy differences, since the proportion of nouns increases with vocabulary size regardless of whether the child tends towards referentiality or expressiveness. For instance, Pine and Lieven argue that not only will a relatively slow referential child appear less referential than a relatively advanced referential child but that a relatively advanced expressive child will appear more referential than a relatively slow expressive child. Examining this issue, Bates *et al.* (1994) controlled for vocabulary level, and found that the association between referentiality and precocity disappeared, suggesting no relative rate advantage existed for referential children.

Recent discussions of the status of qualitative variation suggest that, instead of dichotomizing between "analytic" and "holistic" styles, it might be better to conceptualize differences in terms of the size of the unit which infants produce (Bates, Dale and Thal, 1995). One interpretation of this is that children may be essentially analytic in their

approach to language, but may differ in the size of the unit they are able to process. A possibility is that children's tendency towards either analytic or holistic styles and the size of the unit an individual child deals with may each represent separate kinds of qualitative variation. Thus a child who tends towards an apparent analytic style with an efficient memory for longer units will be able to pick up and use phrases as well as analyzing them into and use their sub-parts.

This section addressed individual differences in lexical functioning as well as in related aspects of language development. Whereas earlier accounts emphasized variation in rate, more recent studies have recognized the value of seeking to explain variation of qualitative aspects of language development. During the 1970's and 1980's, the tendency was to focus on distinguishing between two styles of language development. More recent accounts however observe that these were gross oversimplifications of early language development. Instead, researchers are working towards establishing what constitutes sufficient evidence to enable the description and evaluation of previously undervalued qualitative variation and that the size of the unit of speech infants are able to process may provide a key to understanding developmental variation between infants (Bates *et al.*, 1995).

2.5. Lexical development and conceptual functioning

Theories on how language and cognition relate to each other have evolved significantly over the last 40 years. Before the early 1960's, the prevailing view was that cognition was dependent on language (e.g. Luria, 1961; Whorf, 1956), then, during the 1970's, attempts to explain the relation between language, cognition and development in infancy lead to a divergence between two views. One position was that language and cognition developed alongside each other in correspondence (e.g. Bates, Benigni, Bretherton, Camaioni and Volterra, 1977; Corrigan, 1978; Bates, 1979; McCune-Nicolich, 1981) and an opposing view was that language development depended upon cognitive development and that a serial relationship existed between the two (e.g. Bloom, 1970; 1973; Cromer, 1974;

Harding and Golinkoff, 1979). As a result of several conceptual and methodological criticisms, more recent perspectives have argued for a mutual interdependence between aspects of language and cognition (e.g. Bloom, Lifter and Broughton, 1985; Dromi, Leonard and Shteiman, 1993).

The opportunity to unravel the ways language and cognition relate to each other is significantly expanded through examination of conceptual functioning prior to, or in the early months of language learning. This is because, before the emergence of a lexical repertoire, it is possible to simply consider the infants' structuring of their environment without 'contamination' from their linguistic development. A number of studies have been carried out to gain insight into infants' capacities to categorize, that is, to understand the extent to which infants are able to treat category members as the same sort of thing, that things can be alike. Unfortunately, the label 'categorize' has been used interchangeably in the literature to refer to both the mental process as well as to infants' overt performance on various empirical tasks. Since categorizational capacities have to be deduced from overt physical performance alone, this thesis restricts the word 'categorize' to refer to the process of mental organization.

Most previous studies of infant categorization have focused on objects as the paradigmatic case, biases in which have probably resulted in skewed deductions as to the underlying mental capacity. This thesis has a broader focus, encompassing the acquisition of labels for objects, actions and events. A number of studies which have addressed the nature of conceptual functioning prior to, or in the early months of language learning, are reviewed below. Studies of object concepts are reviewed separately from the few available studies of action / event concepts.

2.5.1. Objects and conceptual functioning

Studies of the categorization abilities in infants under 12 months have often used the habituation-dishabituation technique (Roberts and Horowitz, 1986; Colombo, O'Brien, Mitchell, Roberts and Horowitz, 1987; Roberts, 1988; Younger, 1990). The rationale of this technique is that, if infants are categorizing then their visual fixation time will habituate to a sequence of within-category test stimuli. However, presentation of an out-of-category stimulus will result in a period of increased visual fixation.

Using the habituation-dishabituation technique, Younger (1993) presented 24 10 month old infants with category members and non-category members and found that they disregarded those items which were non-category members, suggesting that, at 10 months of age, infants are able to understand that things which are similar in specific respects belong to the same category. Although these habituation tasks are suitable for infants in their first year, they are thought to be less sensitive to categorization abilities during the second year (Mandler, Fivush and Reznick, 1987). After this time, with the exception of a technique used by Langer (1980) the most common way of investigating abilities in categorization was to use the object manipulation task.

The object manipulation task involves observing the way infants manipulate a mixed array of two kinds of objects and analysing whether infants can be credited with categorization based on spatial grouping or sequential touching analyses. Spatial grouping analysis focuses on the product of object manipulations - how the infants arrange the objects on a surface. However, since infants are rarely observed to group objects spatially until between 18 and 24 months (Ricciuti, 1965; Sugarman, 1981, 1983), most studies have employed a technique to assess the sequential ordering of object manipulations. There have been several variations in the precise method of analysis used, but the general principle remains the same. The idea is that infants might not arrange the objects spatially but that they might

pick up objects belonging to the same category in turn. Infants are credited with categorization on the basis that they touch objects from the same class in succession more frequently than could be expected by chance alone (e.g. Ricciuti, 1965; Nelson, 1973; Markham, Cox and Machida, 1981; Starkey, 1981; Sugarman, 1981, 1983; Gopnik and Meltzoff, 1987; Mandler, Fivush and Reznick, 1987; Mandler & Bauer, 1988; Mandler, Bauer and McDonough; Shore, Dixon, Bauer 1995).

One of the first studies using the object manipulation task paradigm was Riccuiuti (1965), who examined object manipulation in infants aged 12, 18 and 24 months. Four objects of one kind (different geometrical shapes varying in size, colour and form) and four of another kind were employed. Riccuiuti designated three levels of performance. Infants were classed as 'complete' sorters if they manipulated four of one kind of object followed by four of another kind, and 'partial' sorters if they manipulated three or four of one kind of object followed by three of another. Infants who manipulated objects from one group only were classed as 'one group' sorters. Riccuiuti took one observation of an infant engaging in any of the above manipulations as evidence for designating him / her as a 'complete' sorter, a 'partial' sorter or a 'one group' sorter. On this basis, 75% of the 18 and 24 month old infants were sorting whereas in contrast, only around a third of the 12 month olds were sorting. Riccuiuti observed that infants in his study used sorting strategies at 12 months, and concluded that such object manipulations and the categorization abilities associated with them were precursors of language and the concept-related categorizing behaviour of older children. However, in line with criticisms aimed at other studies proposing that cognition precedes language development, it is clear that the links proposed by Riccuiuti are only speculative.

It was argued by Nelson (1973) that Riccuiuti's study did not tap into real-world categories that infants form. Thus in her study, Nelson used plastic aeroplanes, cars, eating utensils and animals. Overall her object sets differed in size, colour, function and form. Nelson's

prediction was that infants would group objects on the basis of function rather than visual perceptual attributes. Nelson's analysis extended Ricciuti's analysis by comparing whether the prevalence of sequential choice was greater than that expected by chance alone. The aim was to examine whether the infant would follow up the manipulation of an object from one group by manipulation of another from the same group. If infants followed up a manipulation from one group with a manipulation from the other group this was classed as an alternation. However, Nelson (1973) did not build this kind of object manipulation strategy into her analysis. We can infer from this that Nelson did not regard alternations as evidence of classification. This is in contrast to later studies where researchers have classed infants who alternate between classes of objects significantly more often than could be expected by chance alone as able to sort.

In contrast to most studies which employed the object manipulation task, a study by Langer (1980) emphasized the importance of discovering the precursors of formal logical cognition in infants' developing actions by considering configurations between objects as the basic unit of analysis. A configuration consisted of bringing an object into spatial contact or proximity or indicating the functional equivalence between objects by acting on them same way. In line with findings from Ricciuti (1965) and Nelson (1973), Langer found that infants were sorting objects according to their similarities at 12 months.

In light of the evidence provided by Ricciuti (1965), Starkey (1981) anticipated that there would be a greater chance of very young infants sorting objects if the objects were made more attractive to the infants. Starkey completed scoring for the sequential touching analysis was completed in terms of four levels of decreasing proficiency. Infants who touched four of one kind of object followed by four of another in sequence were classified as 'level one'. Infants who touched three or four of one kind of object followed by three of another were classed as level two. Level three represented an infant who would touch all four of one kind of object but none of the other kind. Level four included infants who

touched three of one kind of object and none of the others. The results showed that the frequency of sequential touching tended to increase with age. At 12 months, most infants had attained level four and just under half of the infants had attained level two. At six months, no infant touched four like objects sequentially, while 56% and 69% of the nine and 12 month olds respectively attained level four proficiency. Starkey (1981) concluded that classification skills emerge between six and nine months of age. Furthermore, it was found that the amount of sorting activity expected from an object set was predicted by the number of dimensions of difference between the two object groups and their relative attractiveness.

The study which possibly stands out as the most influential in terms of the analysis techniques used is one by Sugarman (1981) who examined the sorting strategies of 40 infants and young children at 12, 18, 24, 30, and 36 months of age. Sugarman used seven object sets (e.g. geometrical forms, dolls, spoons and cups), each comprising of 4 objects of one kind and four of another. Sugarman observed children at all age groups to engage in class-consistent strategies, although, she points out that manipulating objects in just one class can be easily explained by the salience of those objects or features of them. However, Sugarman suggests that between the ages of 12 and 17 months infants tend to contact objects from one class and then the other, then, between 17 and 24 months, infants will begin to spatially group objects belonging to the same class. Thus infants tend to use different strategies to classify objects at different points in the second year of life.

The focus of these first studies of object sorting was to examine the extent to which infants were able to engage in categorization prior to the onset of language. Up until the early 1980's, it was largely accepted that categorization skills necessary for language development may exist before infants speak (Ricciuti, 1965; Nelson, 1973; Sugarman, 1981; Starkey, 1981; Sugarman, 1983). Interestingly, Nelson and Lucariello (1985) noted that the data from Sugarman's (1981, 1983) studies were consistent with the findings from

studies of early lexical development, suggesting that infants do not use words symbolically until the end of their second year. This position contrasts with those who suggest that some infants use words referentially right away (Harris, Barrett, Jones and Brookes, 1988) or that an understanding that words stand for things is not such a discrete development as previously thought (Bates, Dale and Thal, 1995). These recent views do not tie in with the observation that infants fail to engage in object sorting indicative of categorization until the end of the second year. This may suggest that the object manipulation task may be less sensitive to detecting cognitive capacities than previously thought, or it may indicate that it is more developmentally challenging than previously thought.

A further problem with these early studies of object sorting, is that researchers have assigned different interpretations to instances when infants manipulate different class objects in temporal sequence more frequently than could be expected by chance. For example, whereas Ricciuti (1965) focused on the way infants sorted objects from the same class, Langer (1981) suggested that sorting objects by their differences precedes sorting by similarity. It is unclear, however, whether Langer took into account the greater chance probability of selecting different class objects than same class objects.

One concern with Sugarman's (1981) sequential touching analysis is that this particular analysis underestimates sorting abilities in sighted infants. This is because it cannot cope with instances when an infant picks up and holds on to two objects from one class followed by two objects from another class. The sequential touching analysis focuses on the relationship between individual objects being the same or different from the immediately preceding object. On occasions when infants pick up two objects of one kind followed by two of another, the sequential touching analysis underestimates infants' categorization abilities, since the number of 'same' and 'different' recordings remain equal, suggesting that the infant is failing to sort objects.

In recent years, there has been continuing interest in categorization abilities in the pre-linguistic period (e.g. Gopnik and Meltzoff, 1987; Mandler, Fivush and Reznick, 1987; Mandler and Bauer, 1988; Mandler, Bauer and McDonough, 1991; Shore, Dixon and Bauer, 1995). These studies have gone beyond investigating the question of *whether* infants understand about categorical relatedness to asking more elaborate questions. For instance, Gopnik and Meltzoff (1987, 1992) reported that children start to make two-category spatial groupings before manifesting a 'naming explosion'. Thus spatial grouping was treated as an indicator of linguistic categorical competence. However, other studies have found no clear relation between productive vocabulary development and ability to group objects spatially (Gershkoff-Stowe, Smith and Namy, 1992; Freeman, 1993). Furthermore, as pointed out earlier, not all infants manifest a sudden rate change in productive vocabulary, which may suggest that infants who maintain a steadier rate of vocabulary growth actually engage in different kinds of object sorting activity.

Finally, a series of studies by Mandler and colleagues (Mandler, Fivush and Reznick, 1987; Mandler and Bauer, 1988; Mandler, Bauer and McDonough, 1991) have explored the extent to which infants are able to engage in categorization which relies less on perceptual cues and more on functional attributes. For example, by selecting objects belonging to the bathroom (e.g. soap, cotton wool and sponge) and kitchen (e.g. spoon, cup and plate) Mandler *et al.*, (1987) examined whether infants would be sensitive to categories related together through space and time. The rationale was that perceptually, the members of such categories are dissimilar, but that they are related to each other both spatially and temporally. Mandler *et al.* (1987) found that infants aged 14 and 20 months were sensitive to such categories, leading to the conclusion that infants seem able to categorize using knowledge about the time these objects are used and / or their spatial proximity to each other.

In sum, the study of infant categorization abilities emphasizes two lines of inquiry; the first examines the nature of categorization abilities in the first year based on the technique of habituation, whereas the second investigates developing categorization abilities using the object manipulation technique. Evidence suggests that infants become increasingly sensitive to categories defined on a perceptual basis as well as those defined by time and / or space as they get older. However, some doubts have been raised about both the sensitivity of the task as well as the analyses and techniques used to assess abilities in categorization. The lack of agreement as to a clear relationship between productive vocabulary development and ability to sort objects highlights the theoretical non-correlation of explanations for mental and physical categorization as well as the failure to explore the connection between physical ability and understanding which is presumed to underpin it. Once again, the bias resulting from object centered research may be responsible.

2.5.2. Actions/events and conceptual functioning

As discussed in **Section 2.2.3**, in contrast to studies of infants' object categorization, research on the categorization of actions and events has remained largely speculative. Whereas the study of object categorization mostly relies on concrete objects which coincide with the basic-level of abstraction (Rosch, 1978), there has been little research which has applied the same taxonomic levels of abstraction used with objects to the domain of events. However, Rosch (1978) observed that when people talk about actions / events, they use 'get dressed' rather than smaller event units (e.g. 'get shoes on') or larger event units (e.g. 'getting ready to go out'), suggesting the existence of basic-level event categories, and that the size of unit is indicative of abstraction level. Although Rosch's work addresses the possibility that a similar hierarchy is available for categorization of actions and events as for objects, it does not make clear whether or not we would expect infants to start to use event words which are at the basic level of abstraction.

One particular approach to the study of event categorization in infancy has been to suggest that infants build up knowledge about the way objects are used in the activities, the people involved and the sequence of activity (Nelson, 1983, 1985, 1986; Nelson and Lucariello, 1985). The acquisition of such knowledge is thought to help the infant participate in everyday events by anticipating action. More specifically, Nelson proposes that, at 12 months, infants have not yet cognitively analysed these events into their separate constituents, however, during the second year, infants are thought to do so. Thus, according to this approach, infants make the transition from treating information in the environment in large chunks to breaking this down into discrete, smaller chunks during their second year.

Another approach to explaining how infants analyze events has been proposed by Mandler (1992), who speculated that infants first engage in perceptual analysis of the world around them, largely without conscious reflection. However, during the first six months, infants are then judged to recode perceptual information into conceptual primitives by forming relatively underdeveloped representations of spatial relations and movements in space, also referred to as image schemas (Johnson, 1987). These image schemas may include representations of animacy, causality, agency and containment. Such representations are regarded as important for the basis of linguistic meaning, the final level of abstraction proposed by Mandler. Empirical studies suggest that infants are indeed able to respond to superficially similar events differently. For example, Mandler concluded that infants had an image schema for caused motion (e.g. a toy car moves into a ball and causes the ball to move) on the basis that they appear to be analyzing the spatial continuities between moving objects.

Another way researchers have approached the study of event categorization during infancy is through making the distinction between observable aspects of events and unobservable causal relations. A distinction is made between perceptually simple and complex

movements / change. Perceptually simple movements or change refers to events where single entities move in ways that vary little from instance to instance e.g. animates walking or kicking. In contrast, perceptually complex movements may involve more than one entity and a sequence of several movements (e.g. two people building a wall). If infants represent events according to their observable characteristics and group instances of events together on the basis of how similar they are in appearance, then events involving observable, perceptually simple movements by one single entity may be the first to be categorized (Huttenlocher, Smiley and Charney, 1983; Huttenlocher and Smiley, 1991; Smiley and Huttenlocher, 1995). Alternatively, infants may represent events in terms of their unobservable aspects. This in turn, will influence how events are categorized. For example, Smiley and Huttenlocher (1995) noted that members of a category may be grouped on the basis that they involve a similar causal relation between entities or have intentions.

Evidence to distinguish between these two alternatives was taken from observing patterns of early word use. Smiley and Huttenlocher (1995) argued that if infants were classifying events according to appearances then they would use a word to describe the event regardless of the entity in which the movement occurs (e.g. self, objects, others). They argue that in cases where the movement is complex, the infant will use words regardless of the entity producing the move. In addition, they argue that these words may be produced after the event has occurred because this is the time when the outcome of the event is salient. In contrast, if infants are classifying events according to their unobservable aspects then, at first, infants may apply words only to their own actions and prior to the onset of these actions. This is because their own actions will be salient to them before those of others. Huttenlocher and Smiley (1991) examined the spontaneous speech of 10 infants between 13 and 19.5 months of age and found that they represented similarity in terms of the observable aspects of events. Smiley and Huttenlocher (1995) argued that by the time children are using multiword speech they start to form internal state categories. Thus there

is a developmental progression in the sensitivities of infants' conceptual systems which contributes to changes in the way events are represented in early childhood.

In comparison to studies of infants' object concepts as indicated by studies of habituation and sorting strategies, research on infants' event concepts is relatively under-researched. Furthermore, it has been driven largely by speculation during the pre-lexical period or inferred from word usage about the early lexical period. The view that infants start to categorize events in their second year has implications for theoretical explanations of lexical development.

2.6. Environmental influences on lexical development

So far, lexical development has largely been discussed without addressing the extent to which environmental factors influence its rate and nature. This section discusses the role of general environmental factors such as birth-order, gender and socio-economic status as well as the role of the speech environment the infant is exposed to.

2.6.1. The role of general environmental factors

Sociological variables like birth-order, gender and socio-economic status have been viewed alongside qualitative and quantitative aspects of lexical functioning in order to establish the extent to which they play a causal role in language development. Many studies have addressed the extent to which these variables are related to referential or analytic styles. For instance, Nelson (1985) notes that first-born children experience different language learning environments from later-borns. However, there appears to be no clear relationship between language style and birth-order. Some researchers have found evidence for firstborns to be referential and laterborns expressive, whereas others fail to find such a relationship (Bauer, 1984; Tomasello and Todd, 1983). Moreover, Shore (1995) notes that we need to make comparisons between samples of equal sizes and concluded that once this was controlled for, she could discern no trend in either direction.

Shore (1995) also found no clear trends for gender. However, when studies do find a trend it is usually that girls tend to be referential and boys expressive (Plunkett, 1985; Bates, Bretherton and Snyder, 1988). In a comprehensive study, Bates, Bretherton and Snyder (1988) concluded that gender and birth-order differences play only a minor role in language development between one and three years of age.

Despite the failure to find any role for birth-order or gender, there does appear to be evidence that socio-economic class is related to infants' lexical style. The parents of middle-class children seem to engage in more object-labelling activities than do lower-class infants (Golden and Birns, 1976). This finding reiterates the importance of studying socio-cultural differences in lexical learning.

It is perhaps not surprising that there is a little or no relationship between language style and birth-order, gender or socio-economic status, given, as discussed in **Section 2.4.6**, the conclusion that the distinction between referential and expressive styles was oversimplified.

2.6.2. The role of the speech environment

Adults guide children's speech in various ways during the early years by modifying their own speech to make it typically shorter and therefore less syntactically complex than speech directed to adults (Phillips, 1972; Snow, 1973). The speech also tends to be more simple in content than speech directed to other adults, as well as being more focused on the 'here and now' by using the present tense to refer to what the child can see (Broen, 1972; Remick, 1976).

Researchers have also explored the different ways in which adult speech may facilitate lexical development, and found that the density of child directed speech is an important factor in determining which words children learn (Huttenlocher, Haight, Bryk, Seltzer and Lyons, 1991). In support of this, evidence suggests that children learn those words to

which they are most frequently exposed (Hart, 1991; Harris, Barrett, Jones and Brookes, 1988). Adults also promote lexical development by facilitating joint attention to shared referents and using episodes of joint attention to facilitate noun acquisition (Tomasello and Todd, 1983; Tomasello and Farrar, 1986). In contrast, verbs are thought likely to be acquired when caretakers use verbs to refer to an impending action in contrast to one that is completed or ongoing (Tomasello, 1995). Thus children receive reference to an action even before they know what the target of the reference is going to be. However, this temporal gap between the label for the action in the input speech and the corresponding action does not seem to prevent infants from acquiring verbs relatively effortlessly.

Interestingly, Gopnik and Choi (1995) report that Korean-speaking mothers use more verbs and more actions in play than English-speaking mothers. The examination of lexical development within a cultural context supports the abandonment of notions that any one particular style of lexical learning may be faster or superior to another, because, by describing different cultural patterns of lexical development it is recognised that children learn to talk appropriately regardless of cultural context. When we explore the patterns of lexical development within one culture we may be biased towards recognising the patterns typical of that culture. However, when styles atypical to a culture emerge, they may actually turn out to have much in common with the patterns central to another culture.

So far, we have discussed child directed speech as if it plays the same role throughout the early years, though evidence suggests that child directed speech may play different roles during different stages of early lexical development (Barrett, 1995). During the initial period of word acquisition, the influence of the speech environment seems to be important in determining the way children use their first words. There is evidence, for example, that the parents' most frequently occurring use of a word was the use subsequently adopted for the child's initial use for that word (Harris, Barrett, Jones and Brookes, 1988). However, Barrett, (1991) found that the children's subsequent uses of words bore no relation to

meaning of novel words. Until recently, there have been several accounts of how *isolated* aspects of lexical development occur, for instance, those using a constraints approach have proposed that children assume that labels refer to the whole object rather than just part of it (MacNamara, 1972, Markman and Hutchinson, 1984). In contrast, however, more recent accounts endeavour to consider several principles to provide an overview of lexical development as a whole (Clarke, 1983, 1987, 1990; Golinkoff, Mervis and Hirsh-Pasek, 1994; Golinkoff, Hirsh-Pasek, Mervis and Frawley, 1995).

Social pragmatic approaches emphasize the importance of acquiring knowledge through joint action with others and the communicative skills which infants and adults bring to the task (e.g. Bruner, 1983; Nelson, 1985, 1988; Tomasello, 1992, 1995). The most recent accounts of this approach are reviewed below (Nelson 1983, 1985, 1986; Tomasello, 1992, 1995). Not all accounts adopt a constraints or a social-pragmatic approach however. Prototype theory (Bowerman, 1978) and the multi-route model (Barrett, 1983, 1985, 1986) adopt no clear position, although it could be argued that the former resembles more of a constraints approach, whereas the multi-route model adopts more of a social-pragmatic position.

In the light of criticism and new empirical evidence, some theoretical explanations have been modified since their original formulation, and therefore the most recent versions of six different frameworks are presented below. The extent to which each of these frameworks successfully explains the vocabulary explosion, context-bound speech and aspects of the word extension process is considered, as well as the extent to which they explain individual differences between learners and the different developmental histories of words within learners. The extent to which each framework addresses the acquisition of words for actions / events as well as objects is also considered. In preparation for **Chapter Three**, the role assigned to vision in each of these theoretical explanations is also discussed.

maternal speech usage. Taken together, these findings suggested that input speech is important in establishing children's initial uses for words but thereafter the influence of the child's speech environment may play a less crucial role.

The kind of speech parents produce seems to vary according to the birth-order of the child and the number of people involved in the interaction (Pappas-Jones and Adamson, 1987). These researchers observed 16 mothers of first-born children and found that later-born infants used more social regulative speech than mothers of first-borns. In addition, these differences tended to be even more marked when siblings were present for first-borns and later-borns. This study suggests that researchers need to be sensitive, not only to the input speech itself, but the non-verbal aspects of the environments supporting the input speech.

This section has identified how aspects of the adult speech environment might influence lexical development. Caution is required, however, in assuming that there is a unidirectional influence of the parent on the child. Instead, it is important to recognize the bidirectional nature of early parent-child interactions. Recently, some researchers (e.g. Shore, 1995) have taken to examining the 'dyad' rather than one or other of the pair. In line with this orientation, this thesis treats the infant and the mother as a unit, so avoiding the tendency to attribute a causal role to either partner.

2.7. Theoretical explanations of lexical development

Since the early 1970's, a number of different theoretical frameworks, assuming either a constraints / principles approach or a social-pragmatic approach to lexical development have been proposed. The constraints / principles approach regard the task of novel word learning as one where the child is able to limit the number of hypotheses about what a novel word might mean (Golinkoff, Mervis and Hirsh-Pasek, 1994). The task of word learning is aided by one or more principles which serve to guide the child towards isolating the

2.7.1. Prototype theory

Prototypes were central to research in cognitive psychology in the 1970's (Rosch, 1973) and probably first applied to lexical development by Bowerman (1978). The central idea to prototype theory is that, initially, the meaning of a word is learnt by having a prototypical referent for it. The word is then generalised to cover other referents which share a number of perceptual / functional features in common with this referent. Vision is implicated in this framework on the basis that some words are generalised to new referents on the basis of visual similarity, whereas others are generalised on the basis of functional similarity.

Criticisms of this theory have largely been concerned with the problem of defining prototype (Barrett, 1995). However, one strength of this theory is that it offers an explanation for why children underextend; at first, children will use words to refer to referents which bear a high degree of similarity to the prototype. It also copes with overextensions, since children extend words to novel referents on the basis of perceptual or functional features that they share with the prototype. Those words in input speech which are used regularly in social exchanges are those which have a better chance of being the word which will be used to label a prototypic referent. Ironically, because prototype theory does so well at accounting for extensional errors, it also seems biased towards accounting for the acquisition of labels for objects rather than any other kind of word. In this sense, the theory seems readily able to handle lexical development in infants with referential tendencies, but does not readily account for individual differences in lexical development. It also does not encompass the context-bound use of words, nor does it offer any account of how different words can manifest different developmental histories.

2.7.2. Principles of contrast and conventionality

Clark (1983; 1987; 1988; 1990; 1991; 1993; 1995) regards the principles of conventionality and contrast to be central to lexical development. The principle of conventionality states that "for certain meanings there is a form that speakers expect to be used in the language community" (Clarke, 1993, p. 67). This principle guides children towards discovering the conventional terms available for referring to objects, actions and entities. If children observe conventionality, they should take adult language as the target to aim for. To support her case, Clarke uses evidence that children actively repair their own language, pointing out that the kinds of repairs which children make are determined by their level of language functioning. Generally, before age two, these are repairs to pronunciation rather than other aspects of language, then, between the ages of 24 and 42 months, Clarke notes that 40% of all repairs are to do with meaning. It seems then, that children realise that they have not conveyed the meaning they intended, so they make repairs until they are understood. On this basis, Clark argues that children eventually seem motivated to adopt the conventional uses of terms in the adult language.

As further evidence that children observe the principle of conventionality, Clarke notes that children often elicit labels for objects, actions or events during interaction, which suggests that children draw another's attention to something in the environment and ask what its name is because they assume a conventional label exists for it. Additionally, Clark notes that children who request labels for objects also tend to refuse to name things for which they have not yet acquired labels. Whereas previously they might have made an overextension when presented with a novel referent, they now instead attempt to elicit a label.

The principle of contrast states that "speakers take every difference in form to mark a difference in meaning" (Clark, 1993, p. 69). This principle leads infants to assume that any

new term they hear must contrast in its meaning to other terms which they already know. As evidence that children observe this principle, Clarke cites observations that they eventually narrow down their overextensions. For instance, an infant who previously labelled any meal put in front of them as 'dinner' reduce the scope of overextension when they started to label meals served in the morning as 'breakfast'.

Clark (1993) suggests that the principle of contrast may develop from children's understanding of why people do things. She argues that, from an early age, children assume that individuals do things for a reason. In particular, that individuals speak to get listeners to recognize their intentions. Clark carries this argument further to suggest that children assume, when people speak to them, that they would choose one word in a particular situation, rather than any other. She argues that this would lead to children being aware that a particular word is not equivalent to another and that it must contrast with the other meaning.

In the literature, Clark's account is often cited alongside other theories of early lexical development, although in her most recent account, she states these two pragmatic principles are intended to apply to children who have already started to talk. Interestingly, Clark (1993) contradicts herself since she notes that the principles of conventionality and contrast may be observed in children's earliest productions. Clark discusses how the roots of these two principles, stem back to the prelinguistic period, though they are largely linguistically driven and operate during social interaction with others. In particular, input speech plays a crucial role in Clark's account since she asserts that infants use adult speech as the target form.

Although Clark has failed to address how the principles of conventionality and contrast explain the phenomena of context bound usage, the different developmental histories of word usage and the way visual information may be implicated, she has addressed the acquisition of different word types as well as the phenomena of overextensions and the

vocabulary explosion. Evidence provided by Clark and by others (e.g. Barrett, 1978, 1982; Mervis, 1983, 1984) suggest that overextensions emerge when infants use a word to refer to something for which they have yet to acquire the conventional word. The principles of conventionality and contrast work together to emphasize the fact that, in order to be understood, children need to maintain consistency in the conventional meanings they assign to words and that they maintain the same contrasts in meaning.

In contrast to the traditional view that the vocabulary explosion occurs as a result of a cognitive breakthrough when children discover that words function as symbols for things, Clark suggests that the onset of the vocabulary explosion reflects an articulatory readiness for production. The principle of conventionality says that children assume the target phonological form of the adult language. Thus, it could be argued that children undergo a vocabulary explosion, not as a consequence of acquiring a target, but because their motor and cognitive skills have reached an appropriate level. Another interpretation might be that adults simply do not recognize words until they have attained some relatively recognizable state (i.e. they are conventional in phonological terms), since, once they have done this parents may well be more likely to record them in word diaries. Thus Clark's interpretation that children undergo a vocabulary spurt due to motor and memory development may actually have more to do with children achieving conventionality in phonological terms rather than as being due to a sudden increase in the number of novel words per se.

Clark applies her framework to speakers of all languages and, in doing so, acknowledges that it is difficult to specify what kinds of contrasts children will make because it very much depends on the size of their existing vocabulary and the range of situations to which they are exposed. This approach therefore favours an idiographic approach to lexical development since each child will obviously be exposed to it very different experiences.

2.7.3. Developmental Lexical Principles Framework

In 1994, Golinkoff, Mervis and Hirsh-Pasek proposed a framework to account for how children learn words for objects, and a year later, extended their framework to account for the acquisition of labels for actions (Golinkoff *et al.*, 1995). They proposed that a set of six lexical principles function as problem solving heuristics to limit the number of possible meanings of a novel word, and that particular kinds of errors are predicted when children violate the lexical principles. Golinkoff *et al.* (1994) proposed a two tiered lexical acquisition framework consisting of three lexical principles at each level; the first level enable children's word learning to get off the ground by the end of the first year, and the second tier permits children to greatly expand their vocabularies. The first tier is regarded as being perceptually-cognitively based and the second language-specific in origin. Since the second tier emphasizes how children acquire words once they have already established some words, it is only briefly summarized here.

Principle of Reference: this is the principle upon which all other principles depend and concerns the capacity to refer, permitting words to be directly mapped onto a child's representation of the objects or actions in their environment. The use of this principle means that children are using words in a symbolic way, rather than merely associated with something. Researchers generally say that if a child uses a word in the absence of an instrumental goal, in the absence of the object itself and to label multiple exemplars, then the word is being used referentially.

Principle of extendibility: this principle permits children to extend their terms to new exemplars in addition to the original referent. In particular, shape is judged to be a central factor by which object and action labels are extended to novel exemplars. At first, children are thought not to extend terms beyond the original referent, however, later, children start to use words for more than one referent on the basis of physical or thematic similarity. Golinkoff *et al.* extend this principle to encompass the extension of verbs by using Pinker's

(1989) terminology and proposing that children are capable of extracting the 'shape' of events. They acknowledge that the shapes of objects and events are two very different things; for the former, they emphasize the 'persistent, palpable object contour' whereas for the latter they emphasize that the shape lasts as long as the event and refers to the overall configuration of the action. Mandler's (1992) approach offers scope for them to claim that children break down events into a set of discrete meaning components in order to learn labels for actions.

Principle of object scope : this principle guides children towards the likely referent of a term in two ways, first, it states that words label objects rather than actions or anything else. Evidence suggests that children take any novel term to refer first to an object rather than the object's action. Given this, it would appear that Golinkoff *et al.* would find it hard to transfer the principle of object scope to those of labels for actions because objects rather than verbs appear to them to be a priority. Second, the principle of object scope says that words refer to the whole object rather than just parts of them. Evidence that children use words predominantly for whole objects comes from Mervis (1990) and Nelson (1973). In support of 'action scope' Mervis and Bertrand (1993) proposed that similarly for verbs, children learnt names for larger rather than smaller actions. The basis for action scope is that it helps children towards labelling the right part of the event by helping them select out the most salient aspect of the event as the referent for the novel verb.

Principle of categorical scope : this principle says that words can be extended to objects in the same basic level category as the original referent. Thus it allows children to extend words on the basis of shared semantic components.

Principle of the novel name-nameless category (N3C): this principle guides children to map novel names onto previously unnamed categories. Children will be alert for new referents to which new names could be applied, enabling them to rapidly establish new name-referent links.

Principle of conventionality: this principle is adopted from Clark (1993) and has already been outlined in **Section 2.6.1**. In sum it states that children assume that speakers within a particular speech community use words that are conventional to that speech community.

This framework encompasses the phenomenon of extension though it does not explain early context bound usage nor the different developmental histories of words. It is notable that the first tier of this framework is driven by developments in perceptual-cognitive functioning whereas the second tier is related to developments in linguistic functioning. Thus visual information is implicated at an explanatory level for the first tier. In particular, vision is assigned an important role in the principle of extendibility where infants are thought to use shape as a basis for their extensions. As will be discussed in **Chapter Three**, vision provides immediate information about shape whereas touch results in predominantly sequential information. Thus vision offers more scope for detecting differences in shape between objects. It is therefore also possible that this may aid sighted infants to make extensions.

2.7.4. Event representation theory

This framework (Nelson, 1983, 1985, 1986) is cognitive-social in nature and based upon the experience children gain about everyday events before they begin to speak. Children become familiar with a variety of everyday activities such as social routine exchanges and other meaningful events through experiencing and being active in these events. Nelson argues that infants acquire information about the sequence of events, the people / animals who are participating in the events, the objects that are involved in the sequence of actions, and also information about the range of options that can be represented in an event (slot-fillers) (Nelson, 1983, 1985, 1986; Nelson and Lucariello, 1985). For example, at a birthday party, the range of events that could occur might include any number of the following slot-fillers: party-games, the opening of presents, eating birthday cake and singing happy birthday.

Event representations are thought to guide the infants' participation in events, so they can predict what will happen next in familiar circumstances. The developmental status of event representations is thought to change over the first few years of life quite substantially. For instance, during the first year, the constituents of event representations have not yet been analysed into discrete components. When first words are produced they are mapped onto these event representations, thus words first appear tied to well defined situations and hence are context-bound. During the second year, infants begin to break down event representations into separate constituents comprising concepts of objects, people and entities and their actions in the world. Whereas words were previously tied to specific contexts, during the second year words start to be mapped onto the derived concepts. This framework therefore accounts for the way some words are context-bound during their initial use. Once a child has broken down the event representation into its various constituents, it leaves the child with many more concepts to map words onto, so offering scope for understanding the so-called vocabulary explosion. However, this explanation is not sufficiently flexible to explain the observation that, not all infants undergo a vocabulary explosion. Nor does this framework cope with the observation that different words are being used at different levels of functioning within one child's vocabulary at a given time.

However, Nelson's (1985) theory does encompass individual differences, since it would appear that, during these early interactions, some dyads focus on the social realm and use social phrases whereas others focus on objects, using single labels for objects. Nelson (1985) interprets the differences between the children as concerning whether infants believe the function of language to be interpersonal or ideational, emphasizing that most children use both functions of language and that the preponderance of one or the other reflects preference rather than a competence. Parents influence the kinds of lexical development that are going to take place by imposing either well structured events like getting dressed, or play sequences. In the former, consistency will be emphasized, whereas in the latter, the interpersonal is likely to be emphasized.

It is not entirely clear what status is given to visual information in Nelson's framework. However, since experience of the world through actions is emphasized and action-analysis is arguably less dominated by vision than is object-analysis it seems likely that vision plays a less central role than it does in prototype theory. Although Nelson does not elaborate on how events may be analysed it is likely that normally vision plays a significant role in this process.

2.7.5. The multiroute model

This model (Barrett, 1983, 1986, 1991, 1995) relies on a representational approach to lexical development and points to two routes in the process of lexical development, one for the acquisition of social-pragmatic and context bound words and another for the acquisition of referential words. Barrett argues that two kinds of internal representation are important for word acquisition: event representations and prototypes. Thus this model builds on the combination of the prototype and event representation approaches described above.

Based on evidence that children seem to establish both event representations and prototypically structured concepts before they start using words, Barrett argues that words are mapped onto event representations and prototypes when a child recognizes a particular activity or object respectively. Changes in word usage are interpreted as evidence of changes to the underlying representations onto which the words have been mapped. Once a child begins to break down event representations into their constituent components, each action / object / state isolated from the event assumes a prototypic status. By using words first only to refer to objects which have a good resemblance to the original referent, the child might under-extend. Barrett argues that children analyse a prototype into its constituent features and by doing so start using the word to refer to new referents which share certain perceptual and functional features. Barrett argues that prototypes come to consist of clusters of perceptual and functional features. This contrasts with Anglin (1977,

1979) who views prototypes as generalized abstract schema, the central tendency of a sequence of instances a child has experienced.

Barrett's model goes some way towards acknowledging the acquisition of labels for actions and events as well as those for objects. It also accounts for over-extensions by arguing that the new referent shares at least one of the components of the clusters of perceptual and functional features. It also accounts for how these over-extensions are overcome by assuming that a child recognizes the additional features which differentiate the referents and therefore learns to label the action / object appropriately.

Given that the model presents a local approach rather than a global approach to lexical development it is therefore not surprising that it does not account for the onset of a vocabulary explosion. However, the observation that different words can be used referentially while others remain context-bound at a given age is explainable by this model in terms of the extent to which the event representation underlying the usage of the word is broken down. Additionally, some referential words which are used appropriately from the beginning can be explained by saying that the infant has a well developed category for that concept before using the word. Thus the multiroute model explains how it is that a child's vocabulary at a given age can consist of words being used at different levels of appropriateness. It also explains how children may use some words appropriately the very first time they are used, whereas other words may take months before they attain the same status.

2.7.6. The social-pragmatic framework

Tomasello (1995) approaches lexical development using a social-pragmatic approach through viewing early lexical development in terms of how children understand what adults intend at that moment. Unlike Golinkoff *et al.*'s approach, which involves the identification of principles that children use to limit the number of possible meanings of a

novel word, Tomasello emphasizes the communicative skills which infants and adults bring to the task. However, though Tomasello makes comparisons between his social-pragmatic approach he does not view the social-pragmatic framework as an alternative to approaches like Golinkoff *et al.*'s (1994, 1995). Rather, he argues that children most likely do use such principles but that these are not available in the initial stages of language acquisition. He proposes that such principles are used as a result of their attempts to understand the pragmatic intentions of others. Although Tomasello (1995) sets out to contribute to an understanding of how first verbs are learnt, some of the issues also apply to the acquisition of any type of word.

Whereas Golinkoff *et al.* (1994, 1995) propose that children solve the 'reference problem' by using heuristics which guide them towards mapping words onto things, actions and attributes, Tomasello proposes that children must understand adults' acts of reference and that adults have an intention towards their own intentional states. Thus he regards linguistic reference as a social-cognitive act which permits joint attention within dyads (Tomasello, in press).

Having perceived that an adult intends to refer, the infant also has to determine what kind of referent the adult is referring to. Tomasello criticizes Golinkoff *et al.*'s approach on the grounds that, in specifying that infants work down through a hierarchy of referent classes from objects to actions, they omit to detail how a hierarchy could include a number of other classes of words and referents. Tomasello proposes that objects and events have equal status in early cognition and that there is therefore no reason why infants should focus on objects rather than actions. He suggests that social-pragmatic information plays a key role for the infant. To illustrate this he provides the example of a parent playing with a spinning top with a child who has not come across the spinning top before. After playing with it for a while, when the parent says "It's spinning!", the issue is how the child is to know whether the adult noise production is a label for the object or a description of the action.

Tomasello proposes that parents who label objects will be likely to do so when the object is first presented and further argues that children are also sensitive to the timing of adult utterances.

In drawing on Clark's principle of contrast to specify how infants come to understand that a particular noise refers to a particular part of an event, rather than any other, Tomasello (1995) suggests that children come to comprehend verbs designating different aspects of some generic situation (e.g. exchange of objects is associated with verbs such as give, take, share, have etc).

The social-pragmatic framework is viewed alongside developments in understanding of the way infants acquire syntax. For instance, Tomasello (1995) draws attention to Gleitman's view (Landau and Gleitman, 1985; Lederer, Gleitman and Gleitman, 1995) that children have innate knowledge of syntax before they learn words. Gleitman's syntactic bootstrapping theory may offer a partial solution to the problem of how children determine which part of an event another is talking about. This theory concerns the way the syntactic information contained in an utterance may aid the understanding of meaning of novel verbs. The distinction is made between transitive syntactic frames (e.g. Sam is stroking the cat) and intransitive frames (e.g. the cat is yawning). Whereas transitive frames tend to imply causative meanings, intransitive frames signify noncausative meanings (Bowerman, 1982; Fisher, Gleitman and Gleitman, 1991), thus the syntactic frames offer information as to what action the verb refers to.

Empirical support for the idea that children are sensitive to the existence of a link between the formal properties of language and meaning derives from Naigles (1990). Children aged two years were shown videos of multiple or ambiguous actions which were either causal or non-causal. While watching these videos they heard nonsense verbs either presented in transitive ("Look! The duck is gorging the bunny!") frames or intransitive frames (e.g. "Look! The duck and the bunny are gorging!"). Using a preferential looking paradigm,

they showed the causal and the non-causal action separately and asked the child to "Find gorpings". Naigles found that when they had been presented with the transitive frame they spent longer looking at the causative action and when presented with the intransitive frame they spent longer looking at the non-causative action. This study demonstrated that even from a young age, children can use the syntactic frame to limit the referents of the nonsense verb.

Gleitman (1990) herself acknowledges that although her theory may go some way towards explaining how children learn verbs by using syntactical frames, it is not sufficient alone. Tomasello (1995) takes a more extreme position by arguing that it is actually implausible that children could use the various syntactic cues in a novel utterance to identify the kind of referent involved. He argues that children show little evidence acquire syntax prior to learning words. In addition, he regards Naigles's study of intransitive-transitive distinctions as not being sufficient to account for how children can distinguish between individual verbs within these classes.

Finally, Tomasello addresses the problem of which action is being referred to. He draws attention to the kind of situation where several actions are co-occurring and the child has not yet acquired a label to refer to any of them. Tomasello distinguishes between ostensive and non-ostensive contexts and argues that certain social-pragmatic cues are used by children to discriminate the two. In ostensive contexts, by comparison, the referent can be seen and the perceptual salience of actions and their place in the context of discourse is emphasized. In non-ostensive contexts, Tomasello argues that children will be sensitive to the desire of the speaker indicated by nonlinguistic cues like gestures, affective state and by cues from the immediate context. Thus vision is implicated as important for the acquisition of words which refer to concrete, discrete objects and less central to the acquisition of words for actions.

2.7.7. Evaluation of different theoretical explanations for lexical development

Six different frameworks for understanding early lexical development were presented above. Each was evaluated in terms of the extent to which it could explain various phenomena of lexical development, individual differences. The acquisition of different types of words and the extent to which vision is involved. A summary of this information is presented in tables 2.2 and 2.3.

The most striking observation from the tables is that the social-pragmatic approach is limited to explaining only the acquisition of different types of words. At first sight, this may seem the least useful of frameworks for understanding lexical development. However, Tomasello (1995) does not seek to provide an account of these phenomena, instead, he has highlighted the importance of studying how infants and their parents come to understand social-pragmatic cues (e.g. gaze following, pointing gestures, understanding of intention). Since this approach emphasizes the social-cognitive nature of joint action and its role in lexical development, Tomasello has suggested that it may be complementary to the constraints approach since they concern different aspects of the process of lexical development. He suggests that whereas constraints aid the child to attend to the 'kind of things' to which a speaker may refer, the social-pragmatic information may direct attention to the specific instance.

However, Tomasello has also argued that if empirical evidence turns out to support the principles of the constraints approach then this provides further support for the need to view early lexical development in terms of the pragmatics of communication rather than being guided by a set of principles. The social-pragmatic approach offers an alternative way of examining lexical development and is therefore included in further discussion of the relationship between visual information and lexical development in this thesis.

Table 2.2. Evaluation of extent to which different theoretical explanations account for phenomena of early lexical development

	Phenomena of early lexical development		
	Vocabulary explosion	Context-bound usage	Extensions
Pragmatic principles	yes	no	yes
Prototype theory	yes	no	yes
Event rep. theory	yes	yes	?
Multiroute model	no	yes	yes
Lexical principles	no	yes	yes
Social-pragmatic	x	x	x

Table 2.3. Evaluation of different theoretical explanations of early lexical development.

	Acquisition of different word types	Different developmental histories of words within infants	Variation between infants
Pragmatic principles	yes	?	?
Prototype theory	no	no	no
Event rep. theory	no	yes	yes
Multiroute model	yes	yes	yes
Lexical principles	yes	no	yes
Social-pragmatic	yes	x	x

Tables 2.2. and 2.3. demonstrate that, unlike other frameworks, Clark's (1991, 1993, 1995) pragmatic principles approach, the prototype theory (e.g. Bowerman, 1978) and Nelson's (1983, 1985, 1986) event representation theory all account for the vocabulary burst. However, given that this is a questionable phenomenon, it may suggest that these three accounts are more appropriate for explaining more traditional descriptions of lexical development.

It is notable that none of the six frameworks deals explicitly with the extent to which visual information facilitates lexical development, although, it is clear that visual information is implicated at some level. For instance, Tomasello's (1995) framework emphasizes the role of vision in observing that adults have an intention towards their own intentional states. Similarly, Nelson's (1983, 1985, 1986) and Barrett's (1983, 1986, 1991, 1995) frameworks rely heavily on the idea that infants observe and participate in actions and events, visual information is assumed to provide infants with a wealth of experience about the structure of events, which infants are later thought to break down into their various sub-components. Finally, prototype theory (Bowerman, 1978), the principles of contrast and conventionality (Clark, 1983; 1987; 1988; 1990; 1991; 1993; 1995) and the developmental lexical principles framework (Golinkoff *et al.* 1994; 1995) each assign visual information an important role in extending words to new referents on the basis of shape. Examining the extent to which visual information is involved in each of these frameworks is important since studies of patterns of visual attention in sighted infants may provide insight into the different pathways these infants use to get into language.

Overall, the prototype theory, the event representation theory and the pragmatic principles approach frameworks fail to account for as many aspects of lexical development as Barrett's multi-route model and Golinkoff *et al.*'s lexical principles framework. On this basis, the decision was made to exclude these three frameworks from further discussion in the thesis. Further support for focusing on Barrett's multi-route model and Golinkoff *et*

al.'s lexical principles approach is that they have already assimilated the most useful components of Bowerman's, Nelson's and Clark's frameworks into their own frameworks. In particular, Nelson's (1985) ideas about event representations and Bowerman's (1978) account of prototypes are both used in Barrett's (1995) framework. In addition, Clark's (1993) principle of conventionality has been incorporated into the developmental lexical principles framework by Golinkoff *et al.* (1994, 1995).

In conclusion, the frameworks considered most useful in assessing the extent and the importance of visual information in lexical development are the multi-route model, the lexical principles framework and the social-pragmatic framework.

2.8. Summary

This chapter attempted to anchor the way lexical development functions alongside other aspects of early language functioning as well as more general domains of development. Existing biases within the literature for the study of production of labels for objects were pointed out, the need for researchers to address developments in comprehension as well as those in production was identified.

A review of studies of quantitative aspects of lexical functioning demonstrated wide variation in the age at which infants start to talk and also the rate at which lexical development proceeded. Descriptions of a number of phenomena of lexical development were documented, it was concluded that phenomena like the vocabulary explosion and context-bound word usage are not universally occurring in language learners. Moreover, clear differences between the developmental histories of individual words within infants implies that lexical development may depend less on global shifts and more on the particular circumstances of the context for learning of individual words.

The changing role of individual differences in the study of lexical development was addressed and arguments were presented for the importance of considering qualitative as well as quantitative variation. The 'rise and fall' of stereotypic accounts of styles linked to different routes into language were presented, where it was observed that the major challenge for studies of variation in lexical development was the confounding of development with that of stylistic variation. In addition, the value in pursuing the size of the units processed by infants was recognized as a research strategy for future studies.

A review of studies of the conceptual basis for lexical development was carried out focusing on events as well as objects. Habituation techniques and the object sorting task were discussed in relation to the methodological problems associated with each type of research. Trends in the sorting of objects were reported across the second year and related to corresponding linguistic developments. The available evidence on event concepts in infancy suggested that infants are capable of categorizing events from 4 months of age.

Different contextual influences on lexical development were considered; in particular, it was pointed out that it is important to emphasize the dyadic focus rather than that of the caretaker or the child alone. Six theoretical explanations for lexical development were presented and the extent to which each of these frameworks handled the acquisition of different word type and the various phenomena of lexical development was considered. It was concluded that although vision was implicated in each of these theories of lexical development, very few specific claims were made about the actual role visual information plays.

Theoretical explanations of lexical development which fared the best during evaluation were identified; thus the multi-route model (Barrett, 1983, 1986, 1991, 1995), the developmental lexical principles framework (Golinkoff, Mervis and Hirsh-Pasek, 1994; Golinkoff, Hirsh-Pasek, Mervis, Frawley and Parillo, 1995) and the social-pragmatic framework (Tomasello, 1995) were selected, each of these are considered further in **Chapter Three**.

Chapter Three

Lexical Development in Blind Infants

3.1. Introduction

The last chapter concluded that vision is implicated in most theories of lexical development, though few specific claims have been made about the role of vision in word learning. Clearly, an absence of vision does not prevent blind / SVI infants from learning to talk, however, less clear is how non-visual perceptual information influences quantitative and qualitative aspects of lexical functioning. In the light of increased knowledge about how visual information differs from non-visual perceptual information, this chapter considers the implications for conceptual-lexical functioning on blind infants during the second year. Findings from studies on conceptual and lexical functioning in blind infants since the late 1970's are reviewed in relation to studies of sighted infants presented in **Chapter Two**. Research questions to be addressed in this thesis are identified and the objectives underlying each of the four empirical studies are introduced.

3.2. How does visual information differ from other kinds of perceptual information?

The most valuable insights into the difference between visual and non-visual information must surely come from people who have spent most of their life without sight and then regained it. In a recent book, Oliver Sacks (1995) presents portraits of such individuals and includes the following from Valvo (1971) who quotes his patient, T.G: *Before the operation I had a completely different idea of space, and I knew that an object could occupy only one tactile point. I knew...also that if there was an obstacle or a step at the end of the porch, this obstacle occurred after a certain period of time, to which I was accustomed.*

After the operation, for many months, I could no longer co-ordinate visual sensations with my speed of walking...I had to co-ordinate both vision and the time necessary to cover the distance. That I found very difficult. If any walking were too slow or too fast, I stumbled.

The second is from Hull (1990) when he speaks of his own experiences of being blind:

....this sense of being in a place is less pronounced...Space is reduced to one's own body, and the position of the body is known not by what objects have been passed but by how long it has been in motion. Position is thus measured in time....For the blind, people are not there unless they speak....People are in motion, they are temporal, they come and they go. They come out of nothing; they disappear.

These two quotes capture the way in which blind individuals' experience of the world is dominated by time and proximate space. Comparisons between visual and non-visual information have also been made at a more formal level. Hatwell (1990) argues that haptic information conveys tactual-kinesthetic information about proximate space of such a quality that blind individuals rely on it more than any other type of perceptual system. She further remarks that the anatomical and physiological properties of the haptic system mean that the visual and haptic senses differ in the quantity of information available, resulting in a number of functional differences between the two systems. These differences are examined here in terms of the implications for interaction between caretakers and their blind / SVI infants. By characterizing the nature of the perceptual information blind individuals receive, especially relative to the way sighted children receive the perceptual information, it is possible to speculate about how blind infants will make sense of the environment and subsequently acquire language.

The haptic field is limited to the zone of the skin-object contact and therefore perceptual information is predominantly sequential. Although spatial concepts arising from sequencing of tactual-kinesthetic information could be augmented by blind infants placing their hands

on two separate parts of the same object, or more than one object at the same time, Hatwell (1990) suggests that this results in an increased load on attention. In contrast, vision permits information of a spontaneous nature to be available. Thus, until the blind infant initiates exploratory activity beyond their immediate space, there will be reduced access to objects in the distal environment (unless others bring them in contact with the infant) and therefore less information about them. When objects are too large to be manipulated, sighted infants, unlike blind infants, will gain an instantaneous impression of the shape of the objects. Furthermore, they can immediately observe the relationships people share with objects. For example, their early concept of 'tables' might include the following: that tables can be sat at, support things and have space underneath. In contrast, blind infants might have encountered one or more table legs during exploration, however, it is difficult for them to know that that a table usually has more than one leg and that together these legs support a surface. In general, blind infants have less access to information about how the actions of others relate to objects in the world and a lack of information about large objects (e.g. buses), dangerous entities (e.g. fire) and inaccessible objects (e.g. clouds). Thus the blind infant's early experience about things in the world and the actions / events associated with these objects will be very different from that of sighted infants.

Since haptic information is localized to proximate space only, this has important implications for what blind infants learn about other people interacting with the environment. Whereas sighted infants observe people bounce balls to each other, watch brick towers being constructed and subsequently knocked down, blind infants do not have access to such continuity of information. Another example particularly relevant to the social nature of early interaction, is when sighted infants and their parents engage in routines based upon the anticipation of visual action, for instance, a sighted infant will usually demonstrate a positive affective response when 'Jack' suddenly pops out of his box. Toys which rely on such visual effects are made exciting for sighted infants because of the sudden display of colourful information and the role their playmate often takes on. For

example, caretakers often add to the contrast between the period before the toy pops up and the onset of the emergence of the toy by first creating exaggerated facial expressions of anticipation and surprise to accompany the routine. Although blind infants and their parents have been observed to use cloths and the like to share activities like peek-a-boo (Fraiberg, 1977; Urwin, 1978a), in contrast to sighted infants, the experience does not appear to be nearly as dynamic.

Like haptic information, auditory information is also sequential, the absence of the opportunity to co-ordinate vision with sound during the pre-linguistic period limits the possibility of blind infants identifying which particular objects and the actions associated with them make particular sounds. It also means that when a noise ceases, unless the blind infant is in touch with the sound-source, it is difficult to tell whether the object or person making the sound is still there. However, once blind infants have learnt to talk, they have greater access to the environment through hearing the input speech of others about what is going on in the environment and using their own language to elicit information from others about what is going on (Urwin, 1978a, 1978b).

It has been argued that blind individuals 'compensate' for their visual deficit by having heightened awareness of other senses although this position is widely rejected by those who argue that blind individuals are merely better at using non-visual perceptual information (e.g. Axelrod, 1959; Hammill and Crandell, 1969; Warren, 1989). However, Sacks (1995) recently suggested that the tactile and auditory parts of the cortex may be enlarged in the blind. This idea is based on the observation that the 'reading' finger in Braille readers has a large representation on the cerebral cortex and is in line with the view that blind individuals do not experience heightened awareness in other senses. This is not because blind individuals can, for instance, hear 'better' (i.e. hear a higher pitch or detect sounds when their source is further away) than sighted individuals but rather, that

underlying neurophysiological substrates may reflect their reliance on using non-visual senses more *effectively* to form awareness of their environment and to interpret it.

So far, the discussion has assumed that infants are totally blind. Of course, if an infant has some limited vision, this may alter the extent to which the infant understands their environment in terms of either time and / or space. Ophthalmological measures such as visual acuity taken alone are insufficient to predict how a SVI infant will make use of non-visual perceptual information and such measures need to be understood within a social context since the extent to which a parent uses visually-related cues may influence the course of lexical development. For instance, the parent may be aware of the index of their infant's visual acuity, but have difficulties knowing whether or not their infant can perceive social gestures like pointing.

Vision provides a certain quantity and quality of perceptual information that cannot be achieved by any other perceptual system and, whereas sighted infants experience the world through space and time, blind infants experience the world in terms of time and proximal space only, making things in the distal environment more difficult to access. The ways in which an infant whose perceptual-cognitive system is couched in temporal experiences interacts with his/her parent - the context for lexical development - are considered below.

3.3. Implications of a visual deficit for development during the first year

It has been observed that many of the mechanisms of pre-linguistic communication are visually based: eye contact is used to establish and maintain exchanges between caretaker and infant; gaze is used to establish joint attention; and gestures like reaching and pointing provide information about the intentions of the speaker (e.g. Stern, 1974, 1977). Yet evidence suggests that up to six months of age blind infants are able to establish a rapport with their caretakers. Preisler, (1991) reports that infants in her study engaged in imitation,

smiling, and were generally 'social and attentive to their mothers'. This suggests that non-visual perceptual information is sufficient for establishing exchanges between blind infants and their parents. The varying quality of input speech and touching routines (e.g. tickling) appear to serve to provide a focus for the interactions. In support of this, close examination of the interaction between blind infants and their parents reveals special ways of communicating (Fraiberg, 1977; Urwin, 1978b). In particular, Fraiberg draws attention to the way that blind infants' hands are an important source of information about affective states. In addition, a number of studies have drawn attention to the tendency of blind infants and their parents to engage in communication through focusing on rhymes and routines; it appears that such activities permit a blind infant and his/her parent to focus on the same thing for a period of time using touch and sounds (Fraiberg, 1977; Urwin, 1978a, Dunlea, 1989; Perez-Pereira and Castro, 1992).

Observations suggest that up until six months of age sighted infants engage largely in social behaviour which does not involve objects: they smile, vocalize at others and share gaze (Stern, 1985). At around five months of age, sighted infants start to reach out towards objects and then, around six months, they shift from being interested in people to being interested in people and objects. Between 7 and 15 months, sighted infants discover that others have minds in addition to their own and start to share the focus of attention with others by following another's pointing gesture and establishing their own (Murphy and Messer, 1977). Thus around half way through their first year, sighted infants are not only in a position to become more active in controlling their physical environment, but are also able to start combining different aspects of their physical and social environments.

In contrast, Preisler (1991) observed that at nine months, when sighted infants start to establish joint attention either by following the direction of their partner's gaze towards an object or by pointing at the object, the blind infants in her study were not able to engage in joint attention. At eight months of age, Preisler notes that for all five of the blind infants

participating in her study, more than half of the video-recorded interactions were focused on the parent and infant rather than objects. Thus in contrast to sighted infants, person-person-object style interactions were not established in a reliable way until around 21 months. These findings are in line with reports of blind infants and their parents spending a high proportion of their time sharing routines and nursery rhymes (Urwin, 1978; Dunlea, 1989; Perez-Pereira and Castro, 1989). Interestingly, Preisler (1991) noted that the SVI infants in her study were much more able than the blind infants to engage in interpersonal communication in contexts where shared meaning was required. Furthermore, Preisler noted that the SVI infants were able to point and that the interactions resembled more those of sighted infants than blind infants.

A review of the sensorimotor abilities of blind infants suggests that they do not reach for objects until the end of their first year, around six months later than their sighted peers (Lewis, in press). In cases where the object is non-sound producing, this delay may occur because the lack of visual incentive requires the infant to have an understanding that there are 'things out there to be explored'. Sound producing objects provide blind infants with some quality of sequential information, but they do not indicate that sounds have sources whose location can be inferred or found by exploration. Social information obtained through non-visual channels, however, may offer the opportunity for blind infants to understand about how a sound source (e.g. parent's voice) is related to haptic information (e.g. parent touching infant). At present, since little is understood about the way blind infants develop an understanding of space, it is important to consider observations that interactions between blind infants and their parents rarely involve objects (Preisler, 1991) alongside studies suggesting that blind infants' abilities in sensorimotor domains are delayed (e.g. Fraiberg, 1977; Bigelow, 1983). Currently it is not clear whether the relative absence of objects in early interaction results in delayed sensorimotor functioning, or whether the absence of vision per se leads to difficulties in acting on and understanding objects. If, as suggested in **Section 2.3**, it can be shown that blind infants' understanding

of events is more sophisticated than their understanding of objects, this implies that the temporal information in events can be put to good use in their developing understanding of their environment.

In sum, at least for the first six months of life, an absence of visual information does not appear to disrupt the nature of interaction between blind infants and their parents. Instead, the interactions between blind infants and their caretakers seem to be characterized by a high proportion of routines and rhymes (Urwin, 1978; Dunlea, 1989). However, studies also suggest that blind infants are delayed in acting on and coordinating their experiences with objects in interaction and rarely play with objects during the first year.

3.4. Lexical development in blind/SVI infants

Two recent reviews of studies of language development in blind children claim describe opposing findings in the literature: Perez-Pereira and Castro (1992) report that some studies 'have shown that blind children acquire language in a similar way to sighted children' (Urwin, 1983, 1984; Landau, 1983; Landau and Gleitman, 1985; Bigelow, 1987 and Bigelow and Bryan, 1982) whereas others suggest specific or general differences (Cutsforth, 1951; Burlingham, 1961; Fraiberg and Adelson, 1973; Fraiberg, 1977; McGinnis, 1981; Mills, 1983; Andersen, Dunlea and Kekelis, 1984, Dunlea, 1984, Mulford, 1988). Similarly, Andersen, Dunlea and Kekelis (1993) characterized the literature up until the early 1980's as being 'full of seemingly contradictory findings' and identified those studies concluding that blind children's language was delayed (Burlingham, 1961) or 'meaningless' (Cutsforth, 1932) and contrasted them with those which concluded similarities with sighted children (Fraiberg, 1977; Urwin, 1978a, 1978b; Gleitman, 1981; Landau, 1983) or even precociousness (Chomsky, 1980).

This perceived lack of consensus within the field seems misguided, since blind children's language development is frequently inappropriately labelled as either being 'same' or

'different' to sighted children's. Such labels are unhelpful because they oversimplify the task of understanding how an absence of visual information influences language development and refer only to language at a very general level. In their reviews, some researchers have taken evidence from studies focusing on a *particular* aspect of language functioning and used this evidence to address the general question of whether language development is different in this population. Thus specific facets of language functioning have sometimes been inappropriately treated as equivalent to general language functioning. Some researchers focus on how different studies have included children with varying degrees of visual acuity, prematurity and disability and use this to explain why different studies have reached different conclusions (Andersen and Kekelis, 1984; Perez-Pereira and Castro, 1992). Although it is highly likely that such factors will indeed account for some of the differences in findings between studies, it is inappropriate to ignore discrepancies arising because studies have targeted different aspects of language functioning.

Some recent reviews have refrained from making comparisons of blind children's language at a general level and instead focus on comparisons based on particular aspects of language functioning (Dunlea, 1989; McConachie and Moore, 1994; Landau, 1995). This thesis too endeavours to contribute to the debate about the extent to which particular aspects of lexical development is similar or different to that of sighted children without channelling the findings towards addressing the general question of whether language development in blind children is different from sighted children's.

3.4.1. Quantitative aspects of lexical development: age of onset of first words, rate of vocabulary development and the vocabulary explosion

Early studies concluded that blind infants were delayed in the production of their first word (Norris, Spaulding and Brodie 1957; Burlingham, 1961; Fraiberg, 1977; Warren 1977; Reynell, 1978). However, these studies may have revealed developmental delays because they involved infants who were premature and victims of retrolental fibroplasia (e.g.

Norris, Spaulding and Brodie, 1957). This latter condition is thought to be associated with a central nervous system disorder resulting in some maturational lag which, in turn, may account for the late onset of linguistic milestones.

A more recent study by Mulford (1988), who collated the findings from 15 case studies reported in seven separate papers and compared these findings with those of Nelson (1973), concluded that there were parallels between the production performance of blind and sighted infants. On the basis that the first and tenth words emerged at a mean age of 14.7 and 15.1 months in sighted infants, Mulford concluded that there was no evidence of a delay in the onset of speech or the attainment of lexical milestones in these blind infants.

In contrast, a study of nine blind infants by McConachie and Moore (1994) found that the mean age of acquisition of the first and tenth words was 18.2 and 20.8 months respectively. These researchers concluded that the blind infants in their study were delayed in their onset of speech on the basis that their performance was behind that of sighted infants on the norms for Bayley Developmental Infant Scales (14 months median age for acquisition of two words) and for the Reynell-Zinkin Scales (10 to 11 months for production of one clear word by sighted infants). Like Mulford, they compared the mean age at which the blind infants in their study acquired 10 words with Nelson's (1973) findings. Overall, they concluded that there was a significant delay in the acquisition of early milestones in blind infants. Moreover, they argued that this finding may even underestimate the extent of the delay since three of the scores contributing to the overall means were the ages of three infants who at the end of the study still had not achieved this milestone. Interestingly, McConachie and Moore (1994) also studied the onset of speech in nine SVI infants and observed that the first word was produced at a mean age of 15 months. Thus when infants had a small amount of vision they produced their first word a mean of three months earlier than the blind infants. However, this may still be viewed as a delay when compared with the Bayley norm of 14 months and the Reynell-Zinkin norm of

10-11 months. SVI infants produced their 10th word at a mean age of 20.4 months, which is no different to the group of blind infants in their study. In sum, the SVI infants produced their first word earlier than blind infants but that there is no difference between the groups in the onset of the 10th word.

One reason McConachie and Moore (1994) offer for the discrepancy between their own findings and Mulford's was that the latter consisted of special case studies where infants were followed over a number of years. They argued that parents willing to participate in such studies were probably particularly well motivated and therefore that Mulford's case-studies might have been biased toward involving only the more successfully developing infants. One further consideration, however, is the issue of undertaking comparisons between measures of central tendency where samples are based on small numbers of children. For example, the median of 14.2 months for the emergence of two words, established as a norm for the Bayley Scales, was based upon 200 sighted infants. In contrast, Mulford (1988) and McConachie and Moore (1994) based their studies on 11 and 9 infants respectively. Interestingly, the comparison between Mulford's and Nelson's study involved similar small numbers of cases and yielded no significant difference between the two populations.

In addition to commenting on measures of central tendency, several researchers have remarked that there is a wide range in the age at which blind infants produce their first words. For example, Fraiberg observed first words to emerge between 10 and 23 months and Mulford reported a range of 9 and 24 months. Interestingly, this level of variation is similar to that exhibited in sighted infants (e.g. Bayley, 1969; Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick and Reilly, 1993) and suggests that an absence of visual information does not influence the degree of variation in the age at which speech emerges during infancy. Instead, it implies that some of the factors responsible for the early or late

onset of speech in sighted infants may also apply to blind infants (Bates, Dale and Thal, 1995).

It is clearly impractical to make comparisons between blind and sighted infants based on sample sizes on the scale organised by Bates *et al.* (1993) (e.g. over 1,000 infants) or even use a meta-analysis to combine information from different studies. One solution would be to closely match individual blind infants with sighted controls on a number of factors (e.g. birth-order, SES, gender - see **Section 2.6.1**), which would maximize the opportunity to make valid comparisons of performance of early lexical functioning in smaller samples of blind/SVI and sighted infants.

There have been very few systematic studies of the rate of vocabulary development in blind infants, though one by Dunlea (1989) reported a steady rate of acquisition in three of the four infants she studied. In the case of one infant, 'Teddy', Dunlea documented a rapid increase in the number of words produced but noted that these words were restricted to use with specific referents and therefore concluded that 'Teddy' had not achieved the 'naming insight' which is suspected to co-occur with, or act as a pre-cursor to, the sudden rate increase in sighted infants. In line with this finding, McConachie and Moore (1994) noted that blind infants' vocabularies undergo an increase towards the end of their second year. Although both Dunlea (1989) and McConachie and Moore (1994) comment on the rate increase around the end of the second year, as seen in **Section 2.4.1**, the universality of the 'vocabulary explosion' is controversial, so the absence of this phenomenon in three of the four infants in Dunlea's study may be relatively insignificant. The controversial nature of the vocabulary explosion generally may indicate that little significance should be attached to Dunlea's finding that 3 out of 4 of her blind infants provide no evidence for it. McConachie and Moore's comment of a general rate increase around the end of the the second year may also not signify that a vocabulary explosion is a phenomenon which has

a distinct place in theories of lexical development and the thesis will not seek evidence for its existence.

However, McConachie and Moore (1994) also addressed the rate of vocabulary development when infants were first starting to produce words and found that the blind and SVI infants demonstrated different patterns of early vocabulary growth. Whereas the SVI infants took on average 6.1 months to acquire their first 10 words, the blind infants took under half this time. It is important to add to the size of the data base on this issue since McConachie and Moore's study was the first study to report data on the rate of acquisition in the first words produced.

The review of quantitative studies of lexical development in blind infants reveals that the range in age at which blind and SVI infants achieve their milestones are no different to sighted children. When measures of central tendency are used, however, these tend to produce discrepancies between studies. However, suggesting that it may be more useful to treat these discrepancies as the product of variation within the population that is, in any case, readily observable in samples of sighted infants. Two issues were raised for investigation in this thesis: to establish samples of matched blind/SVI and sighted infants in order to examine whether this reveals any difference in the age at which blind infants produce their first words and the rate at which they are produced and to examine comprehension alongside production. The asymmetry between studies of comprehension and studies of production is particularly pronounced in the literature on blind infants. There are very few studies of comprehension in this population (Reynell-Zinkin, 1979), which may have resulted in an underestimation of the lexical repertoires of blind infants. To redress this imbalance, this thesis aims to document developments in comprehension alongside those of production.

3.4.2. What do blind / SVI infants talk about?

Studies of the early vocabularies of blind children suggest that they contain the same kinds of words as sighted infants use when they first speak (Mulford, 1988). Analyses of the composition of early vocabularies have usually been based on children's first 50 words and involved an examination of the distribution of specific nominals, general nominals, action words, relational words, modifiers and personal-social words. Mulford combined data from nine cases from Andersen, Dunlea and Kekelis (1984), Bigelow (1982) and Landau (1982, 1983) and found that these results were comparable with Nelson's (1973) findings for sighted children. She noted that sighted infants referred more to animals than blind infants and that blind infants referred more to furniture / household items than sighted infants. Overall, however, there was no difference between the two groups of infants in the extent to which they referred to food and drink, clothes, toys, vehicles, personal items (e.g. key), eating and drinking utensils, outdoor objects, places, body parts or people.

Studies of the use of action words by blind children have found that blind children limit their use of action words to refer to their own actions (Mulford, 1988), which is perhaps not surprising given that blind children have more access to information about their own actions than those of other people's. Mulford (1988) suggests that most blind infants used personal-social words to express affective states and social relations (e.g. *Night-night*, *Yes*), though she noted that the infants in the studies she examined used social routines to different degrees. In particular, she draws attention to Jerry (Urwin, 1978), who relied on unanalysed phrases such as *Are you sure?* It is perhaps not surprising that blind infants use words in this way given that such phrases usually mark the beginning or ending of some action / event. Given that blind infants have to rely more on temporal information than their sighted peers, they are therefore likely to use words which rely on knowledge of structure of events and activities.

In sum, only negligible differences have been found between the content of early vocabularies of blind and sighted children suggesting that an absence of visual information does not greatly alter the kinds of things blind infants are likely to talk about, though this probably reflects the extent to which their sighted parents maintain corpora of words which are similar to that used by parents of sighted children.

Although the content of sighted and blind infants' vocabularies was found to be similar, Mulford documented two differences in the way blind and sighted children used their words. Unlike sighted infants, blind infants only used words to refer to objects when they were in contact with an object or unless they heard its sound. Again, it does not seem surprising that blind children talk about things they have immediate sensory access to.

In addition, Mulford notes that blind children did not engage in labelling entities in their environment to the same degree as sighted children. In **Section 2.6.2**, it was suggested that sighted children learn labels for objects during episodes of joint attention (Tomasello, 1992, 1995). However, given that blind infants and their parents are not able to participate in the same kinds of joint activities as sighted children (e.g. looking at picture books or looking and pointing at objects in the distal environment) it is predicted that blind infants' vocabularies contain a low proportion of words referring to concrete, discrete objects. Previous studies have included nouns under either 'general nominals' or specific 'nominals'. It is important to define the category pragmatically rather than grammatically and therefore code separately for nouns that, in interaction sequences with young children, are used to refer to discrete entities.

3.4.3. Context-bound word usage

As discussed in **Section 2.4.3**, when sighted children first start to talk, some words are initially tied to specific situations or contexts, for example, a child might use the word 'bye' only when the telephone receiver is put down (Bates *et al.*, 1979). However, on

subsequent occasions sighted children generalise a word's usage beyond referring to a single unique referent or recurring event. Thus a word initially used in a context-bound way usually becomes decontextualised to new exemplars of objects and events. For example, on a subsequent occasion the child used 'bye' when waving goodbye to her father. Dunlea (1989) documented that the four blind children she studied did not decontextualise words in this way and concluded that they failed to objectify the word-referent relationship. In sum, she argued that many of the words produced by young blind children are more appropriately viewed as proto-words.

However, there is evidence that up to half of a sighted child's early vocabulary can remain ungeneralized and / or without errors of extension (Dromi, 1987), which is in line with Dunlea's (1989) findings from her study of blind infants. It is important to compare findings from blind infants against realistic estimates about what sighted infants do. However, if we treat seriously the claim that blind infants may not generalize their words, one explanation may be because the style of interaction between blind infants and their parents does not provide an appropriate forum for generalizing words. As pointed out earlier, the play of blind children and their caretakers usually involves many well structured routines and games (Urwin, 1978; Dunlea, 1989) which rarely involve objects (Preisler, 1991). Furthermore, everyday caretaking events (washing, eating, etc) also involve a high degree of structure. These three characteristics suggest that, during their early years, blind infants spend a high proportion of their time in extremely well defined and predictable contexts with limited involvement with objects. Blind infants may appear to fail to generalise words to new contexts because they experience a restricted repertoire of events and contexts each day and there is therefore little opportunity for investigators to detect changes in word usage. However, if these contexts are examined closely it may be that we can detect subtle ways in which the words are used in different ways over time. This point is supported by Barrett (1995) who, in referring to sighted children, argues that although many early words appear to be used in a context-bound way there are often subtle changes

which suggest that a child is beginning to decontextualize words. For instance, a child may use a particular word when a different person participates in the activity or a new body part is involved in the routine. Thus, rather than concluding that an absence of visual information leads to a deficit in the ability to decontextualise words, it seems important to examine whether blind infants change the way they use a particular word within superficially similar contexts which, in fact, are subtly different from the contexts in which the infant originally used the word.

3.4.4. Extensions

As discussed in **Section 2.4.4**, sighted infants not only extend words appropriately to other referents but they often misapply words by using them to refer to a broader range of referents than is appropriate in adult language. For example, an infant uses the word 'horse' to refer not only to horses but also to include cows, dogs and sheep. Dunlea (1989) observed that the blind infants in her study rarely extended or overextended their early words, only overextending between 8 - 13 % of their first 100 words compared with Anglin's (1977) finding that sighted children overextended around 33% of their total vocabulary. This evidence lead Dunlea (1989) to conclude that blind children use words in a restricted way.

However, there is actually wide variation among sighted infants in the extent to which they overextend words. For instance, Barrett (1995) concludes that most studies suggest that sighted children extend between 7 and 33% of their total vocabulary (e.g. Anglin, 1977; Greundel, 1977; Barrett, 1978; Rescorla, 1980; Nelson, 1982). Although the infants in Dunlea's study fall to the lower end of this range, it is notable that they fall within the range for sighted infants. In sum, it seems likely that Dunlea (1989) has pitched her findings against unrealistic estimates of the performance of sighted infants. However, it is also important to consider explanations why the performance of the blind infants may fall towards the lower end of the range for sighted infants.

A number of reasons why the blind infants in Dunlea's study performed at the lower end of the range for sighted infants are identified. First, as is often the case with sighted infants, it is important to note that the possibility for extension depends upon the availability of a suitable referent. However, as Bigelow (1982) points out, blind children have less immediate access to the environment so it is not surprising that they are not often observed to extend the words they use to other referents.

In addition, the absence of visually based communicative strategies for joint attention make it likely that the frequency of overextensions will be underestimated in blind children. When a sighted or a blind child has an object in their hands it is easy to detect whether or not they are using a word inappropriately (i.e. overextending). However, for an object which is in close physical proximity, but not in contact with the child, it is more difficult to establish whether a blind child is overextending. Sighted children are likely to isolate the target referent by engaging in pointing and shared gaze so that the caretaker is likely to identify which referent (action or object) the child is referring to and therefore is in a position to detect if the child is using the appropriate word. In contrast, blind children do not engage in pointing and it seems likely that the cues that they do produce (e.g. orientation of body) are not powerful or clear enough to allow a caretaker to isolate an object / action from competing ones. In sum, it is possible that researchers may have underestimated the extent to which blind children overextend their words, simply because it is not possible to identify the object / action referred to.

A further possibility is that blind infants have fewer words in their vocabularies which readily lend themselves to overextension. The most frequently cited examples of overextension in sighted children's speech are words which refer to concrete, discrete objects. As discussed earlier, such words are typically learnt in 'point and label' activities such as picture book reading. Labels for concrete, discrete objects readily lend themselves to overextension because they, and the objects they refer to, are central to the kinds of joint

activity sighted infants and their caretakers engage in. It seems likely that blind infants might have been judged to demonstrate fewer instances of overextension because they cannot engage in these kinds of visually based word learning activities. Furthermore, it is documented that objects are not the focus of many of their early interactions (e.g. Preisler, 1991).

On the basis that blind infants participate in fewer 'label and name' contexts than sighted infants in **Section 3.4.2** it was proposed that they would produce fewer labels to refer to concrete, discrete objects in their early vocabularies than sighted infants. Such evidence would support the argument that blind infants do not use words which refer to things which are most prone to overextension.

As pointed out in **Section 2.3** lexical development has been subject to a bias towards studying the acquisition of labels for objects rather than any other category. It is therefore important to consider the extent to which words from other categories are extended. Given that blind infants experience the world more through time and proximal space only, it would seem likely that they would use more labels for actions and that words likely to be overextended, would be labels for actions.

Several reasons have been suggested why it is necessary to re-examine Dunlea's views that blind children do not overextend their early words: one reason is that the performance of blind infants has been pitched against unrealistic estimates of the extent to which sighted infants overextend their words; another concerns the way blind children have less immediate access to the environment making it difficult for them to extend the words they use to other referents; it was also observed that the absence of visual cues makes the detection of overextension in blind infants more difficult; and finally, the nature of interactions between blind infants and their parents suggest that it is unlikely that they would engage in the sorts of joint activity which would promote the use of overextensions. Little is known about the extent to which blind infants extend labels for actions, although it

is predicted here that such words would be more likely to be extended because these represent the kind of experience blind infants have access to more readily.

3.4.5. Individual differences

Studies of individual differences in atypical populations are inevitably restricted to case studies or small samples of children. Studies of blind infants are no exception to this and have mostly involved longitudinal investigations of individual infants (Kitzinger, 1984; Perez-Pereira and Castro, 1992; Wilson, 1986) or are limited to three or four infants at the most (Dunlea, 1989). Although it has been argued that studies based on small numbers offer insight into the patterns of individual variation, Bates *et al.* believe the degree and nature of variation will remain questionable. These researchers claim that estimations of variability require a substantial sample size and have started to study language development in sample sizes of over 1,800 children (Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick, and Reilly, 1993; Bates, Marchman, Thal, Fenson, Dale, Reznick, Reilly and Hartung, 1994; Marchman and Bates, 1994; Fenson, Dale, Reznick, Bates, and Thal, in press). Although current studies of typical children are based on substantial numbers of children, Peters (1994) argues that by focusing on a single child, the researcher has time to investigate 'rich and unanticipated detail' which provides the opportunity to explore new methods for understanding what drives developmental changes. In line with Peter's view, this thesis seeks to examine patterns of conceptual-lexical functioning by studying changes in individual infants in addition to supplementing this information with observations of group trends.

A number of researchers have used the distinction made in the literature on sighted infants between 'referential' and 'expressive' styles to refer to the speech of blind infants. Urwin (1978) noted that one of her infants, Jerry, used many phrases which were ready-made and which could be interpreted as suggesting that the child used an 'expressive' approach. Mulford (1988) has reviewed the extent to which blind infants could be classified as

'referential' or 'expressive' as indicated by the proportion of general nominals in their early vocabularies. Based on nine infants from studies by Landau, (1982), Bigelow, (1981), Andersen, (unpublished data) and Wilson, (unpublished data), Mulford found that only two infants fell into the category of referential style speakers. Overall, she noted that the proportion of general nominals in the children's early vocabularies was 38%, which implies that they were generally expressive in style. From this, Mulford concluded that the patterns displayed by the nine blind infants were not distinctly different from those of sighted infants and that there was no clear typical learning strategy for blind children in this group. Mulford argued that if general nominals are removed from the analysis then the remainder of the vocabulary is similar to that of referential children, with similar proportions of modifiers and action words. In addition, it appeared that the children did not employ multiword utterances to any great degree. In conclusion, Mulford notes that the study of blind infants contributes far more to the study of variation per se rather than to the study of typical vs atypical language development.

The review of the criticisms made of the 'referential'-'expressive' (or 'analytic'-'holistic') literature presented in **Section 2.4.6** concluded that this dichotomy oversimplifies the nature of the differences between infants in early language development and that it would be better to investigate the nature of the relationship between analytic and rote strategies and the size of unit being processed (Bates *et al.*, 1995). The study of blind infants can inform the study of variation in lexical functioning in sighted infants if, for example, we continue to find that blind infants have a tendency towards an 'holistic' style but differ between themselves in the length of unit which they produce. This may suggest that size of unit is a source of variation across all language learners.

3.5. Lexical development and conceptual functioning

In comparison to research on sighted infants, only a small amount of research has been conducted on conceptual functioning in blind infants and this has focused exclusively on

the categorization of objects rather than actions / events. Unlike studies of sighted infants, studies of blind infant's sorting strategies have produced inconsistent findings. For instance, Gerhardt (1982) concluded that the blind infant "AB" in her study appeared to follow the same shift from holding different class to holding same class objects reported for sighted infants (Langer, 1980). When AB was first observed by Gerhardt at 14 months she was sorting objects according to their differences. The precise age at which AB started to sort objects by similarity depended upon the number of objects and the type of contrast between objects in the task. For instance, where tasks involved a total of four objects which differed in one dimension but were similar on another (e.g. four blocks where only two blocks made a sound) AB was able to sort by similarity at 16 months. However, when there were eight objects in the task, AB was not able to sort until 18 months. Overall, the findings demonstrated that when AB had fewer objects to play with, and when the contrasts between the objects in a task were simple, this facilitated sorting. However, it is not clear whether these differences in the child's performance reflect genuine differences in the child's ability to sort arrays of different complexity, or differences in the sensitivity and suitability of the tasks to detect sorting.

Dunlea (1989) also studied object sorting in four blind infants and found that the infants in her study sorted objects around 16 months later than the infant AB. Moreover, this may have been an underestimation since AB may have been able to sort before she was first observed. Until the age of 30 months, none of the infants in Dunlea's study engaged in sorting.

One possible reason for the discrepancy between Gerhardt's and Dunlea's studies may have been the differences in the criteria used to assess sorting strategies. Gerhardt (1981) compared the performance of the infant participating in her study with those of sighted infants based on criteria established by Langer (1980). Using this method, configurations between objects were considered the basic unit of analysis. A configuration consisted of

bringing an object into spatial contact or proximity or indicating the functional equivalence between objects by acting on them in the same way. Gerhardt provided a qualitative description of the trends in object manipulation for infant AB longitudinally. Details about what quantity of particular configurations were necessary to constitute sorting were not provided by Gerhardt (1982). This makes it difficult to make comparisons between Gerhardt's and Dunlea's findings.

The assessment of sorting strategies by Dunlea (1989) used a sequential analysis and involved the examination of whether infants were engaging in same class object manipulations like those described by Sugarman (1983). This involved examining whether object manipulations were recorded as same or different in relation to the object manipulated immediately before. The number of same class object recordings were compared with the number of different class recordings. Infants who manipulated same class objects in temporal sequence more frequently than expected by chance were regarded as sorting on the basis of similarity. Using this criterion, Dunlea (1989) found no evidence for same class manipulations. Furthermore, there was no evidence for the use of rudimentary strategies since infants did not spend more time manipulating one type of object over another, nor did they search for one type of object in preference to another type.

One factor common to both Dunlea and Gerhardt's studies is that they both transferred techniques used with sighted infants to the study of object manipulations in blind infants. Whereas Gerhardt used Langer's (1981) techniques to study the emergence of logic, Dunlea (1989) used the sequential analysis to assess the tendency to sort objects. The sequential analysis is inappropriate for use with blind infants because it makes no allowance for object manipulations which function as haptic scans in these infants. This view is consistent with a point recently made by Landau (1995) who remarked that this method was inappropriate because blind infants would have difficulty keeping track of

which objects they had or had not explored. These observations suggest that it is crucial to develop a technique appropriate to the study of sorting abilities in infants without vision.

In addition to being unsuitable for use with blind infants, the sequential manipulation analysis does not take into account sorting strategies where two objects from one class are picked up followed by two objects from the other class. For instance, an infant who picks up two cylinders followed by two cubes and then two cylinders and so on would produce an equal number of same and different recordings. If the procedure adapted by Sugarman (1982) is followed and these same and different recordings are compared using a Chi-squared analysis then this would lead to the conclusion that the infant was spending more time sorting on the basis of differences (given that the expected scores for different class manipulations is larger than the one for the same class manipulations). It is clear that an infant who consistently picks up two cylinders, drops them both and then picks up two cubes is selecting objects on the basis of both similarity and difference. In other words, they are alternating between strategies. The sequential analysis does not examine the object-pairings which infants produce. Yet picking up an object in each hand would seem one of the most natural things for infants to do when they are presented with a set of objects.

A further problem with studies using sequential analysis is that they have assigned a range of interpretations to observations of infants manipulating *different* class objects in temporal sequence (i.e. alternating between classes) more frequently than could be expected by chance. Clearly, a sequence of manipulations can differ from chance in two directions - either by alternating between different classes or by having runs of similar class objects. Some studies have not even considered different class object manipulations as evidence of sorting (e.g. Riccuiti, 1965). Others have viewed the sorting of objects according to differences as an ability which precedes the sorting of objects by similarity (e.g. Langer, 1981; Gerhardt, 1982). However, these researchers have not reported whether they took account of the fact that there is a greater probability of selecting different class objects

(these researchers used equal numbers of same and different class objects). Given that Gerhardt (1982) adopted Langer's techniques to assess sorting in AB, it is possible that the 'different to same class shift' reported above may have underestimated the extent to which AB was sorting objects according to similarity at 14 months. It is important to consider sorting objects according to their differences as equivalent in developmental status to sorting by similarity. The rationale is that the ability to recognize that an object as 'not another one of those' is equivalent to the ability to recognize that a particular object 'is another one of those'.

Another possible explanation for the discrepancy between the Gerhardt (1982) and Dunlea (1989) concerns the extent of AB's visual impairment in Gerhardt's study. Gerhardt did not elaborate on whether 'blind' meant no visual response or whether it was being used in a different way. It is possible that the infant in Gerhardt's study was performing more in line with sighted infants because she had more vision than the infants participating in Dunlea's study. Infants with residual vision are often reported to manifest developmental patterns more typical of sighted infants (Mulford, 1988). There is a need to examine the extent to which increased vision aids sorting activity by examining whether the performance of SVI infants approximates that of sighted infants or the blind infants.

Studies of object sorting in sighted infants have also influenced the study of blind infants in the choice of objects used in the tasks. Dunlea (1989) paired pieces of fabric with cardboard, metal forks with metal cars, wooden / plastic blocks with cylinders and round plastic rattles with balls. Gerhardt used plastic miniatures, blocks and closed rings (which varied in terms of whether they produced sound). It is important to understand whether the use of materials which are more meaningful for blind infants than abstract plastic miniatures and geometrical forms can influence the ability to sort objects.

It was argued in Section 2.3 that until recently, the literature on sighted infants was biased towards the study of the acquisition of words for objects. Here, it is argued that this

may have led to an underestimation of blind infants' linguistic abilities. Earlier in this chapter, it was described how an absence of visual information results in an infant having access to information which is predominantly temporal in nature and/or information about things which are positioned in the proximal environment: actions, events and objects in contact with their body. However, because the literature has examined conceptual functioning through examining what blind infants do with objects, this may have highlighted any difficulties blind infants may have with objects and ignored their ability to categorize information of a temporal nature. It is proposed here that one alternative way of examining the extent to which infants are able to categorize is through examining the extent to which they are able to produce different clusters of actions for different routines and rhymes. The onset of such an ability would suggest that infants recognize that a particular action is 'another one of those' and that they are able to categorize information predominantly of a temporal nature.

In sum, evidence is inconclusive about the status of conceptual functioning in blind infants derived from object sorting. Previous studies have used inappropriate techniques to assess sorting ability and/or unsuitable materials with blind infants. This thesis seeks to design a new technique to assess sorting strategies in blind/SVI infants as well as using objects which are more appealing to an infant without sight. Furthermore, it recognizes that we need to understand the extent to which blind infants categorize information which is temporal in nature in addition to looking at what they do with objects.

3.6. Is there evidence for a cognitive deficit in blind infants?

This section summarizes the three kinds of observations about the status of early conceptual-lexical functioning in blind infants which leads some researchers Dunlea (1989) to conclude that an absence of visual information results in a cognitive deficit. First, blind infants are claimed not to generalize words beyond the context which they were originally used. Second, it is claimed that they treat words as proper names and rarely extend or over-

extend them to refer to new referents supposedly signifying that they are not constructing hypotheses about the nature and meanings of words to the same degree as sighted infants. Finally, blind infants are claimed to be severely delayed at sorting objects and that the absence of this ability is relevant because it is thought to underlie lexical categorizations (Dunlea, 1989; Andersen, Dunlea and Kekelis, 1993). Overall, Dunlea and co-workers have concluded that vision may stimulate the processes which permit classification, that lexical development in blind infants may be constrained by delays in sensori-motor cognition and that an absence of vision may lead to significant cognitive deficits during infancy (Dunlea, 1989; Andersen, Dunlea and Kekelis, 1993).

This chapter questioned Dunlea's (1989) position that an absence of visual information leads to a cognitive deficit during infancy and criticized her claims about the nature of lexical functioning in blind infants. It has been argued that the frequency of generalisations and extensions / overextensions made by blind infants were compared against unrealistic estimates of the frequency of what sighted infants do. It was suggested that, in the absence of visual cues, it may be harder to detect whether or not a blind infant is generalizing / extending. Furthermore, it was argued that previous studies of object sorting have not been designed appropriately to detect whether blind infants are able to sort, nor have they paid sufficient attention to whether blind infants categorize the type of information they do have access to.

3.7. Environmental influences on lexical development

Consideration of the extent to which general environmental factors influence lexical development may be critical in the study of small samples of atypical children since, if any differences between lexical functioning in blind and sighted infants emerge, we need to eliminate any general environmental influence in order to establish that the differences are due to an absence of visual information other than any general environmental influence. Recognition of the influence of input speech on lexical development is crucial in the case of

blind/SVI infants, since blind children rely on it for information which is readily available to sighted children (Fraiberg, 1977; Urwin, 1978; Andersen and Kekelis, 1982; Rowland, 1983; Kekelis and Andersen, 1984; Mulford, 1988; Moore and McConachie, 1994; Peters, 1994). Studies of the role of general environmental factors and the speech environment on lexical development in blind infants are considered below.

3.7.1. The role of general environmental factors

Most studies of lexical development in blind infants have involved families from the mid socio-economic range (e.g. Mulford, 1988; Andersen, Dunlea and Kekelis 1984; Bigelow 1981, 1982; Landau 1982, 1983). However, two recent studies have involved children from a range of backgrounds (McConachie and Moore, 1994; Moore and McConachie, 1994). It is essential that future research continues to do this so that accounts of conceptual-lexical functioning take into account a variety of parental interactional styles. For example, it was reported earlier that sighted dyads from different socio-economic backgrounds differ in the proportion of nouns they produce. In Section 3.4.2 the prediction was made that blind infants would produce fewer words to refer to concrete discrete objects in their vocabularies than sighted infants. In order not to confound socio-economic status with level of visual functioning, it is important to eliminate socio-economic status as a factor.

3.7.2. The speech environment

Studies suggest particular differences between the kind of input blind and sighted infants receive (Kekelis and Andersen, 1984; Andersen, Dunlea and Kekelis, 1993). These researchers predicted that an absence of vision would lead to caretakers providing information about their child's environment not readily accessible by vision. However, their study of two blind, two SVI and two sighted children between 16 and 22 months demonstrated that, whereas sighted children received more information about their environments, the blind infants were more likely to receive labels for objects and activities

of which they already knew the name. Andersen *et al.* (1993) proposed that caretakers may rely on labels because they find it hard to know what the child was interested in, given they cannot identify which objects and properties of events interest them by using gaze and gestures. They also proposed that caretakers found it hard to gauge their blind child's level of comprehension, and by restricting their speech to using labels they were increasing the chance their child would understand their speech. Similarly, by making requests for a label, they provide a way of getting the child's attention and getting the child to respond to a question.

An alternative way to viewing Kekelis and Andersen's (1984) finding that parents of blind infants rely on a high proportion of requests for action was proposed by Moore and McConachie (1994), who found that parents of blind children used requests for action for encouraging joint activity with their child, for teaching them to use objects and for checking their comprehension of instructions. Thus, although these researchers found the same trend as Kekelis and Andersen, they interpreted the findings as suggesting that communication between the partners was appropriate for the needs of a blind child. Their observations of communication addressed to eight blind children by their parents were augmented by observations of eight SVI children aged from around 18 months of age. Interestingly, they found differences between the kinds of communication occurring between blind, SVI and sighted infants and their parents. In line with previous speculations and findings (Preisler, 1991) they found that even minimal vision makes a difference to the style of communication between parents and their children. In particular, they found that parents of blind children initiated interactions more often than the parents of SVI or sighted children.

Moore and McConachie (1994) also studied the information provided by parents to their blind / SVI infants and found that, unlike the parents of SVI children, the parents of blind children made fewer references to objects at the child's current focus of attention and more references to objects which could be used in joint activity. In addition, they noted that

parents of blind children provided fewer references to specific attributes of objects. When referring to objects, caretakers would describe the properties of objects using general terms (e.g. nice thing) rather than in specific terms (e.g. crinkly paper). These findings are consistent with the findings of Andersen and her co-workers (1984, 1993) who found that blind infants received less input speech orientated towards here-and-now speech than their sighted peers. Instead, parents of blind infants tended to focus on labelling objects and actions that the child was focused on. Moreover, they did not describe the properties or the attributes of the objects. Overall, Andersen *et al.* concluded that the blind infants received information that was less rich than that received by their sighted peers.

One exception to the finding that input speech to blind infants contains less information about attributes of objects is Peters' (1994) report on Seth, a blind child whose language development was documented between 15 and 48 months by his father. Peters (1994) notes that Seth received an abundance of information about objects and their names and attributes. However, Seth's father was a linguist and it is therefore likely that this would have influenced the kind of information he chose to provide to Seth.

The kind of speech Seth received involved a high use of the *eventcast*, which refers to the way speech contains a running narrative on events currently in the attention of the speakers and listeners (Heath and Branscombe, 1986). Peters argues that language which is eventcast for a blind child draws attention to the culturally important aspects of the activity as well as providing labels for the objects / actions involved and syntactic constructions useful for talking about the activity. Moreover, Peters argues that such eventcasts provide the child with a script to follow, enabling the child to break down events into subevents and making it likely that the child will be able to predict what action / object is going to be involved next. Furthermore, with increasing familiarity with the activity, the child is likely to begin to plan their own actions within the activity and even take responsibility for engaging in the activity itself. Peters identifies scripts as providing cognitively useful

information about possible action sequences as well as linguistically useful information on words and the way they are structured.

Overall, therefore, there has been a shift recently from viewing input speech to blind infants as inappropriate, to viewing it as adaptive to the perceptions of the needs of the blind child (Moore and McConachie and Moore, 1994; Peters, 1994). There has also been an emphasis on the differences between styles adopted by parents of children with different levels of visual impairment (Moore and McConachie, 1994).

3.8. Visual deficit and theories of lexical development

Section 2.7 reviewed a number of theoretical explanations to account for early lexical development and compared them in terms of the extent to which they were able to account for several phenomena of lexical development: the vocabulary explosion, context-bound usage and extensions. They were also considered in relation to the topics they addressed: the acquisition of different types of words, variation between words within infants, and variation between infants and the role, if any, they assigned visual information. The three explanations offering the most scope for understanding lexical development were argued to be the multi-route model, the lexical principles framework and the social-pragmatic framework. Findings from studies of conceptual and lexical functioning presented in this chapter lead to the formation of certain predictions about where blind infants would manifest particular difficulties on these three different models. These are considered below.

3.8.1. Multiroute model

Section 2.7.5 discussed how the multiroute model involved two routes to word learning (Barrett, 1983, 1986, 1991, 1995). The first route represented the acquisition of social-pragmatic and context-bound words whereas the second represented the acquisition of referential words. Dunlea's (1989) position that blind infants' speech remains context-bound, according to Barrett's framework, would mean that blind infants would 'get stuck'

on the former route. However, earlier it was suggested that we need to be sensitive to subtle decontextualisations that occur in the kinds of interactional contexts blind infants and their parents share. If we find evidence that blind infants are generalising words within these kinds of situations then this would suggest that blind infants follow the first route and that they progress along this route in the same way as sighted infants. If we find that blind infants use a range of words referentially, then this would suggest that they are mapping words directly onto prototypes and following the route for referential word acquisition.

3.8.2. Developmental principles framework

This framework discussed in **Section 2.7.3** suggests two tiers of principles enabling lexical development to get off the ground (Golinkoff, Mervis, Hirsh-Pasek, 1994; Golinkoff, Hirsh-Pasek, Mervis, Frawley, and Parillo, 1995). The first tier is argued to involve principles which are perceptually-cognitively driven whereas the second is thought to be facilitated by existing linguistic knowledge. The findings from Dunlea's (1989) research suggest that the principles from the first tier do not guide lexical functioning in blind infants who are reported not to extend or generalise their first words.

Golinkoff *et al.*'s (1995) modification of the framework to include a focus on the acquisition of labels for actions provides an alternative window through which to view the lexical development of blind infants. In contrast to the prediction from Dunlea's research, the position taken here is that blind infants are guided by the first tier principles, with a focus on the acquisition of labels for actions / events instead of labels for objects.

3.8.3. Social-pragmatic framework

This framework (Tomasello, 1995) centres around how infants understand the intentional actions of those around them particularly the process by which infants understand a parent's intention towards their own intentional states. It is particularly well suited to understanding lexical development in blind infants (or sighted infants whose early

experiences are predominantly based in time rather than time and space) since it explains how the infant might approach the problem of knowing what part of the environment an adult is referring to in temporal terms (events and actions).

3.9. Directions for research

This chapter has reviewed findings from studies of conceptual-lexical functioning in blind infants by commenting on the extent to which the developmental processes and outcomes are similar between blind/SVI and sighted infants. Questions arising from previous studies, as well as from new issues raised as a result of methodological and conceptual advances, are summarized below.

3.9.1. Summary of research issues arising out of theoretical chapters

The shift in research focus from studying the acquisition of labels for objects towards establishing general principles of word acquisition in sighted infants, coupled with increased knowledge about the nature of non-visual perceptual information blind individuals receive, provides new scope for understanding the process of conceptual-lexical functioning in blind infants.

Studies suggest that blind infants spend a high proportion of interactions in extremely well defined and predictable contexts with less access to objects than their sighted peers, though relatively little is known about the degree to which objects, rhymes and routines are incorporated into interactions during the second year. Information on this point may lead to identifying how functioning is common as between sighted and blind infants.

Current research with sighted infants recognizes variation as information to be explained rather than as inconvenient noise. However, unlike research with sighted infants Bates *et al.* (1995), it is obviously not feasible to establish sizeable samples of blind infants with which to study variation. Furthermore, existing studies of blind/SVI infants are difficult to

compare, not only because samples consist of infants varying in their degree of visual impairment and aetiology, but also because the differences in outcome may say more about the variation between infants than the effect of blindness on lexical functioning. Two solutions to these issues were discussed: the first was to establish matched samples of sighted infants with whom to make direct comparisons with blind infants on the age at which early lexical milestones are acquired; the second was to treat the opportunity to study only a few infants as offering a window on the more detailed aspects of conceptual-lexical functioning.

Chapter Two discussed the reasons why the literature on sighted infants has been more concerned with abilities in production than in comprehension. This asymmetry is judged to be even more pronounced in the study of blind/SVI infants. This thesis attempts to redress this imbalance by tracking emerging abilities in comprehension as well as those in production.

Attention was drawn to the way previous studies investigating the content of blind/SVI infants' vocabularies restricted their analyses to grammatical rather than pragmatic categories of speech. It was discussed how it was important to distinguish between nouns which refer to concrete, discrete objects and those which do not. This distinction was made on the basis that blind infants and their parents are not able to participate in activities where sighted infants and their parents typically focus on concrete, discrete objects (e.g. 'point and label' activities). It was predicted that blind infants' vocabularies would contain a low proportion of words referring to concrete, discrete objects.

The notion that blind infants fail to demonstrate the same patterns of conceptual-lexical functioning as sighted infants leads Dunlea (1989) to claim that an absence of visual information results in a significant cognitive deficit. On the basis of evidence suggesting that blind infants have difficulties sorting objects, generalising and extending/overextending words, Dunlea inferred that their understanding of the word-referent relationship was

impaired. This chapter presented a number of reasons why this position may be misguided. In particular, the frequency of generalisations and extensions / overextensions made by blind infants were compared against unrealistic estimates of the frequency with which sighted infants produce such examples. It was also suggested that, in the absence of visual cues, it is harder to detect whether or not a blind infant is generalizing / extending. It was also reported that studies have disagreed over the extent to which blind infants are able to sort objects (Gerhardt, 1982; Dunlea, 1989) and that the reasons for this may either be infant orientated (e.g. Shore, Dixon and Bauer, 1995) or more to do with the materials and method of analysis used. It was noted that it is crucial to develop materials and techniques which take into account the way blind infants complete haptic scans of the object array.

In discussing the influence of general environmental factors on lexical functioning in blind infants, the notion that demographic factors may influence conceptual-lexical functioning in subtle ways was discussed. Although this thesis does not examine the role of environmental factors in lexical development in blind/SVI infants it acknowledges that the possible influence of birth-order, gender and socio-economic status on lexical functioning needs to be recognized when findings are interpreted. Similarly, input speech to blind infants is not investigated explicitly in the research, although aspects of parental speech to their infants are considered alongside other findings where appropriate.

Finally, the present chapter considered how findings on early lexical-conceptual functioning in blind infants fit into several frameworks of lexical development in sighted infants. In the light of evidence shown not to support Dunlea's position that an absence of visual information leads to a cognitive deficit, it was remarked that there would be new implications for the development of such frameworks.

3.9.2. Aims of the four empirical studies

The four empirical studies to be reported in **Chapters Five to Eight** each aim to further understanding about the extent to which visual information influences conceptual-lexical functioning by addressing one or more of the issues identified in **Section 3.9.1**. In order that any emerging differences in patterns of conceptual-lexical functioning between blind / SVI and sighted infants demonstrated in the empirical chapters can be attributed to a lack of visual information, rather than a general developmental delay, it is important to establish general trends in developmental functioning. The first objective of **Chapter Five** is, therefore, to examine the extent to which the blind / SVI and sighted infants were functioning at the same developmental level as infants of the same chronological age and level of visual ability. The second objective is to track emerging abilities in comprehension and production during the second year. This permits blind and sighted infants to be matched on language ability. The third objective is to shed light on the extent to which previous norms established for blind infants in different areas of development may underestimate their abilities.

Chapter Six investigates the development of conceptual functioning in blind/SVI and sighted infants through studying of the emergence of object sorting strategies in the play of blind/SVI and sighted infants. The aim is to explain the discrepancy between the findings from Gerhardt's (1981) and Dunlea's (1989) study and to track the emergence of object sorting strategies during the second year using techniques and materials appropriate for use with blind/SVI infants.

The study reported in **Chapter Seven** compares the age at which lexical milestones emerge in blind/SVI infants with the age at which they emerge in matched sighted controls. In addition, the aim is to examine the view that blind/SVI infants produce a low proportion of labels for concrete, discrete objects in their early vocabularies.

Finally, the study reported in **Chapter Eight** examines the kinds of experience blind / SVI infants gain with objects, routines and rhymes as well as the way they talk about their experiences across the second year. The extent to which the infants generalize and extend their words is also considered in this chapter.

Findings from each of these four studies will further understanding of what blind / SVI infants understand about objects, actions and events and the way they start to talk about these aspects of their environment. These findings will shed light on the the role vision plays in the conceptual-lexical functioning in sighted infants, which has implications for understanding the extent to which vision is implicated in the multi-route model, the lexical principles framework and the social-pragmatic framework. Finally, it may be possible to identify strategies which may promote lexical development in blind, SVI and sighted infants. If the findings suggest, as Dunlea (1989) concludes, that an absence of visual information leads to a cognitive deficit, then it is important to identify ways in which blind infants' conceptual-lexical functioning can be facilitated. However, if it turns out that an absence of visual information does not lead to any remarkable differences, then this suggests we can focus on identifying strategies useful to both blind and sighted infants.

Chapter Four

Methodology

4.1. Introduction

Although the theoretical and practical significance of studying blind children is well documented, as a population however, they are not well-studied because the low incidence of the condition makes it difficult to establish sizeable samples. A recent survey by Walker, Tobin and McKennell (1992) estimates that around 1 in 1000 children are registered blind, of whom about 70 % are likely to have an additional handicap. Thus there is a tension between, on one hand gaining the theoretical benefits by studying blind infants without additional disabilities and, on the other, obtaining findings which generalise to a majority of infants. The studies reported in this thesis exclude infants with additional disabilities in favour of understanding how a clear cut deficit influences conceptual and lexical functioning. Instead, it includes SVI infants, and therefore, not only are the generaliseability of the findings increased but the theoretical scope is too, since, light will be shed on how a limited amount of vision influences conceptual and lexical functioning.

4.2. Criteria for selection of blind / SVI infants

Four criteria were used in the selection of blind / SVI infants to take part in the studies reported in this thesis: the first was that each infant's visual acuity was equal to or less than a Snellen value of 3/60. This value signifies that something a person with normal sight can see at 60 metres, a person with impaired vision has to view at a distance of three metres. In the U.K, any vision below 3/60 is classified as legally 'blind', however, for the purposes of this thesis, a more stringent criterion for the classification 'blind' was used. Children were classified as blind if there was no visual response at all, or if they could distinguish between light and dark (minimal light perception), or if they could orient towards a light

source (light projection). Other infants with vision poorer than 3/60 were classified as SVI: these infants either could make out the shadows of nearby objects or detect the form of objects. The division between blindness and SVI is important because, as discussed in **Sections 1.2**, evidence suggests that even the smallest amount of vision may alter the course of development (Bigelow, 1990; Preisler, 1991; McConachie and Moore, 1994).

The second criterion was that each infant had no known additional handicaps. The high prevalence of blindness associated with additional handicaps is just one factor which contributes to the heterogeneous nature of the blind and SVI population. Other factors include the extent of visual impairment and its aetiology (Mulford, 1988). Although an understanding of the development of blind and SVI infants with additional handicaps is, of course, important in its own right, the inclusion of such children in this research would, not help ascertain the impact of vision on the lexical acquisition process.

Given the aims of the thesis, it was important to establish a sample of infants who had either just started to use words or were on the verge of doing so, thus the third criterion was that blind or SVI infants should be aged between 12 and 24 months at the start of the study.

Since it was important to maximize the opportunity that blind infants were exposed to a minimum number of different word forms to refer to particular objects, actions and events, the fourth criterion was that each infant came from a monolingual English speaking family.

4.3. Criteria for selection of sighted controls

The initial aim was to match each infant from the low vision group with a sighted infant with monolingual English speaking parents on six factors: gender; lexical functioning; prematurity; social class; birth order and family constellation. Information on gender was available before any visit was made, thus infants were matched for sex. However, it took several visits to different families of sighted infants to identify an infant who matched

satisfactorily on each of the other five factors. The number of visits proved unacceptable for the time available to complete the research, and therefore infants were matched only in terms of lexical functioning. It was considered a bonus if infants were also matched on prematurity, socio-economic status, birth-order and family constellation (these are ordered in terms of importance).

In order to match the infants on level of lexical functioning, some index of lexical ability which measured both comprehension and production was required. This was achieved by using the three language scales of the Reynell-Zinkin Developmental Assessment Scales: the comprehension scale, the expressive (structure) scale and the expressive (content) scale. The average of these three scores was used as an index of lexical functioning. However, it is important to note that these matches were completed at the start of the research and therefore do not take into account the non-linear nature of the lexical acquisition process. Thus a particular infant who matched at the start of the study might be more lexically sophisticated than his/her partner by the completion of the study, since it is difficult to control for this phenomenon in longitudinal studies, it is important to consider this when interpreting findings.

Prematurity was matched by recruiting sighted infants born with a gestation period within three weeks of the gestation period recorded for the target low vision child. Social class was classified according to the Office of Population Censuses and Survey on the Classification of Occupations (1980). Each parent was classified into class I, II, III, IV or V according to their current occupation. In cases where one or both parents were unemployed, the most recent occupation of either parent was used for classification purposes. In families with two employed parents, the social class grouping was calculated by averaging the two parent's social class and using this as the basis for comparison.

Since there are well documented differences between first born and later born children (Nelson, 1981; Shotwell, 1979) the aim was to match first-born blind / SVI infants with

first-born sighted infants and later-born blind infants with later-born controls. The amount of adult input speech each infant received was matched on family constellation, which refers to the number of adults regularly living in a household.

4.4. Recruitment of infants

Three types of referral agency were approached for permission to contact the families of suitable blind/SVI infants: local education services for the visually impaired, a local ophthalmologist and nine local medical research and ethics committees. Sighted controls were recruited through local playgroups, toddler groups and health visitors, and through an advertisement placed in the local newspaper. Informed consent was gained from the parents of all children before they participated in the research.

4.5. The infants

Twelve infants participated in the research, of which each is referred to by a pseudonym. The six blind / SVI infants had varying degrees of impaired vision ranging from total blindness through to the ability to recognise the form of objects in their environment. Five of the infants in the low vision group were classified as blind; two of these were totally blind and one had some degree of light perception. Even though some visual acuity was noted, a further two infants, Roxanne and Lottie, were also classified as blind.

Recent developments in the field of paediatric ophthalmology provide the facility to record extremely low visual acuities. Since estimations of visual functioning are becoming increasingly accurate, it is increasingly difficult to make comparisons between older and more recent studies. Previous studies of lexical development have not had access to such technology and therefore would have tended to underestimate the level of vision of these girls and probably classified Roxanne and Lottie as totally blind. The two girls are also classified as blind in these studies to enable comparisons between this research and previous studies to be made with ease. One justification for doing this is that these two girls

have no useful vision and would be unable to detect any communicative information which would distinguish them from infants classified as having light perception. For example, they would be unable to detect frames of reference like pointing, unable to detect facial expressions, and unable to participate in joint picture book activity - the very kinds of communicative acts thought to be important for the acquisition of words for concrete, discrete objects.

Joseph, the infant with SVI, had enough vision to be able to make out the form of objects and to help with navigation. In addition, six months after the start of the study, Kristian was diagnosed as having minimal form vision. Two of the infants, Kirstie and Roxanne were diagnosed as having an absence of the septum pellucidum. However, these infants were not excluded because in the majority of cases this structural abnormality of the central nervous system is not associated with significant intellectual, behavioural or neurological deficits (e.g. Williams, Brodsky, Griebel, Glasier, Caldwell and Thomas, 1993).

Table 4.1. shows basic characteristics of the blind/SVI infants. The scores for lexical functioning are presented in table 4.2. Infants are presented in order of decreasing visual acuity.

Table 4.1. Visual acuity, visual response, aetiological condition and classification of visual response

Infant	Level of visual functioning	Aetiological condition	Classification of visual response
Joseph	6/250	optic nerve hypoplasia	SVI
Kristian	light perception	leber's amaurosis	blind
Lottie	6/600	leber's amaurosis	blind
Roxanne	6/1000	optic nerve hypoplasia	blind
Kirstie	none	optic nerve hypoplasia	blind
Morris	none	bilateral colmboma	blind

Each blind / SVI infant was matched with a sighted control, data on the five factors on which infants were matched are presented in Table 4.2. Matching for birth order was achieved in three pairs, that is, where first borns were matched with first borns and later borns were matched with later born children. Prematurity or normal time of onset of birth was matched within three weeks in five cases. Family constellation, the number of adults living in the household, matched in five cases. Social class was considered matched if the mean social class taken from the mother and father of the child matched within one class of their target match. This was achieved in all cases. The *mode* number of variables (prematurity, birth order, family constellation and social class) meeting the matching criteria per pair of dyads was *5 (range 4-6)*. This matching was judged to be adequate for the purposes of the research. Although matching was completed on the basis of lexical functioning rather than age, it is useful nonetheless to report the mean ages of the infants. At the start of the study, the mean age for the blind / SVI infants was 17.1 months (s.d = 3.2) and for the sighted infants it was 13.9 months (s.d= 0.88). The infants were studied for a period of 11-12 months. At the close of the study, the mean age for the blind / SVI infants was 28.9 months (s.d = 6.1) and for the sighted infants was 25.01 months (s.d=2.64). All these ages have been corrected for prematurity.

In sum, six blind / SVI infants who had recently started to use words were identified. The blind/SVI and sighted groups produced a mean lexical index of 5.4 (s.d = 0.39) and 5.8 (s.d=0.39) respectively. Table 4.2. shows the lexical indexes for individual blind and sighted infants at the start of the research. All pairs except Kristian and Justin matched within 1 point of each other.

Since the process of constructing two similar samples began by attempting to match each blind / SVI infant with a sighted control, Table 4.2. shows details on the infants pair by pair. However, although the procedure produced two samples that were reasonably

comparable on the matching criteria, the pairwise matching was not so successful, so the statistical analysis treats the two samples as independent groups rather than matched pairs.

Table 4.2. Information on matched pairs at start of study

Infant	Visual status	Sex	Age in months (correction for prematurity)	Index of lexical functioning
Joseph	SVI	male	14.16	5.33
Robert	Sighted	male	13.03	5.33
Kristian	Blind	male	23.00	5.00
Justin	Sighted	male	12.93	6.33
Roxanne	Blind	female	17.57 (14.57)	5.00
Jennie	Sighted	female	13.70	5.33
Lottie	Blind	female	15.63	6.0
Sadie	Sighted	female	15.03 (14.70)	6.67
Kirstie	Blind	female	20.20 (17.87)	5.33
Laura	Sighted	female	13.97	5.33
Morris	Blind	male	17.47	5.67
Joshua	Sighted	male	15.13	6.00

Table 4.3. Additional information on matched pairs

Infant	Visual status	Birth order	No. of days premature	Number of adults	Social class
Joseph	SVI	first	0	2 parent	3.0
Robert	sighted	first	0	2 parent	3.5
Kristian	blind	first	0	2 parent	3.0
Justin	sighted	third	0	1 parent	3.5
Roxanne	blind	first	90	1 parent	3.0
Jennie	sighted	second	63	1 parent	4.0
Lottie	blind	third	0	2 parent	3.5
Sadie	sighted	second	10	2 parent	2.5
Kirstie	blind	first	70	1 parent	3.0
Laura	sighted	first	0	1 parent	4.0
Morris	blind	first	0	2 parent	2.5
Joshua	sighted	second	0	2 parent	3.0

To summarize the characteristics of the low vision sample: five infants in the low vision group were first borns; one third of the sample were premature; four were from two parent families; five parents were class three on the Classification of Occupations. Thus this sample is different from most previous studies (Mulford, 1988; Dunlea, 1989;) because it is based on children who are not from middle class backgrounds.

4.6. Data collection and analysis

All data collection was completed at the homes of the families taking part. The rationale was that the dyads would be most relaxed at home and that the infants would therefore show a wide lexical repertoire. An initial visit to the families of blind and SVI infants was made shortly after they were referred, allowing the researcher to introduce herself and the project, and also to get to know the family. During this visit, once it was clear that the criteria detailed in Section 4.1 were met and the parents were satisfied with what would be involved, they were given the opportunity to sign the consent form.

A range of methods were used in this research: assessments, quasi-experimental, parental self-report and observational. Each method was used longitudinally to track lexical development across the second year. Details on the methods used for each of the four studies are presented in Chapters Five to Eight.

Data are examined using both quantitative and qualitative approaches, since this presented the opportunity to detect group trends as well as the more subtle differences between infants. In the study reported in Chapter Six, findings from Joseph, the SVI infant were considered alongside those of the blind infants since the particular statistical techniques used were sensitive to missing data (see Section 6.3.1). In all other studies, however, Joseph's (SVI) data is considered separately from those of other blind infants in order to detect how having minimal vision influenced patterns of conceptual-lexical functioning.

In each of the four studies reported in this thesis, findings were considered significant at alpha levels of 0.05.

Chapter Five

Longitudinal developmental assessments

5.1 Introduction

This chapter reports findings from developmental assessments administered to the infants. These findings will inform the results from the remaining empirical studies reported in this thesis in three different ways. First, in order to attribute any emerging differences in patterns of conceptual-lexical development between blind / SVI and sighted infants to a lack of visual information rather than a general developmental delay, it is important to establish information about how the general developmental functioning of each infant. The first objective of the present study is, therefore, to use assessments to establish general trends in developmental functioning in order to elucidate whether the infants are functioning at the same developmental level as infants of the same chronological age and visual ability.

Second, as discussed in **Section 3.4.1**, despite the value of studying abilities in comprehension, only a few studies of it exist (Larner and Rowlands, 1988; McConachie and Moore, 1994). It is important to redress this imbalance by tracking changing abilities in comprehension as well as those in production. In addition, as already reported in **Chapter Four**, information on general level of language ability was needed at the start of the research so that it was possible to match low vision infants with sighted infants. Thus the second objective of the study was to track changing abilities in comprehension and production.

Both the first and second objectives require the identification of developmental assessment scales suitable for examining a range of abilities in blind / SVI infants as well as providing for assessment of abilities in comprehension and production. Although Fraiberg (1977)

used the Bayley Scales of Mental Development (Bayley, 1969), these scales are considered inappropriate since many of the items require vision for successful completion and the omission of a substantial number of items leads to doubts about the validity of test scores. One instrument specifically designed for infants and children with visual impairments is the Maxfield-Buccholtz Scales (1957). However, these are specifically concerned with measuring social maturity rather than any other domain of development. In the present study, the Reynell-Zinkin Scales (Reynell, 1979) were utilized since they were suitable for use with visually impaired children, measured a broader range of abilities and had the additional benefit that three of the six subscales assess abilities in language in comprehension and production.

These scales were originally constructed to emphasize the measurement of areas of development considered to be of particular importance to blind and partially sighted children from birth up to around five years of age. They were developed within a clinical setting to aid the design and content of intervention programmes and not to provide an assessment scale by giving a profile for the 'average' blind' child. For this reason, the scales have not been standardized in a conventional manner, although some approximate guidelines for the age at which children achieve particular abilities are suggested by Reynell (1979) based on a sample of 109 blind / partially sighted children.* For convenience, from now on, these data will be referred to as the Reynell-Zinkin norms.

Unfortunately, Reynell's sample included "some quite retarded children" (pg. 12, 1979) and, as a result of this, Reynell aimed to reduce the influence of the range in intellectual ability in her data by plotting the raw scores on each subscale against the age scores on standardized scales for each child using the Maxfield-Buchholtz scale. Reynell admits that this procedure is not entirely satisfactory because the Maxfield-Buchholtz Scales were constructed using children blind as a result of retrolental fibroplasia, a condition which may be associated with a central nervous system disorder. The 109 children in the Reynell-

* Reynell expresses the scores as age equivalents, not as norms, given that it is not possible to standardize assessment on a very heterogeneous population of visually impaired children.

Zinkin sample included 25 children who had additional impairments, and it is therefore possible that the inclusion of these children may have underestimated the performance of partially sighted and blind children. Studies exclude infants with additional disabilities from samples of infants assessed on the Reynell-Zinkin Scales will shed light on the extent to which the performance of blind and partially sighted infants may have been underestimated. The third objective of the present study is, therefore, to examine whether Reynell (1979) may have underestimate the performance of blind / partially sighted children.

There have been two previous studies of the performance of low vision children on the Reynell-Zinkin. Lerner and Rowlands (1988) examined the performance of 11 blind children aged between birth and five years who were either totally blind or had, at most, light perception. The sample included a range of aetiological conditions and came from a range of social backgrounds. Overall, 18 recordings were made from the 11 children. McConachie and Moore (1994) reported the performance of nine blind infants and nine SVI infants on the scale of sensorimotor understanding, the scale of response to sound and verbal comprehension and the scale of expressive language (structure). In line with Lerner and Rowlands's study, the children manifested a range of aetiologies and came from a range of social backgrounds.

Each of the six scales of the Reynell-Zinkin assessments are described below and the extent to which the blind, partially sighted and sighted children perform differently from each other on these scales discussed. For each scale, the extent to which the findings from the studies by McConachie and Moore (1994) and Lerner and Rowlands (1988) fall in line with the Reynell-Zinkin norms is addressed. Unfortunately, the performance of the SVI infants in McConachie and Moore's study are not directly comparable with the partially sighted norms on the Reynell-Zinkin Scales since the partially sighted infants in Reynell's sample were able to engage in visually guided reaching and therefore likely to have more vision than the SVI children in McConachie and Moore's study. This leads to the

expectation that performance of SVI children in McConachie and Moore's study should lie somewhere between the partially sighted norms and the norms for blind children from Reynell's sample. However, we also need to take into account the possibility that Reynell may have underestimated the performance of partially sighted children because she included children with additional disabilities in her sample. We might therefore expect the SVI infants in McConachie and Moore's study to perform in line with the norms for partially sighted children published for the Reynell-Zinkin Scales.

In sum, the three objectives of the present study were to: first, establish general trends in developmental functioning to elucidate whether the infants are functioning at the same developmental level as infants of the same chronological age and visual ability; second, to document basic patterns of comprehension and production; and third, to shed light on the extent to which the performance of blind and partially sighted infants may have been underestimated by Reynell (1979).

5.2. Method

5.2.1. Infants

Twelve infants participated in the first assessment. The aim was to administer the Reynell-Zinkin at 6 monthly intervals in order to achieve three assessments over a 12 month period. However, the blind infant Morris only participated in the first assessment and the sighted infant Joshua only participated in the first two assessments. From the total of 33 assessments administered, the mean interval between assessments was 6.20 months, (s.d. = 1.68).

The mean age of the SVI/blind and sighted groups at the first assessment was 13.9 months (s.d = 0.88) and 17.1 months (s.d. = 3.2) respectively. At the second assessment the means were 22.53 months (s.d = 4.0) and 20.40 months (s.d = 1.5). At the third

assessment the mean ages were 28.9 months (s.d. = 6.1) and 25.01 months (s.d = 2.64). These ages are corrected for prematurity.

5.2.2 The assessments

Each of the six scales of the Reynell-Zinkin Scales were used: social adaptation; sensori-motor understanding; exploration of the environment; response to sound and verbal comprehension; expressive language (structure) and expressive language (content). The content of each of these scales is described below. The test materials used for the assessments were as indicated in the Reynell-Zinkin Scales Assessment manual (1979). The assessments were carried out as indicated by the manual.

5.3. Results

The raw scores for each infant on each scale at each assessment are presented in appendix one and two. The performance of the different groups of infants is compared with data from infants of the same age and visual status as reported by Reynell-Zinkin data. It is recognized that it is not entirely appropriate to make direct comparisons with the Reynell-Zinkin norms since more than one data point is recorded for each infant. However, data from the present study is viewed alongside data from two other studies (Larner and Rowlands, 1988; McConachie and Moore, 1994) creating additional data points with which to make comparisons with the Reynell-Zinkin norms. The authors of these two studies displayed their data graphically alongside the Reynell-Zinkin norms. It was therefore only possible to comment on whether their data was in line with, above or below the Reynell-Zinkin norms.

Although the blind infants are aged differently on each assessment, for each of the six scales, data is presented on the mean performance of the group of blind infants on the first and last assessments. This information provides a rough descriptive index of what the

group was able to do at the start and the end of the study. This is followed by an account of individual performance among the group of blind infants.

5.3.1. Scale of social adaptation

Reynell-Zinkin norms: This component of the Reynell-Zinkin scales is concerned with assessing how children respond to others and the range of their self help skills. Reynell suggested that, on this scale, blind, partially sighted and sighted infants are indistinguishable up until the age of 8 months. All groups start to smile in response to a social activity, recognize a familiar voice and demand attention at around the same age. However, at 8 months when sighted infants start to demonstrate awareness of strangers, blind and partially sighted infants start to fall behind. The Reynell-Zinkin norms indicate a substantial gap between the performance of sighted and blind / partially sighted groups between 17 and 30 months which may arise from items requiring self help skills such as feeding and dressing activities. As can be seen on Figure 5.1, the Reynell-Zinkin norms for blind and partially sighted children are virtually indistinguishable throughout this scale.

Other studies: Larner and Rowlands's (1988) findings indicate that eight of the 18 recordings were in line with those of the Reynell-Zinkin blind norms. The remaining ten recordings exceeded the Reynell-Zinkin norms for blind children. Five of these were in line with the Reynell-Zinkin norms for sighted children. However, it is not clear whether these were from the same child.

Larner and Rowlands noted that the divergence between the performance of the blind children in their study and the Reynell-Zinkin norms reported for sighted children was at its greatest between 18 and 24 months. On this basis, they argued that their findings matched the trends reported in the Reynell-Zinkin Scales. However, it appears that Larner and Rowlands have misinterpreted Reynell (1979) since she specifies that the difference between blind and sighted children is greatest between 18 and 30 months. It is therefore

likely` that the divergence between blind and sighted children is smaller in Lerner and Rowlands's data than in Reynell's study.

Present study: On the first assessment, the mean score for the blind infants was 10.6 (s.d. = 2.88) which signifies that all of the blind infants were able to cooperate in dressing. Three blind infants were able to drink from a cup they were holding themselves, however, most were not yet able to feed themselves. The SVI infant performed in line with the Reynell-Zinkin norms for sighted children. The mean score for the sighted infants on the first assessment was 12.2 (s.d. = 2.23). Thus the sighted infants were able to cooperate in dressing, drink from a cup held by themselves and some were able to undress themselves.

At the completion of the study, some nine months later, the mean score for the blind infants was 13 (s.d. = 4.0). The SVI infant, Joseph was performing in line with the sighted infants. The sighted infants scored a mean of 17.8 (s.d. = 0.45) and therefore were reaching the end of the scale.

Figure 5.1. shows that eight of the 13 recordings for five blind infants were above the Reynell-Zinkin norms for blind children. Out of these eight recordings, four were equal to or above the Reynell-Zinkin norms for sighted children. Four recordings fell below the Reynell-Zinkin norms for blind children. However, three of these recordings came from the same infant. The SVI infant Joseph performed more in line with the Reynell-Zinkin norms for sighted children than with the norms for partially sighted children. Figure 5.2. shows that seven recordings were above and eight were below the Reynell-Zinkin norms for sighted infants.

Figure 5.1. Performance of blind and SVI infants on scale of social adaptation.

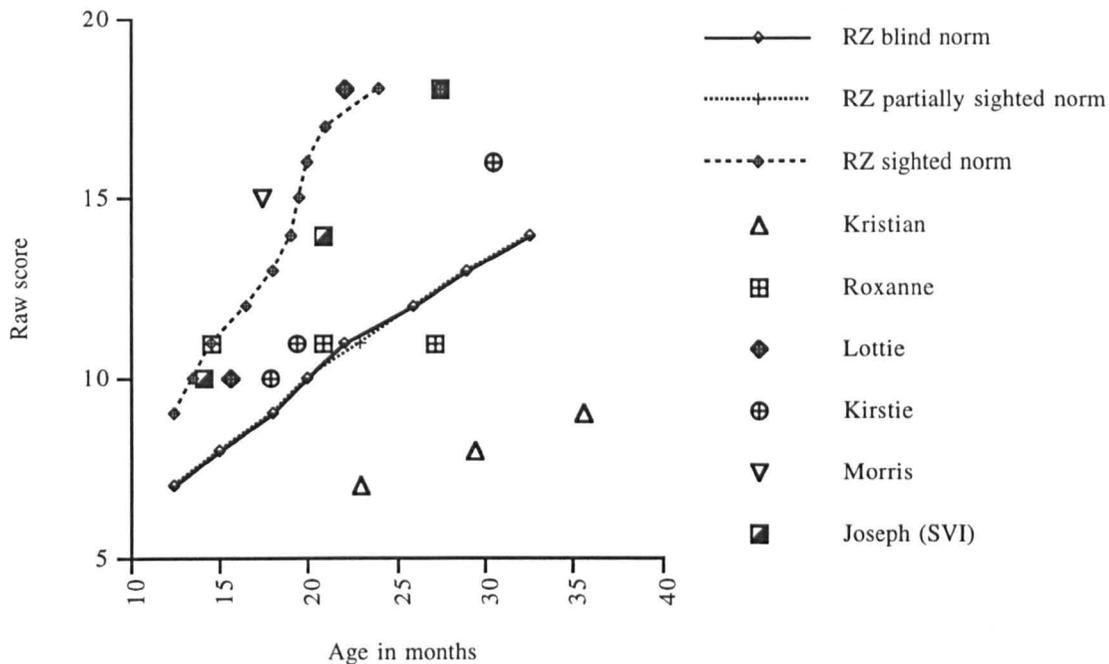
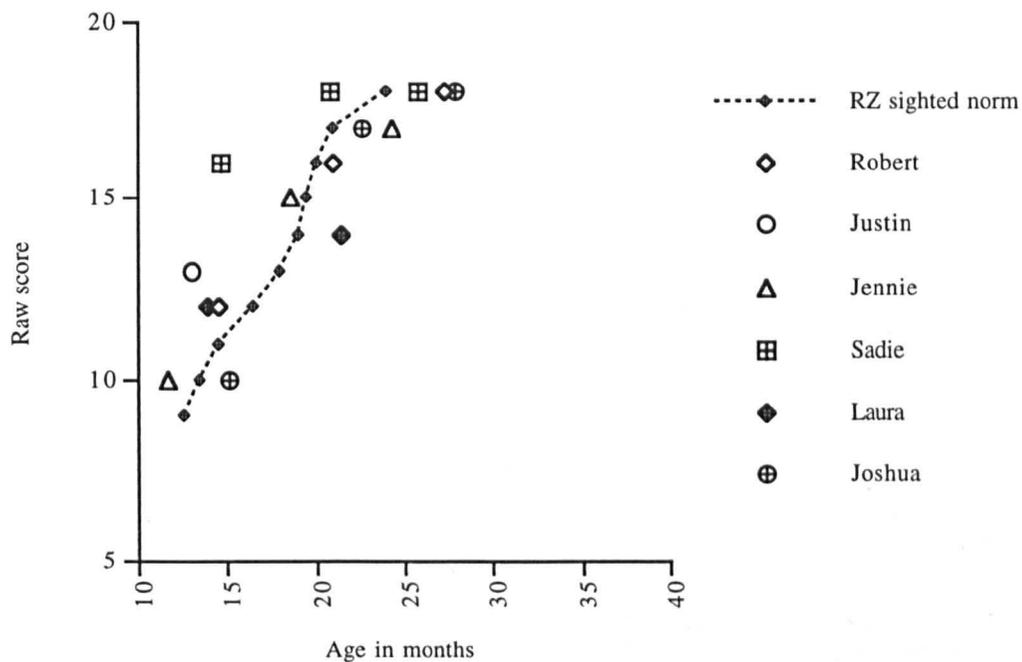


Figure 5.2. Performance of sighted infants on scale of social adaptation.



5.3.2. Scale of sensorimotor understanding

Reynell-Zinkin norms: This scale is concerned with what children understand about objects and the relations between different objects. The Reynell-Zinkin norms indicate that around 6 months, there is a divergence between the performance of blind / partially sighted children and sighted children. Blind children can lag behind the sighted group by as much as a year. At 12 months, whereas sighted infants are able to put items into containers and build towers, blind infants do not achieve this until around 20 months. The extent of visual impairment does seem to influence performance since partially sighted children have a consistent 4 month advantage over the blind group throughout the assessment period.

Other studies: In Lerner and Rowlands study, six of the 18 recordings fell in line with the norms expected for blind children. The remainder of recordings were above the Reynell-Zinkin norms for blind children. Two of these were in line with the norms for sighted children.

In McConachie and Moore's study, five of the 22 recordings were in line with the Reynell-Zinkin norms for blind children. Eleven recordings were above the Reynell Zinkin norms for blind children but below the norms for sighted children. Six recordings fell below the Reynell-Zinkin norms for blind children. Seventeen of the 18 recordings for SVI children scored above Reynell-Zinkin norms for partially sighted children. Nine of these recordings were in line with the norms for sighted children.

Present study: On the first assessment, the blind infants scored a mean of 9.6 (s.d. = 1.34). All the blind infants were able to engage in an extensive search for a lost object and four of them had started to relate two objects to each other though, at this time, only two were able to put objects into containers. The sighted infants were scoring a mean of 13.0 (s.d. = 2.0) which indicates that several of them were able to start putting lids on containers. By the end of the research, the blind infants scored a mean of 13.5 (s.d. =

4.79). In contrast, the sighted infants were scoring 17.8 (s.d. = 2.28). These infants were typically able to understand one-to-one size matching. On the first assessment, the SVI infant, Joseph was performing in line with partially sighted and sighted norms. By the end of the research, he was performing in line with the sighted infants.

Figure 5.3. shows that three of the 13 recordings were in line with norms for blind children and that six recordings were above the norms for blind children. One of these was in line with the norms for sighted children. Four recordings were below the norms for blind children although three of these were from the same infant (Kristian). The SVI infant Joseph performed above the norms for partially sighted children at each assessment.

Figure 5.4. shows that, for the sighted infants, although eight of the recordings were spread around the Reynell Zinkin norm, there were six recordings which fell just under this mean. Moreover, Jennie, Joshua and Robert scored well below what was expected for their age. Overall then, there was a tendency for the scores to fall short of what was expected on this scale.

Figure 5.3. Performance of blind and SVI infants on the scale of sensorimotor understanding

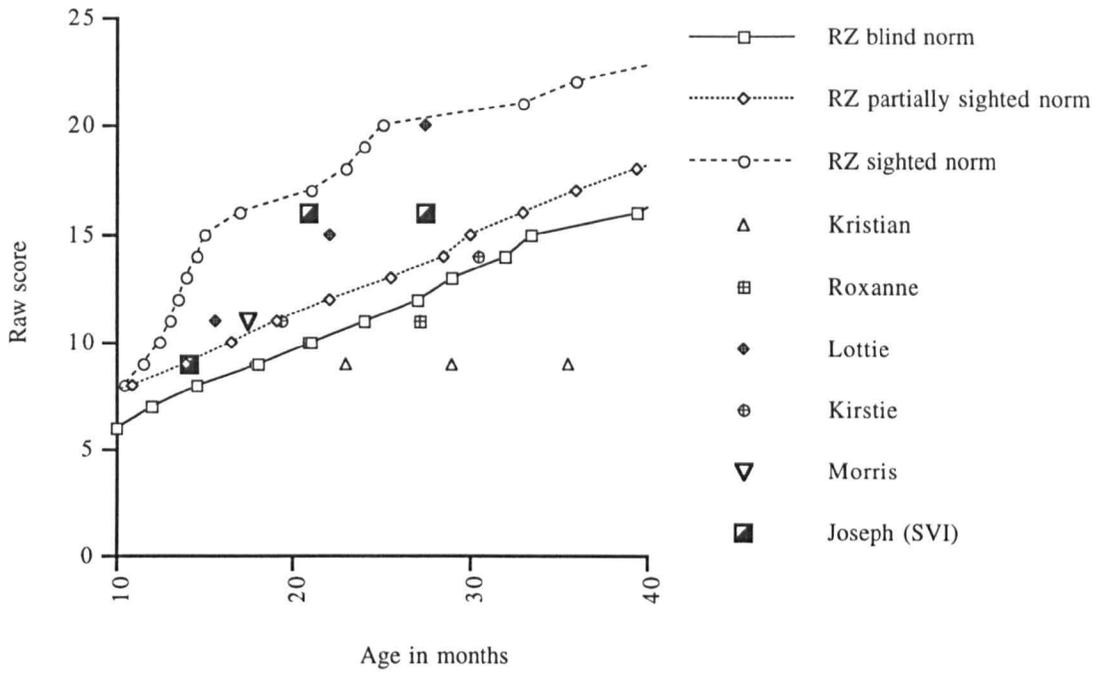
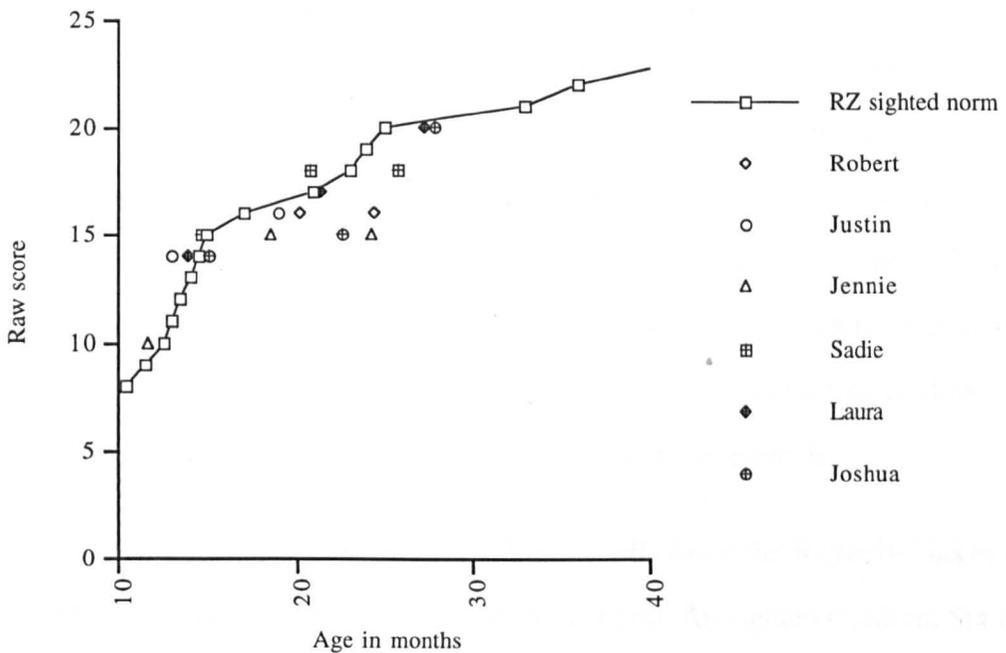


Figure 5.4. Performance of sighted infants on the scale of sensorimotor understanding



5.3.3. Exploration of the environment

Reynell-Zinkin norms: This scale is concerned with children's ability to orientate themselves within the environment and to use large objects (e.g. furniture) meaningfully. Reynell reports that sighted children consistently have an advantage over blind children on this scale. The difference is greatest between blind and sighted children at 18 months, when sighted children are able to engage in directed, purposeful locomotion e.g. hanging up a coat on a peg, sitting on a chair at the table. In contrast, blind infants do not engage in these kinds of activities until between 31 and 36 months of age.

Other studies: Lerner and Rowlands results indicate that four of the 17 recordings fell in line with Reynell-Zinkin norms for blind children. Ten recordings exceeded that of the norms for blind children but below norms for sighted children. Three recordings were below the Reynell-Zinkin norms for blind children.

Present study: On the first assessment, the blind infants were scoring a mean of 5.0 (s.d. = 1.52). This score suggests that typically, an infant could explore objects found during locomotion and also find the door of a room. The sighted infants scored a mean of 6.33 (s.d. = 1.21). This score suggests that the infants could understand the purpose of furniture e.g. use a door handle, climb into a chair and sit at a table. At the completion of the research, the blind and sighted infants scored 6.75 (s.d = 3.40) and 9.7 (s.d = 1.37) respectively. Thus the gap between the blind children and the sighted children widened during the course of the study. The SVI infant Joseph scored marginally above that of the sighted infants both at the outset and the completion of the research.

Figure 5.5. shows that six of the 13 recordings fell above the Reynell-Zinkin norms for blind children. One of these was in line with the norms for sighted children. Six recordings fell below the norms for blind children. The SVI infant Joseph performed more in line with norms for sighted children than with the norms for partially sighted children. Figure 5.6.

shows that, with the exception of Jennie, all sighted infants performed around the level expected for them.

Figure 5.5. Performance of blind and SVI infants on the scale of exploration of the environment

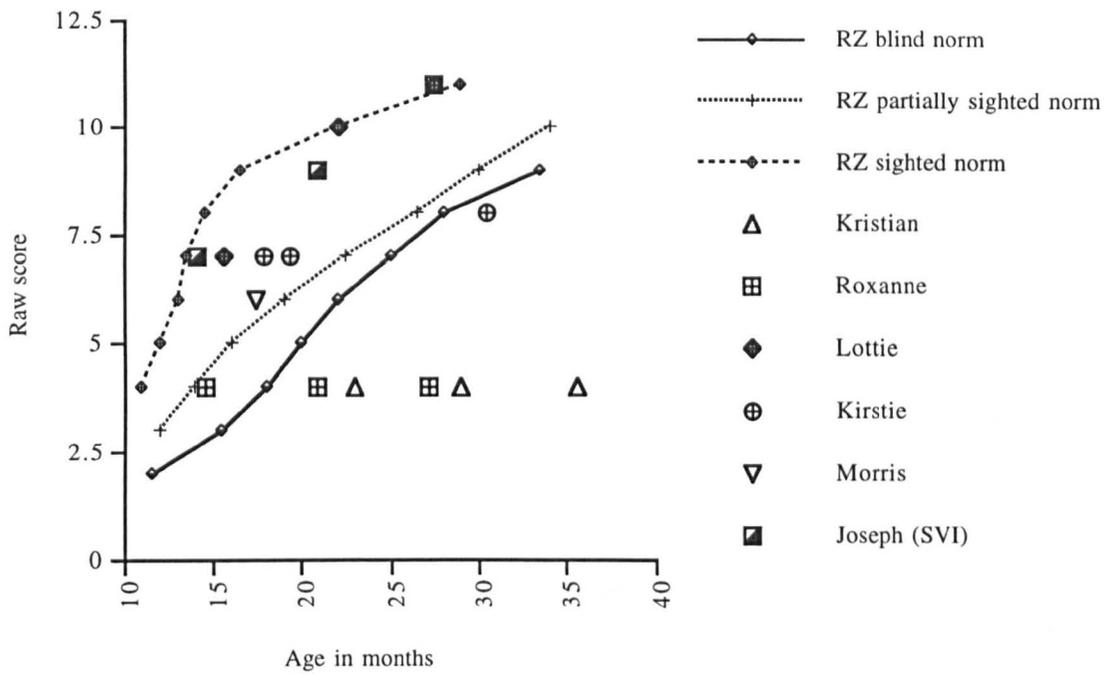
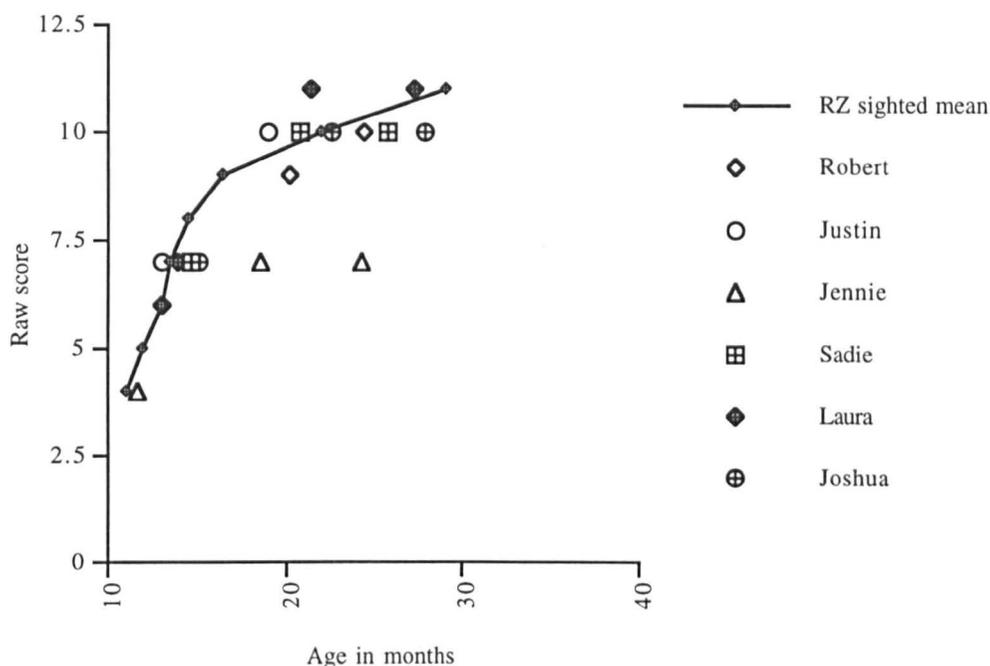


Figure 5.6. Performance of sighted infants on the scale of exploration of the environment



5.3.4. Response to sound and verbal comprehension

Reynell-Zinkin norms: This scale is concerned with the ability to derive meaning from non-linguistic and linguistic sounds. The Reynell-Zinkin norms indicate that sighted children have a consistent advantage over blind and partially sighted children. In particular, there is a noticeable difference between the sighted and blind children in the age at which they are able to select an appropriate object out of a choice of three in response to naming. Whereas sighted infants are reported to do this between 15 and 16 months, blind infants are reported not to do this until 26 and 28 months. The performance of the blind and partially sighted infants is presented as virtually indistinguishable up until the age of 19 months. At this age, an advantage of around three months emerges for the partially sighted group.

Other studies: Lerner and Rowlands note that five of their 18 recordings for blind children were in line with or above the Reynell-Zinkin norms for sighted children. Ten other recordings fell above norms for blind infants and below that expected for sighted children. Three of the recordings fell below that which was expected for blind children.

Five of the 21 recordings in McConachie and Moore's study were in line with the Reynell-Zinkin norms for blind children. Seven recordings fell below these norms. Six recordings were above norms for blind children but below the norms for sighted children. Four recordings were in line with norms for sighted norms. Fifteen of the 21 recordings from the SVI group fell in line with or above the scores expected for the partially sighted group.

Present study: On the first assessment, all the infants scored between 8 and 10 on this scale. A score of 8 signifies that an infant makes an appropriate response to a familiar phrase or words. For example, the infant might clap hands in response to 'do pat-a-cake' or lift up their face in response to 'give daddy a kiss'. A score of 9 signifies that the infant can go beyond recognizing total phrases and intonation patterns to understanding specific words. For instance, an infant touches her nose when asked 'Where's your nose?' A score of 10 indicates that an infant can select a familiar toy in response to labelling. The mean score for the blind and sighted infants on the first assessment was 8.6 (s.d. = 0.55) and 9.0 (s.d. = 1.10) respectively.

At the end of the research, the blind infants scored a mean of 11.0 (3.46) and the sighted infants scored a mean of 13.2 (s.d = 2.78). The blind infants had just started to select objects in response to naming whereas the sighted infants were passing the more advanced tasks concerning the understanding of object labels. The SVI infant was performing in line with both groups at the start of the research and performing in line with the highest scoring sighted infants at the end of the research.

Figure 5.7. shows that five of the thirteen recordings were in line with the Reynell-Zinkin norms for blind children. Five recordings fell below the norms for blind children. One blind infant, Lottie performed above the norms of blind children on all three assessments. The SVI infant Joseph performed above the norms for partially sighted children but below the norms for sighted children. Figure 5.8. shows that 14 of the 17 recordings for sighted children fell below the Reynell-Zinkin norms for sighted children.

Figure 5.7. Performance of blind and SVI infants on the scale of response to sound and comprehension

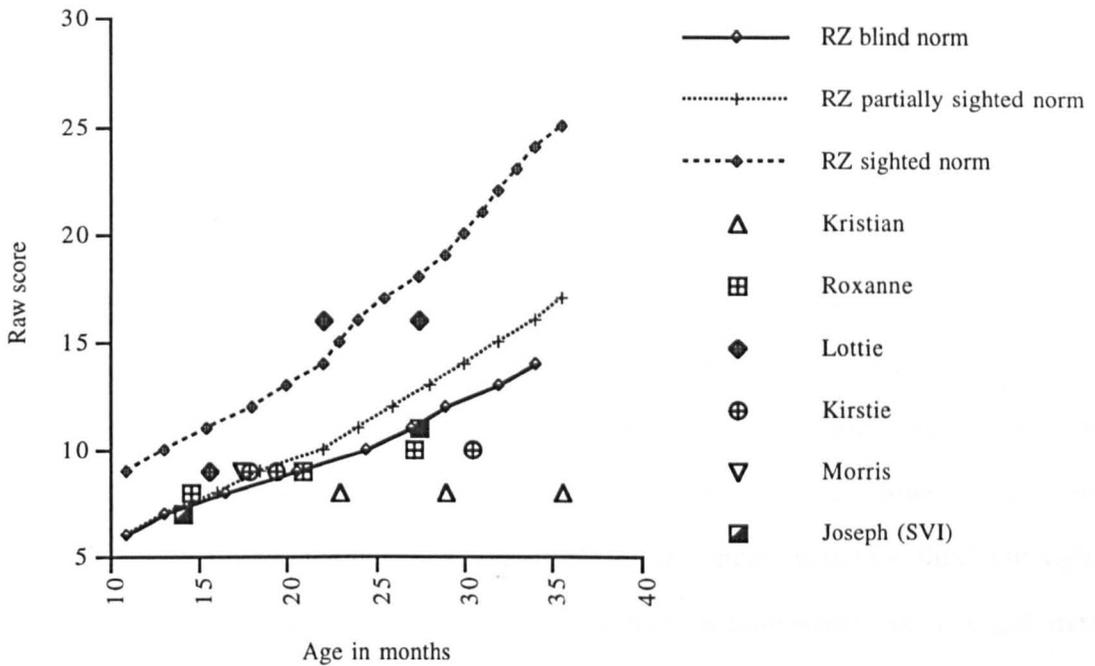
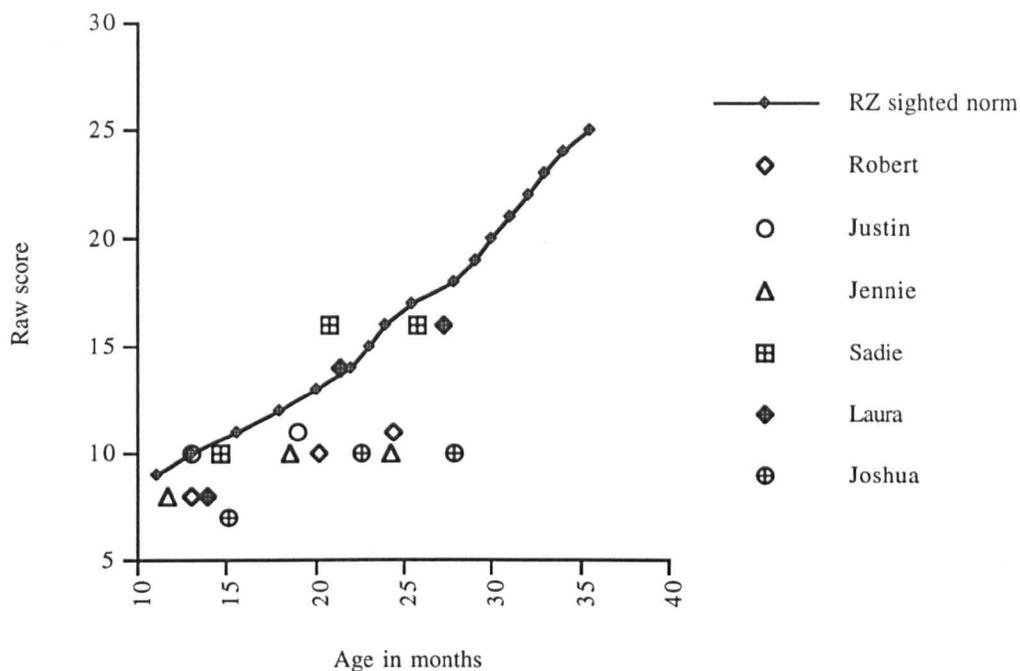


Figure 5.8. Performance of sighted infants on the scale of response to sound and verbal comprehension



5.3.5. Expressive language (structure)

Reynell-Zinkin norms: This scale concerns the emergence of pre-speech sounds, the ability to say words and to put words together. The Reynell-Zinkin norms indicate that the blind, partially sighted and sighted groups start to produce vocalisations other than crying, single syllable sounds and double syllable sounds at around the same age. However, as soon as word production begins, the norms suggest that a gap appears between blind and sighted children. Reynell reports that sighted children have a consistent six to eight month advantage over the blind group. The Reynell-Zinkin norms suggest that partially sighted children lag behind blind children in their attainment of patterned vocalisation simulating speech, and their acquisition of two to four words produced in response to particular situations.

Other studies: Lerner and Rowlands noted that 12 of their 18 recordings for blind children were in line with or above that of the performance expected for sighted children. Three recordings were in line with and three were below norms for blind children.

McConachie and Moore's results indicate that five out of 22 recordings fell in line with norms for blind children. Eight recordings exceeded the Reynell-Zinkin norms for sighted children. Two recordings fell above the norms for blind children but below the norms for sighted children. Eight recordings were below that expected for blind children. Twelve of the 21 recordings for SVI children exceeded the norms for sighted children. Four recordings were below the norms for partially sighted children.

Present study: The mean score produced by the blind infants at the outset of the research was 7.4 (s.d. = 0.55) and, for the sighted infants, it was 8.5 (s.d. = 0.837). A score of 7 indicates that the infants were using one word consistently and appropriately and a score of 8 indicates that the infants were patterning vocalisation. By the end of the research, both groups were scoring a mean of 13 points, although the variability of the blind infants scores was wider. This mean score indicates that the infants were producing on average more than 20 words.

Figure 5.9. shows that seven of the thirteen recordings were in line with the norms for blind/SVI children. Two recordings were above the norms for sighted children. One blind infant Kristian performed below norms for blind / SVI children on all three assessments. The SVI infant first performed in line with what was expected for blind infants and then performed in line with what was expected for sighted infants. Figure 5.10. shows that the sighted infants performed around the Reynell-Zinkin sighted norms.

Figure 5.9. Performance of blind and SVI infants on the scale of expressive language (structure)

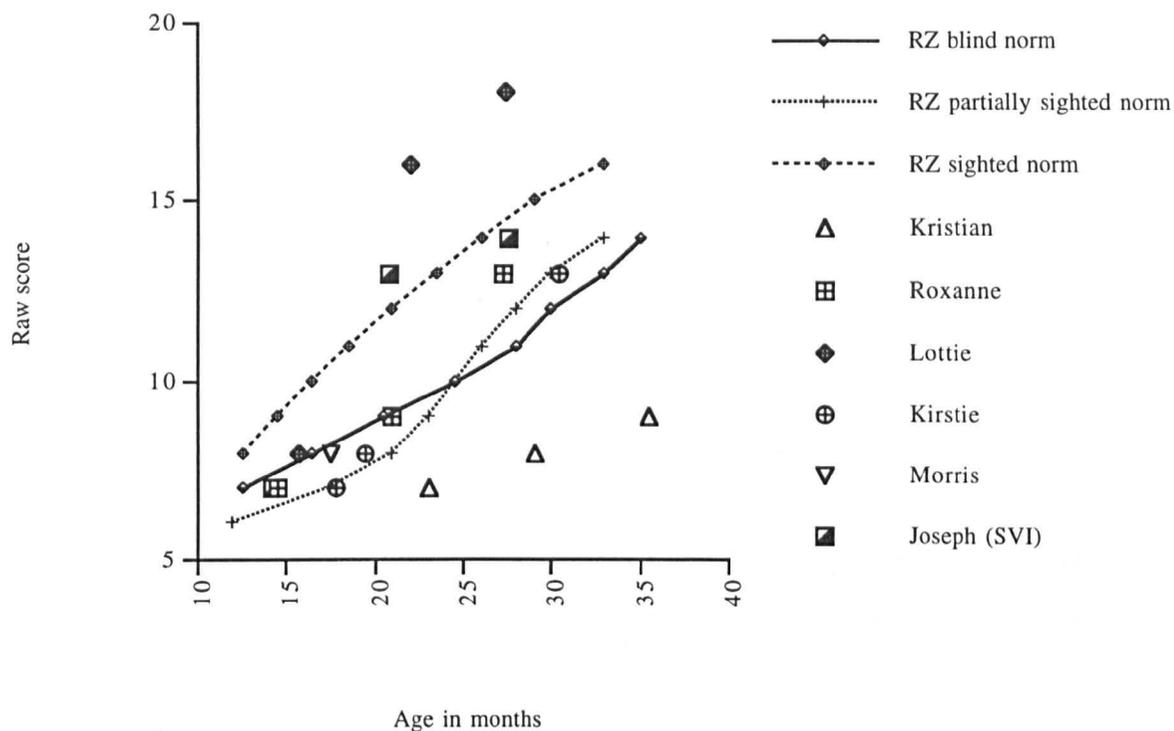
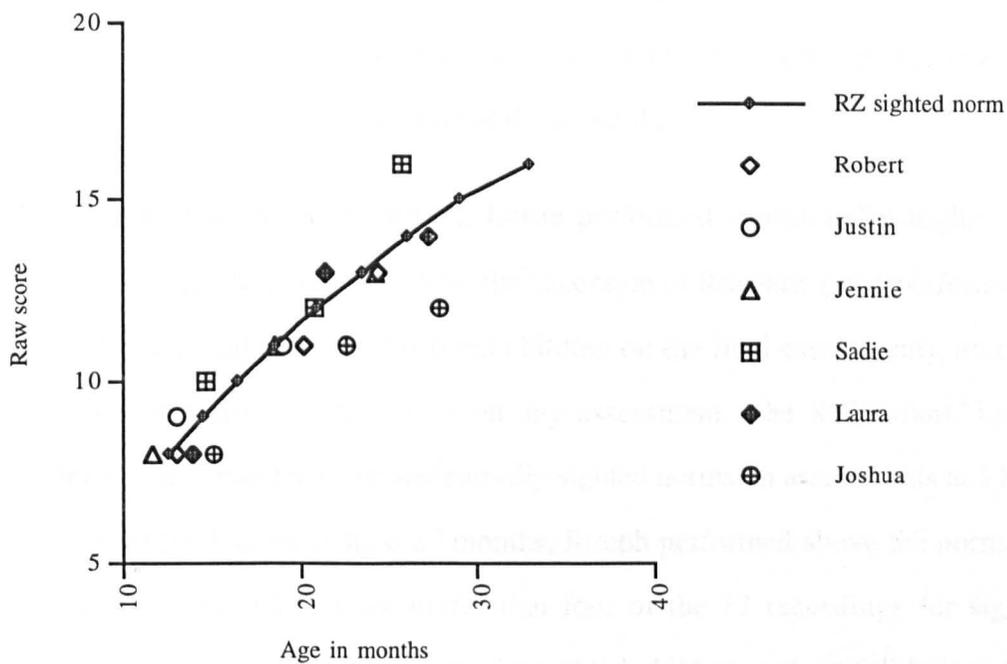


Figure 5.10. Performance of sighted infants on the scale of expressive language (structure)



5.3.6. Expressive language (content)

Reynell-Zinkin norms: This scale examines how children use words and sentences meaningfully. It starts off by examining whether children can name familiar objects and then whether they can describe the use and position of objects and talk about ongoing events. Reynell observed that sighted children start to name objects 12 to 18 months before blind children and that this gap is consistent throughout the age range covered by the scale. The blind and partially sighted groups performance is indistinguishable until 36 months of age when both groups are starting to learn names for objects. Partially sighted children maintain an advantage during the first half of the third year on this scale.

Other studies: Seven of the 10 recordings in Lerner and Rowlands' study were in line or above the Reynell-Zinkin norms for sighted children. All 10 recordings were above the norms for blind children.

Present study: With the exception of one blind infant, all infants scored 0 on this scale on the first assessment. This signifies that they were not able to name objects like cup and ball. However, by the end of the research, the mean scores for the blind and sighted infants were 3.3 (s.d. = 5.85) and 3.4 (1.67) respectively. The SVI infant performed in line with the most advanced sighted infants at the end of the research.

Figure 5.11. shows that one blind infant, Lottie performed substantially higher than expected for sighted infants. However, with the exception of Roxanne (who performed in line with the Reynell-Zinkin norms for blind children on the final assessment), no other blind infant scored a point on this scale on any assessment. The SVI infant, Joseph performed below the norms for blind and partially sighted norms on assessments at 14 and 20 months. On the final assessment at 27 months, Joseph performed above the norms for sighted children. Figure 5.12 demonstrates that four of the 17 recordings for sighted infants fell above the Reynell-Zinkin norms for sighted children and six fell below. Two

recordings were in line with norms expected for sighted children. The remaining five recordings were clustered at zero on the first assessment.

Figure 5.11. Performance of blind and SVI infants on the scale of expressive language (content)

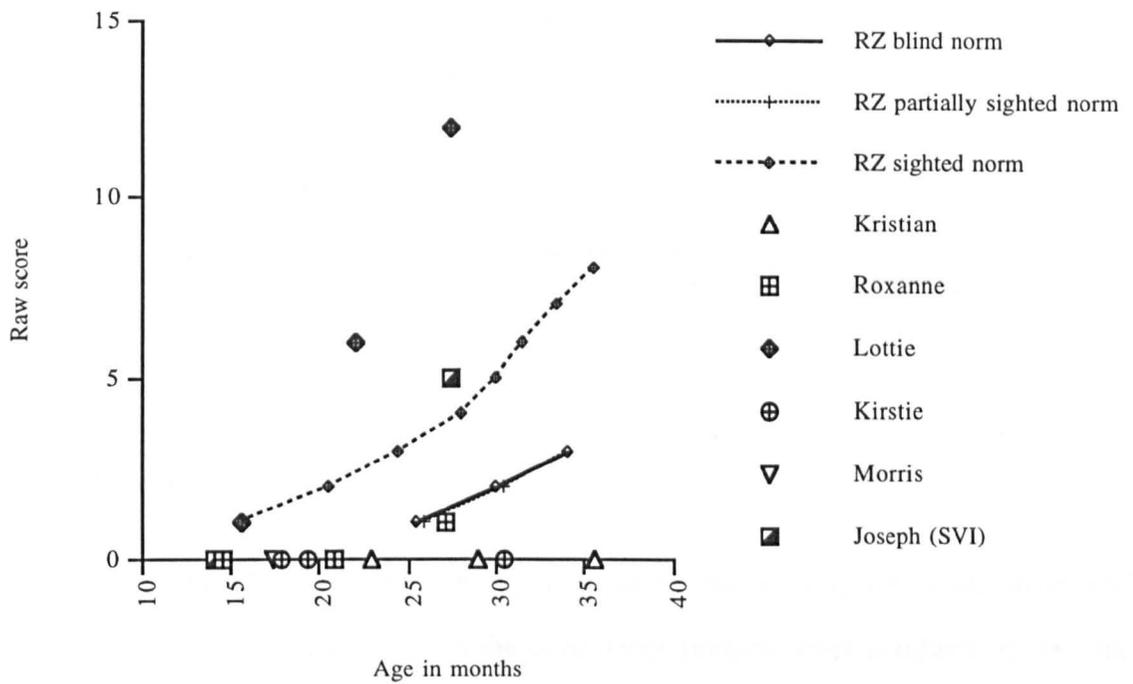
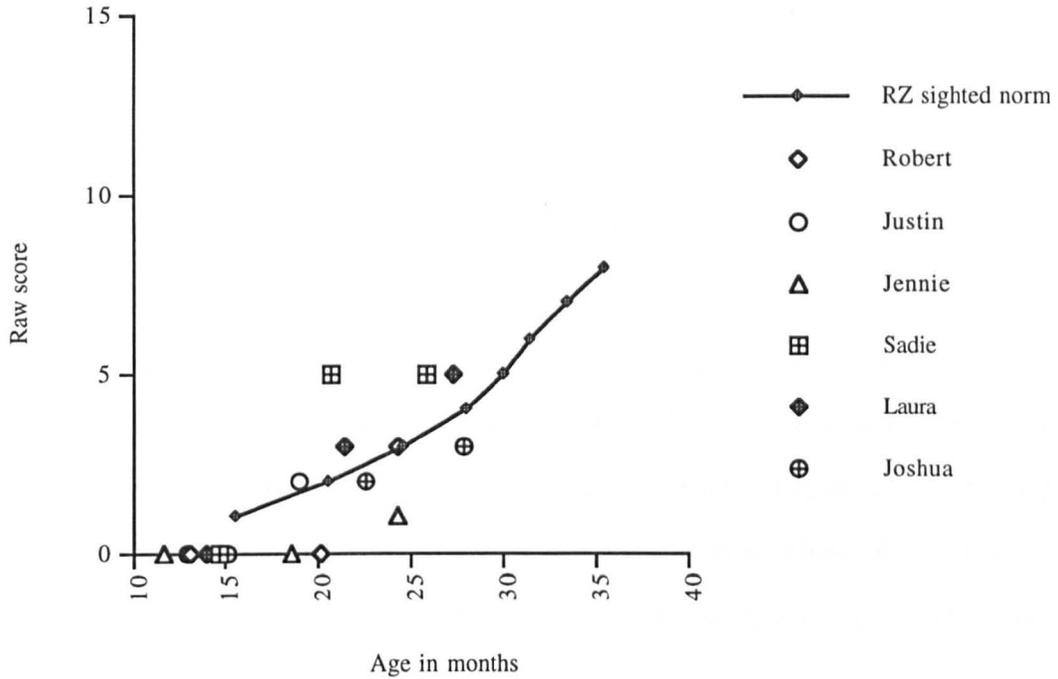


Figure 5.12. Performance of sighted infants on the scale of expressive language (content)



5.4. Discussion

The first objective of the present study was to examine the extent to which the blind, SVI and sighted infants were functioning at the same developmental level as infants of the same chronological age and level of visual ability. The results demonstrate that five of the infants performed at least in line with the appropriate norms on each of the Reynell-Zinkin scales. One exception, however, was the blind infant Kristian who consistently performed below the Reynell-Zinkin norms on each assessment. Moreover, with the exception of Kristian's performance on the scales of social adaptation and expressive language (structure) his level of functioning on all other scales reached a plateau since, his scores between 23 and 35 months of age remained static. In contrast, the blind infant Lottie performed above the Reynell-Zinkin norms for blind and partially sighted children on each assessment scale, and she exceeded the Reynell-Zinkin norms for sighted children on at least two of the three

assessments on both scales of language functioning. With the exception of the scale of response to sound and verbal comprehension, the performance of the sighted infants was spread evenly around Reynell-Zinkin norms for sighted children.

As a group, the blind / SVI infants were less able to initiate activities involving looking after themselves (e.g. drinking and feeding) and lagged behind their sighted controls on the scale of sensorimotor understanding. Whereas the blind/SVI infants were just starting to relate two objects (e.g. putting objects in a container) the sighted infants were able to engage in more sophisticated actions with objects (e.g. getting sweet out of screw-topped bottle). Thus although the blind / SVI and sighted infants were matched on language ability, the assessments indicated that the blind/SVI infants lagged behind the sighted in object understanding involved in both their self-care and play. These observations will aid the interpretation of findings from studies of conceptual-lexical functioning reported in **Chapters Six to Eight**.

The second objective of the present study was to track changing abilities in comprehension and production during the second year. The scores for each blind / SVI infant and their sighted control on the first assessment was reported in **Chapter Four**. At the start of the study, none of the blind/SVI infants were able to select any familiar object in response to someone naming it, although three sighted infants were able to do so. In addition, with the exception of one blind infant (Lottie), none other of the sighted/blind/SVI infants were able to produce words for objects presented to them. However, whereas the sighted infants started to produce labels for objects at around the age of 15 months, two of the blind infants (Kirstie and Kristian) had still not produced labels for objects at 30 and 35 months respectively. A third blind infant (Roxanne) was only able to label one object presented to her at 27 months. In sum, the findings from the scales of response to sound and verbal comprehension, and the expressive language (content) scale, suggest that the blind/SVI infants were delayed in their ability to understand and label words for objects.

In contrast to the blind infants' difficulties with objects, it is interesting that there appeared to be no delay in the emergence of their ability to produce an appropriate response to a familiar phrase (e.g. clapping hands in pat-a-cake), nor was there any sign of any delay on the scale of expressive language (structure). These findings are relevant to the decision to separate the structural and content aspects of language in the design of an assessment scale for blind/SVI children. In its original form (Reynell, 1969), only one expressive language scale existed and there was no distinction between the structural and the content aspects of language. In modifying the scales for use with blind children, the authors split the scale into two on the grounds that many "blind children have a superficial fluency in speech which may mask a difficulty in relating language to a concrete referent." Blind infants' language functioning was assumed to differ from that of sighted infants in two ways. First, the assumption was that 'superficial fluency' was something special to blind children, however, as reviewed in **Section 2.4**, there is evidence that some sighted children appear to start off speaking in unanalysed phrases rather than by using single words (Peters, 1977). This suggests that the division of the scales could also be justified on the basis that there is more than one route into language. Second, Reynell (1979) suggests that blind children have difficulty in relating a word to concrete referents. However, in **Chapter Three** it was suggested that this position should be evaluated more critically because blind infants might relate words to events and actions better than to objects. Furthermore, it was argued that we need to understand whether blind infants are merely more likely to show 'expressive' patterns of development (Mulford, 1988) or whether they manifest a cognitive deficit (Dunlea, 1989). Insight into this issue will be gained from the findings produced in **Chapters Six to Eight**. Subsequently, suggestions will be made for the future design of scales assessing language functioning in blind children.

The third objective of the study was to examine the extent to which the performance of blind children may have been underestimated by Reynell (1979). This was managed by examining how the performance of children on previous studies of blind/SVI children

without additional disabilities (Larner and Rowlands, 1988; McConachie and Moore, 1994) and those from the present study compared to Reynell-Zinkin norms. The results from Larner and Rowlands' (1988) study suggest that the Reynell-Zinkin norms underestimate the performance of blind children on all scales. More conservative, however, were the findings from McConachie and Moore's (1994) study suggesting that the performance of blind children was underestimated on the scale of sensorimotor understanding but not the scale of response to sound and verbal comprehension or the scale of expressive language (structure). The results from the present study suggest that the Reynell-Zinkin norms have underestimated the performance of blind infants on the scales of social adaptation, sensorimotor understanding and exploration of the environment. In contrast, the scales overestimate the performance of blind infants on the scale of expressive language (content) in the first part of the scale.

The only substantial study of the performance of SVI children on the Reynell-Zinkin Scales has been carried out by McConachie and Moore (1994). This study suggested that the performance of these children had been underestimated on each of the scales they examined: sensorimotor understanding; response to sound and verbal comprehension and expressive language - structure. Their findings also suggested that the recordings were more in line with the performance of sighted children than with the norms for partially sighted children. Further support for this comes from observations of the SVI infant Joseph in the present study, Joseph performed more in line with sighted children on all scales except on the expressive language (content) scale. Finally, given that the Reynell-Zinkin norms were intended for children with partial sight rather than severe visual impairment, the results from McConachie and Moore (1994) and the present study suggest that the Reynell-Zinkin Scales may have grossly underestimated the influence of having even the smallest amount of vision. This finding is supported by the observation that in the Reynell-Zinkin samples there were twice as many children with cerebral palsy in the partially sighted group as in the blind group.

The main issue in comparing the Reynell-Zinkin sample with studies based on children without any known additional disabilities concerns the number of children in the sample. At first sight, it may seem unreasonable to make direct comparisons between the results from the Reynell-Zinkin study based on 109 children with those from other studies. After all, Lerner and Rowlands' study was based on only 11 children and McConachie and Moore's was based on nine blind and nine SVI children. The proportion of partially sighted / blind children in the Reynell-Zinkin sample of 109 is not specified. However, it is stated that the 109 children yielded 203 recordings since 44 of the children are assessed between two and seven times each. Furthermore, it is stated that 50 recordings were made of blind children between the ages of 12 and 36 months. If we make the assumption that the distribution of recordings is spread evenly across the age range then this would suggest that around 39 blind children within this age range would have taken part. Taken together, the number of blind children aged between 12 and 36 months in studies by McConachie and Moore's, by Lerner and Rowlands' and in the present study was 25. Although the samples are not equal in size, the findings suggest that it is likely that the Reynell-Zinkin Scales underestimate the performance of blind children on the scales of sensorimotor understanding.

Chapter Six

The Emergence of Sorting Strategies in Object Play

6.1. Introduction

The idea that examining the extent to which infants sort a set of objects into classes is an appropriate indicator of a infant's ability to categorize was discussed in **Section 2.5**. Studies on object sorting in sighted infants during their second year suggest that, at around 12 months, infants have a rudimentary ability to sort objects in the sense of exhibiting a preference since they contact objects from a single class (e.g. Ricciuti, 1965; Nelson, 1973; Langer, 1981; Sugarman, 1983). Approximately four months later, infants' sorting becomes more sophisticated since they start to touch a series of objects in one class, then a series of objects in another. Finally, towards the end of the second year, infants start to sort objects into spatial arrangements.

Researchers have stressed that is only when infants start to sort objects by touching a series of objects in one class, then a series of objects in another, or by sorting two classes of objects into spatially distinct arrangements that infants can be credited with an understanding that things can be alike. In contrast, the selection of objects from a single class is regarded as a rudimentary sorting strategy, since it is not thought to reflect an understanding that more than one instantiation of an object can exist.

The two studies of object manipulation in blind infants discussed in **Section 3.5** produced inconsistent findings. Gerhardt observed that the infant "AB" sorted objects according to their differences at 14 months whereas none of the four infants in Dunlea's study engaged in sorting until the age of 30 months. Two reasons why the discrepancy between Gerhardt's and Dunlea's studies may have occurred were suggested in **Section 3.5**. One reason concerned the different criteria used to assess sorting strategies.

Gerhardt (1981) compared the performance of the infant participating in her study with those of sighted infants based on criteria established by Langer (1980) whereas Dunlea (1989) adopted the analysis methods used by Sugarman (1983). The present study recognizes the importance of devising a technique which takes into account blind infants' reliance on haptic scans in exploring the object sets.

Another reason for the discrepancy between Gerhardt's (1982) and Dunlea's (1989) studies concerned the uncertainty over the extent of AB's visual impairment. In particular, Gerhardt did not elaborate on whether 'blind' meant no visual response or whether it was being used in a different way. The present study pays special attention to the extent to which the performance of Joseph, the infant with SVI approximates that of the sighted infants or the blind infants.

Given these discrepancies, the first objective of the present study is, therefore, to examine the age when sorting strategies in blind infants emerge once the differences between the way Gerhardt (1982) and Dunlea (1989) conducted their studies are taken into account. The aim is not to strive to establish a 'magical' age when blind infants sort objects, instead it is to try to identify factors which lead to differences in the quantity and quality of sorting strategies of blind infants across the second year

Chapter Five established that some blind infants are delayed in their ability to understand labels for objects during their second year. This finding is important, because if the present study suggests that infants are able to sort objects, this would suggest that they have the ability to categorize but that they have difficulties in understanding that others are referring to an object. Alternatively, if blind infants are unable to sort objects then this would suggest that they have difficulty understanding that more than one instantiation of an object can exist. In the light of these predictions, the results from the present study are viewed in relation to data on comprehension reported in **Chapter Five**. The focus is on comprehension rather than production since abilities in comprehension

appear sooner in an infant's development. Further, the ability to understand object labels was chosen rather than any other aspect of language functioning because it was the linguistic counterpart of the non-linguistic ability assessed in the sorting tasks. The second objective of the present study is to examine the extent to which abilities in the comprehension of object labels relate to the ability to sort objects.

Another consideration to take into account in the design of a study assessing the sorting strategies in blind / SVI infants are the criticisms made of previous studies of sighted infants. **Section 2.5** identified two problems arising out of the review of studies of sorting abilities in sighted infants. One concern was that studies using the sequential analysis have assigned a range of interpretations to observations of infants who manipulate *different* class objects in temporal sequence more frequently than could be expected by chance. Whereas some researchers have failed to consider different class object manipulations as evidence of sorting (Ricciuti, 1965) others have viewed sorting by alternating between objects of different classes as an ability which precedes the sorting of objects by manipulating a sequence of objects from the same class (Langer, 1981). Furthermore, as explained in **Section 2.5**, it is unclear whether these researchers take into account the fact that there is a greater probability of sequentially selecting different class objects than same class objects. For example, if there are two classes A and B each with three objects, if the infant selects an object from class A, there remain two same class objects (A's) but three different class objects (B's). In the analysis reported in this chapter, the greater probability of selecting different class objects will be allowed for by calculating the expected chance score for holding different class objects.

A second concern discussed in **Section 2.5** was that the sequential manipulation analysis under-estimates sorting abilities in sighted infants because it cannot cope with instances when an infant picks up and holds two objects from one class followed by two objects from the other class. The sequential analysis focuses on the relationship between

individual objects being same or different to the immediately preceding object. On occasions when infants pick up two objects of one kind followed by two of another, the sequential-touching analysis under-estimates infants' categorization abilities, since the number of 'same' and 'different' recordings remain equal, suggesting that the infant is failing to sort objects. The study reported in this chapter aims to incorporate this strategy into a new analysis. In addition, the third objective of the present study is to make a comparison between the conventional analysis of object-pairing with a new analysis designed to take account of the inability of blind infants to initially select an object to touch using vision.

The majority of studies of sorting ability in sighted infants have relied on cross-sectional methods which preclude an examination of the stability of sorting strategies across the second year. In contrast, the present study uses three time-points at three-month intervals to track patterns in sorting strategies longitudinally. The aim is to track both common trends and individual performance characteristics in the blind and sighted infants. The SVI infant Joseph was included in the blind group for the general analysis. However, in order to establish the extent to which residual vision aids sorting, Joseph's sorting strategies will also be considered separately.

One criticism made of Gerhardt and Dunlea's research in **Section 3.5** was that they had both transferred the materials used with sighted infants directly to the study of blind infants. The present study avoids using the abstract geometrical forms used by Gerhardt (1982) and Dunlea (1989) and instead uses objects believed to be meaningful to blind infants by employing everyday objects which vary in texture, sound and smell.

In sum, the three objectives of the present study were to: first, examine the age when sorting strategies in blind infants emerge once the differences between the way Gerhardt (1982) and Dunlea (1989) conducted their studies are taken into account; second, to examine the extent to which abilities in comprehension of object labels relate to the ability

to sort objects; and third, to compare the sequential analysis with the object-pairing analysis on data produced from sighted infants.

6.2. Method

6.2.1. Infants

All but one pair of infants were tested on this task at each of the three time-points. One pair was only observed at time-point one. Table 6.1. displays the age on administration of the task to infants at each time-point. The aim was establish intervals of 3 months between each time-point so that there would be six months between the first testing period and the third testing period. However, the mean interval between the first and third time-point turned out to be 7.4 months (s.d.= 1.96).

Table 6.1. Age in months and days (corrected for prematurity) on completion of object manipulation task by time-point and visual status.

Infant	Visual status	Time 1	Time 2	Time 3
Joseph	SVI	13;26	17;02	20;17
Robert	Sighted	13;16	17;04	20;04
Kristian	Blind	23;10	26;22	29;14
Justin	Sighted	12;28	16;05	20;16
Roxanne	Blind	14;17	19;26	27;01
Jennie	Sighted	13;21	18;24	22;06
Lottie	Blind	16;19	20;22	23;28
Sadie	Sighted	15;17	18;09	21;02
Kirstie	Blind	16;02	18;23	22;08
Laura	Sighted	14;05	17;05	20;13
Morris	Blind	17;21	no data	no data
Joshua	Sighted	15;07	no data	no data

6.2.2. Materials

There were 10 trials each using a separate set of six objects. Each object set consisted of three exemplars of one class and three of another. The two classes of objects within a set differed on at least one of the following perceptual features: texture, sound, form, shape, smell and function. The object sets and their order of presentation are described in table 6.2.

Table 6.2. Object sets in order of presentation

Task	Object group
1	3 pieces fabric (4"x 4") and 3 pieces greaseproof paper (4" x 4")
2	3 oranges and 3 lemons (pricked to release odour)
3	3 squeazy, squeaky rubber fire-engines and 3 plastic rattles with bells
4	3 hairbrushes and 3 teaspoons
5	3 plastic mouth organs and 3 plastic trumpets
6	3 plastic bottles containing dried peas and 3 plastic bottles containing water
7	3 plastic tubes that groan on inversion and 3 plastic handled sleigh bells
8	3 circular cotton wool pads and 3 junior toothbrushes
9	3 soft cubes with bells inside and 3 oval sponges
10	3 plastic tubs and 3 plastic ducks

6.2.3. Procedure

Infants were normally seated on the floor between their parent and the researcher. At the first time-point, two of the blind infants, Kristian and Roxanne were not able to sit unsupported or able to reach down to the objects. These two infants were seated in chairs and received the object sets on a plastic table attached to the chair. Each new object set was presented in a mixed array directly in front of the infant accompanied by such prompts as "----(infant's name)play! What's all this?" "What have you got?" The object sets were presented to all infants in the same order.

Where necessary, the infant's hands were guided down towards the object set. Parents were encouraged to get their infants to play but were instructed not to interfere with the

play itself or to name the objects. When objects moved out of the child's reach they were returned within reach. Infants were presented with each object set for 2.5 minutes. However, trials were stopped before this time if an infant became upset or refused a set. After an object set had been removed, the next set was presented to the infant. A video recorder was used to film each infant manipulating objects on each of the 10 tasks.

6.2.4. Criteria for classification

The two requirements for the design of a new analysis technique for assessing the emergence of sorting strategies in blind/SVI and sighted infants were first, that it took into account both the time necessary for blind infants to complete a haptic scan of the objects in front of them and second, that infants might use an alternation strategy (see **Section 2.5**). The new analysis technique designed for the present study will be referred to as the *duration analysis of object pairings*. The traditional method for assessing sorting ability as used by Sugarman (1983) and others will be referred to here as the *sequential touching analysis*. The technique used for assessing whether infants are using rudimentary sorting strategies or whether they are sorting from two classes will be referred to as the *analysis of single class bias*. These three analyses are described below. All three were based on the video recordings, as were additional qualitative observations.

Since only a small number of infants participated, the object sets were always presented in the same order. However, as is reported below, there is no effect of task on sorting activity as measured by the sequential and object-pairing analyses. This suggests that order effects of task did not occur in this study.

Duration analysis of object-pairings: Each trial with each set of objects was divided up into episodes as follows. An episode began when the infant who was not already touching an object, came into contact with one. This object was labelled the lead object for this episode and when it was put down this ended the episode. Within each episode, the

durations of all contacts with other objects were recorded. The cumulative duration of touching objects other than the lead object was calculated, together with the cumulative duration of touching objects that were the same kind as the lead object. When an infant is holding the lead object, five objects remained, two identical to the lead object and three different. Therefore two-fifths of the total duration of touching any object other than the lead object was taken as the expected chance duration of same class contacts. The difference between the observed and expected durations reflects the magnitude of the tendency of the infants to pair objects on the basis of class membership.

A concern in designing this analysis was to take into account that the blind/SVI infants would require additional time to complete a sequential haptic scan of the object set in search of a particular object. In an initial exploratory analysis of the data, a two second threshold was permitted for the additional time that it would take to complete a haptically based rather than a visually based search. Thus an episode was not deemed to have started unless the lead object was held for at least two seconds. However, the decision was taken not to require that subsequent manipulations of objects within an episode should be at least two seconds. The first reason for this was that this was that it was rare for Roxanne, Kristian and Kirstie to hold two objects (see **Section 6.3**), and even when they did, it was usually only for a moment. On this basis, it was therefore considered important to consider the small amount of available data from these infants. The second reason for this was that objects being scanned haptically are touched briefly and therefore will have little effect on the duration scores.

The exploratory analyses indicated that inclusion of this threshold did not influence the outcome of the analysis. It is possible that once these infants had explored the object set to 'see what was out there' they had adequate spatial memory to be able to know where to retrieve the objects. In support of this, the mothers of Roxanne and Kirstie commented that in everyday play the infants would hide objects under their limbs and relocate them

once they had finished playing with other objects. On this basis, the decision was made to abandon the threshold.

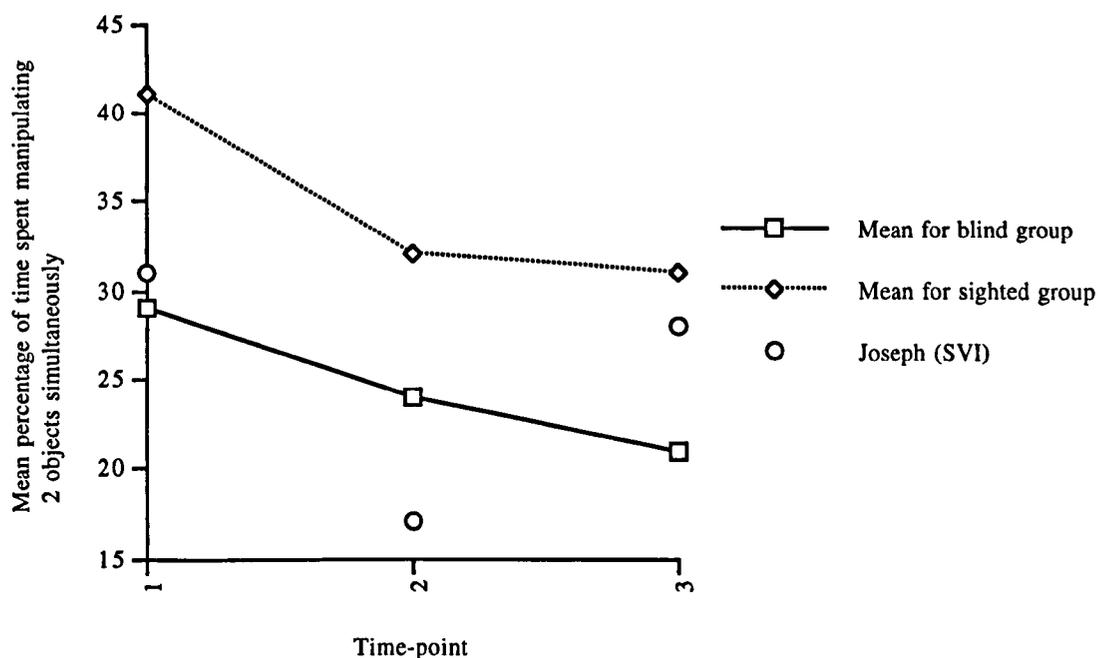
Sequential touching analysis: the method employed by Sugarman (1982) was used to examine whether infants successively handled objects from the same group more frequently than would be expected by chance. For each task, object manipulations were recorded as same class or different class in relation to the object manipulated immediately before. In cases where a particular object was touched, dropped then immediately touched again only the first manipulation was recorded. For each infant, across the 10 object sets the observed total frequency of same class sequential pairs was compared with the expected number of same class object sequential pairs the infant could have made by chance. Chance expectancy for the frequency of choosing similar objects in sequence was computed by multiplying the total number of sequential pairs the child made by 0.4. The justification for this was that when the infant was touching one object, five objects remained, of which two were from the same class as the object contacted.

Analysis of single class bias: in order to rule out the possibility that infants who had been identified as 'sorters' were not simply manifesting a preference towards one object class, and therefore only engaging in rudimentary sorting strategies, the following procedure was carried out. For each infant classified as able to sort, the proportion of selections of objects from each of the two classes of objects was recorded. For each infant, on each task, it was noted whether either of the object sets were manipulated for greater than 75% of the total duration of same class object holds. The cut-off point of 75% is used since this has been used in previous studies (Nelson, 1973). For each infant, at each time-point, whenever the infant engaged in single class object sorting on greater than or equal to 60% of the tasks the infant was classified as a 'rudimentary sorter'.

6.3. Results

Sighted infants spent longer playing with two objects simultaneously than the blind infants at each of the three time-points. On average, the blind infants spent a quarter of the duration of each task simultaneously manipulating two objects whereas the sighted infants spent a third of each task doing so. Figure 6.1. shows the decreasing proportion of time the blind and sighted groups manipulated two objects simultaneously over the three time-points. With the exception of the second time-point, the SVI infant Joseph falls in between the performance of the blind and sighted groups.

Figure 6.1. Mean percentage of time blind, SVI and sighted groups manipulated two objects simultaneously



6.3.1. Analysis of tendency to use sorting strategies

Duration analysis of object-pairings: Using episodes as the basic unit of analysis, the duration data were analysed using a four-factor ANOVA. The factors were blind vs sighted group, infant (nested within group), object set and time-point. The dependent variable was the difference between duration of observed and expected same class object manipulations. From now on, this dependent variable will be referred to as the 'difference score'.

Table 6.3. below shows the outcome from the ANOVA on the duration of object-pairing analysis. It demonstrates that there were no significant main effects on the difference score for visual group, time-point or object-set on observed-expected differences. The main effect of infant was significant, indicating that the difference between observed and expected duration of same class object manipulations varied consistently across infants. No two and three way interactions between time-point, vision and object-set were significant. The lack of an interaction between any combination of these factors indicated that different amounts of sorting were not elicited by different object sets at any time-point.

Table 6.3. ANOVA on duration analysis of object-pairing data

Source	SS	DF	MS	F-ratio	p
Blind vs sighted group	0.87	1	0.87	0.02	0.90
Time-point	55.42	2	27.71	0.50	0.61
Object-set	548.3	9	64.92	1.16	0.32
Infant {blind vs sighted group}	1097	10	198.71	3.56	<0.0001
Blind vs sighted group *infant	415.8	9	46.21	0.83	0.59
Time-point*object-set	739.6	18	41.09	0.74	0.77
Blind vs sighted group * time-point	21.46	2	10.73	0.19	0.83
Blind vs sighted group * time-point *object-set	616.5	18	34.25	0.61	0.89
Error	11064	198	55.88		

Since two of the infants, Morris and his control Justin only participated at the first time-point and also because episodes were not produced for each task by some infants, it was not possible to explore the interactions between infant and object set or infant, object-set and time-point. For the same reasons, it was also not possible to explore whether individual infants differed in level of sorting activity over time. However, it was possible to examine the interactions between infant and time-point and infant and task once the infants Morris and Joseph were excluded from the analysis. The results from this are reported later.

Tests of simple effects showed that individual differences were significant for the blind infants ($F(5, 198) = 4.176, p = 0.001$) and for the sighted infants ($F(5, 198) = 2.936, p = 0.014$). On the basis that the ANOVA showed no significant differences between time-

points or between object sets, matched pair t-tests were carried out between observed and expected scores across all time points for each infant. These are reported in table 6.4 below.

Table 6.4. T-tests on difference scores for blind/SVI and sighted infants

Infant	Visual status	T	df	p
Joseph	SVI	-1.39	22	0.180
Robert	Sighted	-3.12	24	0.005
Kristian	Blind	0.41	26	0.689
Justin	Sighted	-3.68	27	0.001
Roxanne	Blind	-1.93	22	0.067
Jennie	Sighted	-4.05	20	0.001
Lottie	Blind	-2.49	26	0.019
Sadie	Sighted	0.007	26	0.947
Kirstie	Blind	-1.70	24	0.102
Laura	Sighted	-2.13	22	0.045
Morris	Blind	-2.021	9	0.074
Joshua	Sighted	-2.24	8	0.050

The table shows that one blind infant, Lottie and five sighted infants were engaging in sorting strategies. However, the ANOVA showed no group effect on the difference scores so it is not possible to conclude that the sighted infants were sorting more than the blind infants. The amount of sorting activity produced by the blind infants over each of the three time-points is presented below in figures 6.2. and 6.3.

Figure 6.2. Mean difference scores across all time-points for blind infants

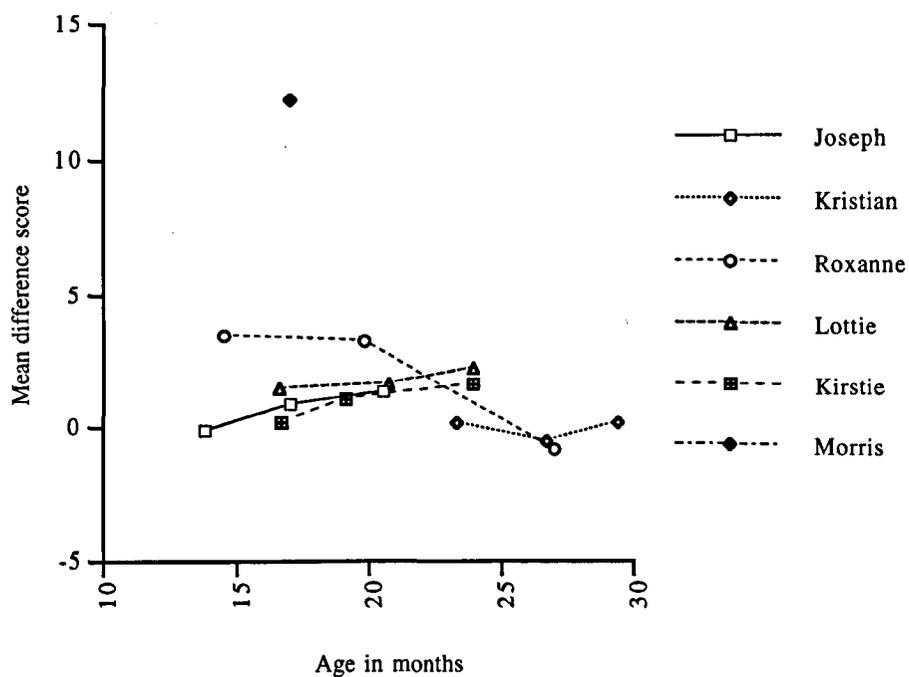
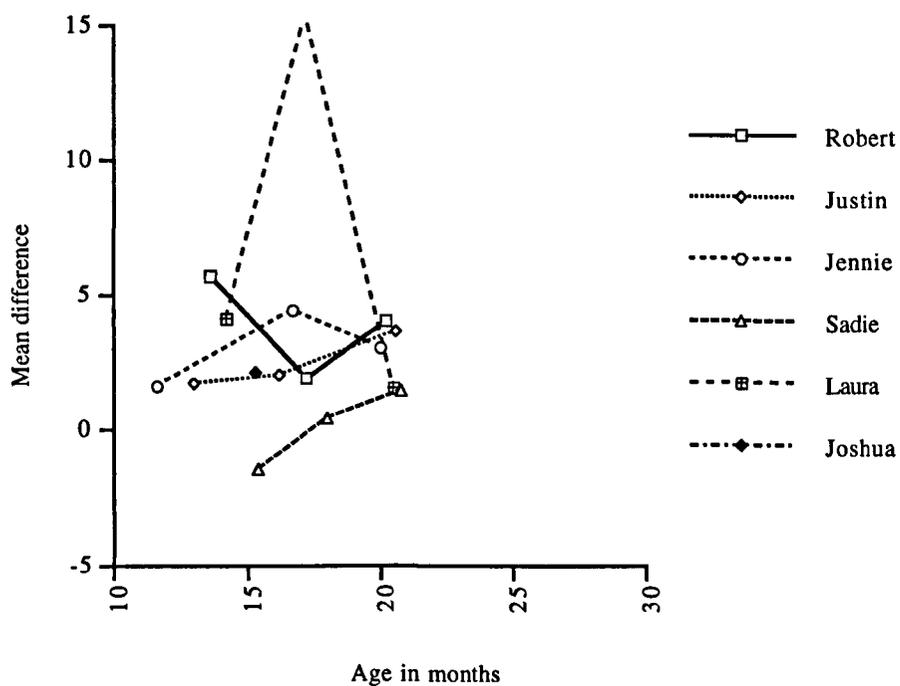


Figure 6.3. Mean difference scores across all time-points for sighted infants



The graphs show that most of the difference scores were above 0. This indicates that most of the infants at most of the time-points engaged in more same class object pairings than different class object pairings. The mean difference score for the blind group was 1.95 (s.d. = 6.73) and for the sighted infants it was 3.2 (s.d. = 8.64). As stated above, the main effect of visual group was not significant. The graphs show that the mean difference between same and expected scores were more variable in the blind/SVI group than in the sighted group. No age trends are discernible in either group.

There was an interaction between infant and object-set ($F(81,129)$, $p=0.03$). Other new interactions permitted by the elimination of Morris and Justin were non-significant.

t. The

four factor ANOVA yielded the results which are reported in table 6.5.

Table 6.5. ANOVA on duration analysis of object-pairing data based on infants participating at all time-points

Source	SS	DF	MS	F-ratio	p
Blind vs sighted group	263.1	1	263.05	7.34	0.008
Time-point	119.1	2	59.55	1.66	0.194
Object-set	763.3	9	84.81	2.37	0.017
Infant {blind vs sighted group}	861.1	8	107.6	3.00	0.004
Infant*time-point	649.8	18	36.10	1.01	0.456
Infant*object-set	4199	81	51.8	1.44	0.03
Error	4623	129	35.8		

Reliability measures on duration analyses of object-pairing: one rater coded the videos using the criteria presented in **Section 6.2.4**. Twenty trials were chosen unselectively from the available pool from the first time-point. Thus approximately 6% of the trials were examined for reliability. The difference scores from the rater and the author were compared using intra-class correlation coefficients (Shrout and Fleiss, 1979) which yielded 90.5% reliability.

Analysis of single-class bias: three of the five sighted infants classed as 'sorters' were manifesting a single object group bias at all time-points, the exception was the sighted infant Laura who maintained a single class object bias until the third time-point when she sorted on the basis of two object classes. The blind infant Lottie demonstrated a single object group bias on the first time-point only. Thereafter, she sorted two classes of objects. In terms of what has been reported for sighted infants by Sugarman (1991), Lottie was sorting two classes of objects rather than one 10 months earlier than reported by Dunlea (1989). With the exception of two infants, the sighted infants maintained the tendency to sort on the basis of one object group until the end of the study. Justin and Laura performed two class sorting in the middle of her second year, which is in line with that reported by Sugarman.

Sequential touching analysis: a three way ANOVA (infant x time-point x same / different class object holds) was completed. The results indicate that there was no overall difference between same / different class object holds ($F(1, 245) = 0.668, p = 0.414$). There was no interaction between infant and time-point ($F(10, 245) = 0.348, p=0.967$) nor was there an interaction between infant x time-point x same / different class object holds. There was, however, a significant difference between infants in the extent to which they sorted objects ($F(5,245)=9.29, p < 0.0001$).

Reliability measures on sequential touching analysis: Ten trials were examined and chosen unselectively from the available pool. Inter-observer reliability measures were completed on the difference scores between the number of same and different class object manipulations from the first time-point. The intra-class correlation coefficient yielded 85% reliability.

6.3.2. The comprehension of words for objects: its relation with sorting ability

The concern here was whether any relationship between the ability to sort objects and to comprehend labels for objects. Since for some infants, at least three months elapsed between administration of the sorting task and the Reynell-Zinkin Scales it was not possible to correlate difference scores from the duration analysis of object pairings with performance on the scale of response to sound and verbal comprehension. Instead, infants were grouped according to their ability to understand object labels as measured by the Reynell-Zinkin scale of response to sound and verbal comprehension. A score of 10 on this scale indicates that an infant can understand at least one label for an object. On this basis, those infants who failed to understand at least one label for an object but who were able to understand at least one label at the end of the study were identified. The mean difference scores derived from the duration analysis of object-pairing were identified for those infants unable to comprehend object labels and compared with performance of these infants once they were able to comprehend object labels.

Seven infants were identified who were unable to comprehend labels for objects at the start of the study but who were able to do so by the end of the study. This group included four infants from the blind group (Joseph, Roxanne, Lottie and Kirstie) and three from the sighted group (Robert, Jennie and Laura). A matched pair t-test was carried out between the mean difference scores on the first administration of the sorting task (when none of these seven infants were sorting) and the mean difference score produced on either the

second or third administration of the sorting task when these infants were able to comprehend labels for objects. The t-test demonstrated that there was no significant difference in sorting ability whether infants were able to or not able to comprehend labels for objects ($t(6) = 0.638, p=0.55$).

6.3.3. Comparison of duration analysis of object-pairing and sequential touching analyses

According to the ANOVA for the sequential touching analysis, there was no difference between the number of same and different class object manipulations for any of the infants in the sighted group. In contrast, the object-pairing analysis indicated that there was a difference between the duration of time holding same and different class objects. Furthermore, the t-tests showed that five of the six infants were sorting. The results suggest that the sequential touching analysis and the duration analysis of object-pairings did not lead to the same conclusion.

6.4. Discussion

The first objective of the present study was to examine the extent to which blind/SVI and sighted infants were able to sort objects. The results demonstrated that when sighted infants were given a set of objects, half of one kind and half of another, they tend to hold simultaneously two objects from the same class significantly more than expected by chance alone. However, on closer examination, the results revealed that three of the five sighted infants regarded as sorters were actually only engaging in rudimentary strategies at all time-points. One exception was the sighted infant Laura, who, on the last time-point manipulated objects from two classes.

One reason why the majority of sighted infants failed to sort objects from two classes and instead, limited their contact to predominantly one class of objects may be associated with the decision to avoid the use of abstract objects. The use of objects identified for their

non-visual perceptual appeal may have resulted in an increased tendency for sighted infants to manifest a single class object bias. Indeed, the data show that the same object sets within tasks appealed to all the sighted infants (e.g. they manipulated the toothbrushes more than the cotton wool, the tubes more than the bells). It is therefore necessary, in any future study to ensure that the objects sets within tasks have equal appeal to infants.

Two blind infants, Lottie and Morris simultaneously held same class objects in their hand significantly more than could be expected by chance alone. With the exception of Lottie, who used rudimentary sorting strategies on the first time-point, the results showed that the infants were sorting objects from both classes. In contrast, the duration analysis of object pairing demonstrated that the other four infants (including the SVI infant, Joseph) were spending time with objects from same and different classes at random and therefore not sorting objects. Interestingly, though the proportion of time infants spent manipulating two objects simultaneously is independent of the degree to which infants sort objects, the results indicated that the two blind infants able to sort objects contacted two objects simultaneously for the longest duration. In contrast, it was striking that Kristian and Kirstie spent on average, nearly 90% of their time either playing with no objects or manipulating only one object. Similarly, Joseph, the SVI infant and Roxanne spent on average, around three-quarters of their time with one or no objects. In sum, whereas the sorters Lottie and Morris spent more time than their sighted controls playing with two objects simultaneously, in contrast, each of the other four blind/SVI infants spent on average, less than a quarter of their time contacting two objects from the same class simultaneously.

On the basis of the finding that Roxanne, Kirstie, Kristian and the SVI infant Joseph preferred to manipulate one object (or no objects) rather than two, it seems likely that the presentation of small, manipulable objects was a relatively new experience for these infants. It is unlikely that sorting strategies will emerge when infants experience of objects

in everyday life consists of handling a single object, let alone several exemplars of it. In support of this, was the finding that with increasing age, the blind/SVI group spent an increasing amount of time manipulating objects. This suggests that either they were receiving increased experience with objects during interactions and/or that they were habituating to the objects presented in this study. In conclusion, for four of the infants, the tasks elicited exploratory rather than sorting behaviour. On this basis, it is predicted that the tendency to engage in exploratory object manipulations will be paralleled by an absence of object orientated play during sessions of spontaneous play. This issue will be investigated further in **Chapter Eight**.

Although the duration analysis of object pairings demonstrated that four of the blind/SVI infants were unable to sort objects, this does not necessarily indicate that they could not. Interestingly, on presentation of the brushes and spoons on task four, several blind infants differentiated function between the objects by putting the spoons in their mouths and brushing their hair. Differentiation of function using different actions must also be an indicator of the ability to categorize. However, one blind infant, Kristian did not engage in any actions appropriate to the object set being manipulated. Roxanne's actions were limited to the shaking of objects. So, with the exception of Roxanne and Kristian, the quantitative analyses did not capture the full extent on what the infants were able to do.

However, observations of the videos yielded some fleeting episodes when the blind infant Roxanne was using sorting strategies, even though, she was not classified as able to sort by the duration analysis of ^{object-pairings}. For instance, at 19 months (corrected for prematurity), on presentation of three shakers filled with water and three filled with dried peas, Roxanne first picked up a water shaker and shook it by her right ear. She then picked up a dried pea bottle and shook it by her left ear and subsequently dropped it, followed by another dried pea bottle which she shook by her right ear before dropping it. Finally, she picked up a water bottle and again shook it, and this time shook the two water

bottles together without discarding either of them. Roxanne was unable to detect the identity of the shakers until she had shaken them but it was clear from the way she was quickly discarding different class objects that she was actively seeking another same class object. Again, this is another example, that the quantitative analyses are unable to pick up. Episodes like this are valuable because they permit the detection of the emergence of sorting ability. Despite the substantial literature based on quantitative analyses on sequential sorting, it seems that this technique is very likely to result in false negative findings - infants who show few overt signs of sorting but who are able to do so.

The findings that two out of the six blind/SVI infants were able to sort objects as assessed by the duration analysis of object pairings, that four out of the six blind/SVI infants could differentiate function between objects, and that Roxanne was observed to manifest fleeting episodes of sorting activity, leads to the conclusion that blind infants are able to sort objects. It seems that Lottie and Morris had attained an appropriate level of developmental functioning necessary for the emergence of sorting salient enough to be detected by the quantitative analyses. The other infants had only just started to manipulate objects according to their similarities and therefore were not holding same class objects for sufficiently long for the duration analyses to classify them as 'sorters'.

The conclusion that blind infants are able to sort objects implies that vision is not necessary to stimulate the classification process. This is in contrast to Dunlea's (1989) conclusion that blind infants cannot sort objects during their second year and in support of Gerhardt's finding that "AB" was able to sort objects in the middle of her second year. It therefore seems unlikely that the discrepancy between Gerhardt's and Dunlea's studies was due to a difference in the level of visual functioning. This interpretation is supported by the finding that the blind infants Morris and Lottie were sorting more than the SVI infant Joseph. This would imply that residual vision does not necessarily aid the onset of sorting ability.

It was discussed in **Section 6.1** how the materials Dunlea (1989) used in her study may not have been sensitive enough to elicit the emergence of sorting skills. The results of the present study indicated, however, that the different object sets used did not influence the extent to which infants were able to sort. It is therefore necessary to turn to a number of alternative explanations why there was a such a discrepancy between the findings from Gerhardt's and the present study on one hand, and those of Dunlea's study. The explanations considered below are attempts to explain why different levels of sorting emerged within the blind/SVI and sighted samples as well as possible explanations why the infants in Dunlea's sample may not have sorted objects until their third year.

One reason why Dunlea's infants did not sort objects may have been because they were like Kristian in the present study and delayed in their sensorimotor abilities. The findings from **Chapter Five** suggest that Kristian reached a plateau at a score of 9 throughout the study. This score indicates that he was only just able to understand that objects could be removed from containers and that he was not able to show fully how objects related to each other. Although Roxanne's performance on the sensorimotor scale was also delayed in relation to the rest of the blind/SVI group, unlike Kristian, her score increased on the second and third administrations of the assessments. This was coupled with the emergence of some fleeting episodes of sorting behaviour. It therefore may be possible that the infants in Dunlea's (1989) study were similar to Kristian and Roxanne in that their inability to act on objects appropriately constrained their ability to sort objects.

It is all too easy to focus on explanations for why particular blind/SVI infants are not able to sort while forgetting that not all sighted infants sort objects. The sighted infant Sadie was clearly not sorting objects as measured by any analysis technique, yet she was the most linguistically advanced sighted infant. Thus her linguistic abilities did not tie in with her performance on the object sorting task. Sadie understood that words can be extended to different exemplars yet her sorting abilities would suggest that she cannot categorize.

One explanation for this finding may be to view Sadie's performance as demonstrating homotypic discontinuity. This phenomenon is talked about by Bates, Bretherton and Snyder (1988) who emphasize that superficially similar behaviours can mean different things at different ages. Thus the absence of the ability to sort objects may be because an infant has already passed through the developmental phase when this type of ability is likely to emerge. However, this explanation may be of little relevance in the case of Dunlea's infants, since the infants in her study were observed to mouth and discard the objects. It is likely that the discrepancy between Dunlea's study and Gerhardt's study may be due to a combination of poor object understanding and an insensitivity of analysis techniques.

The second objective of the present study was to examine the extent to which abilities in the comprehension of labels for objects were related to the ability to sort objects. The findings suggest that there is no difference between infants who are able to understand object labels and those that are not. One explanation for the absence of any relationship between the ability to comprehend labels for objects and the ability to sort objects may concern the mismatch of the items on the comprehension task with those objects used in the study. In a future study it would be beneficial to examine infants' abilities to sort particular objects with their comprehension of labels for these same objects. Another explanation for the failure to find a relationship between abilities in comprehension and abilities in sorting may be that either the ability to sort objects is a poor indicator of categorization and/or the ability to comprehend object labels is developmentally unrelated to the ability to sort objects. Light may be shed on this issue by examining the findings for the third objective concerning the comparison of the sequential-touching analysis with the duration analysis of object-pairing.

The results indicate that there was little consensus between the analysis of sequential touching and the duration analysis of object pairings. The duration analysis of object

pairings demonstrated that sighted infants were sorting objects whereas the sequential touching analysis suggested that the sighted infants were not sorting. **Section 2.5** discussed how the sequential touching analysis is likely to underestimate the extent to which sighted infants are able to sort objects on the grounds that it fails to cope with occasions when sighted infants use an alternation strategy. Although this explanation is important, it is unlikely to account for the large inconsistency between the two analyses alone. In the light of the dearth of previous studies observing the emergence of sorting abilities during the second year, is somewhat surprising that the sequential touching analysis failed to identify any sighted infants as sorting. This may suggest that the reliability of the sorting phenomenon itself is questionable. The observation that infants were sorting according to the duration analysis of object pairings, together with the finding that the sequential touching analysis failed to identify any sighted infants as sorting suggests that these studies tell us more about the way infants act on objects rather than being a useful indicator of their level of cognitive functioning. This position is further supported by Shore, Dixon and Bauer (1995) who found that the quantity of sorting activity varied according to the linguistic style of infants. These researchers demonstrated that infants with referential tendencies engaged in higher levels of temporal grouping, leading to their conclusion that conceptual style mediates relations between linguistic and non-linguistic categorization.

The findings from the present study using the new analysis suggests that vision is not necessary for infants to sort objects. This position directly opposes Dunlea's (1989) view, who found that the infants in her study failed to sort objects until the third year. The findings suggested that there was larger variation within the blind/SVI infants in the degree to which they sorted objects. Possible factors which may contribute to this variation were identified. In light of the finding that the ability to comprehend labels does not appear to be related to extent of sorting activity, concern was raised over the validity of the sorting paradigm as an appropriate indicator of the emergence of the ability to categorize during

the second year. This conclusion appears justified in the light of the finding that there was little agreement between the sequential touching analysis and the duration analysis of object pairings. Evidence from infants in the present study that the ability to sort objects is related to linguistic style will shift the focus of attention from investigating the role of vision in the emergence of sorting strategies to instead investigating the role of individual differences in the emergence of sorting. In addition, it remains to be seen whether the kinds of experience blind/SVI receive with objects during interaction with their parents may shed light on their performance on the sorting task. Finally, it is important to recognize that the present chapter has focused exclusively on the categorization of objects. **Section 3.2** described the ways blind infants rely on information of a temporal nature to make sense of the environment. It is therefore crucial to redress this balance and consider the role of temporal information in the emergence of categorization abilities during the second year. These three issues are addressed in **Chapter Eight**.

Chapter Seven

A Study of Early Productive Vocabulary

7.1. Introduction

Section 3.4.1 discussed how the first studies of lexical development in blind infants agreed that these infants are delayed in producing their first words (Norris, Spaulding and Brodie 1957; Burlingham, 1961; Fraiberg, 1977; Warren 1977; Reynell, 1978). The findings from these studies were then contrasted with those from more recent studies which generally show disagreement over the extent to which speech is delayed (Mulford, 1988; McConachie and Moore, 1994). On the basis of looking at 15 case studies, Mulford (1988) found that blind infants acquired the first and tenth words at 14.7 and 15.1 months respectively, which she reported to be in line with the performance of sighted infants reported in Nelson's (1973) study. On the basis of these findings, Mulford (1988) concluded that there was no delay in the onset of speech or the attainment of lexical milestones.

In contrast to Mulford, McConachie and Moore (1994) demonstrated that the blind infants (n=9) in their study produced their first and tenth words at a mean age of 18.2 and 20.8 months respectively, which they compared with norms for sighted infants (14 months on the Bayley Scales of mental development and 10-11 months on the Reynell-Zinkin Scale). On this basis, McConachie and Moore concluded that the blind infants in their study were delayed in the production of their early lexical milestones. In addition, McConachie and Moore found that the nine SVI infants participating in their study produced their first and tenth words at an average age of 15 months and 20.4 months respectively and concluded that the SVI infants were delayed in the acquisition of early lexical milestones, but to a

lesser degree than the blind infants in their study. This finding suggests that having even a minimal degree of vision promotes the earlier production of words.

Section 3.4.1 drew attention to the way early studies of the onset of lexical milestones included infants with the condition retrolental fibroplasia, making it difficult to undertake comparisons with findings from more recent studies. Although more recent studies have not included infants with this condition (Mulford, 1988; McConachie and Moore, 1994), there continues to be disagreement between studies over the extent to which blind infants are delayed in the production of their lexical milestones. Two reasons why the discrepancy may have arisen between McConachie and Moore (1994) and Mulford's (1988) study were identified. The first concerned McConachie and Moore's (1994) suggestion that Mulford's sample may have been biased toward involving only the more successfully developing infants, resulting in an earlier age of onset for several lexical milestones. The second concerned the issue of undertaking comparisons between measures of central tendency where samples are based on small numbers of children. Whereas when measures of central tendency are used, these tend to produce discrepancies between studies, however, when studies of the range in age at which blind and SVI infants achieve their milestones are reviewed, these indicate that these infants are no different from sighted children. It is possible that blind infants vary in the age at which they produce their first words as much as the sighted population. In light of the impracticability of ever establishing a large sample of blind/SVI infants to examine the variation in the age at which first words are produced, alternative methods have to be found.

The problem of previous studies restricting their focus to the 'more successfully developing children' was confronted by McConachie and Moore (1994) by including infants from a range of backgrounds. However this was not possible in the present study since five of the six infants all came from similar backgrounds, the lower range of socio-economic status. The present study therefore sought to compare the performance of the blind/SVI infants

with an equal number of matched sighted controls in order to reduce the possibility that any differences between infants in the age of onset of speech would be explainable by factors other than vision. The first objective of the present study is, therefore, to examine the extent to which differences in the age of onset of the first and tenth word between blind/SVI infants persist once comparisons are made with sighted controls matched on various factors.

A study of rate changes in the acquisition of early productive vocabulary by McConachie and Moore (1994) suggested that whereas SVI infants took on average 6.1 months to acquire their first 10 words, the blind infants took under half this time. Thus although the blind infants were initially slower than SVI infants to produce their first words, they were faster in learning subsequent words. There is an absence of information about the extent to which rate differences exist between blind and sighted infants when samples of equal numbers are used. Thus the second objective of the present study is to examine the extent to which there are rate differences in early vocabulary acquisition between blind/SVI infants when they are matched with sighted controls.

Section 3.4.2 reviewed studies of qualitative aspects of early lexical functioning and concluded that the early vocabularies of blind infants largely contain the same kinds of words as those of sighted infants (Mulford, 1988; Dunlea, 1989; McConachie and Moore, 1994). Mulford combined data from nine cases from Andersen, Dunlea and Kekelis (1984), Bigelow (1981, 1982) and Landau (1982, 1983) and found these results to be comparable with Nelson's (1973) findings for sighted children. The finding that only negligible differences existed between the content of early vocabularies of blind and sighted children suggests that an absence of visual information does not greatly alter the kinds of things blind infants are likely to talk about. However, because blind infants and their parents are not able to participate in the same kinds of activities as sighted infants and their parents (e.g. learning words for things in the context of picture-book activity or looking

and pointing at objects in the distal environment), we should predict that their vocabularies will contain a low proportion of words which refer to concrete, discrete objects. Previous studies have categorized nouns as either being 'general nominals' or 'specific nominals', but it is important to define the category pragmatically rather than grammatically. Nouns which in interaction sequences with young children, are used to refer to discrete entities should be distinguished from general nominals which do not. It is predicted from this that, when the category of general nominals is divided into those that refer to discrete concrete objects and those that do not, then blind infants would produce fewer labels for the former category than SVI and sighted controls. The third objective of the study is, therefore, to examine the extent to which blind/SVI infants use words for concrete discrete objects in their early vocabularies

In sum, the three objectives of the present study are to: first, examine whether, once comparisons are made between matched blind/SVI and sighted infants, there are any differences in the age at which lexical milestones are achieved; second, to examine whether there are any differences between groups in the rate at which words are produced; and, third, to examine the proportion of words which refer to concrete, discrete objects as a proportion of the total vocabulary and to compare this with more traditional analyses which do not breakdown the category of general nominals.

7.2. Method

7.2.1. The infants

One SVI and five blind infants and their sighted controls participated in this study, further information on the characteristics of the sample were presented in **Chapter Four**.

7.2.2. Data collection

The principal method of data collection was by parental self-report diary, although this was supplemented by verbal report from parents and observations made during visits to each family. An additional source of data was available for infant Lottie, who tended to use lengthy phrases rather than single words. Given Lottie's highly expressive style of language learning, her mother found it difficult to keep track of any new phrases produced. Although a complete diary record is unavailable for Lottie, a researcher who visited her family as part of a separate project was able to provide information about the first 10 words learnt.

Diary

At the beginning of the study, parents were requested to record all new words and to note whether they were produced spontaneously or whether they were an imitation of input speech. The diary also included the date the word was produced and space to note whether there was a new meaning to the word than when it was first used, and the parent's interpretation of the child's utterance. Parents finding it no longer possible to keep track of their child's ever-increasing vocabulary were requested to limit the record to spontaneously produced new words. A copy of the diary sheet is given in appendix three.

Parental verbal report

During each of the visits any new diary sheets completed since the previous visit were collected from the parents. Informal discussion with the parents provided further details about the context in which each new word had been learnt. This information was recorded and used to supplement the diary sheets.

7.2.3. Procedure

Parents received the word-diaries on or shortly after the initial visit had been made and received verbal instruction on how to use the diary sheets at this time.

7.2.4. Categories of words produced

After diary sheets had been collected, the words produced by infants were classified into categories. In line with previous studies, Nelson's (1973) classification scheme was used to code the composition of early vocabularies in blind infants (Mulford, 1988; McConachie and Moore, 1988). Table 7.1. presents the different categories used for categorizing the words. The category 'labels for concrete, discrete objects' permits differentiation between different labels for things within the category of 'general nominals'.

Table 7.1. Categories used to classify composition of early vocabulary

Nominals - words referring to 'things' in the environment were coded as either specific or general nominals.

Specific nominals - words referring to only one exemplar of a category, whether a proper name or not (e.g. *Mummy, Sue*)

General nominals - words referring to all members of a category, whether child or adult defined (e.g. *bear, drink, table*).

Words referring to concrete, discrete objects - words which refer to objects which are manipulatable.

Action words - referring to words that describe, demand or accompany action or express attention or demand for attention (e.g. *sit, look!*).

Modifiers - words referring to properties or qualities of things or events, expressing recurrence, disappearance, attribution, location and possession (e.g. *gone, mine*).

Personal-social words - those expressing affective states and social relations. In line with Mulford (1988), the present study also included utterances accompanying social routines, i.e. utterances which remain unanalysed by infants but which are repeated in appropriate contexts (e.g. *don't do that*).

Function words - those words which serve a purely grammatical function (e.g. *where, what, for*).

7.3. Results

7.3.1. Onset of the first word

The mean age of emergence of the 1st word milestone for each group are reported alongside findings from other studies (Bayley, 1969; Reynell, 1979; Mulford, 1988; McConachie and Moore, 1994). McConachie and Moore (1994) amended Mulford's (1988) figures since Mulford misquoted Bigelow's (1987) onset data. Thus data here are the correct data.

Table 7.2. Mean age in months when first word produced.

Studies of blind/SVI infants	age	s.d	range
Present study:			
<i>Blind (N = 5)</i>	11.0	5.6	4.5 - 17.2
<i>SVI (N = 1)</i>	8.8	-	-
McConachie & Moore (1994):			
<i>Blind (N = 9)</i>	18.2	5.2	-
<i>SVI (N = 9)</i>	15.0	5.1	-
Mulford (1988)			
<i>Blind (N = 14)</i>	14.3	4.5	9.0 - 24.0
Studies of sighted infants	age	s.d	range
Present study (N = 6)	12.7	2.9	7.3 - 14.6
Bayley scales (1969) (N = 1262)	14.2	-	10 - 23
Reynell (1979) (N = 43)	10 - 11	-	-

The data presented in table 7.2 separates the data from the SVI infant Joseph from the other blind infants. It shows that the blind, SVI and sighted infants acquired their first words at a mean age of 11 months, although there was greater range in the age at which the blind

infants produced their first word. There was no significant difference between the blind and sighted groups in the age at which the infants acquired their 1st word (Mann-Whitney $U=16$, n.s). In this analysis, for convenience, the SVI infant Joseph was included with the blind infants. Some of the blind infants attained their first word before the lower end of the Bayley Scale range for sighted infants.

7.3.2. Onset of the tenth word

Table 7.3. reports the mean age of emergence of the 10th word for each group alongside findings from other studies. There was a one and a half month difference between the blind and sighted groups in the age at which they produced their tenth word, however, this difference was not significant (Mann-Whitney $U=10$, n.s). Again, there was a wider range in the age at which the blind infants produced this milestone. The SVI infant performed in line with findings for the sighted group. The blind / SVI infants in the present study on average produced their tenth word ahead of the mean ages reported for the blind and SVI infants in McConachie and Moore's study.

Table 7.3. Mean age in months when tenth word produced

Studies of blind / SVI infants	age	s.d	range
Present study:			
<i>Blind (N = 5)</i>	18.7	5.3	10.8 - 25.6
<i>SVI (N = 1)</i>	16.4	-	-
McConachie and Moore (1994):			
<i>Blind (N = 9)</i>	20.8	4.7	-
<i>SVI (N = 9)</i>	20.4	4.0	-
Studies of sighted infants			
Present study (N = 6)	16.3	2.4	11.9-18.9
Nelson (1973) (N = 18)	15.1	1.8	13 - 19

7.3.3. Rate of production of first 10 words by blind and sighted infants

Table 7.4. reports the time elapsing between the first and tenth words in the present study alongside findings from other studies. The performance of the SVI infant Joseph was in line with the performance of the blind infants, both groups taking around seven months to achieve their first 10 words. The sighted infants acquired 10 words more quickly than the blind infants taking four months on average. However, there were no significant differences between the blind / SVI and sighted groups in the rate of acquisition of the first 10 words (Mann-Whitney $U=13$, n.s.).

Table 7.4. Mean age difference in months between production of 1st and 10th word

Studies of blind / SVI infants	age difference	s.d	range
Present study:			
<i>Blind (N = 5)</i>	7.70	7.4	2.1-17.2
<i>SVI (N = 1)</i>	7.57	-	-
McConachie and Moore (1994):			
<i>Blind (N = 9)</i>	2.5	-	-
<i>SVI (N = 9)</i>	6.1	-	-
Studies of sighted infants	age difference	s.d	range
Present study (N = 6)	4.19	3.2	1.5 - 10.4
Reynell-Zinkin (1979) (N=43)	7-9	-	-

Table 7.4.2. Individual trends in the age of acquisition of first words.

Infant	Visual Status	Age in months (corrected for prematurity)	
		on acquisition of : first word	tenth word
Joseph	(SVI)	8.83	16.40
Robert	Sighted	14.60	18.90
Kristian	Blind	8.40	25.56
Justin	Sighted	13.33	17.33
Roxanne	Blind	4.50	18.96
Jennie	Sighted	10.40	11.90
Lottie	Blind	8.40	10.8
Sadie	Sighted	13.83	15.83
Kirstie	Blind	16.5	18.60
Laura	Sighted	7.33	17.70
Morris	Blind	17.20	19.70
Joshua	Sighted	14.40	16.33

7.3.4. Individual trends in the acquisition of early lexical milestones

It was striking that the two blind infants, Kristian and Roxanne, who performed behind the other blind infants on the Reynell-Zinkin Developmental Assessments reported in **Chapter Five**, produced their first words in line with top end of the performance of sighted infants on the Bayley Scales. However, this advantage was not maintained in terms of the rate of word acquisition, since these two infants turned out to be the slowest of all infants participating in the study to acquire 10 words.

With the exception of Morris and his sighted control Joshua, there seemed to be little relation between blind / SVI infants and their sighted controls in the age at which they achieved their early lexical milestones and the rate at which they did so. Possible reasons for this are discussed in **Section 7.4**.

7.3.5. Analyses of vocabulary content

The original plan to analyse the first 50 words for each infant's vocabulary was not possible due to lost diary sheets, increasing constraints on parents' time or infants not having acquired 50 words by the end of the study, diaries were incomplete in 7 cases out of a total of 12. The mean number of words recorded for the 12 infants was 42.9 words (s.d = 11.7). The lowest common denominator for analysis was 35 words. Therefore analyses are based on the proportion of the first 35 words which fell into each of the categories listed in Table 7.1.

Traditional analysis: The category of general nominals contained the largest number of words for the sighted group and the SVI infant, Joseph. However, the standard deviation indicates large variation amongst the sighted infants in the number of general nominal words produced. For the blind group, the largest number of words occurred in the personal-social words category. For all groups, the smallest number of words were produced in the

functional category. Table 7.5 presents the mean number of words in each of the different categories.

Table 7.5 Mean number of words produced in each of the categories by blind, SVI and sighted infants

Category	Blind (n=4)		SVI (n=1)	Sighted (n=6)	
	Mean	s.d.		Mean	s.d.
General	9.5	3.7	20	16.3	6.3
Specific	6.0	1.4	7	5.83	1.5
Action	2.75	1.7	0	1.83	1.2
Modifiers	4.00	3.8	3	2.83	2.1
Personal-social	12.50	5.9	5	6.60	4.8
Functional	0.25	0.5	0	1.50	1.8

There was no significant difference between the groups in the proportion of general nominals (Mann-Whitney $U=8$, n.s.), specific nominals (Mann-Whitney $U=12.5$, n.s.), action words (Mann-Whitney $U=13.5$, n.s.), modifiers (Mann-Whitney $U=13.5$, n.s.), personal social words (Mann-Whitney $U=8.5$, n.s.) and functional words (Mann-Whitney $U=9$, n.s.).

The proportion of labels for concrete, discrete objects in early productive vocabulary: to capture the changing nature of vocabulary content, the proportion of labels for concrete, discrete objects in vocabulary sizes of 10, 20, 30 and 35 words were documented. The proportion of these words in the total number of words produced by each infant was also recorded. The findings from the SVI infant, Joseph are considered separately from the five blind infants. Data are available for five blind infants at a vocabulary size of 10 words. Thereafter data are available for four blind infants at a vocabulary size of 20, 30 and 35 words. Data are available for all 6 sighted infants at each of these vocabulary sizes and the mean number of words for concrete discrete objects the blind, SVI and sighted infants

produced in their first 35 words is reported in table 7.6. The words for concrete, discrete objects produced by infants in their first 35 words are reported in table 7.7.

Table 7.6. Mean number of words for concrete discrete objects blind, SVI and sighted infants produced in their first 35 words

Visual group	Mean	s.d.
Blind (n=4)	5.5	1.7
SVI (n=1)	15	-
Sighted (n=6)	11.2	5.7

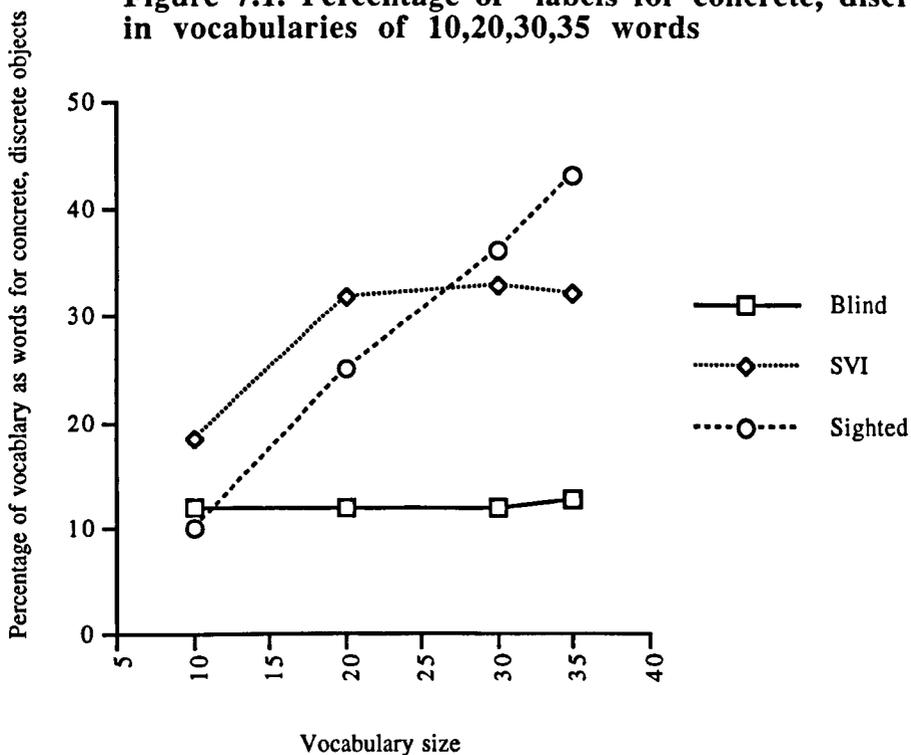
The SVI infant Joseph was included in the blind group for a two-factor ANOVA (blind vs sighted infants x vocabulary size 10, 20, 30 and 35) which demonstrated a significant difference between the blind and sighted groups in the proportion of words for discrete objects in their early vocabularies ($F(1,36) = 0.45, P=0.002$). The ANOVA indicated that there was no interaction between group and vocabulary size ($F(3, 36) = 0.45, p=0.72$).

Table 7.7. Labels produced for concrete, discrete objects in first 35 words.

Infant	Visual status	Labels for concrete, discrete objects
Joseph	(SVI)	teddy, sock, car-key, hat, clock, 'nana, coat, biscuit, brick, bib, duck, crisps, chair, bird, shoes.
Robert	Sighted	shoes, plane, ball, car, duck, fish, dog.
Kristian	Blind	dog, dummy, car, brick, organ, cat.
Justin	Sighted	cup, plane, shoe, car, lorry, bus, train, cat, nappy, ball, bike, crayons, soap, video, book, horse.
Roxanne	Blind	car, biscuit, rusk
Jennie	Sighted	car, shoes, keys, boc-boc (bottle), chicken.
Lottie	Blind	not available
Sadie	Sighted	car, doggie, car-keys, brick, sweet, biscuit, di-di (dummy), ball, bear, crisp, spoon, apple, shoes, socks, cheese, bus, pegs, pants, dish, tie.
Kirstie	Blind	shoe, sock, nappy, ear-rings, bed, bus.
Laura	Sighted	bread, car, bra, ball, door, train, duck, dog, chair.
Morris	Blind	telephone, trampoline, biscuit, weetabix, button.
Joshua	Sighted	banana, ball, chocolate, dummy, crisps, fish, bed, apple, plane, cheese.

Figure 7.1 presents the trends in the percentage of labels for discrete objects at 10, 20, 30 and 35 words for each group. The graph demonstrates that the percentage of these words increased with increasing vocabulary size for sighted infants and the SVI infant. In contrast, the percentage of words for discrete objects in the blind infants vocabularies remained constant at 12%. Thus at each vocabulary size (except at 10 words), blind infants produced around a third to a half as many words for discrete objects as sighted infants.

Figure 7.1. Percentage of labels for concrete, discrete objects in vocabularies of 10,20,30,35 words



7.4. Discussion

The first objective of the present study was to investigate whether, once the sample of blind / SVI infants were matched on socio-biological factors, any differences emerged in the age at which early lexical milestones were achieved. The results suggest that the blind, SVI infants produced their first and tenth words at similar ages to the sighted infants and further, for the second objective of the study, that there was no difference between the groups in the rate at which these words were acquired. All infants produced their first words by the upper limit for sighted infants, although the range in age when these milestones were achieved was wider for the blind infants than it was for the sighted infants.

The results from the present study support the findings in Mulford (1988) but are not in line with those from McConachie and Moore's study (1994). It is likely that the previous discrepancies in the literature are due to variation which requires explanation rather than 'getting rid of'. Candidate principles for explaining why some sighted infants are "early talkers" and others are "late talkers" are offered by Bates *et al.* (1995), who propose that we need to explore processing dimensions of language development by taking into account such factors as the role of auditory short-term memory, perceptual acuity, unit size and the speed-accuracy trade-off in language functioning. It is likely that such factors, which are thought to influence the age at which sighted infants begin to talk and the rate at which they learn words, will also apply to blind infants. Furthermore, the finding that there was a greater range in the age at which the blind infants produced their first words may suggest that vision influences such processing dimensions in the first year.

The third objective of the study was to examine the extent to which blind/SVI infants produced fewer words for concrete, discrete objects than their sighted controls. The findings demonstrated that the blind infants produced significantly fewer words referring to concrete, discrete objects than their sighted controls and, further, that the proportion of

these words did not increase with increasing vocabulary size. It is likely that this may reflect the way interactions between blind infants and their parents are rarely focused on concrete, discrete objects. More information is needed on the way blind infants experience concrete, discrete objects. This issue will be explored further in **Chapter Eight**.

An implication of the finding that fewer words for concrete, discrete objects are produced is that overextensions will also feature less regularly in the speech of these infants. The most frequently cited examples of overextension in sighted infants' speech are based on labels for concrete, discrete objects which are typically learnt in 'point and label' activities such as picture book reading. It is possible that blind infants might have been judged to demonstrate fewer instances of overextension because they cannot engage in these kinds of visually based activities which are often associated with word learning in sighted infants. This issue is discussed further in the next study.

Chapter Eight

A Longitudinal Study of the Nature of Interaction and Productive Speech in Blind/SVI Infants

8.1. Introduction

Evidence was discussed in Section 3.3 that interactions between blind infants and their parents are characterized by use of rhymes and routines (Urwin, 1978; Dunlea, 1989; Perez-Pereira and Castro, 1990; Perez-Pereira and Castro, 1992) and a virtual absence of objects up until the end of the first year (Preisler, 1991). A delay in sensorimotor functioning during the first year is also reported (Fraiberg, 1977). These findings were contrasted with patterns of development observed in sighted infants, suggesting that, at around 6 months, sighted infants make the transition from participating in interactions without objects to being able to focus on referents outside the interaction. Taken together, the findings suggest that, during their first year, blind infants receive limited access to objects but experience rather more involvement in social routines and rhymes. Less is known, however, about the extent to which blind infants experience objects, routines and rhymes are during their second year. The first objective of the study is, therefore, to examine the extent to which objects, actions and events are incorporated into interaction during this period.

Knowledge about the extent to which blind infants handle objects and get involved in routines and rhymes will shed light on the varied nature of the experience blind infants are exposed to, and which parts of this experience may shape what they talk about and the way they use words. If, for instance, blind infants rarely engaged in object play, it would be somewhat surprising if they started to talk about those objects in their absence. However, if objects are found to be involved in interactions but rarely talked

about, this might suggest that the infants and/or their parents may have difficulties referring to concrete, discrete entities. If we found that blind infants played with objects but largely referred to actions and events rather than objects, this would suggest that blind infants are able to refer, but that at this stage of lexical functioning, they restrict their ability to refer to actions and events rather than objects.

The study reported in **Chapter Seven** provided evidence that blind infants rarely use labels for concrete, discrete objects, at least until the 50 word milestone. Data is needed on the extent to which such patterns are stable across the second year in a naturalistic setting. The second of the study is, therefore, to understand the extent to which blind infants gain experience with objects, routines and rhymes and what they talk about during their second year.

The study reported in **Chapter Six** classified at least two blind infants as able to sort objects. However, it was pointed out in **Chapter Three**, that the study of the ability to sort objects is only one way of studying emerging abilities in categorization. Particularly in the case of blind infants, it is important to take into account the extent to which they categorize actions. The difficulties in designing a suitable task to examine the way infants categorize actions / events was discussed in **Section 2.3** (Tomasello and Merriman, 1995). These researchers pointed out that, unlike the object manipulation task where objects are physically sorted, unless actions are represented on cards they cannot be sorted in the same way. It was also pointed out that any two dimensional image of actions would not do justice to the dynamic qualities of action. An alternative way of assessing whether infants categorize actions is to explore whether, for each of a number of different nursery rhymes, infants are able to initiate specific cluster of actions. If, infants are able to initiate an appropriate cluster of actions for more than one rhyme, this would suggest that they understand that actions relate to the particular rhyme and that the actions go with each other whilst indicating that they can select those (appropriate) actions from the

pool of nursery rhymes they are familiar with. The emergence of these abilities would indicate actions are being categorized. It is important to consider infants' abilities to categorize actions since this will shed light on the extent to which an absence of visual information limits the ability to categorize *per se*, or alternatively, whether it limits the ability to categorize objects rather than actions. The third objective of the present study is, therefore, to examine the extent to which blind / SVI infants are able to initiate appropriate self-action in nursery rhymes familiar to them.

Knowledge about the extent to which objects, routines and rhymes are involved and talked about during interaction will aid understanding of the way blind/SVI infants *use* their speech. In particular, it will shed light on the contexts within which blind/SVI infants generalise and extend their words. **Section 3.4.3** noted that Dunlea (1989) concluded that many of blind infants' first words function as protowords and that they fail to generalize words beyond the context in which they were originally used. Two reasons were identified why this conclusion was questionable. The first concerned the way Dunlea (1989) compared her findings with unrealistic estimates of the extent to which sighted infants generalise their words, and the second concerned the idea that the focus of the interaction between blind infants and their parents may not readily lend itself to the identification of word generalisations. It was suggested that the highly structured nature of interactions might mask the way words are used in different ways over time. If it is found that interaction between blind infants and their parents do not involve objects, then we must look for subtle ways in which blind infants may generalise words within routines. The fourth objective of the present study is, therefore, to examine whether blind infants generalise their words, and, in particular to examine whether they are generalising words within routines and rhymes.

Another way in which the findings from the first two objectives of the study reported in this chapter may aid understanding of the way blind/SVI infants *use* their speech

concerns the conditions under which blind infants extend their speech to new referents. In **Section 3.4.4** Dunlea's (1989) conclusion that the blind infants in her study rarely extended/overextended their first words was questioned for a number of reasons. Dunlea (1989) compared Anglin's (1977) estimate that sighted infants overextend around 33% of their first words with her own observation that blind infants overextended between 8-13% of their first 10 words. However, as noted by Barrett (1995), most studies of sighted infants report that they extend between 7 and 33% of words in their total vocabularies (e.g. Anglin, 1977; Greundel, 1977; Barrett, 1978; Rescorla, 1980; Nelson, 1982). Given that Dunlea's findings fall at the lower end of this range, it was proposed that her conclusion about the extent to which blind infants extend their first words have been pitched against unrealistic comparisons of the extent to which sighted infants do so. A number of reasons why Dunlea's observations fall at the *lower* end of the range are considered below.

It was argued that the principal explanation why Dunlea observed blind infants to extend their words to other referents as frequently as sighted infants may be due to an underestimation of the phenomenon in blind infants. A number of reasons were proposed: first, as is often the case with sighted infants, it is important to note that scope for extensions often depend upon the emergence of a particularly suitable referent. Bigelow's (1982) point that blind infants have less immediate access to the environment means that it is not surprising that they are not often observed to extend the words they use to other referents. Second, the absence of visually based communicative strategies for joint attention also make it likely that the frequency of overextensions will be underestimated in blind infants. When a sighted or a blind child has an object in their hands it is easy to detect whether or not they are using a word appropriately (i.e. overextending) or not. However, for an object which is in close physical proximity, but not in contact with the child (but that a blind child knows is present), it is more difficult to establish whether a blind child is overextending. Sighted children are likely to isolate the target referent by

engaging in pointing and shared gaze. So that the caretaker is likely to identify which referent (action or object) the child is referring to and is in a position to detect if the child is using the appropriate word. In contrast, blind infants do not use gestures like pointing and it seems likely that the cues that they do use (e.g. orientation of body) are not powerful enough for them to isolate an object/action from competing ones. In sum, these factors may have lead researchers to underestimate the extent to which blind children extend/overextend their words.

A further possibility is that blind infants have fewer words in their vocabularies which readily lend themselves to overextension. The most frequently cited examples of overextension in sighted children's speech are based on words which refer to concrete, discrete entities which are typically learnt in 'point and label' activities such as picture book reading. Such words readily lend themselves to overextension because they are typical of the interactions between sighted children and their caretakers. It seems likely that blind infants have been judged to demonstrate fewer instances of overextension because they cannot engage in these kinds of visually based word learning activities.

Section 2.3 described how the study of lexical development has focused on the acquisition of labels for objects rather than any other category and how it is important to consider the extent to which words from other categories are extended too. Evidence that blind infants do extend words for actions / events would support the view that blind infants conceptual functioning is couched in temporality rather than focused towards objects. The fifth objective of the present study is, therefore, to examine the extent to which blind infants extend words for actions rather than words from any other category.

In contrast to other studies reported in this thesis, this chapter does not include findings from sighted infants alongside those of blind infants since the explanation of differences in lexical and conceptual functioning between infants within the blind group is more theoretically relevant than comparisons across groups. The findings reported in **Chapters**

Five and **Six** suggest that there is wide variation between blind infants in the age at which they are able to label concrete, discrete objects and the ways in which they manipulated objects. Discerning the source of this variation will be more enlightening than a comparison with sighted infants.

In sum, the five objectives of the present study are to: first, examine the extent to which blind/SVI infants' interactions with their parents involve objects, rhymes and routines; second, to understand the ways blind/SVI infants talk about their activities; third, to consider the extent to which blind/SVI infants are able to initiate appropriate self-action in familiar nursery rhymes; fourth, to look at spontaneous productive speech for evidence of generalisations; and fifth, to look at spontaneous productive speech for evidence of extensions.

8.2. Method

8.2.1. The infants

All six blind/SVI infants participated in this study. The aim was to film the infants at home at three monthly intervals for a duration of nine months. Practical constraints meant that, as can be seen from Table 8.1. the intervals at which these observations were made deviated from the three months target. The mean interval between observations was 4.3 months (s.d.= 2.9). Overall, Joseph, Kristian, Roxanne and Lottie, Kirstie and Morris were studied over a period of 10, 8, 12, 9, 24 and 2 months respectively. Mean ages are not reported at each time-point, since the data are not examined by summing across infants at each time-point.

Table 8.1. Age in months and days (corrected for prematurity) at each play session

Infant	Visual status	(i)	(ii)	(iii)	(iv)
Joseph	SVI	14;05	18;13	20;24	24;02
Kristian	Blind	24;18	27;26	30;22	32;04
Roxanne	Blind	15;14	19;26	no data	27;01
Lottie	Blind	16;19	20;22	22;01	25;05
Kirstie	Blind	12;28	17;03	23;28	36;02
Morris	Blind	17;21	19;25	no data	no data

8.2.2. Procedure

No materials were provided, instead, parents were encouraged to play as they would normally. Given that playing 'normally' in front of a video camera is a notoriously difficult thing to do - the first couple of minutes of each session were used as a 'warm-up' period and therefore not used. Play sessions were video-recorded for a minimum of 20 minutes and up to 30 minutes.

8.2.3. Coding methods

Twenty minutes of each play session were analysed in the following ways:

The use of objects, routines and rhymes in play activity: five categories were distinguished; these are described in table 8.2. Joint activity refers to periods when the dyad was engaged in the same activity, either with or without objects. The category 'joint activity' is distinguished from 'joint attention' where two individuals are both focused on the same external referent. Joint activity does not necessarily require the presence of an object and refers to periods when infants and their parents are focusing on a particular exchange, toy or merely just sat talking with each other.

Extent to which infants initiated actions for familiar rhymes

For each dyad using rhymes and routines, the nature of the involvement of the infant and the parent in the rhymes was observed. The range of rhymes used by different dyads was observed alongside the extent to which infants used different actions for different rhymes without instruction from their partner. In particular, the changing nature of use of action by the infant was documented across the second year.

Word generalisation and extension: These data are presented in qualitative form based on examples from observation sessions, parental interview and the parental diary study reported in **Chapter Seven**.

8.3. Results

8.3.1. To what extent were objects, routines and rhymes incorporated into interactions?

The study of the nature of play is approached by observing how patterns were established within individual dyads as well as by noting commonalities between dyads.

Did infants play alone or engage in joint activity?

Data on the extent to which infants and their parents engaged in joint activity during the play sessions permits insight into kinds of contexts in which blind/SVI infants experience objects/rhymes/routines. Overall, each dyad spent between 14 and 19 minutes of each 20 minute session engaged in joint activity. In contrast, the SVI infant, Joseph spent only a mean of three minutes in joint activity with his mother across all observation sessions. Five of the six infants maintained their tendency to either play alone or with their parent over the course of the study. The exception was Lottie, who engaged in increased amounts of joint activity across her second year. Table 8.3. presents the proportion of the

twenty minute session infants spent in joint activity and alone across each of the observation sessions.

Table 8.3. Percentage of the 20 minute session infants spent playing alone

Infant	Visual status	(i)	(ii)	(iii)	(iv)
Joseph	SVI	89.8	65.4	91.9	86.7
Kristian	Blind	1.7	6.4	7.1	3.9
Roxanne	Blind	39.1	0	no data	10
Lottie	Blind	60.6	22.5	19.8	8.8
Kirstie	Blind	9.8	26.8	4.2	12.0
Morris	Blind	20.6	34.6	no data	no data

Given that blind infants spend such a high proportion of the play sessions involved in joint activity rather than playing alone, findings about the way they play with objects and engage in rhymes/routines will largely be based on episodes of shared activity rather than what blind infants do when playing alone.

Joint activity involving objects

The proportion of time objects were incorporated into joint activity varied across dyads. Figure 8.1. shows the variation between dyads in the extent to which they incorporated objects into joint activity. Kristian and Morris and their parents spent between 82% and 100% of their time in joint activity involving objects throughout the course of the study. In contrast, Roxanne and her mother spent under one third of their time in joint activity focused on objects. Two striking patterns emerged for both Joseph and Lottie: the proportion of time spent playing with objects in joint activity nearly doubled between 14

- 18 and 16 - 20 months respectively. Thereafter, for both these infants, the amount of time spent playing with objects increased steadily.

Table 8.4. provides the percentages of time in joint activity that dyads focused on more than one object. During periods of joint activity, the infants spent significantly more time playing with one object rather than with more than one object ($t(16) = 2.714, p = 0.015$).

It was striking that, across all three observation sessions, Roxanne and her mother only spent a total of 7 seconds engaged in joint activity with more than one object. Similarly, Kirstie and her mother only played with more than one object when Kirstie was 36 months (corrected for prematurity). Interestingly, at 24 months, Kristian and his mother spent a quarter of their time playing together with more than one object. However, this time halved by the time Kristian was 27 months and, thereafter, Kristian and his mother failed to engage in joint activity with more than one object. The other infants, Joseph, Lottie and Morris varied in the proportion of time they spent playing with more than one object. However, for at least one observation session, each of these infants spent over half the time in joint activity involving more than one object.

Figure 8.1. Percentage of time in joint activity dyads incorporated objects into play

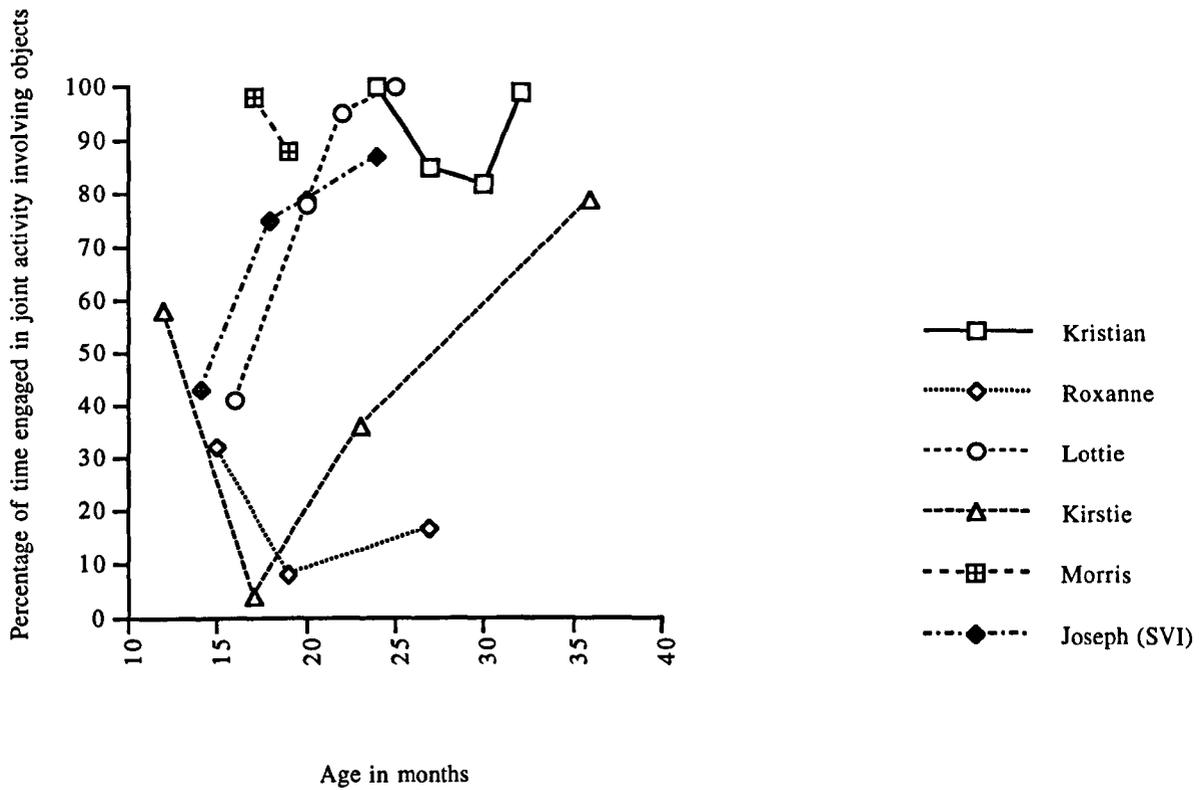


Table 8.4. Percentage of time in joint activity where dyads played with more than one object

Infant	Observation session			
	(i)	(ii)	(iii)	(iv)
Joseph (SVI)	0	34	0	87
Kristian	26	11	0	0
Roxanne	1	0	-	0
Lottie	5	4	55	0
Kirstie	0	0	0	13
Morris	89	70	-	-

Joint activity involving rhymes and routines

Two dyads (Roxanne and Kirstie) spent a large proportion of time in joint activity engaged in rhymes and routines. Table 8.5. shows that, for Roxanne and Kirstie, with the exception of the last observation, the number of different rhymes and routines increased during the 20 minute play session. In addition, for Lottie, Kirstie and Kristian, rhymes and routines accompanied play with objects, this is described later.

Table 8.5. Frequency of different nursery rhymes across observation sessions

Infant	Observation session			
	(i)	(ii)	(iii)	(iv)
Joseph (SVI)	0	1	0	0
Kristian	1	5	2	2
Roxanne	7	17	no data	14
Lottie	3	7	1	1
Kirstie	5	6	10	9
Morris	0	0	no data	no data

During rhymes, Kirstie would stand opposite her mother and sway vigorously from side to side or jump up and down. As Kirstie became more mobile round her home, she and her mother would start to sing individual lines of songs to each other while not in physical contact with each other. It was as if the lines functioned as the equivalent of quick eye-gazes at each other across the room.

In addition to singing traditional nursery rhymes together, Kirstie and her mother developed several routines involving either exchanges or particular phrases. One example of this was when Kirstie's mother would say to Kirstie, 'Are you clever?', to which Kirstie

replies 'I'm very clever'. This exchange was often repeated several times. Another routine the dyad engaged in involved Kirstie's mother asking Kirstie where her eyes, ears and other various body parts were as well as getting her to pretend to sneeze, laugh and cry. Interestingly, as Kirstie got older, her mother elaborated these routines by adding a qualifier to describe body parts (e.g. where's your big mouth?).

Kirstie and her mother did not simply restrict routines to actions. It is convenient to describe here some examples of how objects became drawn into routines. After eating, Kirstie's mother would take Kirstie's cloth bib off and let her hold onto it for some time. Kirstie's mother started to label Kirstie's bib 'washing' and get Kirstie to shake it around and then flap it in the air to dry it. Thus Kirstie carried out various actions to do with 'doing the washing'.

When Kirstie was 17 months, the dyad engaged in another routine which involved Kirstie standing in the middle of a room with a plastic toy in her hand and dropping it onto the floor and then retrieving it. The opening 'Aaaah!' marked the start of the routine and coincided with Kirstie dropping the object. Kirstie and her mother usually repeated this routine several times:

K and M: Aaah!

M: Pick it up

Kirstie bends down to feel for toy and to retrieve it

Kirstie and her mother clap

M: Are you clever?

K: I'm very clever.

During the course of the study, Kirstie used increasingly sophisticated ways to initiate rhymes and routines. At 17 months, she used to say 'again' and grab her mother's hand and start jumping to request a routine. At 20 months, she would sing one line of a rhyme

to request a particular rhyme and at 36 months she requested rhymes by saying 'else shall we sing?' Thus through engaging in routines and rhymes, Kirstie was acquiring various ways to request more of a particular activity. Interestingly, Kirstie also rejected routines and rhymes by putting her hands over her ears.

Unlike Kirstie, Roxanne was less mobile and therefore engaged in rhymes and routines on her mother's lap by sitting face to face with her. However, at the end of the study Roxanne was more mobile and was able to assume a similar position to Kirstie by standing opposite her mother and swaying. In contrast to Kirstie, Roxanne's rhymes and routines did not involve objects, though once her mother used the drawstrings on a sweater she was wearing as a snake to touch Roxanne as she said 's-ss-s'. Initially, Roxanne followed the same pattern as Kirstie by making requests for more rhymes / routines by physically directing the actions of her mother. At 15 months, Roxanne initiated clapping her mother's hands together and at 19 months she would then request rhymes by reproducing a part of the rhyme. Like Kirstie, Roxanne also rejected rhymes she did not enjoy by blocking off her ears with her hands. Roxanne's mother focused on Roxanne's mouth for cues as to whether she was engaging in rhymes which Roxanne enjoyed and also to how to time her next actions. The routines performed by this dyad involved elaborate actions on the part of Roxanne's mother, for example:

M: I'm coming (pats arm of sofa loudly)

M: I'm coming (pats arm of sofa loudly)

M: I'm coming to get you (runs fingers up Roxanne's arms and tickles her).

In another routine, Roxanne's mother would pull Roxanne close, shiver, and say, 'br-r-r-r-r-r....it's free...zing!' They would also engage in lots of 'football supporter' style clapping exchanges where Roxanne would repeat a clapping sequences involving complicated rhythms of 4-5 seconds duration. With increasing age, Roxanne played a greater role in

initiating this activity and in participating in the activity, since she took turns with her mother.

Kristian's mother frequently sang rhymes to him when they played with a particular object, this single object permitted Kristian and his mother to focus on the same thing. However, unlike the infants Kirstie and Roxanne, Kristian played a less active role in participation in these rhymes. In particular, Kristian did not initiate rhymes during the observations, instead, his mother would direct the activity by saying something like: 'give me your hand then' and reach out to take it to start an episode of 'round and round the garden'. Kristian was able to anticipate the onset of particular actions within rhymes (e.g. tickling) since he laughed before the action. Kristian's mother frequently used routines to attract his attention, for example :

Kristian is sat on the floor faced away from his mother without holding any toys.

M: There are no toys over there

M: What are you doing over there?

M: Where's Kristian gone?

Kristian's mother uses cloth to play peek-a-boo with him.

M: Kristian's gone

M: Kristian's hiding

M: Where is he?

M: K...

M: ...Kristian...there he is!

When Kristian's mother wanted to draw attention to a particular toy, she presented it to Kristian by tapping part of the object and singing a rhyme appropriate for some component of it (e.g. singing 'chick, chick, chick, chicken' to refer to a pop-up chicken). Thus Kristian's mother labelled objects using rhymes as well as providing information about the thing (e.g. making animal sounds).

Like the other infants, the infant Lottie also experienced a range of routines and rhymes, however, unlike the others, she initiated these herself before the start of the study. Similarly to Kirstie and Roxanne, Lottie produced the last word of individual lines of rhymes as well as taking turns to exchange individual lines with her mother. Lottie and her sister (K) would make up short routines and also engage in producing lines in turn with each other:

K: Once upon a time

L: Lottie went to a cafe

K; Bought a cake

L: And ate it.

For Lottie, it appeared that rhymes merely served to accompany joint activity involving objects since Lottie was able to establish her mother's attention by calling out 'Mum!' and waiting for a response. The routines frequently involved the repetition of actions focused around large objects (e.g. laundry basket, wicker chair), Lottie would request her mother to 'do it again' (e.g. lift Lottie in the basket, put the basket on her head). As described earlier, for this dyad, objects became increasingly involved in interaction across the second year. It appeared that, objects were introduced through the use of routines which became more sophisticated with time.

Infant play alone involving objects

With the exception of the SVI infant Joseph, each infants spent as little as an average of between one to six minutes playing alone. Thus the findings in this section are restricted to being based on limited observations.

It was striking that Kristian and Kirstie did not touch any objects when alone until the second observation session. Similarly, when playing alone, Roxanne did not play with any objects during two of the three observation sessions.

In contrast, Joseph and Morris spent a consistently large proportion of time playing alone with objects. On average, these two spent 79% and 81% of time spent playing alone respectively with objects over the course of the observation sessions. The other two infants, Lottie and Kristian, varied in the extent to which they manipulated objects when playing alone. Over the course of the study, this ranged between 43-71% and 0-99% respectively.

An examination of the extent to which infants playing alone manipulated more than one object demonstrated that, with the exception of Joseph, infants did not often play with two or more objects. The most striking finding was that when Kristian, Roxanne and Kirstie played alone they did not manipulate more than one object on any of the observation sessions. Overall, Lottie spent 6% or less of her time spent playing alone with more than one object on three observations sessions. Unlike, the other infants, Joseph spent around a quarter of time playing alone manipulating more than one object.

Infant play alone not involving objects

With the exception of Joseph, the infants spent most play sessions in activity with their parents. However, during the time they played alone without objects, the infants varied in what they did. Joseph, Morris and Lottie often walked round until they came across an object or some furniture to play with. In contrast, at the outset of the study, Roxanne spent long periods in her walker on one spot and Kirstie would spend time playing alone bouncing round on the settee. However, by the end of the observation sessions, she initiated rhymes and sang them as she walked from one side of the room to the other.

Infant or parent refers to object in distal environment

There were few references to objects in the distal environment - most of these were parents labelling distant noises in the environment. For example, at 17 months, Kirstie's mother referred to a baby crying outside. At 32 months, Kristian's mother comments on their pet dog whining in the kitchen. In contrast, Joseph, the SVI infant, was able to gesture towards distal objects. At 18 months, he directed his hand towards the curtains to indicate that he wished to start a routine of playing 'peek-a-boo'. Interestingly, in contrast to the literature on sighted infants, Joseph directed his arm towards objects he wished to refer to without pointing his index finger.

Lottie was the only infant to use language to request information about what was going on around her - three examples of this are considered below. In the first example, Lottie is playing in a room where her mother and Aunt are sitting. Her aunt has not spoken for a while, The inferences Lottie makes about her aunt's silence derive from what she says to her mother:

(i) L: She's gone home

M: She ain't

L: She has

L: On settee

M: No, she's over there on the chair,

M: Look, by the radio.

(ii) Lottie talking to her mother at 25 months:

L: Who's in the room?

(iii) Lottie requesting a drink from her mother at 25 months:

L:Go get her bottle

L:What's Mum putting in?

L:What you put in?

L:Milk?

L:Squash?

Overall trends in use of objects, routines and rhymes during play sessions

This section combines the findings from periods when infants played alone and when they engaged in joint activity in order to establish overall trends in the nature of play during the second year. The findings suggest some clear differences between the dyads in the nature of their play. Joseph, Kristian, Lottie and Morris spent on average over 75% of their play sessions engaged in object focused activities whereas Roxanne and Kirstie and their mothers incorporated objects considerably less frequently. For Joseph and Lottie, there was a clear trend of increasing object play with age.

This figure gives the impression that infants spend a large proportion of their time gaining experience with objects. However, described below in **Section 8.3.2**, there is large variation in the quality of object play engaged in by these infants and their parents. Furthermore, Kirstie, Kristian and Roxanne rarely played with more than one object either alone or with their parents. The infants were significantly more likely to play with objects during joint activity than alone ($t(19) = 2.814, p = 0.011$).

8.3.2. What do blind/SVI infants talk about?

In light of the finding that Morris, Lottie, Kristian and Joseph frequently handled objects, whereas in contrast, Roxanne and Kirstie rarely engaged in object play, one concern was to examine whether there was any difference in the way these infants used their speech. For each infant, a description of their changing lexical abilities across the observation sessions is presented below. In order that these abilities can be viewed alongside any changes in the extent to which objects, rhymes and routines were incorporated into interaction, a brief description of this activity is provided too.

(i) Joseph (SVI)

Throughout the course of the study, Joseph's play was largely object focused and characterised by very few periods of joint activity with his mother. Joseph often played with small, metal toy cars as well as driving round in a sit-in plastic model. He often put objects inside others (e.g. bricks into containers) and explored household items like rugs and video cassettes as well as participated in routines (e.g. hiding in the curtains) with his mother.

The number of utterances Joseph produced during each session increased with time. At 14 months he only produced one intelligible utterance then at 18 months he produced five different utterances. At 20 and 24 months Joseph produced 15 and 17 different utterances respectively within the 20 minute observation session.

Joseph spoke about the objects he played with using single word labels (e.g. book, teddy, car, ball, cardi, pop, bricks). In line with the findings reported in **Chapter Seven**, Joseph readily produced words to refer to concrete, discrete objects when talking about objects. At 20 months, Joseph was referring to changes in the state of objects and people (e.g. allgone, Nanny gone). Furthermore, he was using two word constructions like 'mummy's

door'. He produced labels for action at 20 months, talking about the disappearance of people (e.g. baby gone) or food / drink (e.g. finished pop).

(ii) Kristian

Kristian spent the majority of play sessions with his mother in joint activity focused on one object. However, over time, the focus shifted from spending periods of joint activity on several objects to playing with one object embedded in rhymes and routines. This shift may represent changing strategies employed by Kristian's mother in order to establish joint attention with Kristian. At the start of the study, when several objects were involved, Kristian's mother worked to establish and maintain his attention with these objects but Kristian would often appear disinterested and whine. In contrast, on presentation of a single electronic toy, it was easier for his mother to maintain a continuous focus of attention. Kristian's mother initiated the choice of object which Kristian would play with and she would also remove one electronic toy and quickly replace it with a new one.

During the course of the study, Kristian's visual acuity improved and his mother started to introduce a book with very large pictures by holding it close to his face. Kristian's mother labelled items in this book as well as animals in a pop-up game. On both these occasions, she consistently labelled the object and subsequently embedded the label within a song or produce the noise made by the animal. For instance, in one animal pop-up game, she labels a rabbit followed by the song 'Run rabbit run, run, run!' During rhymes, Kristian's mother would physically punctuate pauses between utterances by tickling Kristian or touching him in some other way.

Kristian rarely produced words during play sessions, and when he did single words were produced. At 24 months, Kristian produced the words 'gone' and 'good'. Then at 27 months he produced 'brick', 'cup', the 'K' sound for the first letter of his name, 'good' and 'go'. At 30 months, he produced no words. At 32 months, he produced 'good' and 'go'.

On examination of his first words diary and the spontaneous utterances produced in the play sessions, it is clear that the words Kristian produced often began with 'g'. It is speculated from this that he was acquiring words which required the least visually based information for imitation of input speech to occur. There is some support for this in the initial stages of lexical development in blind infants (Mills, 1983; Mulford, 1988).

(iii) Roxanne

At 15 months, Roxanne, spent around a third of the play session shaking one sound-producing object in her walker. On subsequent observations, the amount of time Roxanne spent playing with objects either alone or with her mother was very low. It was striking that over course of the study, Roxanne spent only 1% of her time in joint activity with more than one object present, suggesting that Roxanne had little experience of playing with more than one object at any one time.

Instead of involving objects in play, the dyad relied on routines where Roxanne would typically sit opposite her mother. At the last observation, Roxanne was able to stand opposite her mother and sway from side to side in time to the rhymes - thus she was starting to play a more active role in joint activity. Roxanne's mother relied heavily on making distinctions using the tone of her voice (e.g. whispering) and she would also sing rhymes and leave the end of lines blank for Roxanne to complete. This dyad rehearsed a substantial number of routines, typically, Roxanne's mother initiated the routines and encouraged Roxanne to join in, e.g. by clapping her hands together. Like Kristian's mother, Roxanne's mother engaged in much physical contact during these games, and notably punctuated the ends of utterances with an exaggerated tone of voice and touch.

Roxanne did not produce any words in play sessions until the final observation at 27 months when she produced 10 different utterances (rhymes were excluded in this count). Most of these were single words and did not refer to objects. The only exception was

when she said 'want crisps'. Roxanne used words for actions, for example she used 'spinning' to describe the side to side movement she made while standing opposite her mother. In addition, she used 'stop' and 'move' to request her mother to do things. Also, she was able to request rhymes by producing a word from the routine e.g. 'sticky' to request a rhyme they knew with the word sticky in it. In sum, Roxanne, and her mother did not play with objects and certainly did not talk about them. Instead, they interacted together by focusing on action routines and songs.

(iv) Lottie

Between 16 and 25 months, the amount of time Lottie spent in joint activities with her mother increased at each observation session from 39% to 91%. Coupled with this, there was a dramatic shift from non-object focused to object focused interactions. Overall, Lottie received and initiated much play with objects.

Rhymes and routines were most frequently used in joint activity at 20 months. Lottie and her mother spent much time engaged in routines like 'Row the boat' and 'Twinkle twinkle little star'. These routines were not usually sung in unison. Rather, in some routines the mother sang a line, omitting the last word in each line for Lottie to complete. In others, Lottie and her mother would alternate between singing lines each.

Objects incorporated into play sessions were usually household items rather than toys e.g. laundry basket, boxes, nuts, fruit, ornaments. In general, large, discrete objects were played with rather than lots of small manipulatory ones. The objects tended to be used in a way which involved body parts (e.g. wearing laundry basket on head, putting on watch, taking shoes on and off, sitting on inflatable dumbbell and using it as a horse, sitting on swing).

It was striking that Lottie largely produced phrases rather than single words - clearly, object labelling was not a strategy used by this dyad. Interestingly, when Lottie's mother

requested labels for objects, Lottie would label objects rather than use a phrase, suggesting that Lottie understood what was required by a request for a label.

Lottie used increasingly longer phrases between 16 and 25 months. At 16 months, the longest unimitated phrase produced was six words long ("Don't put it in your mouth"). Mostly, however, the phrases were around 3-4 words long ("Sit in the chair", "wanna go back in"). By the end of the study, Lottie was able to produce longer utterances (e.g. "Let's show Sarah what I can jump out for").

Lottie was observed to use phrases more appropriately across the course of the study. For instance, at 16 months she used the phrase "'Take your shoes off'" to request her mother to take Lottie's shoes off as well as to put them on. In contrast, at 26 months in referring to events, she was able to capture the differences between changes in states, e.g. "She got a snotty nose" then after having had her nose wiped, she said, "She ain't got a snotty nose now," and "Mum wiped it off the snot." However, Lottie continued to use pronouns inappropriately until the end of the study. For example, at 20 months, she would tend to use 'you' and 'I' interchangeably. In contrast, she seemed able to analyse other utterances by using slot-fillers e.g. 'Get mummy to take the lid off, get mummy to put it on her, get mummy to sit by you.'

Lottie was by far the most talkative infant. The total number of utterances produced increased across the four observations from 31 at 16 months through to 76 at 25 months. While listening to Lottie, it was striking that she frequently referred to objects, ongoing actions and events without using labels for objects. On this basis, Lottie's utterances (not including rhymes) were classified into utterances containing nouns and no verbs (e.g. "There my keys"). A second category were utterances containing no nouns - not including personal pronouns - (e.g. "Let Sarah listen") and finally those utterances containing both nouns and verbs (e.g. "Can have a nut to play with?"). Table 8.6 shows that Lottie

produced substantially more utterances without nouns than either utterances with nouns or utterances containing both nouns and verbs.

Table 8.6. Percentage of Lottie's utterances containing nouns only; verbs only, and both nouns/ verbs

	Age in months			
	16	20	22	25
Nouns	23	30	27	28
Verbs	48	16	51	38
Dual	29	54	22	34
Total no. of utterances	31	43	67	76

Although we might reasonably expect the proportion of utterances containing references to both objects and actions to increase with language ability, it was striking that the majority of utterances were without nouns at $\frac{3}{4}$ of the four observation sessions. The exception was at 20 months, when over half of Lottie's utterances contained both nouns and verbs. Lottie rarely labelled objects with single words. One exception was at 16 months when Lottie said 'elephant' when her mother asked her to label an ornamental elephant. At 20 months, Lottie labelled twice during the session. She referred to the braille machine as 'the buttons' and the laundry basket as 'basket'.

Finally, the following example illustrates Lottie's understanding that that names refer to objects or entities. This example also demonstrates that difficulties blind infants and their parents have in establishing joint focus on an object. Here, Lottie needs to know the name of something, and in the absence of visually based gestures to refer to an object that is not touching, she coins her own label (fitt) - no-one else present knew what the word 'fitt' referred to.

L: What's a fitt called?

L: Is it a paper?

L: It's a newspaper

L: Is it a sweet?

Lottie was by far the most linguistically precocious of infants participating in the study. What we can learn from her clearly holistic approach to language development is addressed in the discussion.

(v) Kirstie

Kirstie rarely played alone throughout the four observations. Even when she did play alone, she not manipulate objects until 36 months. In joint activity focused on objects, Kirstie and her mother usually played with one electronic toy. Similarly to Kristian's mother, Kirstie's mother would choose the object that was to be the target of their interaction. Up until 23 months these interactions were characterised by Kirstie standing close and faced away from her mother. Then, when Kirstie was older, at 36 months the two stood side by side or opposite each other.

The number of routines Kirstie and her mother engaged in increased with age. Kirstie often led non-object focused interactions by requesting rhymes through producing a line and / or producing the appropriate body movements. From 23 months, the two maintained attention at a distance by singing lines of routines to each other.

The number of utterances produced during each session increased from 4 at 12 months to 30 at 36 months. The only concrete, discrete objects that Kirstie referred to with labels during the four observation sessions were 'crisps', 'biscuit' and 'keys'. Whereas Lottie produced utterances containing nouns and verbs, Kirstie did not do this until 36 months when she shook the bottle of pop she had been drinking from and said 'splashing the water', then 'splashing the pop' and finally 'splashing the bubbles'. Thus she was able to select different nouns, all concerning liquids to slot into her phrases.

Overall, there seemed to be an asymmetry between Kirstie's level of comprehension and production since, several times, when her mother requested her to engage in labelling activities Kirstie did not produce the labels but appeared able to comprehend the request.

For instance, Kirstie did not refer to any of her body parts throughout the sessions. However, she was able to point to her nose, ear, hair and also produced appropriate responses to her mother's requests to laugh, cry, sneeze, cough. When Kirstie was 23 months old, her mother would elaborate on requests for Kirstie to point to her mouth by saying things like "Where's your big mouth?" instead of just "Where's your mouth?"

(vi) Morris

In line with other dyads, Morris spent most of the observation time in joint activity with his mother. The amount of time Morris played with one object doubled between 17 and 19 months of age while playing alone. Much of the object play with his mother involved several objects. Rhymes were rarely incorporated during the two observation sessions. However, when they were, unlike other dyads, Morris's mother appeared to use them to soothe / quieten Morris rather than to establish attention with him.

Morris produced phrases of around two to four words in length adopting the unusual strategy of failing to articulate the words with his lips. Thus he established such an accurate imitation of the prosodic qualities of the input speech and differentiated the sounds sufficiently for others to understand him. At 17 months, Morris produced: "Pom-pom", "Hello", "What is it?", "Very rough", "What's that?" "Rockey rockey" and "Follow the string". At 19 months, he produced: "One cotton reel," "Hallo Morris", "In your pocket", "Socks off", "Up to potty", "Ding a ling" and "Take your cardigan off". Morris clearly used phrases as the units of speech to refer to objects and the actions they involve. Like Lottie, Morris used utterances to describe activities rather than labelling the objects. For example, he said "Take your cardigan off" as a request to have his cardigan removed rather than, as many sighted children might would, just say "cardigan off". Morris also used pronouns inappropriately presumably because he was not analysing phrases into their constituent parts.

Morris and his mother often engaged in tasks which had clear goals to them: (shapes in holes, rings on pins etc). These kinds of goal orientated activities created the opportunity for Morris's mother to support the achievement of the goal through verbally and physically guiding Morris's manipulations of objects (e.g. posting shapes through holes). Since the topic of their interaction was instructional, Morris's repertoire of productive utterances may have been underestimated in the present study. An examination of productive speech during non means-ends activities may have led to a different conclusion. The following section reports on the infants' speech in just such a context.

Talking about objects in the sorting study

The infants Kirstie, Kristian and Roxanne rarely engaged in situations where there were objects or where there was more than one object, and it was therefore considered important to examine how infants talked when they were presented with several objects on the sorting task (**Chapter Six**). In addition, as explained above this provided the opportunity to assess what Morris was saying during less goal orientated activities.

Another reason for examining the transcripts produced from the sorting task was that the referents available to the infants were controlled. It was noticeable that Kirstie, Kristian and Morris frequently enjoyed playing with different electronic talking/music toys. However, such objects do not provide much opportunity for studying the emergence of lexical phenomena since there is little to distinguish between the toys. In particular, they were all around the right size to be held in two hands and made of plastic. By using everyday objects that infants presumably would have had experience of (e.g. brushes, spoons, oranges, toothbrushes), there was reason to believe that they provided a greater opportunity for infants to talk.

The infants varied in the extent to which they talked about the objects. Kristian and Kirstie did not produce any utterances during any of the observation sessions. Joseph did

not talk about the objects until 20 months, and similarly, Roxanne started to produce words while she was playing with the objects on the last observation session when she was 27 months of age.

The infants Lottie and Morris provided the most utterances during the sessions. Morris labelled Lottie maintained the style she used in spontaneous play sessions by talking about what the object would be used for rather than labelling it outright. At 16 months Lottie reproduced phrases appropriate to the context where the objects would be used (e.g. for the brush, "Make her posh" and for the spoon, "Dinnertime" and "Eat it"). Then at 23 months, she refers to the same objects in name ("There's a brush" and "There's a spoon). Table 8.7. presents examples produced by the infants across the three observation sessions.

The infant Lottie produced the most utterances during each of the three administrations of the sorting task. It is clear from her utterances that she rarely used single word object labels to talk about the objects. Instead, she produced phrases containing information about the context (e.g. dinnertime) the object was used in or a label for the action (e.g. shake). It is more difficult to discern patterns from the other infants because they only produced a limited amount of speech during the task.

Table 8.7. Utterances produced by infants during object sorting task

Infant	Task	Age in mths	Utterance
Joseph	groaning tubes	20	Baby
Roxanne	pea/water shakers	27	Pop Water Shaking Donkey
Morris	brushes/spoons	17	Brush your hair Spoon Brush
	pea/water shakers		What is it? Open it
	tubs/ducks		Quack quack
Lottie	oranges/lemons	16	Taking the skin off And another one Skin off
		23	Mum, peel it for her Peel it Peel it for her mummy
		25	M: What's this then?(hands her orange) L: Apple L: Want an apple in the skin
	fire engines/ rattles	16	Squeeze it Shake shake shake Bite Shake it baby
		23	That's a bell There's another one there There's Sarah's toys What is it? Shall Mummy shake it? Mum take it Mummy bummy Want mummy to have it Sarah give her another toys

Table 8.7. (continued)

Infant	Task	Age in mths	Utterance
Lottie	brushes/spoons	16	Let mummy brush it Make her posh Dinnertime Eat it
		20	Whats this? Get Mum to brush your hair
		23	There's a brush There's a spoon

8.3.3. Did the infants produce appropriate actions for familiar rhymes?

Dyads who involved rhymes in joint activity were Roxanne, Kirstie, Lottie and Kristian and their parents. The range of rhymes used by different dyads is considered alongside the extent to which infants were able to use different actions for different rhymes without explicitly being instructed by their parent. In particular, the changing nature of use of action by the infant is documented across the second year.

(i) Kristian

Kristian and his mother regularly engaged in a range of rhymes involving actions (e.g. 'round and round the garden' ring a ring a roses' and 'wibble wobble wibble wobble jelly on the plate'. However, between 24 and 32 months of age, Kristian failed to initiate actions in these rhymes. Instead, his mother guided his body into producing particular actions.

(ii) Roxanne

Of all the dyads, Roxanne and her mother produced the largest repertoire of rhymes, of which some were accompanied by a particular sequence of actions. At 15 months Roxanne was able to anticipate the movements made by her mother by moving her own

hand to 'protect' her arm, where her mother was going to tickle her. Roxanne was also able to clap her hands in response to patacake. However, in all other rhymes, although Roxanne's mother gave her space to respond, Roxanne was unable to carry out the appropriate action in response to the rhyme unless her mother physically guided her. Thus, throughout the course of study, Roxanne was physically capable of completing the actions but failed to initiate the appropriate actions.

(iii) Lottie

Lottie and her mother engaged in a number of conventional rhymes with actions (e.g. 'ring a ring a roses', 'head, shoulders, knees and toes') as well as some rhymes without. (e.g. 'twinkle twinkle little star'). Lottie was able to produce appropriate actions to particular rhymes at the start of the study when she was aged 15 months, for example, in 'ring a ring a roses' she would fall down at the appropriate point and perform other actions without guidance from her mother in other rhymes.

(iv) Kirstie

Kirstie and her mother engaged in several rhymes involving actions (e.g. 'ring a ring a roses', 'round and round the garden'). Kirstie was able to anticipate action in these rhymes since when her mother stopped singing and producing actions at 12 months, Kirstie was able to continue without support. At 17 months, Kirstie was able to produce actions to request rhymes as well as initiating movement at the onset of a particular rhyme (e.g. clapping to patacake or touching a bodypart in response to a familiar phrase).

8.3.4. Usage of words in productive speech: generalisations

The examples (a) - (f) below present instances of generalisation either observed during the play sessions or reported by parents. Details on usage are presented when the infants produced the word beyond the context where it was initially used.

(a) Infant: Morris Age: 18 months

Word / phrase: kitchen

Comments on early usage: early usage of 'kitchen' was contextually inflexible since Morris produced it of stepping back and forth between the kitchen and lounge in own house.

Comments on subsequent usage: Morris stepping back and forth between kitchen and lounge at neighbour's house - thus there was a subtle change in usage but it remained context-bound.

(b) Infant: Morris Age: 19 months

Word / phrase: on the kitchen floor

Comments on early usage: in traditional terms this usage would be regarded as contextually inflexible usage since Morris only produced the phrase when he stood on the vinyl floor in kitchen.

Comments on subsequent usage: a few months later, Morris produced this phrase while standing on the vinyl floor of his family's caravan.

(c) Infant: Morris Age: 19 months

Word / phrase: supermarket

Comments on early usage: contextually-inflexible since Morris restricted use of 'supermarket' to being pushed in pushchair.

Comments on subsequent usage: - produced word when playing with pushchair at home, subtle change in usage but remained context-bound.

(d) Infant: Morris **Age:** 19 months

Word / phrase: into the sand and into the bucket

Comments on early usage: this phrase was classified as context-bound since Morris only produced it when he was using a spade to shovel sand into a bucket on the beach with his mother. However, it is difficult to see how this phrase might be used to refer to situations other than the one which is describe here.

Comments on subsequent usage: Morris produced this phrase while he was playing alone with bucket and spade in the cupboard at home - thus he decontextualised usage of the phrase to a context where no sand was available.

(e) Infant: Morris **Age:** 19 months

Word / phrase: thumby thumb thumb

Comments on early usage: first productions limited to use during a routine involving naming of body parts and therefore were regarded as being contextually inflexible.

Comments on subsequent usage: Morris started to produce 'thummy thumb thumb' in response to mother making requests for labels of body parts.

(f) Infant: Morris **Age:** 17 months

Word / phrase: one, two, three, four.....thirteen.

Comments on early usage: Morris produced a number each time he climbed up the stairs at home.

Comments on subsequent usage: Morris counted each button he felt on his mother's shirt (and also his neighbour's shirt) - thus he had begun to decontextualise the usage of the whole phrase to another type of thing (e.g. buttons). It is extremely unlikely that Morris understood what 'one' and 'two' referred to but rather that he recognized that each time he came across another exemplar of an item he would produce the next number in the sequence.

(g) Infant: Lottie **Age:** 15 months

Word / phrase: oh she's posh

Comments on early usage: produced in response to her mother brushing her hair

Comments on subsequent usage: Lottie started to use this phrase in response to a range of situations which involved a change to her own appearance: putting shoes on, wearing her mother's watch and having her face wiped.

(h) Infant: Kirstie Age: 12 months

Word / phrase: allgone

Comments on early usage: used to refer to when food finished

Comments on subsequent usage: decontextualised to refer to end of rhymes, music and disappearance of objects.

(i) Infant: Kristian Age: 29 months

Word / phrase: garden

Comments on early usage: only used when crawling to back of house.

Comments on subsequent usage: decontextualised since used when back door overlooking garden open and when when getting out of car to enter house.

(j) Infant: Roxanne Age: 27 months

Word / phrase: spinning

Comments on early usage: used only as a request for routine.

Comments on subsequent usage: comment on own action and request for routine.

Summary of findings from word generalisations: examples (a), (d), (e) and (f) demonstrate the way Morris produced words / phrases originally learnt in routines and started to use them in similar or new situations. In example (a), the word 'kitchen' was originally introduced by Morris's mother when he walked through from the lounge to the adjoining lounge. This led to a routine where Morris used to stand in the doorway adjoining the kitchen and lounge and step from the carpeted floor of the lounge to the vinyl floor of the kitchen, and back again. This activity was initially a shared routine for Morris and his mother, which subsequently became a routine Morris initiated alone and produced 'kitchen' as he stepped back and forth from the lounge into the kitchen. The observation that Morris was able to produce 'kitchen' at his neighbour's house demonstrated that Morris had an understanding that the label could also apply to kitchens other than the one in his own house. Of course, it may be argued that Morris believed he was still in his own house, however, the floor surface in the two lounges / kitchens provided different contrasts, which may suggest that Morris was detecting a difference

between the floor surfaces and therefore able to decontextualise the word. Full decontextualisation of the word kitchen, however, would require that Morris was able to produce the word outside occasions when he was stepping back and forth between the two specific pairs of rooms.

Most of Roxanne's utterances consisted of individual words from rhymes or portions of rhymes, thus her speech remained context-bound in the sense that she did not go on to use units of utterances outside the rhyme itself. The few words / phrases Roxanne did produce which were unconnected with rhymes tended to be names of family members, and she usually produced these when she sat alone on the floor or while she was settling down to sleep at night. Similarly, Kristian often appeared to rehearse his repertoire of words in the absence of any particular ongoing object, action or event. In sum, for Roxanne and Kristian, their speech did not appear context-bound, but rather, it was produced across a range of situations in the absence of any critical object, action or event, suggesting that they lacked the ability even to relate their speech to a particular context. Interestingly, although there was a large degree of overlap between the nature of Roxanne's and Kirstie's speech in the way that both infants sang rhymes, Kirstie differed from Roxanne since she also produced words to refer to objects, actions and events. Overall, the performance of Roxanne, Kirstie and Kristian was in direct contrast to Joseph who was observed to use many of his words referentially. In addition, the infant Lottie was more advanced than the other infants and had already started to analyse her language early in her second year. It is therefore likely that any examples of generalisation would have been more obvious during this earlier period.

8.3.5. Usage of words in productive speech: extensions, underextensions and overextensions.

The examples (a) - (w) below present instances of extensions, underextensions and overextensions observed during the play sessions or reported by parents. The conditions in which infants rescinded under-extensions or over-extensions are also described.

(a) Infant: Morris Age: 19 months

Word / phrase: that's a zip.

Comments on early usage: Morris had experience of zips on clothes and referred to a zip he was wearing on his sleepsuit.

Comments on subsequent usage: extension of word - talking about zip he felt on a cushion.

(b) Infant: Kirstie Age: 25 months

Word / phrase: cold

Comments on early usage: appropriate use of cold to refer to fridge.

Comments on subsequent usage: appropriate extension to refer to sensation of rain on skin.

(c) Infant: Kirstie Age: 17 months

Word / phrase: goodnight-grandad

Comments on early usage: contextually flexible since produced when undressed regardless of activity (changing bib, going to loo, changing clothes).

Comments on subsequent usage: rescinded overextension by restricting usage to when getting undressed at bed-time.

(d) Infant: Kirstie Age: 19 months

Word / phrase: babba

Comments on early usage: used referentially since produced to refer to when others cried as well as to talk about herself.

Comments on subsequent usage: rescinded overextension by using babba to refer to herself and other small children.

(e) Infant: Kirstie Age: 25 months

Word / phrase: hot

Comments on early usage: used referentially to refer to the cooker and the warmth of the sun on the bus but overextended to refer to fridge as well.

Comments on subsequent usage: Overextension rescinded when Kirstie started to refer to warmth only e.g. bath water, cooker, hot food.

(f) Infant: Kirstie Age: 26 months

Word / phrase: park

Comments on early usage: 'park' was used referentially since it was used in range of situations - on getting into cars and buses regardless of destination, and playing in the park.

Comments on subsequent usage: rescinded overextension by restricting usage to when she was getting into buses and playing in the park.

(g) Infant: Kirstie Age: 36 months

Word / phrase: press it

Comments on early usage: this was referentially to refer to pressing buttons on a variety of electronic toys but it was also overextended to refer to the action of doing something to objects (e.g. request to use drumstick on xylophone).

Comments on subsequent usage: continued to be overextended at the end of the study.

(h) Infant: Joseph Age: 14 months

Word / phrase: book

Comments on early usage: used to refer to books as well as video cassettes - thus early usage of book was over-extended.

Comments on subsequent usage: rescinded overextension by referring to videos by using word 'book'.

(i) Infant: Joseph Age: 14 months

Word / phrase: teddy

Comments on early usage: used 'teddy' to refer only to one particular teddy in a range of situations (request for teddy, labelling teddy)

Comments on subsequent usage: rescinded underextension by referring to a range of teddies.

(j) Infant: Lottie Age: 16 months

Word / phrase: box

Comments on early usage: used referentially to refer to many kinds of containers (e.g. case, margarine tubs, boxes).

Comments on subsequent usage: no information available.

(k) Infant: Lottie Age: 16 months

Word / phrase: have a crisp

Comments on early usage: used referentially to request crisps, to label them and to overextend them to objects which made rustling sounds (e.g. a doll with a head that rustled). It is possible, however, that Lottie really thought she was touching a packet of crisps, in which case it would be unrealistic to refer to this example as an over-extension.

Comments on subsequent usage: no observations of Lottie using 'crisps' to refer to things which are crisps.

(l) Infant: Lottie Age: 16 months

Word / phrase: sweets

Comments on early usage: used referentially to refer to sweets and to request sweets but it was also overextended to paper.

Comments on subsequent usage: Lottie restricted usage of the label to refer to sweets.

(m) Infant: Lottie Age: 16 months

Word / phrase: music

Comments on early usage: used referentially to refer to music and overextended to appliances producing sounds (e.g. the radio, video camera).

Comments on subsequent usage: Lottie made requests for the music to be played/stopped and therefore rescinded her overextension by using language to refer to the sounds rather than the appliances.

(n) Infant: Lottie Age: 15 months

Word / phrase: broke it

Comments on early usage: Used referentially but overextended to refer to falling objects, to doors and to biscuits.

Comments on subsequent usage: Lottie continued to overextend 'broke it' across the course of study - e.g. on lifting lid of case.

(o) Infant: Lottie Age: 16 months

Word / phrase: ring

Comments on early usage: used referentially to refer to watches and jewellery (bracelets, rings).

Subsequent usage: overextensions rescinded to refer to rings worn on fingers.

(p) Infant: Lottie Age: 23 months

Word / phrase: lamp

Comments on early usage: overextended to refer to lamps as well as plastic trumpets.

Comments on subsequent usage: data not available.

(q) Infant: Lottie Age: 20 months

Word / phrase: the buttons

Comments on early usage: used 'the buttons' referentially to refer to the braille machine, chocolate buttons, electric organ, button on doll.

Comments on subsequent usage: use of word to refer to objects which require being pressed.

(r) Infant: Lottie Age: 20 months

Word / phrase: cup of tea

Comments on early usage: used referentially to request a drink, to comment on a drink but overextended to refer to all drinks served in bottle. The following exchange illustrates this:

M: What you got in that bottle?

M: What is it?

L: Cup of tea

M: No..it's a cup of -

L: Cup of tea

M:...ooh...no, its not a bottle of tea, it's a bottle of coffee.

Comments on subsequent usage: rescinded overextension by restricting usage to referring to tea served in bottle and finally, tea served in mug. At 25 months, Lottie demonstrates understanding that a bottle can contain different kinds of drinks:

L:Go get her bottle

L:What's Mum putting in?

L:What you put in?

L:Milk?

L:Squash?

L: It ain't orange squash

(s) Infant: Lottie **Age:** 23 months

Word / phrase: bouncy-castle

Comments on early usage: used referentially to refer to activity on bouncy-castles but also overextended to refer to sponges and the swing in her garden.

Comments on subsequent usage: data not available

(t) Infant: Lottie **Age:** 23 months

Word / phrase: baby

Comments on early usage: underextended to refer to herself crying.

Comments on subsequent usage: overextended to refer to the sound of someone crying and also to toys which make a groaning sound.

(u) Infant: Lottie **Age:** 23 months

Word / phrase: sink

Comments on early usage: used referentially to refer to sinks, basins and overextended to refer to margarine tubs.

Comments on subsequent usage: not available.

(v) Infant: Kristian **Age:** 29 months

Word / phrase: brick

Comments on early usage: produced while playing with material cubes

Comments on subsequent usage: overextended to refer to any toy he played with on floor.

(w) Infant: Kristian **Age:** 30 months

Word / phrase: cat

Comments on early usage: to refer to a kitten.

Comments on subsequent usage: extended to a big picture in a book.

Summary of extensions and overextensions

Kirstie's overextensions were largely made on the basis of similarity of action or event: thus 'goodnight' was produced in response to activities involving the removal of clothing;

'park' was produced in response to any journey on a vehicle; 'press it' was produced as a request to act on sound-producing toys or instruments; 'baby' was produced in response to the sound of someone crying. The only over-extension to be made on the basis of touch was 'hot' to refer initially to the cooker. Similarly, a number of Lottie's over-extensions were made on the basis of action: thus 'broke it' referred to the movement of parts of objects, 'cup of tea' referred to anything to be drunk, 'the buttons' referred to objects which required pressings in addition to buttons and 'bouncy castle' referred to objects involving some of the same action as going on a bouncy castle. 'Crisp', 'sweets', and 'baby' were used to refer to objects making similar sounds to crisps, sweets, and babies. 'Music' was used to refer to appliances which made sounds. Finally, 'sink', 'lamp', 'ring', 'box' were produced in relation to objects with similar function and/or shape. Thus Lottie appeared to overextend words to new referents on the basis of action, shape/function and sound.

Joseph, the SVI infant produced few over-extensions, however these appeared to be made on the basis of shape e.g. referring to a video cassette as 'book'. Similarly, Kristian rarely over-extended the few words he produced, though the one over-extension he produced concerned the way he would refer to any object encountered during locomotion as a 'brick' - thus the over-extension seemed to be made on the basis of 'object encountered on floor.'

8.4. Discussion

The first objective of the present study was to describe changing patterns of activity during the second year in terms of the proportion of time dyads spent together in joint activity and time spent alone playing with objects. The finding that blind infants and their parents spent around three-quarters of play-sessions in joint activity is perhaps not surprising since parents may have interpreted my request for them and their child to appear on the video doing what they 'normally do together' as being seen to be involved

in the same activity together. However, the finding that the SVI infant Joseph spent longer playing alone than in joint activity is open to a number of possible interpretations. It is possible, for instance, that factors like differences in parental perceptions of the experimental set-up, parental-rearing style, infant temperament may have influenced the extent to which Joseph played alone. However, it is also likely that the limited amount of visual information available to Joseph enabled him to move unaided around his environment, which may in turn, have contributed to the large proportion of time spent playing alone. Certainly, Joseph was more skilled at navigating around his house than any of the blind infants, and it is therefore likely that this ability gave Joseph the opportunity to explore toys and objects without the need for his mother to bring the objects to him, as was the case with the blind infants.

Previous research suggests that objects are rarely introduced into interactions with blind infants until the end of their first year and that these infants, unlike sighted infants, gain little experience with objects (e.g. Preisler, 1991). However, the findings from the present study suggest that for two dyads (Morris and Kristian) objects were frequently incorporated into interactions, and for three dyads (Lottie, Kirstie and the SVI infant, Joseph) objects became increasingly incorporated into play activity across the second year. In contrast, Roxanne and her mother engaged in object play, on average, for less than one third of the duration of the play sessions. The finding that five of the dyads played with objects in interaction suggests that if any problems had existed in introducing objects into interaction towards the end of the first year, they had certainly resolved themselves by the middle of the second year. We can conclude therefore, that an absence of visual information in the infant does not necessarily prevent the dyad from engaging in object-focused interactions during the period of early language acquisition. Reasons why Roxanne and her mother did not also introduce objects into the interaction in the same way as other dyads are discussed later.

Although the findings demonstrate that five of the dyads gained considerable experience with objects during their second year, it was striking that for two of these infants (Kirstie and Kristian), this experience turned out to be extremely restricted. Instead of gaining experience with several objects, Kristian and Kirstie spent significantly more time playing with one object rather than a number of objects. Furthermore, when Kristian and Kirstie did play with objects they tended to be plastic electronic sound-making toys either held by their parents or supported by a table. The infants were encouraged to press buttons to elicit music, animal noises or social expressions (e.g. hello baby), so even when these infants played with one object, this experience was usually localized to a small, moveable parts of the object. Furthermore, the object was usually kept stationary (e.g. held by the parent) and existed in isolation from other objects. In particular, three of the mothers (of Kristian, Kirstie, Morris) selected the toy which was to be the focus of the interaction and also determined when the episode of play with that particular object would end.

Interestingly, three dyads (Morris, Joseph and Lottie) gained experience playing with more than one object and were also able to manipulate two objects simultaneously when presented with a group of objects in the object sorting study. Thus their performance in spontaneous play was consistent with their performance on the sorting task. It would appear then, that an absence of visual information does not prevent joint activity involving objects during the second year, though distinct differences emerge between dyads in the ways objects are incorporated into joint activity. Kristian, Roxanne and Kirstie consistently demonstrated either a minimal amount of object play (Roxanne) and/or restricted their play to one object (Roxanne, Kristian, Kirstie). Moreover, it emerged that unless a parent introduced an object, it was unusual for Kirstie and Kristian to play with objects on their own. These three infants lacked the motor experience of handling an object in each hand as well as lacking the opportunity to make immediate comparisons between objects and to experience how objects related to each other. They

also lacked the opportunity to understand where objects came from, and that 'things' in the environment can be made from a variety of materials and exist in a range of forms. The implications of this impoverished experience in the object domain for conceptual-lexical functioning are that Roxanne, Kristian and Kirstie did not refer to 'things' in their environment and that they would also lack understanding of how objects can relate to each other. These predictions are supported by the findings presented in **Chapters Five to Seven.**

The second objective of the study was to determine what the infants talked about during spontaneous play during the second year. The results showed that for infants with substantial experience with objects (Joseph, Morris and Lottie) only Joseph referred to objects using labels. In contrast, Morris and Lottie used expressions describing aspects appropriate to the context of the activity concerned. With increasing age, Lottie produced more labels for objects. Not surprisingly, infants (Roxanne, Kirstie) who rarely played with objects did not refer to them. In sum, with the exception of the SVI infant Joseph, infants in their second year did not refer to concrete discrete objects using labels. Instead, they spent their time using phrases to describe the activity (e.g. during a meal Morris would say 'on your spoon and up to your mouth'). In contrast to previous studies of blind infants' vocabularies which have concluded that there is nothing striking about the content of the early productive vocabularies, this study concludes that the proportion of labels produced to refer to concrete, discrete objects is low. For those infants who did not play with objects, this is perhaps not surprising, since if objects are not present then in the context of infant interaction they are unlikely to be talked about. However, what still remains to be accounted for is why blind infants who do have experience with objects do not produce labels for them.

One reason why blind infants may not refer to objects even when they play with them is because the ostensive contexts in which sighted infants readily appear to learn words do

not arise in interaction between blind infants and their parents. For example, parents of sighted infants refer to objects by pointing and labelling objects displayed in two-dimensional format in books or to salient objects in the context of everyday play. If a sighted infant has acquired the *Principle of reference* (Golinkoff, Mervis and Hirsh-Pasek, 1994) and therefore understands that words have the capacity to refer, then there is a strong likelihood that they will understand that the word in the input speech refers to the picture. This is because parents will usually label an object at the same time that they are pointing to a picture of the object concerned. This 2-D image is usually clearly isolated, therefore reducing the problem of trying to elucidate to which entity the parent is referring. Even in more ambiguous situations, however, the sighted infant seems to have an advantage over the blind infant in acquiring labels for concrete, discrete objects. First of all, a sighted infant has the opportunity to observe gesture (the index finger pointing) which provides a salient clue about which object the parent is referring to. Furthermore, the sighted infant also has the opportunity to observe which other objects are present. This is relevant, because if the sighted infant has already acquired the name of some or all of the other objects present then this increases the likelihood that the infant will pair the label with the correct referent. In contrast, unless the blind infant is touching a group of objects - which, as we have seen from the findings in the present study, is something they are unlikely to do, then they have a greater problem in establishing the target referent of the parent's speech.

In addition to examining the extent to which objects are incorporated into interactions between blind / SVI infants and their parents, it is also crucial to examine the extent to which rhymes and routines played a facilitative role in conceptual-lexical development. The third objective of the study was to gain insight into the extent to which infants were able to initiate sequences of self-produced body actions in response to particular nursery rhymes. It was demonstrated that of those four dyads incorporating rhymes into play activity (Roxanne, Lottie, Kirstie and Kristian), two of the infants (Lottie and Kirstie)

were clearly able to initiate rhymes whereas other infants were either unable to (Kristian) or just starting to (Roxanne). However, it was not simply that Roxanne and Kristian were unable to execute the movements of the rhymes since, once their mothers moved their limbs in the appropriate way, the infants were able to participate. Roxanne possessed the roots of the ability to perform particular actions since she was able to initiate clapping actions in response to 'pattacake' but she could not produce other actions for other rhymes. Of the four who engaged in rhymes, Kirstie and Lottie were able to use particular sets of actions with particular rhymes suggesting that they were able to understand that particular actions belonged with particular sound patterns. This must be as adequate an indication of ability to categorize as is the ability to sort objects. Further, it suggests that Kirstie and Lottie had insight into the idea that a set of sounds could refer to a set of actions. What we may have isolated here, are some of the ways infants who rarely play with objects (Kirstie) demonstrating insight into the idea that sound patterns (e.g. the nursery rhyme) can refer to a particular set of actions. It is speculated here that this ability provides an important grounding for understanding that words can refer to specific actions and events.

The fourth objective of the present study was to investigate the extent to which blind infants generalised their words. The idea was not to approach this objective by examining the frequency, since, as was reported in **Chapter Two**, it is known that infants vary widely in the number of words they generalise. Instead, the aim was to focus on how words / phrases were subtly used in different ways across time. Infants in the present study who produced long phrases in their speech also tended to refer specifically to actions and events. For instance, Morris would say "on the kitchen floor and off the kitchen floor" when stepping from the kitchen through to the living room and back again. Morris would also use "Up to the big potty" on talking about a potty located in the bathroom but use "up to the little potty" to refer to a travel potty. It was common for Morris's and Lottie's utterances to map onto specific events which would describe them

so accurately that it is possible to see no need for the utterance to be decontextualised. For instance, it is hard to see how "Up to the big potty" would be decontextualised because it already accurately describes a specific event. Thus it is possible to speculate that infants adopting strong holistic styles to lexical functioning may be less likely to generalise words since their utterances already describe an object/action/event very specifically. This position would suggest that it is not an absence of visual information per se that leads to a 'failure' to generalise words, but rather, that infants who take a holistic approach to language learning are less likely to make these generalisations because the language they already have does the job adequately.

The fifth objective of the present study was to investigate the extent to which blind infants extended and overextended their words. As was the case for generalisations, the aim was not to compile a record of the frequency with which extensions were used since previous studies show that extensions are a phenomena which infants use to varying degrees. Instead, qualitative descriptions were provided of instances occurring during the course of study. It was observed how Kirstie and Lottie both overextended words on the basis of action and that Lottie also over-extended words on the basis of shape / function and sound. It appeared then, that movement, and to a lesser extent, more spatially defined information was used by these infants to influence the way they produced speech. The findings from the fourth and fifth objectives of the present study both indicate that the blind infants Kirstie, Lottie and Morris infants were able to use their words far more flexibly than Dunlea (1989) proposed and that, furthermore, they were able to use their speech more appropriately over the second year.

Chapter Nine

General Discussion

9.1. Introduction

The purpose of this thesis, to further understanding of the extent to which visual information influences lexical development, was supported by three aims: first, to examine how an absence of visual information influences conceptual and lexical functioning; second, to explore the role of vision in the conceptual and lexical development of sighted infants; finally, to identify strategies which aid conceptual and lexical functioning during infancy. The studies in this thesis each addressed different aspects of conceptual-lexical development through studying how blind, SVI and sighted infants understand objects, actions and events and how they start to talk about these particular aspects of their environment. A summary of the findings yielded from each of the four empirical chapters is presented first followed by a discussion of how the findings have contributed to satisfying each of the three aims of the thesis.

9.2. Summary of findings

Chapter Five presented information about the status of developmental functioning as measured by the Reynell-Zinkin Scales for the blind/SVI and sighted infants participating in the studies. The first objective of the chapter was to establish general trends in developmental functioning in order to examine if the infants were performing in line with norms for infants of the same visual status and chronological age. The findings demonstrated that whereas the performance of the sighted infants on all but the scale of verbal comprehension was spread evenly around the Reynell-Zinkin norms for sighted children, the performance of two blind infants were

inconsistent with the Reynell-Zinkin norms for blind infants. The blind infant Lottie performed above the norms on all scales whereas the infant Kristian's performance remained delayed. Furthermore, his performance remained static across his third year. The finding that these two infants differed from the Reynell-Zinkin norms for blind infants was carried forward to aid interpretation of subsequent studies in the thesis.

Considered as a group, the blind / SVI infants lagged behind the sighted group in their understanding of objects on the basis of the Reynell-Zinkin Scales. In particular, the blind infants were delayed relative to sighted controls in their ability to use objects to carry out self-care activities (e.g. feeding and grooming) and in their ability to understand how parts of objects relate to each other.

The second objective of **Chapter Five** was to document basic patterns of comprehension and production in the infants. The most striking finding was that the blind infants were delayed in both their ability to understand and to produce labels for objects. However, there appeared to be no delay in their ability to produce an appropriate response to a familiar phrase, nor in their ability to use structural components of language.

The third objective of **Chapter Five** was to shed light on the extent to which the performance of the blind and partially sighted infants may have been underestimated by Reynell (1979). When considered alongside findings from other studies (Larner and Rowlands, 1988; McConachie and Moore, 1994), the findings suggest that norms for the scale of sensorimotor understanding clearly underestimated the performance of blind infants. In addition, there was some indication that the performance of blind infants may be underestimated on the scales of social adaptation and exploration of the environment. It would also appear that the Reynell-Zinkin norms may underestimate the influence of having even the smallest amount of vision.

Chapter Six investigated conceptual development in blind / SVI and sighted infants through studying the emergence of object sorting strategies. The idea was to explain the discrepancy between Gerhardt's (1981) and Dunlea's (1989) studies and to track the emergence of object sorting strategies during the second year using techniques and materials appropriate for use with blind/SVI infants. The first objective, to examine the extent to which the blind infants were able to sort objects, demonstrated that whereas the sighted infants were judged only^{to} be using rudimentary sorting strategies at all time-points, two blind infants, Lottie and Morris were sorting objects from two classes. For the other four blind/SVI infants, the task elicited exploratory manipulations rather than sorting strategies. Observations suggested that four of the blind/SVI infants differentiated function between objects by using stimuli appropriately (putting a spoon in their mouth and brush on their hair) and that one blind infant, Roxanne, manifested fleeting examples of the ability to sort objects. It was concluded that Lottie and Morris had obtained an appropriate level of developmental functioning necessary for the production of behavioural sorting salient enough to be detected by the quantitative analyses. It was also concluded that having some residual vision did not appear to influence the extent to which Joseph was able to sort objects.

The third objective of the study reported in **Chapter Six** sought to examine the extent to which the comprehension of object labels was related to the ability to sort objects. The findings suggested that there was no difference in sorting activity between the times when blind/sighted infants were unable and able to understand labels for concrete, discrete objects.

The fourth objective of the study reported in **Chapter Six** was to compare the sequential-touching analysis with the duration analysis of object-pairing. The findings suggested that there was little consensus between the two methodologies.

Chapter Seven investigated the nature of the earliest productive vocabularies of the blind/SVI and sighted infants. The first objective of the study was to examine whether, once the sample of blind/SVI infants were matched on socio-biological factors, any differences between blind/SVI and sighted infants emerged in the age at which early lexical milestones were achieved. The results suggested that the blind/SVI infants produced their first and tenth words at similar ages to the sighted infants. Further, there was no difference between the groups in the rate at which these words were acquired.

The second objective of the study reported in **Chapter Seven** was to examine the extent to which blind/SVI infants produced fewer words for concrete, discrete objects than their sighted controls. The findings demonstrated that blind infants produced significantly fewer words for concrete, discrete objects than their sighted controls.

The study reported in **Chapter Eight** used a naturalistic setting to study the context for conceptual and lexical development and the usage of productive vocabulary. The first objective was to describe the changing patterns of activity during the second year in terms of the proportion of time dyads spent together in joint activity and time spent alone with objects, and to assess the extent to which rhymes/routines were incorporated into interactions during this period. With the exception of the SVI infant, Joseph, the infants and their parents spent a large proportion of time in joint activity playing with one object. Whereas the SVI infant Joseph largely played alone with several objects, two of blind infants (Kristian and Kirstie) largely played with one electronic toy.

The second objective was to determine what the infants talked about during the second year. It was striking that, with the exception of the SVI infant Joseph, the blind infants did not refer to concrete, discrete objects using labels. Instead, they used phrases to refer to the activity that the object was involved in.

The third objective was to gain insight into the extent to which infants were able to initiate sequences of self-produced body actions in response to particular nursery rhymes. It was demonstrated that, of the four dyads incorporating rhymes into interaction, two of the infants (Lottie and Kirstie) were able to initiate particular sets of actions with particular rhymes whereas other infants were either unable to (Kristian) or just starting to (Roxanne).

The fourth objective was to investigate the extent to which the blind infants generalised their words through focusing on how words / phrases were used in subtly different ways across time. It was clear that infants using holistic approaches to lexical development were less likely to generalise phrases because their language already communicated sufficient information about the activity.

The final objective was to investigate the extent to which blind infants extended and overextended their words. The findings demonstrated that movement, shape and function provided the basis upon which words were overextended.

9.3. How an absence of visual information influences conceptual and lexical functioning

The studies in this thesis sought to increase knowledge about blind/SVI infants' understanding of objects, actions and events and the way these infants talked about these aspects of their environment. This section discusses how the findings have furthered understanding of how an absence of visual information influences conceptual development, quantitative aspects of lexical development, and the content / usage of early speech. Conclusions are drawn about the extent to which the findings suggest evidence for a cognitive deficit in blind/SVI infants.

9.3.1. Quantitative aspects of lexical development: age of onset of first words and rate of vocabulary development

The finding that there was no difference between the matched blind and the sighted groups in the age of onset or the rate at which early words were produced contrasts with McConachie and Moore's (1994) finding that blind infants are slower than SVI and sighted infants to acquire their first words but supports Mulford's (1988) conclusion that they are not.

One reason McConachie and Moore (1994) offer for the discrepancy between the findings from their own and Mulford's report of several studies was that Mulford's study may have been biased toward involving only the more successfully developing infants. However, the findings from the present research suggest that it is unlikely that this factor plays a role in the production of words since the dyads participating in the present research came from less privileged backgrounds than those infants participating in Mulford's (1988) study. Furthermore, the blind infants, Kristian and Roxanne, who consistently performed behind other blind infants on the Reynell-Zinkin assessments were among the first infants in both groups to acquire their first word. This implies not only that visual information does not influence the age at which infants acquire their first word but that general developmental ability is a poor predictor of the age of the emergence of the first word. However, it should be stressed that the developmental demands associated with the production of the first word are judged to be less severe than those associated with the production of later words. The first 'word' is unlikely to be used referentially and also will be likely to undergo significant phonological repair with time (e.g. ma to mama to mummy).

It is tempting to speculate that the finding that Roxanne and Kristian were the slowest infants to acquire ten words signifies that the emergence of this milestone is more cognitively demanding. However, the findings still support the notion that

visual information plays little, if any role in facilitating the emergence of the first ten words. This finding supports the recent emphasis of Bates *et al.* (1995) who identify factors contributing to the early and late production of words. They identify several processing-related dimensions of language development such as the role of auditory short-term memory, perceptual acuity, unit size and the speed-accuracy trade-off in language functioning. Such factors are thought likely to influence the age of onset of first words.

Although the findings suggest that there are few differences between blind and sighted groups in the age of onset of first words, the findings from the Reynell-Zinkin assessments suggest that, overall, the blind group were delayed in both their comprehension and production of labels for objects. However, it would appear that this delay has little to do with the ability to refer *per se*, but more to do with the ability to understand that words can be used to refer to concrete, discrete objects.

9.3.2. What do blind / SVI infants talk about?

The findings from the study reported in **Chapter Seven** suggest that blind infants produce a low proportion of words referring to concrete, discrete objects in their early vocabularies. Furthermore, the findings suggested that the proportion of these words did not increase with increasing vocabulary size. **Chapter Eight** reported that, in the case of the infant Lottie who was using multiword utterances, a large proportion of utterances contained no labels for objects. Similarly, the infants Roxanne and Kirstie used words for actions rather than labels for objects. It was striking that even though the infants Joseph, Morris and Lottie gained experience with objects, only the SVI infant Joseph used object labels to refer to things in the environment.

It would not be particularly surprising that blind infants did not refer to objects if they were not playing with them. This was the case for the two blind infants (Kirstie and

Kristian) who rarely played with more than a single object, and for Roxanne who did not play with objects on three of the four observations across the second year. However, even when the blind infants did gain experience with objects they did not use labels for them. An absence of vision clearly does not necessarily prevent objects from being used in interaction. It would appear, however, that for some dyads an absence of visual information leads to difficulties in objects being involved in interaction. Furthermore, it is possible that blind infants focus on labelling actions and events not only because they are relying on information which is of a sequential nature but because the absence of visual information from the infant directs the parent to focus on talking about actions and events rather than about objects in the environment.

9.2.3. Generalisations and extensions in productive vocabulary

Dunlea's (1989) conclusion that blind infants rarely generalise and extend their language is thought to be misguided. Two principal reasons for this conclusion were outlined in **Sections 3.4.3 and 3.4.4**. The first concerned the way Dunlea pitched estimates of the extent to which blind/SVI infants generalise/overextend words against unrealistic estimates of the extent to which sighted infants do so. The second concerned the way that an absence of visual information may lead to the phenomena of generalisation and overextensions being underestimated in blind infants.

In **Chapter Seven** it was proposed that the production of fewer words for concrete, discrete objects by blind infants will lead to overextensions featuring less regularly in the speech of these infants. In **Chapter Eight**, it was proposed that infants leading towards holistic styles of lexical development may be less likely to generalise their words since their utterances already describe an object/action/event very specifically. This suggests that it is not an absence of visual information per se that leads to a 'failure' to generalise words but, rather, that infants who take a holistic approach to

language learning are less likely to make these generalisations because the language they use already communicates sufficient about the situation.

Taken together, these different factors lead to the conclusion that an absence of visual information reduces the opportunity for researchers to detect whether blind infants are overextending and / or generalising. Furthermore, it is clear that, because the orientation of blind infants and their parents is away from interactional contexts involving the labelling of concrete discrete objects, an absence of visual information during infancy is likely to lead toward social interactions which develop in different ways from those of sighted infants.

Some of the reasons why blind infants do not overextend and generalise their words to the same extent as sighted infants have been discussed. However, on occasions when blind infants do generalise and / or extend their words it appears that they do so in particular circumstances. In **Section 3.4.3** the need to examine interactional contexts typical to blind infants and their parents was emphasized. The reliance on a high degree of structure through the use of routines and rhymes may have led to a bias against the detection of generalisations between blind infants and their parents. This is because up until recently, the study of sighted infants has been dominated by the study of their relations with objects and new approaches are required in order to study the way blind infants generalise within interactional contexts involving routines. The conditions under which blind infants are likely to over-extend their words also requires examination in different ways from those used with sighted infants. The findings reported in **Chapter Eight** suggest that infants relied on action, shape, function and sound as a basis to overextend their words.

9.2.4. Conceptual development in blind/SVI infants

Previous research has demonstrated that interactions between blind infants and their parents are characterised by an absence of objects during the first year (e.g. Preisler, 1991). In contrast, the findings from the present research indicate that, for at least the latter part of infancy, most dyads (but not Roxanne) engaged in object-play. Thus any difficulties which had existed during the first year involving objects in interaction, had certainly disappeared by the second year for most of the infants. However, the finding that the dyads from the low vision group spent a large proportion of time engaged in object-play may be misleading since, on closer examination, two of the five infants' experience with objects was largely limited to play with a single, plastic electronic toy and a third infant failed to receive any experience with objects during three of the four observation sessions. Typically, the parent selected, introduced and removed the toy from the focus of the interaction and used it to support dancing (Kirstie) or singing (Kristian) activities. Thus three blind infants lacked the opportunity to understand where objects came from and how they related to each other. In addition, they lacked the opportunity to understand that 'things' in the environment can be made from a variety of materials and exist in a range of forms.

The limited experience these three infants had in handling objects was also reflected in the study of sorting ability since these infants manipulations served as explorations rather than as any attempt to sort objects. In contrast, the infants Lottie and Morris received rather more experience of manipulating a variety of objects and spent more time manipulating two objects and were able to sort from two classes of objects. This finding directly challenges Dunlea's (1989) position that blind infants are unable to sort objects until their third year and, instead, supports Gerhardt's finding that "AB" could sort objects half way through her second year. It was concluded in **Section 6.4**

that the discrepancy between Dunlea's and Gerhardt's study is likely to be due to a combination of poor object understanding and an insensitivity of analysis techniques.

Attention was drawn to two alternative ways of understanding the ability to categorize during infancy. The first was through examining whether infants are able to use objects appropriately (e.g. put a spoon in their mouth). The finding that several of the blind infants were able to differentiate the functions of different objects suggests that they were categorizing objects by use. The second was to focus on whether infants were able to categorize actions. The idea was to examine whether infants, for a number of different nursery rhymes, were able to initiate a cluster of actions. Infants who were able to initiate an appropriate cluster of actions for more than one rhyme were also able to understand that actions relate to a particular rhyme and that actions group with one other whilst indicating that they can select those (appropriate) actions from the pool of nursery rhyme routines they are familiar with. Overall, these two observations suggest that it is important to consider alternative ways in which blind infants are able to categorize. The focus on the ability to sort objects alone is biased against the kinds of information blind children have available to them and may lead researchers to underestimate the cognitive abilities of these infants.

9.3.5. Evidence for a cognitive deficit in blind infants?

Observations that blind infants fail to demonstrate the same patterns of conceptual-lexical functioning as sighted infants led Dunlea (1989) to claim that an absence of visual information results in a significant cognitive deficit. On the basis of evidence suggesting that blind infants have difficulties sorting objects, generalising and extending/overextending words, Dunlea implied that their understanding of the word-referent relationship is impaired.

Dunlea's (1989) position has been questioned on several grounds. First, Dunlea's observations have been influenced by a bias existing in the literature on sighted infants towards conceptual-lexical functioning defined in terms of object understanding and noun usage. Second, Dunlea has inappropriately applied methods used with sighted infants to the study of blind infants. Third, the findings from this thesis suggest that some blind infants are able to sort, extend and generalise words. However, the extent to which blind infants do so will be inevitably less than that of sighted infants since their perceptual-cognitive approach is more grounded in temporal information than is the case in sighted infants.

9.4. The role of vision in facilitating conceptual-lexical functioning in sighted infants

9.4.1. Is vision necessary or sufficient for normal conceptual-lexical functioning during infancy?

Evidence from the four studies in this thesis indicated that some blind infants were able to sort information which was either temporally or object based, to produce words from the same age and at the same rate as their sighted controls, and to use analysed phrases to communicate with others. This strongly suggests that visual information is not necessary for successful conceptual-lexical functioning during infancy. However, it is also clear that not all the blind infants were able to categorize or use language in the same way as the other infants. It is speculated that this signifies that, although vision is not necessary for normal conceptual-lexical functioning, its absence puts the blind infant at risk of an off-course or a static development during infancy.

The more successfully developing blind infants seemed to be relying on a holistic approach to language development coupled with a tendency not to use labels for

concrete, discrete objects both in the first 50 words and more generally across the second year. Instead, they used phrases which contained verbs and reference to the situation an object would normally be used in (e.g. 'peel it!' rather than 'orange'). The infants appeared to be making their way into language through a reliance on non-object focused information. On this basis, it is argued that blind infants, can make their way into language using a route which is merely one end of a spectrum of routes used by sighted infants.

9.4.2. Implications of findings for theoretical frameworks of lexical development

In **Chapter Two**, it was shown that vision is implicated in most theories of lexical development even though few specific claims have been made about the role of vision in word learning. The three frameworks considered most useful for understanding lexical development were identified as the multiroute model (Barrett, 1983, 1986; 1991;1995); the developmental lexical principles framework (Golinkoff, Mervis, Hirsh-Pasek, 1994; Golinkoff, Hirsh-Pasek, Mervis, Frawley and Parillo, 1995) and the social-pragmatic framework (Tomasello, 1995). The findings from the four studies in the thesis inform these theoretical explanations of lexical development in several ways. First, in **Section 3.8**, in the light of Dunlea's (1989) conclusions about conceptual-lexical development in blind infants, several predictions were made about where blind infants should experience difficulties according to these three models. The findings from the four studies in this thesis question Dunlea's (1989) claims, which, in turn lead to implications about how an absence of visual information influences the perceptual-cognitive bases of these models.

Second, the study of blind infants informs us on which of the models are most appropriate for the general understanding of conceptual-lexical development. The study of conceptual-lexical functioning in blind infants is timely because, although researchers (e.g. Tomasello, 1995) have recently recognized the importance of

addressing what infants understand about actions/events as well as their talking about them, it is notable that blind infants present themselves as an important opportunity for the formulating theoretical frameworks of lexical development. One reason why blind infants offer such an opportunity is that non-visual information inevitably is less oriented towards objects. In addition, findings from previous studies and the studies in this thesis suggest that interactions between blind infants and their parents involve less focus on objects (Preisler, 1991) and, even where objects are involved, the focus may often be limited to involving a single object only (**Chapter Eight**). Furthermore, labels for concrete, discrete objects are used relatively rarely in the vocabularies of blind infants. Thus blind infants are exposed to both a high proportion of perceptual information which is sequential as well as social, and which is likely to focus on actions and events rather than objects. Given this, blind infants provide researchers with the opportunity to examine conceptual-lexical functioning in contexts largely free from the bias towards objects which has dominated the study of sighted infants.

Third, frameworks for understanding lexical development in sighted infants do not talk explicitly about the role of vision, but nonetheless hint at the role visual information plays in the lexical extension process as well as in the mechanisms used for establishing joint attention. To date, it is not surprising that researchers have not made the role of vision in conceptual-lexical development a research priority since multi-sensory information provides the basic perceptual information on which sighted infants construct understanding about their environment. It has not been necessary to establish which aspects of lexical development rely on which particular source of perceptual information because the primary concern has been with elucidating the nature of the processes involved rather than the role played by any perceptual system. However, the study of blind infants forces researchers to consider the extent to which visual information interacts with which specific processes of conceptual-lexical functioning.

Multi-route model

As discussed in **Section 2.7.5**, the multi-route model provides for two routes into the early stages of language development; one for the acquisition of social-pragmatic and context-bound words and the another for the acquisition of referential words. Since Barrett (1995) infers from infants' changing use of individual words that they are breaking down particular event representations into their constituent parts it is not possible to 'test' the model as such. However, it is possible to comment on the implications of particular findings from previous studies of blind infants (Dunlea, 1989) and the new findings from the studies presented in this thesis for understanding the extent to which blind infants follow the social-pragmatic path or the referential path.

It was observed in **Section 3.3.3** that Dunlea (1989) maintained that blind infants use words which remain context-bound at the time when sighted infants are beginning to use words flexibly. Implicit in Dunlea's (1989) position, is the notion that there is a shift from using most words in early vocabulary in a context-bound way to using these words in a range of situations. This assumption was shown to be questionable in **Section 2.4.3**, since infants appear to use some words referentially right from the start of their lexical careers. In addition, in the light of the discussion presented in **Section 3.3.3**, it appears that Dunlea's position is flawed on several grounds. First, Dunlea pitched the performance of blind infants unrealistically low compared to sighted infants. Second, it was proposed that, because blind infants engage in activities involving rhymes and routines, their interactions are characterised by a high degree of structure. The results from **Chapter Eight** indicate that some blind infants do spend a high proportion of time in these kinds of activities. On closer examination, it emerged that infants and their parents were developing routines and that words were being used by infants in new ways. Third, two of the blind infants used phrases several

words long. These phrases often described an activity particularly accurately and, therefore, it was hard to envisage any new ways in which the phrase might be generalised to new situations. Thus the infants were producing the phrase in response to the precise object/activity they were involved with. This finding supports Bates *et al.*'s (1988) finding that infants who are expressive in style will be more likely to use context-bound speech. This suggests that, in the event that infants do not generalise their words, this may say more about their style of lexical development than whether they are blind. In turn, it may be that the role of visual attention is less crucial for infants approaching language using a holistic style.

Developmental lexical Principles Framework

This framework consists of a set of six lexical principles functioning as problem solving heuristics to limit the number of possible meanings of a novel word. Golinkoff *et al.* (1994) proposed a two tiered lexical acquisition framework consisting of three principles at each level. The focus here is with the first tier which is perceptually-cognitively based and thought to enable word learning to get off the ground by the end of the first year.

The principle upon which all other principles depend - the principle of reference - is thought to guide infants toward mapping words directly onto underlying representations of objects or actions in their environment. Notably, this differs from the view that linguistic reference is a social-cognitive act which permits joint attention within dyads. Previous research suggested that blind infants experience difficulties in establishing that words can be used symbolically and that this is as a result of a cognitive deficit (Dunlea, 1989). However, the findings from **Chapter Five** demonstrated that, although some blind infants had difficulties understanding that words could stand for objects, they experienced little difficulty understanding that words could refer to actions. This suggests that these blind infants had the

capacity to refer but were limited in the scope of this ability to refer. This finding is consistent with the way Golinkoff *et al.* have extended their original theoretical framework to include the acquisition of labels for actions as well as objects.

The principle of extendibility permits infants to extend terms to refer to new exemplars. Shape is judged to be a central factor by which object and action labels are extended to novel exemplars. Recent research seeks to identify what constitutes the 'shape' of events for children (Mandler, 1992). Whereas Dunlea (1989) suggested that blind infants were poor at extending words to new referents, the results from the present study suggests that blind infants in their second year were clearly able to extend words on the basis of action. In addition, it is important to note that, as discussed in **Section 3.4.4** it is far more difficult to detect when blind infants are extending their words. Furthermore, since the results from the study reported in **Chapter Seven** suggest that blind infants rarely use words referring to concrete discrete objects the overextensions will feature less regularly in the speech of blind infants. The most frequently cited examples of overextension in sighted infants' speech are based on labels for concrete discrete objects which are typically learnt in 'point and label' activities such as picture book reading. It is unlikely that infants will engage in ostensive situations where words for actions will be overextended. For example, in a picture book activity there are typically many pages displaying new objects. It is somehow more difficult to imagine a situation where infants would be exposed to a stream of labels for different actions presented one after the other. Thus, because of the nature of actions, their labels do not lend themselves to being acquired in the same way as object labels. Actions are, of course worthy of the same attention as the acquisition of labels for objects. However, their acquisition needs to be understood in terms of different explanatory concepts since perceptually they capture different space from that of objects.

The principle of object scope put forward by Golinkoff *et al.* (1994) proposes that children are guided towards an understanding that words label objects rather than actions or anything else. The finding from **Chapter Eight** suggesting that blind infants are using words to label actions and events rather than objects would indicate that this principle is not guiding blind infants in limiting the possible meanings of words. Studies of sighted infants suggest that they are limiting the possible meanings of words by assuming that labels describe objects rather than anything else. It is proposed here that a *complete* absence of visual information would lead to blind infants being guided by a principle of action rather than object scope. The findings from the one SVI infant, Joseph suggested that he was relating words to objects rather than actions. The finding that SVI infants perform more in line with sighted infants is in line with previous studies (e.g. Mulford, 1988). To date, little is known about the extent to which sighted infants are guided by object scope rather than action scope. It would seem appropriate for the framework to recognize individual differences between infants in the extent to which they label objects or actions rather than to suppose that infants either label objects in preference to actions or vice versa. By doing this, the framework would recognize and start to address the criticisms aimed at it in **Section 2.7.3**. Infants who pay more attention towards actions would be regarded as showing a general bias towards actions, and conversely, those infants biased towards objects could be judged to be demonstrating object scope.

One component missing from Golinkoff *et al.*'s discussion of the principle of object scope is the extent to which conversational partners influence the extent to which infants will be likely to be guided by object rather than action scope. Peters (1994) suggested that the parent of the blind infant she studied provided event-casts - giving a running commentary - which enabled the child to break down events into sub-events making it likely that the child will be able to predict what action / object is going to be involved. Peters identified the usefulness of event-casts as providers of

information about action sequences in a cognitive sense as well as structural information in a linguistic sense. The providing of information about the sequences of events is very likely to lead linguistic development towards action/events rather than objects-centered orientation. It is therefore necessary to examine the way the dyad approaches the task of understanding that words are vehicles for meaning in situations where actions and objects are being used. This focus on the social-cognitive aspects of the word-learning context supports the approach proposed by Tomasello (1995) which is addressed below.

Social-pragmatic framework

Tomasello's (1995) social-pragmatic approach to lexical development focuses upon the importance of infants understanding the pragmatic intentions of others. As in the constraints approach, Tomasello identifies the three central 'tasks' of lexical development as being how infants understand reference, to what part of the environment the adult is referring, and how the infant knows which part of the action the adult is referring. However, unlike the constraints approach, Tomasello emphasizes the role of intention involved in each of these tasks.

Using the language of Tomasello's approach, the findings reported in this thesis suggest that all infants understood that their parents *intended* to refer. However, it appeared from evidence of their delayed ability to comprehend labels for objects that this ability to refer did not extend to understanding that other people can refer to objects. In contrast, the infants did not appear to have difficulties in understanding requests for action. On this basis, it is argued that an absence of visual information does not lead to a cognitive deficit, but rather that understanding that an adult intends to refer to objects is more difficult than understanding that an adult intends to refer to an action / event.

9.5. Strategies for promoting conceptual and lexical development

The conclusions from the first two aims of the thesis contribute to the third aim, to identify ways to promote conceptual and lexical development. Since the findings suggest that an absence of visual information does not lead to a cognitive deficit it is important to identify ways in which blind *and* sighted infants' conceptual-lexical functioning can be facilitated.

Since first words are an important developmental milestone for the parent of any infant, but particularly for parents of blind infants since new channels for communication are opened, it is possible that parents may draw conclusions about the rate of their child's general development from the extent to which their child is viewed as an early or late talker. It is reassuring for parents to know that infant's first words may emerge any time from their first birthday through toward the end of their second year. It is important to stress that factors other than an absence of visual information are more responsible for influencing the onset of first words. Thus this aspect of lexical development less open to interventions than other aspects of conceptual-lexical functioning.

Two themes running through this thesis, are, first that an absence of visual information is associated with a perceptual-cognition system which has easier access to temporal information than it does to information about objects and space; second, that there has been an imbalance between the study of what infants understand about objects and what infants understand about events and this imbalance is only just beginning to be rectified. One implication of this is that if parents expect their infant to rely on temporal information they will observe them learning to talk using information from actions and events. Talking about actions and introducing objects in terms of their actions and/or function is likely to be more effective than labelling

them without providing a context. Furthermore, the findings from the last study suggest that blind infants need to gain motor experience of acting on several objects so that they have the opportunity to make comparisons between objects and to experience how objects relate to each other.

One way of guiding dyads towards incorporating action/event based information into the interaction would be to point towards the role of rhymes and routines in play promoting early conceptual and communicative development. Rhymes and routines offer scope for blind infants to understand about the structure of events, to engage in rewarding emotional contact with their parents, and to learn to categorize actions.

It is important to reduce the bias towards assessing infants' understanding of objects in scales of developmental assessment. For example, there is a need to examine the degree to which blind infants understand phrases containing labels for actions as well as for objects. Failure to recognize that early conceptual functioning in blind infants is likely to be more grounded in temporal rather than object-based information will lead to an underestimation of blind infants' abilities.

9.6. Directions for future research

A systematic study of the nature of rhymes and routines used by some blind infants and their parents will shed light on how blind infants make use of temporal information to understand that adults intend to refer to actions and objects around them. Developments in the literature on sighted infants will aid the understanding of these issues (e.g. Tomasello, 1995). For example, by studying whether parents of blind infants use speech which precedes an action or whether their speech coincides with the action, it should be possible to see the ways parents make particular aspects of their infants' environment salient to them. This information will provide valuable insight into the extent to which it is possible to identify specific communicative

exchanges which serve to promote how blind infants understand that adults can refer to objects, as well as actions.

In light of the conclusion that blind infants can make their way into language using a route which is merely one end of a spectrum used by sighted infants, future studies of conceptual and lexical functioning in blind infants need to focus on the differences between dyads rather than making direct comparisons with sighted controls. For example, the study of blind infants will shed further light on the nature of holistic styles. If visual attention is shown to be less central to holistic approaches to language development, the study of blind infants will provide the most convenient way to examine these issues. In addition, since blind infants and their parents focus on temporal information to a greater extent than their sighted peers, a comparison study with dyads from Korea, where the role of objects is not emphasized in interaction, would serve as a vehicle to test the prediction that it is the absence of visual information per se which results in, or goes hand in hand, with a strong holistic approach to language learning.

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Appendix 1. Raw scores from performance on the Reynell-Zinkin Scales of s adaptation, sensorimotor understanding and exploration of the environment.

Infant	Vision	Age in mths (corrected)	Social adaptation	Sensorimotor understanding	Exploration of environment
Joseph	SVI	14.2	10	9	7
		20.8	14	16	9
		27.5	18	16	11
Kristian	Blind	23.0	7	9	4
		29.5	8	9	4
		35.6	9	9	4
Roxanne	Blind	14.6	11	8	4
		20.9	11	10	4
		27.2	11	11	4
Lottie	Blind	15.6	10	11	7
		22.0	18	15	10
		27.5	18	20	11
Kirstie	Blind	17.9	10	9	7
		19.4	11	11	7
		30.4	16	14	8
Morris	Blind	17.5	15	11	6
Robert	Sighted	13.0	12	11	6
		20.1	16	16	9
		24.3	18	16	10
Justin	Sighted	12.9	13	14	7
		18.9	17	16	10
		11.6	10	10	4
Jennie	Sighted	18.5	15	15	7
		24.3	17	15	7
		14.7	16	16	7
Sadie	Sighted	20.7	18	18	10
		25.8	18	18	10
		13.9	12	14	7
Laura	Sighted	21.5	14	17	11
		27.3	18	20	11
		15.1	10	14	7
Joshua	Sighted	22.6	17	15	10
		27.8	18	20	10

Appendix 2. Raw scores from performance on the Reynell-Zinkin Scales of verbal comprehension, expressive language (structure) and expressive language (content).

Infant	Vision	Age in mths (corrected)	Verbal comprehension	Expressive language: structure	Expressive language: content
Joseph	SVI	14.2	9	7	0
		20.8	10	13	0
		27.5	16	14	5
Kristian	Blind	23.0	8	7	0
		29.5	8	8	0
		35.6	8	9	0
Roxanne	Blind	14.6	8	7	0
		20.9	9	9	0
		27.2	10	13	1
Lottie	Blind	15.6	9	8	1
		22.0	16	16	6
		27.5	16	18	12
Kirstie	Blind	17.9	9	7	0
		19.4	9	8	0
		30.4	10	13	0
Morris Robert	Blind Sighted	17.5	9	8	0
		13.0	8	8	0
		20.1	10	11	0
Justin	Sighted	24.3	11	13	3
		12.9	10	9	0
		18.9	11	11	2
Jennie	Sighted	11.6	8	8	0
		18.5	10	11	0
		24.3	10	13	1
Sadie	Sighted	14.7	10	10	0
		20.7	16	12	5
		25.8	16	16	5
Laura	Sighted	13.9	8	8	0
		21.5	14	13	3
		27.3	16	14	5
Joshua	Sighted	15.1	10	8	0
		22.6	13	11	2
		27.8	13	12	3

Appendix 3. Diary record sheet

MORRIS'S WORD DIARY

When Morris says a new word (or a word that Morris has said before but with a new meaning to the last time he used it) please record it here.

The word is _____

Please delete whether this was a new word for Morris OR whether this was a word Morris has said before but this time with a new meaning.

New word / old word with a new meaning

Today's date _____

Briefly describe what was happening or what Morris was doing when he said this word:

(For example: Morris was eating mashed banana on your lap / a friend came into the room / you were both singing Pattacake / you were on the swings in the park / Morris was banging bricks together / Morris was smelling a flower)

Was Morris talking about a person or animal or thing? Yes / No

If yes, what was it?

Was Morris copying what you or anyone else had just said when saying this word?

Yes / No

Was Morris trying to get a message across when saying this word? Yes / No

If yes, what was the message?