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Cross-linguistic studies of lexical access and processing in monolingual English and bilingual Hindī-English speakers

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Cross-linguistic studies of lexical access and processing in monolingual English and bilingual Hindī-English speakers

A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy

in

Language and Communicative Disorders

by

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2006

Dedicated to the loving memory of my mentor, **Professor Elizabeth Bates**, who has been an inspiration to me both professionally and personally and a truly incredible person who will be missed dearly by all of her colleagues, students, family and friends.

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LIST OF ABBREVIATIONS

AoA	Age of acquisition
PN	Picture Naming
WR	Word Reading
HPN	Hindī picture naming
HWR	Hindī word reading
EPN	English picture naming
EWR	English word reading
RT	reaction times
L1	first language or dominant language
L2	second language or non-dominant language

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PREFACE

How are words and pictures accessed from the mental lexicon? What are the factors that affect the accessibility of these words? Do words that are learned early in life have the fastest access times? Why are words named faster than pictures? Do these two tasks tap into the same processes or different processes? Are there the same or different lexical-semantic systems involved in processing two languages? How do bilinguals access information? How are the languages represented and organized in bilingual children learning two languages simultaneously? Is there a critical period (i.e., maturational constraints) for learning a second language? These are some of questions that have been studied in psycholinguistic research in monolingual and bilingual language processing. Answers to these questions will enhance our understanding of "normal" language processing (in both monolinguals and bilinguals). Such information about language processing is essential for the development of general theories of language acquisition, processing and use. It is also needed for the development of appropriate methods of assessing and treating language impairment in children and adults.

The human capacity to understand and produce words is of great interest to language researchers and a wide range of questions has been posed. For example, how are words "listed" in the internal lexicon? Are the word forms and their meanings dissociable? What other information is included with a lexical "item"? In particular it has been assumed that the characteristics of the words it must co-occur with or those it can co-occur with are listed. Researchers in the field have additionally considered that there may be more than one lexicon for different modalities- one for the written word forms to some extent distinct from the one for oral word forms. Researchers have also asked how lexical items are accessed, or searched or located in the service of lexical processing and word and sentence production.

Broadly speaking, lexical access can be described as a process where perceptual stimuli (such as language: which combines oral, visual or sometimes tactile information) is transformed into a representation including semantic, syntactic and morphological properties of the word. In addition, the individual has access to motor programs enabling him/her with the means to speak, sign or write the word (Federmeyer & Bates, 1997). Understanding this process of "lexical access" is one of the fundamental questions in psycholinguistic research. The study of lexical access is important for two reasons. Not only will such study help us understand an integral component of the language system, but also more generally, studies of lexical access allow us to address a fundamental question about brain function: how does previously stored information about an input pattern get retrieved? One approach to studying lexical access has been to determine what kind of stimuli and processes (i.e., both cognitive and linguistic) can affect it. The lexical domain is well suited to an experimental study of this problem, since words form a well-structured and easily manipulated set of patterns (Forster, 1992). In a variety of language tasks, words are not easily accessible; some tasks take longer to produce and recognize words than others. Accessibility refers to the speed of retrieving items (including lexical items) from a long-term memory (Lachman et al., 1974; Cirrin, 1983). The problem of accessibility has been approached by studying psycholinguistic variables (such as frequency of word occurrence, age of acquisition of the word, etc.) that affect the speed of retrieving words from lexical memory (Carroll and White, 1973b; Lachman et al., 1974). In psycholinguistic research, rapid picture or word naming tasks are commonly used to study the processes underlying lexical access.

The present dissertation is aimed at examining monolingual and bilingual lexical access to address some of these issues.

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ABSTRACT OF THE DISSERTATION

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The present dissertation addresses a set of questions about processes involved in lexical access and literacy and psycholinguistic factors (such as word learning age, word frequency etc.) that affect them in monolingual and bilingual speakers. Four experiments examined these issues for nouns in native English speakers and bilingual Hindī-English speakers with a developmental perspective. Experiments 1 and 2 were conducted with English monolinguals in San Diego. In experiment 1, age of acquisition norms were collected from college-age adults. In experiment 2, online picture naming data was collected from four age groups of English monolinguals (5-7, 8-10, 11-13 and college-age adults). Experiments 3 and 4 were conducted on Hindī-English bilinguals in India. In experiment 3, age of acquisition and word frequency norms were collected from college-age adults. In experiment 4, online picture naming and word reading data were collected from three age groups of Hindī-English bilinguals (8-10, 11-13 and college-age adults). Comparisons of performance on two lexical access tasks (on-line picture naming and word reading) in monolingual English speakers and bilingual Hindī-English speakers, were conducted. Results and discussion are aimed at addressing issues of language processing, lexical access and development. Overall, results indicate that there is developmental improvement on the lexical access tasks. In addition, the predictor-outcome relationships are generally similar for both monolinguals and bilinguals. Age of acquisition is the most consistent predictor of both picture naming and word reading behavior, in both monolingual and bilingual speaker. There are differential effects of frequency in the languages of the bilingual in the word reading task, with orthographic differences interacting with frequency effects. However, there are interesting differences that arise between the monolinguals and within the bilinguals, because of language dominance and proficiency. Results and discussion focus on quantitative analyses, examining lexical access processes in monolinguals and bilinguals, and examining the relationship between the psycholinguistic variables (such as age of acquisition, frequency, and syllable length) and performance on the language production tasks. Future directions focus on highlighting some limitations of this research, in addition to discussing the need for more in depth qualitative analyses, and extending these paradigms to clinical populations.

CHAPTER 1

LEXICAL ACCESS IN MONOLINGUAL SPEAKERS

1. Models of lexical access in speech production

One of the more important yardsticks of one's skill in language is the ability to speak it fluently. Therefore, it should come as no surprise that language production is one of the three core topics in psycholinguistics, along with language comprehension and language acquisition. However, interestingly enough, in psycholinguistic research, language comprehension has received more attention than language production. About three decades ago, Fodor, Bever, and Garrett (1974, p.434) observed that, "Practically anything that can be said about language production must be considered speculative even by the standards current in psycholinguistics." This pessimistic outlook in the above quote is reflected by the paucity in production research, which is typically attributed to the problems of achieving the ideals of experimental control and measurement (Bock, 1996). However, when one extends one's sights beyond the traditional experiment, the quantity and diversity of information about production is substantial, ranging from artificial intelligence through articulatory phonetics to psychoanalysis, rhetoric and psycholinguistics (Scheriefers, 2005). Analyses of spoken language from all these different domains offer some useful insights into the processes involved in language production. Research in language production for the past couple of decades has undergone a rapid transformation from an observational enterprise to one with a set of experimental paradigms and modeling techniques for examining different types of questions (Bock, 1996).

Given the scope of this dissertation, I will briefly review two groups of models coming from different philosophies and highlight the salient features of a prototypical model from each group. One of the most influential models of language production has been proposed by Garrett (e.g., 1976, 1980, 1988). According to this model, the formulation of a sentence involves a sequence of processes generating different levels of representation, i.e., the preverbal representation, functional representation, and positional level representation (for a more detailed review see Garrett, 1980, 1988). In this model, lexical access to content words involves two distinct stages i.e., lexical selection and retrieval of word forms, and proceeds in two serially ordered and independent stages.

Following this seminal proposal by Garrett (1975, 1976), current models of speech production assume that lexical access occurs in two main "stages" (e.g., Bock, 1995; Carramazza, 1997; Dell et al., 1997; Levelt et al., 1999). In the first stage, the lexical item corresponding to an intended meaning is activated and selected from a set of activated lexical nodes. In the second stage, the phonological properties of the selected lexical node are retrieved and the word is finally articulated. There is also general agreement on the assumption that semantic representations activate multiple lexical nodes during the first stage of lexical access. That is, it is assumed that the semantic system activates not only the intended lexical item but also other semantically related words. The lexical node with the highest level of activation, usually corresponding to the intended meaning, is selected. However, there are major differences among the models of lexical access. One of the most important areas of disagreement concerns whether stages operate in discrete, serial order or in cascaded fashion.

Serial Access Models

The discrete serial models of lexical access (e.g., Levelt, 1989: Levelt et al., 1999; Roelofs, 1992; Schriefers, Meyer & Levelt, 1990) posit that only the lexical node selected in the first stage sends activation to the phonological layer. According to this view, the activation of semantic competitors at the lexical node layer does not lead to the activation of their phonological properties. Furthermore, the phonological content of the target word receives activation only after the target lexical node has been selected. Thus phonological activation is restricted to the selected lexical node.

To understand the salient features of serial access models, I will briefly describe Levelt's model (1989), which is a prototype of the serial access models. In Levelt's model, speech production is divided into four steps: *message generation, grammatical encoding, phonological processing* and *articulation.* These steps are covered by three autonomous processing components: *the conceptualizer*, *the formulator*, and *the articulator*. The assumption of autonomy (often referred to as the modularity principle) has important implications for the functioning of the model. It forbids all interaction between the processing components (or modules), which means that each component is operating independently, and is unaware of what is happening in the previous or following parts of the production process. Each of the three processing components contains a number of procedures that make up the speaker's procedural knowledge. The procedures operate on the declarative (or factual) knowledge that is stored in the speaker's memory. The first processing component, the conceptualizer, generates messages. The formulator covers two steps of the speech production process: grammatical encoding and phonological encoding. In the third component, the articulator, the phonetic plan is transformed into overt speech. To account for the fact that speech production process is very fast, Levelt (1989) suggested that it is largely automatic. The high degree of automaticity allows the speech production process to operate incrementally, which means that it combines serial and parallel processing. Each fragment of the message goes through each of the processing components in the same order. As soon as a fragment exits one component, the next component starts operating on it. Levelt's model (1989) of speech production also includes a speech comprehension system, which speakers use to parse both internal and overt speech. There have been some revisions to the original model since 1989 and the more recent models have adapted more features from the network models (e.g., Roelofs, 1992).

Cascaded or Interactive Activation Models

In contrast, the cascaded activation models of lexical access (e.g., Caramazza, 1997; Dell, 1986; Dell et al., 1997; Dell & O'Seaghdha, 1991, 1992; Humphreys, Riddoch & Quinlan, 1988; Harley, 1993; Peterson & Savoy, 1998) assume that activation flows continuously from the lexical layer to the phonological layer. According to these models, all lexical nodes activated through the semantic system spread some proportional activation to their corresponding phonological segments, regardless of whether they are selected. Therefore, phonological activation is not restricted to the lexical node selected in the lexical layer.

To give the reader a better understanding of the general idea about this group of models, I will briefly review one of the more important models in this category, Dell's model of speech production (1986, 1988). Dell's theory combines aspects from linguistic theory, such as linguistic levels, rules, and units, with the mechanism of spreading activation. According to Dell (1986), at least three levels of encoding need to be distinguished: syntactic encoding, morphological encoding and phonological encoding. Each level of encoding is associated with a set of productive or generative rules that define the possible combinations of units at that level. The rules are said to generate frames with categorized slots. At the morphological level, these might be slots for stems and affixes, and at the phonological level, there might be slots for onsets, nuclei, codas, consonants and vowels. The slots are created by the linguistic rules need to be filled in with units, such as words, morphemes or phonemes. These units are stored in the lexicon, which has the form of a hierarchical network with connections between the nodes at the syntactic, morphological and phonological levels. The units are specified for the category to which they belong. Retrieval of the required units from the lexicon takes place via the mechanism of spreading activation. In general, the node of the required category with the highest level of activation is the one that will be selected. After its selection, its activation level drops to prevent its being selected over and over again. The nodes that have been selected to fill in a frame’s slots are tagged (to specify the order in which they need to be encoded), and together, they constitute a representation of the sentence to be spoken. Higher-level representations, such as those at the syntactic level, guide the selection of the nodes at the lower level. Thus, a word selected to fill a particular syntactic slot will spread activation to the morphemes that are needed to fill the slots of the corresponding morphological frame. Similarly, activation will spread from the morphemes to the phonemes needed for phonological representations.

To summarize so far, the various models of language production that have been proposed can be broadly categorized into two distinct groups. Despite the fact these two groups of models are similar in many respects there is one critical difference between them. The interactive activation accounts of word production have bidirectional connections i.e., interactions between the various linguistic levels. By contrast, the discrete two-stage theories adhere to the principle of modularity, strictly prohibit bottom-up information flow, and do not allow bi-directional flow of information between the different processing components.

Now with a clearer idea about the issues/models in the area of language production, I will focus on one of the component processes of language production, i.e., lexical access. There is now a rapidly growing body of empirical data that enables us to better understand the processes involved in language production. New experimental procedures and tasks have been developed, and at least for some component processes like lexical access and grammatical encoding, explicit computational models have been developed (Schriefers, 2005). Word reading and picture naming, described in some detail in the following sections, are two of the more frequently used tasks to understand lexical access.

1.1. Picture Naming

The cognitive operations underlying picture naming have long been of both theoretical and practical interest (Snodgrass et al., 1996). Many cognitive psychologists consider naming of objects to be one of the fundamental abilities that humans use to communicate through language (Brown, 1958; Terrace, 1985). Some of the earliest studies which examined picture naming were carried out by Cattell (1886). Since then, numerous studies of picture naming have been conducted across a range of paradigms including not only behavioral methods, but also neural imaging and electrophysiological measures designed to elucidate the processes and brain regions involved in picture naming (Snodgrass et al., 1996; Murtha et al., 1999; Hernandez et al., 2000). For the past two decades, on-line research methods have become increasingly popular in language production research. Of these methods, picture naming, the laboratory analogue of object naming (as pictures), is one of the more frequently used tasks. Vocabulary knowledge and single-word retrieval are quite sensitive to individual differences in cognitive ability and to impairment of the cognitive system (Michael & Gollan, 2005). Lezak (1995) observed that vocabulary tests are highly correlated with verbal IQ and the inability to name objects (or pictures) is one of the most common cognitive complaints reported even after very mild brain damage (Michael & Gollan, 2005).

At a very general level, the act of naming of an object is thought to comprise of a number of stages. The first involves visual processing of the object that ultimately leads to the activation of a representation in the conceptual system, i.e., object recognition. With this stage, sensory information about the object becomes available. Since there will be simultaneous activation of other representations, the next stage is concept selection. All current models of language production assume that lexical access involves not only activation of the target lexical representation but of several candidates. The next stage is lexical selection or the selection of the target word from the set of candidates. This is followed by the activation of the phonological word form that can be articulated. These operations must occur quickly and efficiently in fluent speech with the assumption of more or less sequential occurrence. How quickly and efficiently the objects are recognized, therefore depends on (a) efficiency of the visual process in extracting information from the stimulus, (b) how the objects are represented in long term memory, and (c) how the activation and matching takes place (Glaser, 1992, Johnson et al., 1996, Barry et al, 1997, Barry & Hirsh, 2001).

Despite their overall similarities, cognitive models of naming differ in certain particulars. In the dual coding model (Paivio, 1971, 1986), cognition is assumed to be based on two independent but interconnected, non-verbal and verbal representational subsystems. The nonverbal subsystem consists of non-linguistic object representations or "imagens" (Paivio, 1986) and the verbal subsystem of linguistic word representations "logogens" (Morton, 1969, 1979). Internal representations in both subsystems are assumed to be modality-specific, retaining characteristics associated with direct perceptual experience. Most relevant to picture naming are the visual characteristics of imagens and auditory-motor characteristics of logogens. During naming, the stimulus picture directly initiates representational activity within the non-verbal subsystem. Activation accumulates until the recognition threshold for a particular imagen is exceeded (i.e., the pictured object is identified). Activation then spreads by way of referential connections from the imagens to the associated logogens (names) in the verbal representational system. One logogen may eventually receive sufficient activation to exceed its threshold, thereby initiating production of that name as a response. Dual coding theory also assumes that a stimulus activates multiple representations in proportion to their structural similarity to the target representation. This assumption of spreading activation is necessary to account for facilitative and interference effects of similarity in a host of semantic and episodic memory tasks (Paivio, 1986).

Other models of naming parallel the dual coding model in the assumption of separate subsystems representing modality-specific information. However, in addition, many models include an abstract, amodal form of representation for the meanings of pictures and their names (Potter & Faulconer, 1975; Snodgrass, 1984), such that pictures activate their names primarily by way of an indirect route through the amodal semantic system. Thus, in the case of picture naming, these models assume four rather than three, processing stages. Early visual processing generates an initial image-like representation, which retains surface features of the stimulus object which then activates a conceptual node in the amodal semantic system that corresponds to the meaning of the object (i.e., the concept is identified). Meaning access then permits representation, which in the fourth stage leads to subsequent production of that name.

Other more recent models also incorporate abstract conceptual representations but differ from the four stage amodal models in the organization of naming stages. For example, Glaser (1992) distinguished between the two cognitive subsystems: the semantic and the lexicon. During naming, the semantic system subsumes the functions attributed to the first two stages of amodal models: initial processing of objects or pictures and conceptual access. Thus, Glaser envisioned three naming stages: concept identification, name activation and response generation.

Implications of Picture Naming Models for Development

Most of the theoretical models of picture naming have been based on adult performance. While some researchers have extended the adult models to developmental data to explain the patterns seen in picture naming performances in children (Cycowicz, Friedman, Rothstein, & Snodgrass, 1997; D’Amico, Devescovi, & Bates, 2001; Berman, Friedman, Hamberger, & Snodgrass, 1989; Cirrin, 1983; Johnson & Clark, 1988) there is still much to do. From the developmental literature, it is apparent that children’s performance on picture naming tasks becomes better with increasing age until they reach adult levels of performance. This is reflected in faster response times, and closer approximation of adult levels of naming accuracy with increasing age (Berman et al., 1989; Clark & Johnson, 1994). There are also changes in the nature and distribution of naming errors during development (Wiegel-Crump & Dennis, 1986), where one would see, that with increasing age, there is an increasing number of correct names and errors that are semantically related to the target in lieu of the "no responses" (i.e., omissions). These changes presumably are a result of the overall cognitive development which includes both non-linguistic and linguistic knowledge.

A challenging problem in the developmental literature on naming is to understand and isolate the error responses on the picture naming task due to the children's lack of word or object knowledge from naming difficulties per se. In this regard, there have been very few attempts to determine which naming stages are affected by development (Bisanz et al., 1979; Hoving et al., 1974; Johnson, 1994, Clark & Johnson, 1994). If one approaches this problem logically, developmental changes could occur at any or all stages of naming and at similar or different rates across various stages. We need additional evidence of the developmental changes at specific stages in order to build a model that would account for both adult and children's performance (Johnson et al, 1996).

In summary, lexical predictors such as age of acquisition and word frequency are the most important determinants of naming behavior on picture naming tasks. Some studies have also reported other psycholinguistic variables such as goodness of depiction ratings as being significant predictors in picture naming behavior. In addition, the findings in the literature indicate that while similar factors affect performance of children and adults on the picture-naming task, children are less efficient than adults. The performance differences across age cannot be readily explained by a developmental change in the psycholinguistic variables (such as frequency, age of acquisition, etc.) affecting lexical access, because these appear to be very similar in adults and children. Chi (1976, 1977; Cirrin, 1983) suggested that developmental differences in picture naming latency are due to the use of more efficient processing strategies by older children and adults. In accordance with this view, some researchers have suggested that organizational factors and the representation of items in memory are similar in children and adults (Cirrin et al., 1981; Nelson et al., 1975). Conversely, qualitative differences appear to exist in the strategies used to access stored information by children and adults (Chi, 1977; Cirrin, 1983). However, what are yet to be understood is how the principles underlying the structure of the immature lexicon differ from those of the mature lexicon, and how and when these factors change over time. Models of picture naming will need to explain not only increased developmental mastery, but also the age-dependent loss of certain kinds of non-target naming such as production of word associations and the generation of nonwords phonologically similar to target names.

1.2. Word Reading

Research on visual word recognition (i.e., also called *word reading*, *word naming* or *word pronunciation*) has mainly attempted to understand how the properties of words influence processing and has mostly focused on the issue of lexical access. A number of models of the lexical access process have been proposed, each providing a slightly different account of the various factors that affect this process. Before discussing the relevant literature in word reading, I will briefly review some of the most influential models of word reading, which include: Morton's (1969) logogen model, Forster's (1976) search model, and Becker's (1976) verification model. In addition, I will briefly review two connectionist models of word reading belonging to two different classes: Interactive Activation Model (IA) model (Rumelhart & McClelland, 1982; McClelland & Rumelhart, 1981) which is a direct access model and the Seidenberg & McClelland model (1989) which is a prototype of the parallel distributed processing models.

Morton's (1969, 1982) logogen model is one of the earliest examples of a direct access, interactive activation based model of word recognition. Each word in the lexicon is represented by an independent, information detecting unit called a *logogen* that contains orthographic, phonological, syntactic and semantic information. Logogens monitor the input signal (auditory or visual) for relevant information. As information is gathered, the activation levels of the logogens rise. When a logogen has gathered enough information to exceed a recognition threshold, the information contained in the logogen becomes available to the cognitive system. Therefore, words which have been primed by semantically related words will be recognized faster than unprimed words. The word frequency effect is explained by assuming that logogens corresponding to high frequency words have a higher initial resting level than low frequency words.

The major alternative to the direct access models such as the logogen model has been Forster's (1976) search model. Forster assumes that lexical access takes place by means of a frequency ordered search through an orthographically or phonologically defined subset of the lexicon. In this model, frequency is the primary mechanism by which the lexicon is searched. Low frequency words will therefore tend to be recognized more slowly than high frequency words since their lexical entries will be searched later than those of the high frequency words. In addition to the frequency ordered search, words can also be accessed by semantically driven search operating in parallel with the frequency ordered search. A word will be recognized as soon as either of these searches is successful. The semantic-search operates by means of semantic cross-referencing between individual lexical entries. In Forster's overall model of language comprehension, lexical access is a completely autonomous subcomponent of a strictly bottom-up system.

Becker's (1976) verification model represents a synthesis of concepts from both the logogen model and the search model. The presentation of a word results in the generation of a perceptually based candidate set, the sensory set. Candidates in the sensory set are ordered in terms of their frequency, with high frequency words being verified before low frequency words. The effect of context is to generate a second set, the semantic set. The semantic set contains contextually probable words and is presumably equivalent to the set of primed words in the logogen model. Like priming in the logogen model the semantic set becomes available before the word to be recognized is presented. A new word can be verified against the semantic set as soon as it is presented and before the perceptual set can be generated. Words which appear in the semantic set will therefore be recognized faster than words which appear only in the sensory set. Perhaps the most interesting aspect of the verification model is that it gives an account of inhibition which does not depend on the operation of an attentional mechanism or some higher level process. Inhibition is a consequence of the fact that the semantic set must be searched before the sensory set. A further interesting property of this model is that it predicts that the magnitude of the inhibition will simply be a function of the size of the semantic set.

The Interactive Activation (IA) model recognition (McClelland & Rumelhart, 1981; Rumelhart & McClelland, 1982) is an elaboration of the logogen approach. The IA model of visual word comprises three different types of units/codes corresponding to linguistic representations at three hierarchically arranged levels: visual letter features, letter units and word units. When a string of letters is presented to the IA model, this visual input switches on particular features at each letter position, which subsequently excite letters that contain these features which then excites words in which that letter occurs in the spatial position in question. In this way, activation feeds up from the bottom of the model to the top. However, it also feeds from the top down, so that words reinforce the activation of the letters that comprise them, and letters reinforce the features that comprise them. Units at a given level inhibit other units at the same level which form inconsistent interpretations of the input. At each level units compete to be the winners. Thus the model settles into a state whereby a single letter is recognized in each letter position, and a single word emerges as the most active. Only one set of word units is proposed for both orthographic and phonological modalities. The IA model accounts for the frequency effect by allowing high frequency words to have a higher "base rate" activation level.

The distributed model of word recognition was introduced by Seidenberg and McClelland in 1989 as part of their wider theoretical framework seeking to detail some of the psychological processes that underlie reading. The preceding approaches to word recognition have posited a 'localist' representation for each word stored in the lexicon, be they in lists or network. Stored along with each word is its pronunciation and the task of recognition and naming thus involves accessing the correct 'word unit'. Seidenberg and McClelland propose a radically different approach, whereby word recognition is a question of computing codes, specifically orthographic (letter), phonological (sound) and semantic (meaning) codes. Mapping between the codes is achieved using distributed representations developed over connectionist networks during exposure to a corpus of words. In short, Seidenberg and McClelland denied that there is a need for word unit representations at all. In some respects, the Seidenberg and McClelland model can be seen as a progression of the IA model, in the sense that statistics of word frequency (and the frequencies of letter associations within those words) are captured within the structure of both models. But while the IA model required the help of the modelers to build in this information, in the distributed model, its presence is due to the nature of the task itself. The combined influence of all the mappings of the network acts on a shared set of connection weights, and imprints structure onto the network. The Seidenberg and McClelland model was constructed with two main aims in mind. Firstly, the model was expected to learn regular words, exception words and novel letter strings, using the same distributed network. Traditional accounts of naming (e.g., Coltheart, Curtis, Atkins and Haller, 1993) have proposed a dual-route model of naming maintaining that regular and novel pronunciations were performed by a separate functional system from the one that generates pronunciations of exception words. Secondly, the model was intended to show how the ability of subjects to make lexical decisions could be explained without recourse to localized representation of words, or initially even without recourse to meaning (for a more detailed review of the connectionist models see Dijkstra & de Smedt, 1996). The Seidenberg and McClelland model is an interactive model for the reading system. The model recognizes words as follows. The perceptual system is assumed to pre-process the input and provide orthographic coding of the stimulus to the network. From this, semantic and phonological codes are computed via banks of hidden units. The orthographic information is then reproduced on the input units. This reproduction process allows the model to test the familiarity of the letter string. The model comprised a standard three layer feedforward network, trained with the backpropagation learning algorithm (Rumelhart, Hinton & Williams, 1986). The model simulates the naming data by virtue of the fact that frequency, regularity and consistency are all mediated by a common mechanism that of changes to the network's weights.

In recent reviews of the word recognition literature, Marslen-Wilson (1990) and Forster (1989) have commented that current models of word recognition are becoming increasingly similar to each other. In their original forms, many of the models made strong predictions about the effects of different lexical variables on speed and accuracy. However, with failure to support these predictions, the models have been revised. Many of the core assumptions that differentiated the various models have been weakened or lost, and this revision process has led to a convergence of the models on a few basic principles.

a. A basic assumption that underlies current models of word recognition is that there is activation of multiple candidates during the early stages of the recognition process. Also, the models are more or less similar regarding the assumption of a strict serial search through the entire lexicon which becomes unsustainable when the size of the lexicon is compared to the speed and efficiency of word recognition (Feldman & Ballard, 1992; Forster, 1989).

b. Most of the models have also assumed a small set of selection rules which are key to understanding how a unique word is selected from a set of possible candidates.

c. Another principle shared by many models addresses the common problem of the conversion of the physical signal into a form that can make contact with some symbolic code in lexical memory. With the exception of a few models (Klatt, 1979, 1989), most models of word recognition operate via a process that matches the input against stored representations based on acoustic-phonetic or orthographic structure of the word (Forster, 1978; Luce, 1986; Marslen-Wilson, 1987; McClelland & Elman, 1986).

This concluded our overview of the main models of language production in monolinguals especially, picture and word reading. It is noteworthy, that these models have been developed largely on the basis of data from monolingual speakers. In the next chapter, I will discuss relevant aspects of bilingual lexical access.

CHAPTER 2

BILINGUALISM

A bilingual/polyglot is a person who understands and uses two or more languages to varying degrees and in different contexts in daily life. Researchers in this field have debated over whether the term "bilingual" or "multilingual" should be reserved only for those who have near perfect or equal command over two or more languages, or should be used to refer to any person who uses two or more languages on a regular basis. Although the former definition is endorsed by some researchers, others contend that it represents an unrealistic and monolingually-based view of bilingualism (Fabbro, 1998). As Grosjean (1989) points out, it is inappropriate to regard bilingual individuals as the sum of two monolinguals since bilinguals use their languages in different situations and with different audiences and this is reflected in their knowledge and performance in each language. Thus, the term "bilingual" should, realistically speaking, be used to designate an individual who uses two languages on a regular basis. Similarly, the term "multilingual" may apply to any person who uses more than two languages on a regular basis. Although multilingualism may not be directly comparable to bilingualism, for the present purposes the term "bilingualism" will be used to encompass cases of multilingualism (Genesee, 1994). Following Grosjean (1982; 1999) and Fabbro (1999), the term "bilingual" will be used to refer to any adult or child who uses two languages on a regular basis, regardless of his/her relative proficiency in each.

Viewed globally, bilinguals constitute a majority of the world's language users (Fabbro, 1998). Furthermore, bilinguals are clearly a heterogeneous group, varying in such dimensions from one another as the manner of language acquisition (formal vs.

informal), the context of the current use of each language, the degree of proficiency in spoken or written aspects of each language and the degree of structural distance between the languages. Any of these dimensions of language experience may influence language processing or representation. However, most theories of language organization, until recently, have not addressed how bilingual language experience might matter, and have focused instead on single language users as the implicit norm. Viewing monolinguals as the canonical language user has in turn had distinct repercussions for how research on bilingual or multilingual users has been conducted and interpreted (e.g., bilinguals have either been ignored altogether, or when studied have been depicted as the sum of two monolinguals in one person, thereby not considering how knowledge of one language may influence processing of another language). Only over the past few decades have there been systematic approaches to studying language processing and language impairment in bilinguals as distinct from monolinguals, or from other bilingual subgroups. In the current era of interdisciplinary research, researchers are approaching the study of bilingualism from various perspectives, asking questions and developing models about language acquisition, processing, organization, and breakdown in multiple language users (Hernandez et al. 1999; Vaid et al., 1991; Wulfeck et al, 1986). In the following section, I present a selected overview of issues in bilingualism research, with a particular emphasis on models of bilingual language production.

1. Lexical Access in Bilingual Speakers

Since the 1960's, a central aspect of bilingual research has been directed at understanding the organization of the bilingual mental lexicon, especially on the question of whether there is a single integrated lexicon or separate lexicons for the individual languages. Most of the research has been on lexical representation (Schreuder & Weltens, 1993), but some research has examined lexical processing and production. The question of lexical-semantic representation in bilingual adults began to be addressed several decades ago and remains unresolved today. As is the case with models of monolingual lexical-semantic representation, several models of bilingualism were proposed and continue to be tested (e.g., Weinreich, 1953; Lambert et al., 1958; for reviews see Keatley, 1992; Francis, 1999). These models make different predictions for different ages and manner of second language acquisition and for varying levels of proficiency. As some researchers have pointed out (Heredia, 1997; Grosjean, 1999; Francis, 1999), the results of these studies may reflect different processing demands across languages, tasks, and individuals rather than actual models of organization or representation. Converging evidence from numerous studies has suggested that two languages within a bilingual person share at least some, if not all, of the same underlying conceptual representations although some studies point to language-specific representations (e.g., De Groot & Nas, 1991; Kirsner *et al.*, 1984; Chen & Ng, 1989; Grainger & Beauvillain, 1988; De Groot & Nas, 1991; Jin, 1990; Durgunoglu & Roediger, 1987; Kintsch, 1970, Glanzer & Duarte, 1971; Heredia & McLaughlin, 1992; Kolers, 1966; Paivio *et al.*, 1988). The revised hierarchical model of lexical-semantic processing in bilinguals is based on the premise that a common conceptual store subserves separate lexical systems that are functionally-connected (Kroll & DeGroot, 1997). Recent research in bilingual word recognition suggests that words in both of the bilinguals' languages are typically activated even under conditions when the input or output is only in one language, or even when the task does not require processing in the other language, suggesting that lexical access is not language-selective in bilinguals (Grainger & Dijkstra, 1992; van Heuven *et al.*, 1998).

2. Models of Speech Production in Bilingual Speakers

When learning a second language (L2), individuals usually report being better able to understand than speak their L2. This is also typically the profile observed in children during early stages of language acquisition, with comprehension being far greater than production. However, this difference may depend on how the L2 is learned and may lessen over time, and eventually disappear with increasing proficiency in both languages. This difference at least in the early stages of language acquisition suggests that the processes involved in L2 speech production and comprehension require different levels of language competence (Costa & Santesteban, 2004a, French & Jacquet, 2004). Most of the earlier research in bilingualism has focused on language comprehension. Much less research has been dedicated to developing models of language production in bilinguals. This could be a reflection of the state of affairs in the monolingual literature, where the current models of language production in monolingual speakers are not very well developed or because of the intrinsic difficulty in developing experimental paradigms in language production (Costa, 2005). Over the past two decades, however, some researchers have tried to develop models accounting for the entire speech production process from the conceptualization of messages to their articulation (De Bot, 1992; De Bot & Schreuder, 1993; Green, 1986; Poulisse & Bongaerts, 1994). In the following section, I will review the bilingual models of language production.

Bilingual Data of Relevance for Speech Production Models

Speech produced by bilingual speakers, and particularly speech produced by unbalanced bilingual speakers, who are still learning the second or foreign language (both referred to as L2), has certain characteristics that need to be taken into account when developing a model of second language production (Poulisse, 1997).

First, in the case of unbalanced speakers, there is the obvious point that L2 knowledge is not complete. L2 speakers generally have fewer words at their disposal than L1 speakers. In addition, L2 speakers' grammatical knowledge is often underdeveloped; this may lead them to avoid certain grammatical structures in L2 or to produce sentences that are ungrammatical. Second, L2 productions tend to be more hesitant, to consist of shorter sentences, and to contain more slips of the tongue than L1 productions. Third, L2 speech may carry traces of L1, especially when the learner's proficiency level in L2 is low. Deliberate use L1 system is often manifested as "code-switching" (Grosjean, 1982). According to Grosjean, these code-switches are sometimes motivated by a lack of a particular word in one of the languages or the greater availability of the word in the other language. Other forms of code-switching are sometimes socially or psychologically motivated. L2 speakers may also unintentionally use their L1 system. These are referred to as "performance switches" (Giesbers, 1989, cited in Poulisse, 1997). There are studies that show that while bilingual speakers often move between their two languages with ease, they are also capable of staying within a given language, as when addressing monolinguals. This ability to control which language to use when is another aspect that needs to be accounted for by models of second language production.

In summary, second language production differs from first language production in three ways: L2 knowledge base is incomplete, the procedures lack automaticity, and the two languages may be mixed, either intentionally or accidentally. Of these three differences, monolingual models of speech production can easily account for the first two. One can assume that the lexicon contained fewer and less specified items and that processing is to some extent serial rather than parallel to allow sufficient attention to be devoted to the different steps. Only the third difference, the possibility of mixing the two languages, seems to pose a problem for monolingual models, in that it requires existing monolingual models to be modified. Below I consider some models of language production that address the case of second language users.

Green (1986) proposed a second language production model using the subset hypothesis. According to this hypothesis, bilinguals have two subsets of neural connections, one for each language, where each can be activated and inhibited independently. At the same time, they possess one larger system from which they are able to draw elements of either language (i.e., independent and interdependent). Green proposed a framework that is meant to account for the performance of normal as well as brain-damaged bilinguals. In view of the fact that bi- or multilingual brain-damaged patients sometimes lose command of one language but not the other, he supposed that the bilingual's languages are organized in separate subsystems. Green proposed that these subsystems could be activated to different extents. He distinguished three levels of activation. Languages are most activated when they are "selected", that is, when they are currently being spoken, and hence control the speech output. They are less activated but still "active" when they are in regular use, but not spoken at that time. Active languages play a role in ongoing processing, and that accounts for the occurrence of language interference effects in bilingual lexical tasks or L1 transfer effects in L2 speech. Finally, languages are least active when they are not t in regular use and do not affect ongoing processing. In Green's view, a bilingual speaker who wishes to speak a particular language must ensure that its activation exceeds that of the competing languages. In addition, Green postulated the existence of a device called a "specifier", which specifies the system to be controlled in case of language switches or translation from one language to the other. Green paid much attention to the resources that are needed to regulate the activation levels. The resources are described as energy, or fuel, without which the system cannot work. Since the resources are limited, they must be replenished in time to keep the system running, to avoid breakdown (i.e., occurrence of errors). Green's model of bilingual language production and his representation of languages as subsystems that can be activated bears resemblance to Dell's (1986) model where the words of the language are stored in a neural network from which they are selected as a result of activation spreading among them. An advantage of Green's model is the notion of a 'specifier' that sets the activation going. Another advantage is that of the explicit role given to the resources. This makes it possible to explain why beginning learners of L2 suffer more from L1 interference effects than advanced learners. Beginning learners need to invest more energy in learning and speaking L2; as a result they have fewer resources to suppress the activation level of L1. A drawback, however of Green's model is that it is fairly general and fails to give a detailed account of the morpho-phonological encoding in bilinguals' speech.

Another model of bilingual word representation, which bears similarity to Dell's idea of a hierarchical network, has been recently developed by Grainger and Dijkstra (1992). This was based on the connectionist network model of visual word recognition, the Interactive Activation (IA) model, developed by McClelland and Rumelhart (1981; cited in Grainger and Dijkstra, 1998). Grainger and Dijkstra proposed a Bilingual Interactive Activation (BIA) model of visual word recognition. They assumed three representational levels, containing letter nodes, word nodes, and language nodes respectively. The nodes are connected with each other, both within and between levels. An important feature of the model is that word units are activated in parallel. Thus, unlike most of the existing models of bilingual word recognition, this model features a search process that is not serial. There are two versions of the BIA model, one in which activation spreads unidirectionally, from letter units to word units to language units, but not the other way around, and another version that allows activation to spread in both directions. These two versions are considered to be implementations of the two most common hypotheses regarding lexical representation in search models of bilingual word recognition, i.e., the language tag hypothesis and the language network hypothesis. For this reason, Grainger and Dijkstra (1992) support the "language network" version of the BIA model. The crucial experiments are those that show language context effects in bilingual lexical decision tasks. A unidirectional version does not allow for activation to spread from the language to the word level. Grainger and Dijkstra (1992) using this model could support the idea that in the initial phases of word recognition, words belonging to different languages may be activated simultaneously.

A more complete account of bilingual speech production was first given by de Bot (1992). De Bot based his model on Levelt's (1989) model of speech production. He retained most of the features of the original model, making only the changes that were absolutely necessary. The first issue was about the decision to speak in one language rather than the other. Following Levelt's (1989) account of registers, such as casual talk or telegraphic speech, de Bot argued that the decision to speak in a particular language must be made in the conceptualizer, because it is influenced by the speaker's knowledge of the situation, including the participants and their knowledge of the languages. De Bot then raised the problem that not all languages lexicalize concepts in the same way. To solve this problem, he suggested that the language to be used is determined in the conceptualizer as part of macro planning and that subsequently, during micro-planning language specific encoding takes place, so that the preverbal message contains language specific information to be lexicalized by the formulator. With respect to the second component in Levelt's model, the formulator, de Bot (1992) hypothesized that it is language-specific, meaning that different procedures are applied to the grammatical and phonological encoding of L1 and L2 speech, at least for the languages that are typologically different. To account for code switches, de Bot followed Green (1986) and suggested that bilinguals produce two speech plans simultaneously, one for the selected language (i.e., language that is being spoken at the moment) and one for the active language (which is not being spoken at the moment, but which is used regularly by the speakers). In his proposals for the organization of the mental lexicon, de Bot (1992) adopted Paradis' (1994) subset hypothesis and stipulated that L1 and L2 lexical items form different subsets that can be activated to different extents, depending on which language is currently being used. All subsets are said to belong to a larger single lexicon, therefore, the lexicon is said to be language-independent. However, De Bot pointed out that if one talks of lexical items in terms of spreading activation, then the question of one or two lexicons becomes irrelevant. In that case, the important question, according to him is whether lexical items from different languages are related to each other, whether they can activate each other equally, and whether they can be activated simultaneously. Finally, de Bot suggested that there is only one articulator that makes use of one large set of sounds and pitch patterns from both languages. Depending on the frequency and the quality of contact with L2, learners develop their own language specific norms for L2 sounds. Also, with beginning L2 learners, L1 norms may be used in the production of both L1 and L2 speech. In this way, de Bot explained phonological interference from L1.

De Bot's model is appealing but it poses some problems. One of these is regarding the method of selecting the language. De Bot assumed that the information concerning language choice is included in the preserved message so that it can be used to raise the activation level of the selected language. He supposes that two speech plans are formulated in parallel, one for the selected language and one for the active language. According to de Bot, this last assumption is necessary to explain "fluent and frequent code switching". However, it is not clear how the alternative speech plans can be formulated in parallel if the information in the preverbal message raises the message activation level of one of the languages only. It is possible to argue that the other language is activated from the previous usage, but that makes it unclear how the speaker manages to keep the two languages apart. Thus, de Bot's last assumption seems to be in conflict with his earlier assumption. Another problem with de Bot's last assumption is that L2 production appears to be uneconomical, because, in theory, there should not be any limit to the number of alternative plans that are being produced.

De Bot and Schreuder (1993) in their later work gave up the idea of two parallel speech plans and refined de Bot's (1992) proposal of lexical processing in bilingual language production. Their revisions were based on an adaptation of Levelt's (1989) model by Bierwisch and Schreuder (1992). The most important difference between Levelt's model and the model by Bierwisch and Schreuder concerns the addition of the component VBL (verbalizer), whose task is to map pieces of conceptual structure contained in the preverbal message to semantic representations of the lemmas in the lexicon. So it is the VBL that determines whether one selects the words to express one's intentions. The VBL is placed between the conceptualizer and the formulator. Bierwisch and Schreuder argued that it was necessary to have this component because there is no one-to-one correspondence between the concepts and words. In their discussion of second language production, de Bot and Schreuder (1993) again noted that different languages lexicalize in different ways. Like de Bot (1992), de Bot and Schreuder (1993) suggested that information concerning language choice is contained in the preverbal message in the form of a language cue. They emphasized that the preverbal message itself is not language specific. It only contains the language cue that is then passed onto the VBL, which uses it as a cue in the retrieval of the lexical items. With regard to mixed language use, they pointed out that it was unusual. De Bot and Schreuder argued that the instances of mixed language use could be accounted for if the language cues have different values. With respect to the question of language separation in the mental lexicon, de Bot and Schreuder again followed the subset hypothesis, proposed by Paradis

(1994). They proposed that words belonging to a particular language from the subset that can be activated and deactivated in its entirety. They suggested that subsets are formed as a result of the fact that the words belonging to the same language are normally used together, so that there are strong connections between them. When a language cue specifies a particular language all words in that language receive some activation, which makes it easier to select them. At the same time, the words of the other language are deactivated. Since the speaker's L1 has high default activation as a result of continuous use, the activation level of L1, when selected, is higher than that of L2 when selected. This argument is used to explain why speakers take less time to name L1 words than L2 words (Chen & Leung, 1989; Poulisse, 1997). The high activation level also makes it difficult to suppress this language when a person wishes to speak L2, increasing the chances of unintentional L1 use (De Bot & Schreuder, 1993).

Another model developed by Poulisse and Bongaerts (1994) proposed an account of second language speech production, again based on Levelt's (1989) model. In this model, lexical access is described without the intervention of a separate VBL component. Like de Bot and Schreuder (1993), they suggested that bilingual speakers manage to separate different language systems and to mix them, if they wanted to by specifying the language choice in the preverbal message. However, unlike de Bot and Schreuder, they propose a language component, rather than a language cue, which plays a role in the activation of individual lexical items. The model features imply that conceptual information and the language cue work together activating the lemmas of the appropriate meaning and language. In other words, language is one of the features used for selection purposes. As Poulisse and Bongaerts assumed that L1 and L2 are stored in one network, the words need to contain information that specifies the language to which they belong. For this reason, Poulisse and Bongaerts (1994) adopted Green's model (1986) suggestion that lemmas are tagged with the language label. In addition, they also argued that lexical items of L1 and L2 are simultaneously activated by one and the same conceptual plan. The idea of simultaneous activation is also a feature of the Grainger and Dijkstra (1992) model. De Groot (1992) also suggested a similar idea, wherein semantically related words share a number of features both within and between languages. De Groot claimed that such a description is compatible with the results of a large number of studies on word translation, semantic priming within and between languages, bilingual word association, and between language repetition priming. Poulisse and Bongaerts (1994) argue that their model of lexical access explains how language learners differentiate between lexical items of the two language systems. Increased activation of either L1 or L2 lemmas is the result when the preverbal message contains the specification. They explain the intentional mixing of L1 and L2 speech as a consequence of incomplete lexicalization of a particular concept in L2 or because the L2 speaker has not yet learned the word. Finally, the model is also used to explain unintentional L1 use in L2 speech as a slip of the tongue, resulting from an erroneous selection of L1 lemmas instead of L2 lemma. Poulisse and Bongaerts (1994) also suggest that their model can explain why L1 words (especially function words) frequently occur in L2 speech, especially in beginning L2 learners (Poulisse and Bongaerts, 1994). They supposed that this is because the amount of activation needed to access a lexical item is dependent on a word's frequency. Because L1 words, particularly L1 function words are more frequent than their corresponding L2 words for beginning L2 speakers, the chances that L2 learners accidentally select and unintended L1 lexical item, instead of the intended L2 item, are very high. This is truer, when beginning L2 learners have little attention to spare, as their speech is not fully automatized.

One of the most important similarities of the four models reviewed so far is that all these models assume the “language non-specific” selection hypothesis. According to this hypothesis, lexical selection mechanism is sensitive to the activation levels of all lexical nodes regardless of the language to which they belong. There is selective activation or inhibition in one of the languages. Inhibition may occur proactively (before lexical access) or reactively (after activation of words in both languages). The selection of the target lexical node is done by selecting the node with the highest level of activation, regardless of the language. In contrast, the “language-specific” selection hypothesis, the lexical selection mechanism is blind to the activation levels of the lexical nodes from the non-response language. That is, only the lexical nodes in the response language are considered as candidates for lexical selection. Therefore, lexical selection in the bilingual speakers would proceed in the same way as in the case of monolingual speakers (for e.g., Roelofs, 1998).

Despite their similarities, especially with three of the models based on Levelt’s model, there are some important differences among the models reviewed here. First, the verbalizing component, introduced by de Bot (1992) and de Bot and Schreuder (1993), is not featured in other models. A second difference is that Green (1986) and de Bot and Schreuder (1993) have adopted the “subset hypothesis” to explain the organization of the bilingual mental lexicon, and argue that these subsets are activated in their entirety. Poulisse and Bongaerts (1994) supposed that lexical items are tagged for language and are related to items from the same as well as different languages within network. A third difference is that in Poulisse and Bongaerts' representation, each conceptual chunk is specified for language in the preverbal message.

All the models reviewed here explain certain aspects of speech production in bilinguals but they are not complete. In order for the model to be complete the focus should be on both higher and lower levels of processing (i.e., morphological and phonological encoding and articulation). Also, the models focus on adult L2 learners who are not fluent in L2 i.e., unbalanced bilinguals. To date less attention has been paid to theorizing about early simultaneous bilinguals (who are learning both the languages at the same time), bilinguals whose lexicons are still developing (childhood bilinguals) or late proficient bilinguals (who are relatively proficient in both languages).

With respect to the neural level of organization, there is some consensus for a shared neural substrate across the bilingual's languages (see Vaid, 2002 for a review). This finding is consistent with recent models of bilingual lexical-semantic organization that claim the existence of two separate lexicons mediated by a common conceptual store (Kroll & Stewart, 1994; Heredia, 1997), as well as by models that claim a shared lexicon (Kroll & de Groot, 1997; van Heuven *et al.*, 1998). The behavioral data are corroborated by neural imaging studies (using fMRI, PET and ERP methods) of bilingual language processing which indicate considerable overlap in the neural substrates active for each language (Perani et al., 1998; Yetkin et al., 1995; Illes et al., 1999; Hernandez et al., 2000; Klein et al., 1999; Chee et al. 1999a, 1999b; Neville et al, 1992; Weber-Fox & Neville, 1996). When differences have been found, they have been explained by subjects' relative proficiency in their second language, which is frequently confounded with the age at which the second language began to be acquired (Klein et al., 1995, Perani et al., 1996; Dehaene et al., 1997). The activation of neuroanatomical areas during semantic tasks seen in all bilinguals may reflect access to this common conceptual store.

In summary, research in bilingual lexical access is still a burgeoning area and there have been increased efforts over the past few decades to improve our understanding of these processes. However, there are still huge gaps in our knowledge and while all the current models do address certain aspects of bilingual language processing, there are no comprehensive models which address these issues in different types of bilinguals. In the next chapter, I will present a review of the relevant literature in both monolingual and bilingual lexical access examining the two language production tasks. It will be seen that such studies are relatively few.

Indeed, only a few studies have looked at the effects of psycholinguistic variables on lexical access. We have limited information on the nature of lexical processing and effects of various lexical predictors (such as AoA, word frequency) in bilingual speakers. There haven been no studies of the combined effects of the variables that have been typically reported as significant predictors of naming latency in monolingual studies of lexical access. In addition, there have been no studies of the locus, degree and extent of the effects of these psycholinguistic variables on naming tasks. Finally, few if any studies have explored the developmental trajectories for these two tasks and the varying effects of lexical predictors across development. Studies are clearly needed to examine the relationship between the lexical predictors and lexical access tasks in bilinguals of varying proficiency in L2 across the lifespan. To address these issues, the present research examined language production in Hindī-English children and adults. In the next section, I will briefly review the empirical evidence in the literature using language production tasks.

CHAPTER 3

CROSS-LINGUISTIC COMPARISONS OF LEXICAL ACCESS AND LITERACY IN MONOLINGUALS AND BILINGUALS

In the past several decades, our understanding of language processing has been enriched by numerous studies conducted from various perspectives (cognitive, developmental, educational, and neuropsychological) and in diverse populations (clinical case studies, group studies, etc.). However, despite the multitude of studies, there are still several gaps in our knowledge, especially with regards to language production. In this chapter, I will present a brief review of the relevant studies on language production in monolinguals and bilinguals using the picture naming and word reading paradigms. In addition, I will present the rationale for my own cross-linguistic research with these two populations.

1. Predictors of Lexical Access in Production Tasks: Evidence from Monolinguals

Certain properties of usage that characterize lexical items are related to the speed with which those lexical items are accessed in tasks such as word reading and picture naming. Age of acquisition and word frequency are the most commonly reported lexical predictors which significantly affect the speed and accuracy of retrieval in the two lexical access tasks.

1.1. Picture Naming

Studies of real-time picture naming in adults examine the time it takes for participants to produce a name (typically the first name that comes to mind) when they see a picture, along with the type of responses that are produced (Carroll & White, 1973;

Oldfield & Wingfield, 1965; Snodgrass et al., 1980; Snodgrass & Yuditsky, 1996). Snodgrass and Vanderwart (1980) were among the first to use a large stimulus set of 260 pictures for a picture-naming task, and Snodgrass and Yuditsky (1996) extended the methodology to an on-line version of the task to measure naming times. In both studies, the dominant name (i.e., target name) for each picture (defined as the response given by the largest number of participants or the modal response), along with the number (token) and nature (type) of alternative names provided for each picture was established. For the dominant names generated by each picture, Snodgrass and colleagues investigated the impact of certain variables thought to be central in memory and retrieval. The underlying rationale of this paradigm is the notion that a picture's features affect the length of time it takes to gain access to the picture's name. Studies have examined correlations between naming behavior (latency and accuracy) and age-of-acquisition, word frequency, visual complexity, concept familiarity, and word length to evaluate which of these variables are the most important predictors of lexical retrieval. Some properties, such as word length (number of letters or syllables) are more objective whereas others such as word frequency or age of acquisition are estimates of variables whose actual values are unknown. Attributes that have been reported to affect word retrieval in adults have also been shown to affect the level of naming accuracy and/or latency in young children (Johnson & Clark, 1988; Johnson, 1992; Cycowicz et al., 1997; D'Amico et al., 2001).

Lachman and Lachman (1980) suggest that the key variable influencing naming latency is the codability or the uncertainty of the name. Researchers have defined uncertainty, at least in theory, as the number of names that are connected to an object's representation. Oldfield and Wingfield (1965) have contended that the time it takes to name an object is a linear function of the log frequency of the occurrence of that particular word/name in written language. Humphreys et al. (1973) claimed that word frequency impacts naming latency but only for the pictures chosen from the categories in which items were visually different from each other. Carroll and White (1973), however, challenged this notion and argued that pictures whose names were learned or acquired early in life are named faster than pictures with names that were learned at a later age, and therefore, AoA and not word frequency controls the speed with which items are accessed and named.

Several recent studies lend further support to the notion that AoA is a critical factor in naming latency. For example, Morrison, Ellis and Quinlan (1992) reported evidence corroborating the importance of AoA over word frequency and added that naming time or latency is affected more by word length (i.e., length of picture's name) than by word frequency. Snodgrass and Yuditsky (1996) also reported that AoA and picture codability (name or concept agreement) were the most important predictors of picture naming latency and accuracy.

An international collaborative effort (Bates et al., 2003) looked at timed picture naming in seven languages (English, German, Spanish, Italian, Bulgarian, Hungarian and Chinese) that vary along dimensions known to affect lexical access. Investigation and analyses over items concentrated on variables that established cross-language universals and cross-language differences. Regarding universals, the number of alternative names had sizeable effect on naming speed within and across languages even after the target-name agreement was controlled, hinting at inhibitory effects from lexical competitors.

For all the languages, word frequency and goodness-of-depiction had large effects, but objective picture complexity did not. Effects of word structure variables (such as length, syllable structure, compounding, and initial frication) varied across languages. Strong cross-language correlations were found in naming speed, frequency and length. 'Other-language' frequency effects were also observed (e.g., Chinese word frequencies predicting Spanish naming times) even after within-language effects were controlled (e.g., Spanish word frequencies predicting Spanish naming times). These startling cross-language correlations dispute widely held beliefs about the lexical locus of length and frequency effects, suggesting instead that they may (at least in part) reflect familiarity and accessibility at a conceptual level that is shared over languages. With these findings from adults as a backdrop, we next turn to the developmental literature.

1.1.1. Picture Naming: Developmental Evidence

Different attributes of pictures, such as object or picture familiarity (Lachman et al., 1980), word frequency (Oldfield et al., 1965) and word learning age (Carroll & White, 1973; Snodgrass et al, 1996; Iyer et al, 2001) have been reported to correlate with naming latency and to affect memory, particularly retrieval processes. However, although researchers and clinicians rely upon pictorial stimuli in a wide array of tasks, only a few reaction-time studies have attempted to collect normative data on pictorial stimuli from adults (Snodgrass et al, 1980) or on children (Berman et al, 1989; Cycowicz et al, 1997).

In the few developmental studies reported using the picture naming task, there is general agreement among researchers that younger children are less efficient in naming, i.e., making more errors and taking longer to name pictures than older children and adults (Cirrin, 1983; Wiegel-Crump, 1986; Cycowicz et al., 1997; D'Amico et al., 2001). In addition, researchers agree that the effects of lexical variables on naming behavior are similar for both adults and children (Cirrin, 1983; Berman et al., 1989; Johnson & Clark, 1988; Cycowicz et al., 1997).

In summary, lexical predictors such as AoA and word frequency are reported to be the most important determinants of naming behavior on picture naming tasks in both adults and children. Some studies have also reported other psycholinguistic variables such as goodness of depiction ratings as being significant predictors of picture naming behavior. In addition, findings in the literature indicate that while similar factors affect performance of children and adults on the picture-naming task, children are less efficient than adults. The performance differences across age cannot be readily explained by a developmental change in the psycholinguistic variables (such as frequency, age of acquisition, etc.) affecting lexical access, because these appear to be very similar in adults and children. Chi (1976, 1977; Cirrin, 1983) suggested that developmental differences in picture naming latency are due to the use of more efficient processing strategies by older children and adults. In accord with this view, some researchers have suggested that organizational factors and the representation of items in memory are similar in children and adults (Cirrin et al., 1981; Nelson, 1975). Conversely, qualitative differences appear to exist in the strategies used to access stored information by children and adults (Chi, 1977; cited in Cirrin, 1983). However, what are yet to be understood is how the principles underlying the structure of the immature lexicon differ from those of the mature lexicon, and how and when these factors change over time. Models of picture naming will need to explain not only the increased developmental mastery, but also the age-dependent loss of certain kinds of non-target naming such as production of word associations and the generation of nonwords that are phonologically similar to target names.

1.2. Word Reading

Many studies of visual word recognition have examined the impact of psycholinguistic variables such as word length, word frequency, word learning age, familiarity, imageability and meaningfulness. In the following section, I will briefly review the most important variables that have been reported to affect performance in word-recognition tasks.

The frequency with which a word appears in print (such as Kucera & Francis, 1967) has a strong influence on word recognition (e.g., Forster & Chambers, 1973; Balota & Chumbley, 1984; Broadbent, 1967; Inhoff & Rayner, 1986). Because frequency has pervasive effects on performance, accounting for this factor has played an important role in the development of models of word recognition and naming. Frequency is commonly assumed to influence processes that lead to lexical access. In addition, several researchers have observed that frequency has an impact on “post access” or “post lexical” processes. The naming process is commonly viewed as involving the access of information about the word stored in lexical memory, using this information to generate an articulatory-motor program and executing this program. Frequency could influence all of these stages (McRae et al., 1990). There has thus been considerable controversy in the literature regarding the locus of word frequency effects in the tasks used to build word recognition models (e.g., Balota & Chumbley, 1990; Forster & Chambers, 1973; Monsell et al., 1989).

Several word recognition studies (Morrison & Ellis, 1995; Gerhand & Barry, 1998, 1999b, 1999a) have also suggested the importance of another factor, age of acquisition (AoA). The basic idea here is that the age at which a word is learned, not merely how often it occurs in adult usage, affects lexical access and retrieval of information from the lexicon. All other things being equal, words learned early in life are recognized and produced faster and more accurately than words learned later. As noted earlier, this has been proven true for a variety of lexical processing tasks including object naming, word naming, visual lexical decision and auditory lexical decision (Barry, Morrison & Ellis, 1997; Carroll & White, 1973; Ellis & Morrison, 1998; Gerhand & Barry, 1998, 1999a, 1999b; Gilhooly & Gilhooly, 1979, Turner, Valentine & Ellis, 1998) which have mostly reported AoA effects independent of word frequency effects.

Other psycholinguistic variables that have been reported in the literature as affecting performance on the visual word recognition task include word familiarity, (Boles, 1983; Connine et al., 1990, Balota et al., 1991), semantic variables i.e., concrete/abstract dimension, meaningfulness of a word (Bleasdale, 1987; de Groot, 1989; Balota & Ferraro, 1993), word length effects, i.e., total number of letters or characters in the word (Forster and Chambers, 1973; Balota, 1994), neighborhood density and neighborhood frequency (Andrews, 1989, 1992; Grainger, et al., 1989; Grainger & Seigui, 1990, Luce & Pisoni, 1989, cited in Balota, 1994), and word superiority effects (Wheeler, 1970; Johnston & McClelland, 1973; McClelland & Johnston, 1977).

1.3. Picture Naming vs. Word Reading: A comparison

Evidence from memory research suggests that there are differences in the way in which pictures and words are represented. Reaction time (RT) studies have shown that category decisions and size comparisons are processed faster with pictures than with words (at least for adults) (Irwin & Lupker, 1983; Paivio, 1976, Potter & Faulconer, 1975; Smith & Magee, 1980). However, previous studies that have explored word reading and picture naming in sentence contexts have reported shorter latencies for word reading (at least in adults). Potter and Faulconer (1975) and Potter et al. (1986) suggested one possible theory to account for this RT difference, namely that picture naming involves compulsory lexical access, whereas word reading could (at least in principle) be carried out without accessing the complete semantic and grammatical representation of the word (both lemma and concept). In studies that have investigated single-word reading and single-picture naming outside of a sentence context, effects of lexical variables, such as word frequency, AoA, and/or word familiarity have been reported for both visual word naming and picture naming, although the locus of these effects is still controversial (Bates, Burani, D'Amico & Barca, 2001; Barry, Morrison & Ellis, 1997; Brysbert, Lange, & van Wijnendaele, 2000; Carroll & White, 1973a, 1973b; Ellis & Morrison, 1998; Gerhand & Barry, 1998; Gilhooly & Logie, 1981; Morrison, Chappell & Ellis, 1997; Morrison & Ellis, 1995, 2000; Morrison et al., 1992). With regard to effects of semantic factors, such as imageability or concreteness, most models of object and/or picture naming assume that perceptual information and conceptual information are the major factors driving the activation of phonological word forms (e.g., Humphreys et al., 1995). By contrast, most models of word reading include at least two distinct sources of phonological activation: orthographic and semantic (see e.g., Coltheart, Curtis, Atkins & Haller, 1993; Plaut, McClelland, Seidenberg & Patterson, 1996). Indeed, the effects of semantic variables on single-word reading are still a matter of debate (see Balota, Ferraro & Connor, 1991). Recent studies of word reading in English have shown that imageability effects are normally not observed for short, regular/consistent words: instead, the primary influence of imageability is on low-frequency exception words (Cortese, Simpson & Woolsey, 1997; Strain, Patterson & Seidenberg, 1995; Zevin & Balota, 2000). These results suggest that the semantic system is recruited only when the speaker finds it difficult to generate a pronunciation by relying on the orthography-to-phonology system (for a more detailed review, see Balota et al., 1991).

In the studies reported in the following chapters, I will be comparing performance profiles of English monolinguals and Hindī-English bilinguals of various age ranges on picture naming and word reading tasks. Given the nature of the current findings in the literature, it is predicted that word reading will be faster than picture naming in both monolinguals and bilinguals (at least for adults). However, developmentally there might be a cross-over in task advantage with younger children (who are learning to read) being faster in naming pictures in reading words. Of further interest is how bilinguals will perform relative to monolinguals, particularly given that the two languages of the bilinguals are distinct in orthography and in other respects.

2. Predictors of Lexical Access in Production Tasks: Evidence from Bilinguals

The main thrust of research in bilingual language processing has been in trying to understand the nature of the bilingual lexicon (for a more detailed review, please see Iyer, 2003). Very few studies in the literature have examined the effects of various lexical predictors on language processing (specifically using language production tasks) in bilingual speakers. The few studies that have been conducted have looked at the effects of only some of the variables on tasks of lexical access. In the following section, I will briefly report the findings from the handful of relevant studies that I have found in the literature.

2.1. Picture Naming

One study examined the effect of lexical predictors such as frequency, word length and (in the case of English) age of acquisition on name agreement response of the Spanish-English speaking adults (Goggin, Estrada & Villarreal, 1994). The researchers reported that name agreement decreased as language skill decreased. Both word frequency and word length were found to be related to name agreement. Modal responses given by monolingual speakers were nearly identical in the two languages, and the types of non-modal responses were affected by both naming language and language skill.

In the developmental literature, there are two behavioral studies of which I am aware that have used the on-line picture naming paradigm to understand the basic-level encoding skills in bilingual children. Mägiste (1992) designed several studies using response times on picture- and number-naming tasks with German immigrant children learning Swedish in school in order to test the predictions of the critical period hypothesis for second language (or L2) acquisition (e.g., Johnson & Newport, 1989). Mägiste's results implied that elementary school children were able to attain a "balanced form of bilingualism" a couple of years earlier than high school students at the same stage of L2 learning, on the same picture-naming task. These results were inferred as supporting the critical period hypothesis for second language acquisition. It was interesting to note that the published data also showed that, after several years of residence in Sweden, both groups of children showed faster response times on the picture-naming task in L2 than in L1 (i.e., first language). A study by Kohnert and her colleagues (1999) examined the lexical-semantic skills in early sequential Spanish-English bilingual children who immigrated to the United States at a young age. This study investigated developmental changes in lexical production skills in these bilingual speakers in both Spanish (L1) and English (L2), exploring the effects of age, years of experience and basic-level cognitive processing using a on-line picture-naming task. There were 100 participants at five different age-levels (5-7, 8-10, 11-13, 14-16 years, and young adults) all of whom had learned Spanish as a first language at home, with formal English experience commencing at five years. Reported results indicated that there were developmental gains in both languages across age. However, there was a developmental cross-over such that the youngest children who were Spanish dominant initially went through a period of relatively balanced Spanish and English skills in middle childhood, which culminated in a clear pattern of English dominance among the adolescents and young adults.

2.2. Word Reading

With regard to studies using the word recognition tasks in bilingual speakers, only a few have looked at the effects of lexical predictors (such as word frequency, AoA, imageability). In most of the studies using the word recognition task in bilinguals, the main goal has been to understand the nature of the lexical-semantic organization. However, these studies have in addition to their main purpose, also examined the effects of lexical predictors on the word naming tasks. Von Studnitz and Green (1997) used a lexical decision task in German-English adults to test the costs of language switching for both words and nonwords. Results indicated switching costs wherein the bilingual participants were slower on trials involving a language switch than on non-switch trials. In addition, frequency effects were noted suggesting greater response variability on low-frequency than on high frequency stimuli in both the languages of the bilinguals. Another study examined second language (L2) word recognition in the visual modality, addressing L2 word recognition in relation to both the writing system characteristics and learners' reading proficiency (Chitiri et al., 1992). L2 readers show sensitivity to the characteristics of their L2 script but this skill must be developed. As with learning to speak a language, readers go through different stages of development, gradually approaching the pattern of native speakers. With increasing proficiency in L2 reading, there is a progressive change of attention from predominantly graphic to syntactic and semantic processing (Cziko, 1978, 1980; Hatch et al., 1974; Liu, 1996).

Two semantic variables that have been reported to have differential effects on lexical access tasks in bilinguals as a function of proficiency are: context and imageability. In the case of context effects the findings are equivocal. The findings from one study suggested that unskilled bilinguals rely more heavily on context lexical access tasks in L2 than skilled bilinguals (Frenck & Pynte, 1987). These findings appear to support the hypothesis that context effects diminish in L2 acquisition as skill in L2 increases. However, this theory has been opposed by Liu and her colleagues (1996). The findings from their monolingual (Liu et al., 1996) and bilingual (Liu, 1996) studies suggest that subjects rely heavily on sentence context in word recognition tasks regardless of their skill and proficiency in the language. Liu and her colleagues argue that context effects are 'meaning-based' and that the locus of these effects is at the conceptual level independent of linguistic experience. Liu and her colleagues (1996) also propose that, imageability, which is another 'meaning-based' variable, would affect performance on lexical access tasks for both skilled and unskilled speakers. In addition, Liu (1996) examined the effects of 'form-based' variables, such as frequency, neighborhood density and word length in Chinese-English bilinguals using an auditory word recognition task. She posits that effects of such 'form-based' variables will be more at the word level and therefore the effects of these variables on lexical access would vary as a function of proficiency and skill in a language. To this end, Liu reports findings, which support the idea of differential effects of such 'form-based' variables as a function of linguistic experience. Novice bilinguals displayed greater reliance on the form-based information on lexical access tasks than advanced bilinguals, that is, the effects of length, frequency and density, all decreased with increasing L2 exposure.

In summary, only a handful of studies have looked at the effects of psycholinguistic variables on lexical access. We have limited information on the nature of lexical processing and effects of various lexical predictors (such as AoA, word frequency) in bilingual speakers. There have been no any studies on the combined effects of all the variables that have been typically reported as significant predictors in monolingual studies of lexical access. In addition, no study to date has examined the locus, degree and extent of the effects of these psycholinguistic variables on naming or the developmental trajectories for word or picture naming tasks. Studies are needed that examine the relationship between the lexical predictors and lexical access tasks in bilinguals of varying proficiency in L2 across the life span. My research investigated picture naming and word reading in Hindī-English children and adults. One of the additional questions addressed in this research, is the nature of relationship between lexical access and reading proficiency. Therefore, in the next section, I briefly review the literature relating lexical access tasks and reading proficiency.

3. Relationship between Naming Tasks and Literacy

The topic of literacy has been of concern to psychologists, anthropologists, philosophers, historians, linguists, clinicians, and teachers in recent years. The term "literacy" has a number of meanings and uses. It refers not only to basic reading and writing skills but also to the acquisition and manipulation of knowledge via written texts, the metalinguistic analysis of grammatical units, the structure of written and oral texts, the impact of print on the history of mankind, and the philosophical and social consequences of formal education (Ravid & Tolchinsky, 2002, Goody & Watt, 1963; Chafe & Danielewicz, 1987; Olson, 1991; Ong 1992).

The operational definition of literacy used here will be the ability to read and write. There is an increasing appreciation of the important role of the lexicon and language development in the acquisition of literacy. For example, difficulties in accessing the lexicon are likely to compromise children's communication and their ability to acquire academic skills (Snyder & Godley, 1992). Findings from nearly three decades of research strongly indicate that a significantly high percentage of both adults and children with reading disabilities struggle in rapidly naming the most familiar visual symbols and stimuli in the language (i.e., letters, numbers, colors, and simple objects). Many of these children and adults do not show severe word-finding difficulties. However, they are significantly slower than their average-reading peers on speeded naming tasks, where they are requiring rapid retrieval of names for commonly occurring stimuli (Wolf, Bowers & Biddle, 2000).

The late neurologist Norman Geschwind (1965; 1972) spawned the present line of neuropsychological research with the hypothesis that a possible early predictor of reading readiness is the child's ability to name colors. Geschwind's assumption was that the cognitive components involved in color naming, i.e., where the child is required to provide a verbal label for a visually presented, abstract stimulus, would make a good early predictor of later reading performance. This hypothesis was tested by Denckla (1972) who in collaboration with Rudel (Denckla & Rudel, 1974, 1976a, 1976b) conducted a series of studies with different clinical groups. In one of the first studies, Denckla (1972) found that the speed or rate with which names were accessed was what differentiated dyslexic readers from others, rather than the naming accuracy (color naming). Taking this finding a step further, Denckla and Rudel (1976a, 1976b) designed a serial, continuous naming task and investigated the naming ability of average readers, dyslexic children, and learning-disabled children for highly familiar visual symbols (letters, digits, colors and common objects). Denckla and Rudel's cross-sectional results indicated that the children's speed at naming such visual symbols was strongly related to their reading performance. These researchers were the first to design a “rapid automatized naming” (RAN) task which was used to determine continuous, serial naming speed performance on common visual stimuli. RAN tasks assess the speed with which children produce verbal labels for a serial array of the most basic visual symbols and are the prototypical tasks used in the most cited research (Wolf, Bowers & Biddle, 2000). These studies stimulated a long series of investigations into the relations between naming speed and reading ability. As a result, a large group of cross-sectional studies in both reading and neuropsychology have demonstrated that continuous naming-speed tasks are strongly correlated with reading performance (Ackerman, Dykman, Gardner, 1990; Blachman, 1984; Bowers, Steffy & Swanson, 1986; Ellis, 1981; Spring & Capps, 1974; Spring & Farmer, 1975; Spring & Davis, 1988).

In the studies that are part of my dissertation research, I explored the nature of the relationship between lexical access and literacy. Specifically, I examined picture naming (especially response times) and its link to word reading behavior as a function of reading proficiency in the two languages of the Hindī-English bilinguals.

4. Languages of Interest

The two languages compared in the present research are Hindī and English. Because of their different histories, these two types of languages display interesting differences at every level: in the <u>writing system</u> (orthography), in the <u>sound system</u> (phonology), in the <u>word structure</u> (derivational morphology), and in the <u>grammar</u> (inflectional morphology and syntax). In the following section, I briefly present an overview of Hindī and then compare Hindī and English on the most salient aspects of language (Table 3.1).

A Brief Overview on Hindī (and Devanagari)

Hindī belongs to the easternmost branch of the Indo-European language-family, known as Indo-Aryan, which dates back at least three thousand years. Hindī is a modern Indo-Aryan language spoken in South Asian countries (India, Pakistan, and Nepal) and other countries outside Asia (Mauritius, Trinidad, Fiji, Surinam and Guyana) by approximately six hundred million people, either as a first or a second language (this figures includes speakers of Urdu). Hindī is a descendent of the Sanskrit language. The term "Hindī" is an adjective, Persian in origin, meaning "Indian". The language is written in the Devanagari script (for more details, see Shackle & Snell, 1990).

Hindī has a simple 10-vowel system albeit with the further possibility of contrast through nasalization. Hindī grammar distinguishes between short and long vowels. The distinction between short and long vowels has a phonemic as well as prosodic value. Hindī has a much more complex system of consonants. The consonantal inventory is principally governed by the elaborate contrasts of voicing and aspiration across five points of articulation. Hindī has 33 consonants, of which there are 20 stops or plosives, subdivided into unvoiced and voiced, unaspirated and aspirated, 5 homorganic nasals, 4 "semivowels", 3 unvoiced sibilants, a voiced glottal fricative, and 2 retroflex flaps. The basic phonology typically prefers a syllabic structure in which consonants alternate with vowels, avoiding clusters of consonants either initially or finally within a word (e.g., this is why English words like "strength" are tongue-twisters for native Hindī speakers). Hindī has a level of syllabic stress. The general tendency is to stress long vowels somewhat more than short ones in isolated words, and to mark the end syllable of a syntactic unit with a short pause. Hindī does not have emphatic stress. Emphasis is made through emphatic particles and/or inversion of the normal word order.

The Hindī noun grammatically marks gender (masculine and feminine), number (singular and plural), case (direct, oblique and vocative), and declensions ('thematic' and 'athematic'). There are no specific definite and indefinite articles in Hindī. Hindī has the following types of pronouns: demonstrative, personal, possessive, possessive-reflexive, reflexive, reciprocal, interrogative, indefinite and relative. The Hindī verb form encodes voice (active and passive), mood (indicative, subjunctive and imperative), aspect (imperfective-habitual, progressive-continuous, and perfective), and tense (present and past) which is further subdivided according to aspect. A Hindī verb is either object taking or non-object taking. The basic Hindī sentence structure is simple, but, as in any other language, a sentence can be expanded in various, seemingly complicated ways. In general, word order in Hindī is fairly free although it is subject to certain constraints (see, e.g., Vasishth, 2002b). However, the syntax of a simple Hindī sentence is distinguished by the typical word order: SOV, the use of postpositions, pre-modifying adjectives before nouns, and the frequent use of enclitic particles (sometimes called 'emphatics') (for more information see Sandahl, 2000).

The Devanagari alphabet is the script originally used to write down Sanskrit. It consists of 48 letters and additional diacritical signs. These together represent every sound of the Sanskrit language (Bright, 1996; cited in Vaid & Gupta, 2002). The arrangement of the alphabet is strictly phonetic. Letters are classified by place of articulation: vowels and diphthongs are presented first, then consonants with an inherent implicit schwa vowel. The script is written and read from left to right. All words in

Devanagari are written with a horizontal bar linking the letters. There is no cursive style nor is there a distinction between upper versus lowercase. Devanagari has syllabic as well as alphabetic characteristics. Like other syllabic writing systems, units in Devanagari are written as consonant-vowel structure (there is an inherent vowel associated with each consonant). Like alphabetic systems, the consonants themselves correspond to phonemes. Indic scripts are also termed "augmented consonantal symbols" largely because consonants form the primary graphemes, and are written in a strict left-to-right linear order, whereas vowels are written in diacritic form and are positioned nonlinearly around the consonants (Vaid & Gupta, 2002).

Table 3.1 summarizes the important contrasts between Hindī and English. I have presented a fairly broad comparison of the two languages in order to provide a better understanding of the differences and similarities between the two languages. However, for the purpose of my own studies, the relevant contrasts, given the nature of the tasks, are those of orthography, phonological transparency, prosodic cues and the degree of lexical ambiguity of words. If we look more carefully at the underlined contrasts in the table, we find that there are differences between the two languages, which will have interesting implications for performance on lexical access tasks in these two languages. For example, the most important difference between the two languages where I would predict differences in processing is at the orthographic level. Hindī is a transparent, alphasyllabic script while English is relatively opaque and is classified as an alphabetic script. As a result, in the word reading task, I would expect faster reading times in Hindī than English, all other things being equal. Another interesting comparison between Hindī and English is with regard to the effects of certain psycholinguistic variables on word reading and picture naming performance. Word frequency is one of the most important predictors of word naming in English. However, while there are no published studies to date on frequency effects in Hindī , some studies with Kannada, a South Indian language analogous to Hindī in transparency and alpha-syllabic script, found no effects of frequency on word naming (Rao, 1994; Matthew, 1995; Kurien, 1996; cited in Karanth, 2002). These studies reported that word attributes such as word length were the only significant predictors of performance on word naming tasks. However, some evidence from other transparent scripts challenges this conclusion. Bates and colleagues (2004) in their results from a cross-linguistic study of picture naming in seven languages reported frequency as a significant predictor of picture naming behavior for all the languages, including a fairly transparent language, Spanish. However, this result is based on a picture naming paradigm, whereas the previous findings reported with Kannada used a word reading task. Therefore, the different findings could be due to task differences. It would be interesting to see if there is indeed a dissociation between the two tasks in Hindī , i.e., whether there are differential effects of word frequency or other psycholinguistic variables for picture naming and word reading in Hindī.

Table 3.1. Comparison of Hindī and English

	Hindī	English
Language family	Indo-Aryan	Indo-European
Use of conjunct consonants	High	High
Articles	No definite or indefinite articles	Has definite and indefinite artciles
Nouns	Nouns: mark gender, number & case	Nouns: mark number
Basic word order	SOV	SVO
Word order variability	Relatively free word order	Low
Omission of constituents in free standing sentences	Subject can be omitted.	Not permitted
Inflectional morphology	Rich	Sparse
Morphological regularity	High with very few irregular forms of plural and past tense.	One regular and multiple irregular forms for plural and past tense.
Use of compounding	Medium; verbs: serial verbs nouns: reduplication/repetition	Medium
Prosodic cues to words	Syllable stress, no emphatic stress	Syllable stress, emphatic stress
Grammatical cues to words	Form class, gender	Form class
Lexical ambiguity for words out of context	Low for all categories, due to inflectional morphology.	Moderate, especially for nouns and verbs
Script	Devanagari, no cursive, no upper-lower case distinction.	Roman, has cursive and upper & lower case letters.
Orthography	alphasyllabic, consonants written in left-to-right linear order, vowels positioned non-linearly around the consonants	Alphabetic, left to right.
Orthography to Phonology mapping	Transparent/regular, shallow	Opaque/ irregular, deep

5. Summary of Predictions

The present research represents an extension of an ongoing research effort designed to understand the processes underlying picture naming in specific and lexical access in speech production in general. Our previous research had established a large pictorial stimulus set and picture naming and word naming data were obtained from various populations including typically-developing children and adults and groups at risk for language impairment.

The goal of my dissertation was to enrich our understanding of processes involved in lexical access in bilingual vs. monolingual populations. To this end, I compared the performances of English monolinguals and Hindī-English bilinguals on the two lexical access tasks i.e., picture naming and word reading, across three age groups (8-10 year olds, 11-13 year-olds, college-age students). In addition, I compared within each group differences in performances on the two tasks. The developmental trajectory of performance on these tasks was also explored. The basic issues that I will be addressing along with the predictions are listed in the table below.

Table 3.2. Main issues and predictions

Issue	Predictions
Developmental trajectories on lexical access tasks	Across the 3 age groups, there will be developmental gains for both tasks in both languages. Younger children will be faster at picture naming than word reading with a crossover in task advantage, with older children and adults being faster in word reading. This should be true for both languages of the bilingual.
Lexical Predictor effects on lexical access tasks	AoA and word frequency will be strongest predictors of lexical across all ages in each of the languages, independent of linguistic experience in that language. There should be similar effects of predictor variables on naming behavior (both picture and word naming) across the different age groups.
Proficiency effects on lexical access tasks	The magnitude of differences between picture naming and word reading times in (adults) although in the same direction in both languages will vary as a function of proficiency in the two languages. The effects of lexical predictors (at the word level) such as syllable length, frication, frequency will vary as a function of linguistic experience in a particular language. While effects of these lexical predictors will be seen in both languages, the effects would be more pronounced in the less fluent language.
Language effects on lexical access tasks	In balanced bilinguals, Hindī word reading times will be faster than English word reading times. However, I do not predict any such patterns with the picture naming data. Whatever advantage there might be it will be with English PN (since all the items in the study have been obtained in a English speaking western culture). In bilinguals who are English dominant (the typical adult profile in urban India), the word reading advantage over picture naming in adults might be diminished in the English dominant bilinguals because of the structural features of Hindī (i.e., transparent, shallow orthography).
Link between lexical access and literacy	PN performance will be good predictor of word reading behavior in the corresponding languages.

CHAPTER 4

AGE OF ACQUISITION RATINGS IN ENGLISH MONOLINGUALS

1. Background and Rationale

In psycholinguistic research, word frequency has proven to be an important determinant of performance in lexical tasks. For example, frequency is associated with both accuracy and latency in picture-naming tasks (e.g., Forster & Chambers, 1973; Humphreys et al., 1988; Jescheniak & Levelt, 1994; Oldfield & Wingfield, 1965). Intuitively it seems plausible that word frequency should affect naming latency, with the representations of words that are used more often becoming more rapidly accessible as a result of repeated activation. The classic, oft-cited study of picture naming by Oldfield and Wingfield (1964, 1965) reported an inverse linear relationship between picture naming latency and log frequency. They selected 26 pictures that varied widely in Thorndike-Lorge (1944) name frequency and found that naming latency was negatively correlated ($r = -.80$) with frequency. Goodglass, Theurkauf, and Wingfield (1984) replicated this finding (cited in Snodgrass et al, 1996). However, there is an increasing body of evidence suggesting that, at least in some tasks, apparent frequency effects may be wholly or partly accounted for by age-of-acquisition (AoA), that is, the estimated age at which a word is usually acquired (e.g., Brown & Watson, 1987; Carroll & White, 1973a; Gilhooly & Gilhooly, 1979, Morrison & Ellis, 1995). Most researchers agree that by their very nature, frequency and AoA are highly correlated: i.e., high-frequency words tend to be learned earlier in life than are low-frequency words. Nonetheless, some investigators have suggested that AoA is actually a more powerful predictor than frequency, and that frequency effects often disappear when their overlapping variance with AoA is controlled. Therefore, in the absence of AoA as a predictor variable, frequency may emerge as an apparently important predictor largely because of the variance it shares with AoA. Broadly speaking, the methods used to obtain AoA data in the literature can be grouped into two classes. One class relies on the data collected from vocabulary tests and/or parental reports of children's abilities. Such methods are used to determine the "real" age at which words are acquired, i.e., an objective measure of age-of-acquisition. On the other hand, given the difficulty of establishing an objective measure of age-of-acquisition (i.e., "real" AoA), most studies of AoA have used an alternative method, the "rated" AoA, i.e. subjective measures (adult ratings) of word learning age.

Several studies have used the subjective AoA measure to collect data on word learning age from adults (Carroll & White, 1973a, b; Lyons et al, 1978; Gihooly & Hay, 1977; Morrison, Ellis & Quinlan, 1992; Snodgrass & Yuditsky, 1996; Lachman, 1973; Barry, Morrison & Ellis, 1997). These studies have reported results where they have found significant and substantial effects of AoA on naming times over and above the effects of word frequency. However, it is less clear exactly what these AoA ratings are measuring. Are they really measuring the age at which a child acquires a particular word? How do these ratings compare with developmental data (such as vocabulary tests)? In the age-of-acquisition literature, many of the same groups of researchers collecting AoA rating data from adults have also attempted to validate adult estimates of word learning age against more objective measures derived from developmental data, including texts by and for children, and performance by children on vocabulary tests (Carroll & White, 1973a; Lyons et al., 1978, Gilhooly & Gilhooly, 1980; Walley &

Metsala, 1992; Gathercole & Adams, 1995; Morrison et al., 1997; DÁmico et al., 2001). So when the subjective ratings obtained from adults were compared with developmental data, these adult ratings were highly correlated with developmental data. So it appears that the AoA ratings obtained from adults are not only a reliable measure, as different sets of subjects, at different times, with different researchers, produce consistent ratings for the items. Also, the AoA ratings are a valid measure of real word learning age as is seen with the high correlations with developmental data. In addition, these studies also report data that AoA ratings are arguably the best predictors of picture naming latency. Results from some studies also report that other than word-learning age, attributes such as imageability, frequency, etc., also play a significant role in predicting the picture naming latencies.

In this chapter, I present results from an age-of-acquisition rating study (Iyer et al., 2001) where AoA ratings were collected from English monolingual college students, as part of a larger project, the International Picture Naming Project (Bates et al., 2000; Szekely et al., 2003). There were two main goals in undertaking this study. First, we wanted to validate the previously reported findings on a larger stimulus set (520 items). Second, we also wanted to verify if the adult ratings were a reliable measure of objective AoA by comparing the ratings with two sets of developmental norms (Fenson et al, 1994; Morrison et al., 1997).

2. Method

2.1. Subjects

Fifty-three monolingual (male = 30; female = 23), English speaking, right-handed undergraduate students participated in this study. All the subjects who participated filled out an initial screening questionnaire to verify that they met selection criteria for participation in this experiment. The selection criteria were that all subjects must be native English speakers who were not early bilinguals. In addition, the subjects had to be right handed with no hearing impairments or cognitive deficits. All the subjects were recruited from the University of California, San Diego community and each subject either received one-hour research credit or was paid $7.00 for participating in the experiment. The subjects' ages ranged from 19-40 years (Mean age = 23 years).

2.2. Materials

A total of 520 picturable nouns comprised the stimuli for this study. The stimulus set was obtained from the International Picture Naming (IPN) project [Bates et al, 2000]. This IPN project is an international, collaborative, cross-linguistic study investigating lexical access using a picture-naming paradigm for a large set of picturable nouns and verbs. The stimuli used in the IPN study consist of black-and-white line drawings, which were scanned into the computer, so that the digitized stimuli could be presented electronically under tightly controlled timing conditions. The target names for these stimuli (operationalized as the names given by the largest number of adult participants in a timed naming task) have been coded for a variety of attributes such as word frequency, familiarity, length in characters, length in syllables, presence/absence of word-initial fricatives (which are known to reduce the sensitivity of the voice key in recording naming times), and (where available) imageability ratings. Appendix A contains the list of stimuli used in all the monolingual and bilingual studies.

2.3. Design and Procedure

Instructions for the AoA ratings were adapted from Carroll and White (1973b). Participants were instructed to rate each item, on a 9-point scale (2, 3, 4, 5, 6, 7-8, 9-10, 11-12, 13+ years). The subjects were asked to estimate the age at which they learned the word, in either spoken or written form. The dependent measures in this experiment were the age-of-acquisition ratings obtained from the participants.

3. Results and Discussion

Comparisons of the AoA ratings collected in the present study with previous studies clearly indicate that we were able to replicate the effects found in these earlier studies. We compared our AoA ratings to AoA ratings from previous studies, and obtained high correlations with the two sets of data used i.e., $r = 0.89$, $p < 0.0001$ (with Carroll & White, 1973a) and $r = 0.89$, $p < 0.0001$ (with Snodgrass et al., 1996). This suggests that these ratings were a reliable measure as we were able to replicate results from previous studies.

Second, a comparison of the AoA ratings with data from parental reports (i.e., using MacArthur Communicative Development Inventory developed by Fenson et al., 1994) and objective AoA data (based on vocabulary tests from children, Morrison et al, 1997) indicated that these adult ratings do, to a relatively large extent, reflect real word learning age. The results of correlational analyses with the two developmental data sets were $r = 0.63$ ($p < 0.001$; with Fenson et al., 1994) and $r = 0.6$ ($p < 0.001$; with Morrison et al., 1997). While most of the concepts represented by the pictures/words used in this study were learned at an early age, participants used the entire scale, placing age of acquisition for some items as late as 13 years. This suggests that some stimulus items used may not have been acquired by younger children. These strong correlations with objective developmental AoA data suggest that the AoA rating method used in the present study is also a valid measure of word learning age.

4. Future Directions

Our main goals in undertaking this study were to develop valid and reliable AoA norms. This study was part of a larger project where we wanted to examine the relationship between lexical access and psycholinguistic variables such as word learning age, frequency, etc. Given the difficulty in establishing objective AoA norms, we collected these AoA ratings for all the items in the IPN database. The subjective AoA ratings have repeatedly proven to be an effective substitute in the absence of objective data.

In the next chapter, I will report the results from an on-line picture naming study, where we used these AoA ratings and other psycholinguistic variables (such as frequency, syllable length, visual complexity etc.) in our efforts to understand the nature of lexical access and how these psycholinguistic variables affect it.

Future investigations include trying to understand the effectiveness of the age-of-acquisition ratings with bilingual and multilingual populations, for example, whether the AoA ratings collected in the target language are a good predictor of naming behavior in that language. In addition, if we are making the argument that the locus of these AoA ratings is at the conceptual level and not at the superficial lexeme level, than it would be interesting to see if the AoA ratings obtained in L1 can be used to predict performance on language production tasks in L2.

CHAPTER 5

PICTURE NAMING IN ENGLISH MONOLINGUAL ADULTS AND CHILDREN: AN ON-LINE BEHAVIORAL STUDY

1. Rationale

Our group has been developing a series of tasks using a large pictorial stimulus set in order to tap into the various processes involved in lexical access in typically-developing children and adults and in groups at risk for language impairment. These norming studies are a part of a larger endeavor to develop an International Picture Norming (IPN) Database (Bates et al, 2000). The IPN project is a large cross-linguistic study collecting norming data for 520 pictures of objects and 270 pictures of actions across 7 languages. Armed with the initial data obtained from the on-line behavioral studies, these tasks have also been incorporated into language activation studies using functional neural imaging techniques to investigate the neural substrates of lexical and sentential processing (Saccuman et al., 2005; Dick et al., 2004).

In this section, I present results from an on-line picture-naming task for a subset of the object pictures, collected from normal English-speaking adults (with ages ranging from 19-40 years) and three groups of children (11-13 years 8-10 years and 5-7 years). We had several goals. First, we wanted to obtain normative data from adults and children for a timed picture naming study. Second, we wanted to compare performances by children and adults on the same items, over several different age levels. In fact, this is the unique feature of the present study, wherein we are examining the participants' performance on the picture-naming task across early life span with the youngest age group ranging from 5-7 years old, in addition to three other age groups, 8-10 year olds, 11-13 year olds and adults (mean age = 25 years). Third, we also wanted to investigate relationships among children and adults' dependent measures (naming times and naming responses) with various predictor variables including frequency, age-of-acquisition, and word length. Finally, we wished to validate the research design and stimulus set before extending our study to bilingual and clinical (children with language impairment and adults with aphasia) populations.

2. Method

2.1. Subjects

All participants (children and adults) were native English speakers with normal language status.

Adults. For comparison with performance by children, norming data were collected from 30 monolingual, English-speaking undergraduates from the university community. All participants filled out an initial screening questionnaire to verify if they satisfied the criteria for participation in this experiment. The selection criteria were that the participants in the study should be native English language speakers (and not early bilinguals), right-handed with no hearing impairments or any known cognitive deficits. All either received one-hour research credit or were paid $7.00 for participating in the experiment. Their ages ranged from 19-31 years (M age = 25 years).

Children. 107 children ranging from 5 years to 13 years participated in the study. These children were grouped into the 3 age ranges (5-7, 8-10 and 11-13 year olds). All the children were pre-screened to see if they satisfied the criteria for the experiment. Most of the children also had standardized test scores to determine their normal language and cognitive status. For the children, the parents were asked to fill out an initial screening questionnaire to verify if they were without any hearing impairments, no cognitive or neurological deficits and also to determine if they were native English speakers. A socio-economic status (SES) index was also obtained for each child based upon the educational level and occupation of the parents. Informed consent forms were obtained from the parents and the children. After task completion, children received either a small gift or money for their participation and the parent received reimbursement for travel.

2.2. Materials

There were 260 picture stimuli used for object naming, all black-and-white line drawings of common objects drawn from a larger corpus of 520 pictures (International Picture Naming Database). The rationale for a smaller dataset was because this task would be better suited for children, a task that would relatively easy for them (especially younger children). This stimulus set was selected, in addition, to obtain a set of pictures that could be used with cross-linguistic populations. Therefore, items selected out of the larger set were those that were more consistently named by the adults, less culturally biased, with an easy to moderate difficulty level (as determined by RT and name agreement in results for a separate norming sample—Szekely et al, 2003). These 260 items, listed in Appendix A, included drawings of mostly household objects, animals, fruits and vegetables, and persons. The items were scanned into the computer and were presented on the computer screen.

2.3. Design

The pictures were presented randomly on the center of an Apple Macintosh monitor, using a simple script in PsyScope 1.1 (Cohen, MacWhinney, Flatt, & Provost, 1993). During testing, participants wore headphones with a sensitive built-in microphone (adjusted to optimal distance from the participant's mouth) that was connected to a button box, a measuring device, designed for use with Macintosh computers. Voice-onset times were recorded via a button-box connected to the Apple Macintosh, running a simple script written in PsyScope 1.1 (Cohen, et al., 1993). Verbal responses were recorded with a cassette recorder. In addition, an experimenter sitting next to the participant recorded any false triggers of the voice key and any naming errors. There were five randomized orders of the stimulus list to control for order effects and participant's fatigue. On each trial, initially, a fixation symbol ("+") for the duration of 500 msec was presented on the monitor. This was a signal for the participants to focus and get ready for the picture. The target picture remained on the screen for a maximum of 3 seconds (3000 ms). The picture disappeared from the screen as soon as the microphone registered a vocal response. If there was no response, the picture disappeared after 3000 ms and the inter-stimulus interval (ISI) was1000 ms. The ISI was added to the total response window just in case speakers initiated a response right before the picture disappeared. Hence the total window within which a response could be made was 4000 ms.

2.4. Procedure

All participants were tested individually, in a quiet room. They were instructed to name the pictures that would appear on the screen as quickly as they could without making a mistake, and to avoid coughs, false starts, hesitations (e.g., "uhmm"), articles or any other extraneous material (e.g. "a dog" or "That's a dog") other than the best and shortest name they could think of for the depicted object. To familiarize participants with the experiment, a practice set of 5 pictures (not included the stimulus set) were given as examples. The practice items could be repeated if the experimenter felt that the participant did not yet understand the procedure.

The dependent measures in the study were the participants' naming responses and the naming times.

2.5. Scoring

The scoring criteria used for the present study were modeled closely on procedures adopted by the International Picture Norming study (Bates et al., 2000).

I. The data-coding for each picture was determined empirically, in two steps. First, the data were participated to error coding to determine which responses could be retained for both naming and RT analyses. Three error codes were possible:

a. <u>Valid response.</u> Refers to all the responses with a valid (codable) name and usable, interpretable response times (no coughs, hesitations, false starts, or pronominal verbalization like "that's a ball").

b. <u>Invalid response.</u> Refers to all the responses with an invalid RT (i.e. coughs, hesitations, false starts, pronominal verbalizations) or a missing RT (the participant did produce a name, but it failed to register with the voice key).

c. <u>Nonresponse</u>. Refers to any trial in which the participant made no verbal response of any kind.

I. All valid responses and all the invalid RTs with a codable response were coded into different lexical categories in relation to the target name, using the same criteria adopted for the adult study.

a. Lexical Code 1. The target name (dominant response operationally defined as the modal response i.e., most frequent response for each group).

b. Lexical Code 2. Any morphological or morphophonological alteration of the target name, defined as a variation that shares the word root or a key portion of the word without changing the word's core meaning. Examples would include diminutives (e.g. 'bike' for 'bicycle'; 'doggie' for 'dog), plural/singular alterations (e.g. 'cookies' when the target word was 'cookie'), reductions (e.g. 'thread' if the target word was 'spool of thread') or expansions (e.g. 'truck for firemen' if the target word was 'fire truck').

c. Lexical Code 3. Synonyms for the target name (which differ from Code 2 because they do not share the word root or key portion of the target word). With this constraint, a synonym was defined as a word that shared the same truth-value conditions as the target name (e.g., 'couch' for 'sofa' or 'chicken' for 'hen').

d. Lexical Code 4. This category was used for all names that could not be classified in codes 1-3, including hyponyms (e.g. 'animal' for 'dog'), semantic associates that share the same class but do not have the target word's core meaning (e.g. 'cat' for 'dog'), part-whole relations at the visual-semantic level (e.g. 'finger' for 'hand'), and all frank visual errors or completely unrelated responses.

2.6. Data Reduction

For each picture seven dependent variables were derived for analyses from the two raw dependent measures.

a. Nameability of the picture (percent of all participants who were able to produce a codable response with a valid RT).

b. Percent name agreement (percent of participants producing the target names out of all codable responses with a valid RT).

c. Mean reaction times across all valid trials (i.e. mean latency for all participants who produced a valid response on that item, regardless of the content of that response).

d. Mean reaction times on target naming (i.e. mean latency only for those participants who produced the target name for that item).

e. Percent of participants producing a codable response classified as a morphological variant (Lexical Code 2).

f. Percent of participants producing a codable response classified as a synonym (Lexical Code 3).

g. Percent of participants producing a codable response that failed to meet criteria for Lexical Codes 1-3 (Lexical Code 4, including frank visual errors, more ambiguous superordinate category names like "animal" or "food").

In addition to these performance measures, several predictor/independent variables were considered in attempting to account for the variance in the naming accuracy and latency. These variables were selected based on (1) their availability (2) their successful use in previous picture-naming studies (3) their theoretical rationale in accounting for the process of picture naming. The eight predictor variables that were selected here for the analyses are:

1. Age-of-Acquisition norms. (a) An objective measure of age-of-acquisition (AoA) was derived from published norms for the American version of the MacArthur Communicative Inventory (Fenson et al, 1994), a parental report form that provides valid and reliable data about lexical development in children from 8-30 months. For our purposes here, the CDI yields a simple 3-point scale: 1=words acquired on average between 8-16 months; 2= words acquired between 17-30 months, 3= words that are not acquired in infancy (>30 months). (b) A subjective AoA measure, i.e., a rating study where adults were asked to rate each of the items on a 9-point scale corresponding to age in years ranging from <2, 3, 4, 5, 6, 7-8, 9-10, 11-12, 13+> (for more details see chapter 4).

2. Frequency (natural log values) of the target names from spoken sources (Baayen, Piepenbrock, & Gulikers, 1993).

3. Word length, measured in number of characters, and number of syllables.

4. Rough estimates of visual complexity for each of the pictures were obtained, based on the format of digitized picture files (Szekely & Bates, 2000).

5. Goodness of depiction ratings were made by college students, who were asked to determine (on a 7-point scale, from good to bad) whether the picture was a good representation of the concept to which the target name refers.

6. Presence/absence of a fricative or affricate in the initial consonant (0 = no fricative or affricate; 1 = fricative or affricate), a variable that has been reported to influence the time required for a response to register on the voice key.

7. Animacy (0 = animate, for persons or animals; 1 = inanimate, for all other referents including plants, body parts, foodstuffs).

8. Pictures were further grouped into one of 6 lexical categories, to explore possible differences in word retrieval that do not form a scale: objects, food, animals, persons, mobile objects, body parts.

3. Results and Discussion

Appendix A presents the stimuli, listed in alphabetical order, used in the picture naming study. In the first stage of lexical coding, in which the target name for each picture is empirically derived, the four groups provided the same target name for 235 of the 260 items. The target (modal) names differed across the four groups for 25 of the stimuli. Looking at the differences in target responses across the four groups for 25 of the 260 picture items, we find the there is no consistent pattern that emerges. However, it was noted that for a few pictures, children in the younger age groups (especially the 5-7 year olds) sometimes used the function of the object to name a picture when they were unable to produce the name. For example, the children in the 5-7 age group would often say “weigher” for a “scale”, “roller” for “rolling pin”, etc.

In order to focus on the developmental differences across these four groups, when the target items were held constant, these 25 items were excluded; and all correlational and regression analyses are based on the remaining 235 pictures.

<u>Fatigue Effects across the Four Groups</u>

In order to verify if there were any fatigue effects given the fact that this particular study was conducted in single session, we computed separate Pearson product-moment correlations for the 4 groups, examining the relationship between the order in which the pictures were presented and 4 of our primary dependent variables, total RT (mean response times of items with valid and codable responses), nameability (percent valid responses), target RT (mean response times items with target naming responses) and name agreement (percent production of the target name) [see Table 5.1 for summary of correlations]. Since four different random orders were used, these analyses conflate across the four pictures that were presented at each position on the list of 260 items. For all the four groups, we found no correlation between the order of presentation and nameability or name agreement. However, there were small but significant positive correlations between event order and naming latency (total RT and target RT) for two of the groups (i.e., 5-7 and the 11-13 year olds) [see Table 5.1]. This pattern did not emerge for the other two age groups (i.e., 8-10 year olds and adults). Therefore, while accuracy on the task was not affected as a result of the duration of the task across the four age groups, naming latency became longer as the session progressed for two groups and the remaining two groups show similar trends though they do not reach significance. These results justify our reasoning for using a relatively large stimulus set and also validate earlier studies conducted in the lab where similar trends were found with adults and children thus re-affirming our confidence in using these long lists. Also, our results do not corroborate the general concerns expressed in the literature (e.g. Snodgrass & Vanderwart, 1980; Snodgrass & Yuditsky, 1996) about using lists of this length or longer since the assumption is that performance would be adversely affected.

Table 5.1. Correlational analyses between the dependent measures and item position to determine fatigue effects

VARIABLE	AGE GROUP	R VALUE (WITH ITEM POSITION)	P VALUE
Total RT	5-7	0.2742	0.0000
	8-10	0.0773	0.2139
	11-13	0.3533	0.0000
	Adult	0.1447	0.0195
nameability	5-7	-0.1193	0.0547
	8-10	-0.0398	0.5227
	11-13	-0.0498	0.4244
	Adult	-0.0601	0.3342
Target RT	5-7	0.2463	0.0001
	8-10	0.0347	0.5775
	11-13	0.3852	0.0000
	Adult	0.1483	0.0167
Name agreement	5-7	0.0095	0.8783
	8-10	-0.0064	0.9176
	11-13	0.1263	0.0419
	Adult	0.0402	0.5192

Comparing Mean Performance across the Four Groups

Tables 5.2 (a) and (b) provide the descriptive statistics of the four dependent measures (i.e., total RT, nameability, target RT, and name agreement) for the four age groups, computed over items. Looking at the means for both nameability and response times [Table 5.2 (a) and (b)], there is a general trend wherein the older age groups are more accurate and faster than the younger age groups. Simple post-hoc t-tests over participants indicate that on nameability and name agreement while the youngest age group (i.e., the 5-7 year olds) were the least accurate (p < .001), followed by the 8-10 year olds (p < .001), the difference in naming between the two older groups (i.e., adults and the 11-13 year olds) was not significant.

However, with regard to the naming latency (both for valid and target responses) [Table 5.2 (a) and (b)], while adults were faster than all the younger age groups (p < .001), the 11-13 year olds were faster (p < .001) in naming than the youngest group (i.e., 5-7 year olds) but were not significantly faster than the 8-10 year olds.

Table 5.2 (a). Summary statistics of valid RTs (RTs with codable response) and nameability for the four age groups (over items)

	VALID RT				NAMEABILITY			
	5_7	8_10	11_13	ADULT	5_7	8_10	11_13	ADULT
N	260	260	260	260	260	260	260	260
Mean	1320	1156	1097	929	82%	92%	95%	97%
SD	235	214	188	170	16%	10%	7%	5%
SE	15	13	12	11	1%	1%	0%	0%
Median	1250	1122	1060	887	88%	96%	97%	100%
Min	926	786	777	660	14%	33%	51%	74%
Max	2078	1950	1663	1598	100%	100%	100%	100%

Table 5.2 (b). Summary statistics of target RTs (RTs with target response) and name agreement for the four age groups (over items)

	TARGET RT				NAME AGREEMENT			
	5_7	8_10	11_13	ADULT	5_7	8_10	11_13	ADULT
N	260	260	260	260	260	260	260	260
Mean	1309	1144	1084	919	80%	83%	86%	87%
SD	246	215	184	163	21%	19%	17%	16%
SE	15	13	11	10	1%	1%	1%	1%
Median	1236	1094	1043	873	88%	91%	94%	94%
Min	926	786	777	660	3%	17%	31%	23%
Max	2175	1853	1674	1407	100%	100%	100%	100%

For the analyses over items, simple one-way-ANOVA over age and post-hoc t-tests were conducted for both naming responses and reaction times. The results indicate that across the 4 age groups, for all valid and target responses, older age groups have a significant advantage over the younger age groups on both the naming responses and especially response times ($p < .05$). Therefore, across the four age groups, the younger age groups of children were slower and less accurate than the older age groups. All the participants found the task easy to do, enjoyable and all of them completed the task. However, the younger children (5-7 year-olds and 8-10 year-olds) had to take more breaks than the older groups of participants in order to finish the task. No participant had to be eliminated based on his or her performance on the task.

Looking at the summary table (over items) for the different response types [Tables 5.3 (a) and (b)], the four groups of participants differed significantly ($p< 0.05$)

from each other with respect to naming responses. Adults produced the highest percentage of valid responses (produced a codable response on items with a valid and usable RT) and were followed by the 11-13 year-olds, 8-10 year-olds and 5-7 year-olds [Table 5.3 (a)]. For adults and 11-13 year-olds, the invalid responses and non-responses were very infrequent. The 8-10 year-olds had a higher percentage of invalid responses and of non-responses and the youngest age group (5-7 year-olds) were by far the worst, as expected, produced the highest percentage of invalid responses and non-responses [Table 5.3 (b)].

Table 5.3 (a). Distribution of valid RT and nameability for the different response types for the four groups

	VALID RT				NAMEABILITY			
	5-7	8-10	11-13	ADULTS	5-7	8-10	11-13	ADULTS
Target	1309	1144	1084	919	80%	83%	86%	87%
Modified target	1530	1368	1249	1128	3%	4%	4%	3%
Synonym	1517	1431	1398	1122	7%	6%	6%	6%
Other	1565	1369	1344	1079	11%	7%	5%	4%
Good RT	1320	1156	1094	925	82%	92%	95%	97%

Table 5.3 (b). Distribution of invalid responses across the 4 age groups

	NR	INVALID RT
5_7	12%	6%
8_10	5%	3%
11_13	3%	2%
Adult	1%	2%

Tables 5.3 (a) and (b) provide a distribution of the different valid and invalid responses across the four groups. What we see is that the alternative responses are low, even for the younger age groups. The response patterns seen with the younger ages are not typical of the data reported in the literature. The general finding in the literature is that younger children have high proportions of non-responses and alternative naming responses (Cycowicz et al, 1997; Berman et al, 1989). However, in our data we see that the younger children while having a higher percentage of non-responses do not have a high number of alternative responses. One of the reasons that could explain this result is that we had initially selected stimuli that were age-appropriate and would be nameable even by the younger children since we did not want floor effects.

Looking at the naming latencies for the four types of response types [Table 5.3 (a)] we can see a similar pattern across the four groups, with all the four groups showing significant differences ($p < 0.05$) in picture naming times. Adults were the fastest, followed by the older age group, the 8-10 year-olds and the youngest age group. As expected, from findings in previous picture naming studies in children and adults (Johnson et al, 1996, Cycowicz et al, 1997), the youngest aged children were the slowest on the task (395 ms slower than the adults), followed by 8-10 year olds (231 ms slower than the adults), and the 11-13 year olds (165 ms slower than the adults).

<u>Relationships among the Dependent Variables</u>

To examine the relationships between the naming responses and naming times, correlations across the dependent variables were calculated (all calculations are computed over items). The resulting correlation coefficients for the four age groups are reported in Tables 5.4 (a), (b), (c), (d) and 5.5 (a) and (b). We see that there are significant correlations among the dependent variables across the four ages. As we would expect, production measures (nameability and name agreement) and the naming latencies (valid and target) are negatively correlated (i.e., items that are easier to name also have a lower RT). The direction of these correlations was the same in all the four groups. In these tables [see Tables 5.4 (a), (b), (c) and (d) and 5.5 (a) and (b)], we expected to see a high correlation among the dependent variables within each age group. This was certainly true for the younger age groups, but less so, for the adults due to the truncation of range that was a consequence of the item selection criteria. The direction of these correlations was the same across all the four age groups. First, overall nameability and name agreement were significantly ($p < .001$) and positively correlated, as we would expect, but the values were the highest for the youngest age group (i.e., 5-7 year olds) and the lowest for the older age groups (11-13 year olds and adults) [Tables 5.4 (a), (b), (c) and (d)]. In addition, high nameability and high name agreement were associated with faster naming latencies (overall and target) across the four age groups. The correlation coefficients between the naming responses (nameability and name agreement) and response times (total and target) are the highest for the youngest group (i.e., 5-7 year olds) and the lowest for the older age groups (i.e., 11-13 year olds and adults) [Tables 5.5 (a), and (b)].

Table 5.4 (a, b, c & d). Summary tables of the correlational analyses among the dependent variables for items with the same target response (235 items) across each of the 4 age groups

Table 5.4 (a). Correlations among the dependent variables for the 5-7 year olds

	I	**II**	**III**	**IV**
I. Total RT	--			
II. nameability	-0.78**	--		
III. Target RT	0.96**	-0.76**	--	
IV. name agreement	-0.68**	0.61**	-0.69**	--

**p < .001 *p < .01

Table 5.4 (b). Correlations among the dependent variables for the 8-10 year olds

	I	**II**	**III**	**IV**
I. Total RT	--			
II. nameability	-0.68**	--		
III. Target RT	0.97**	-0.66**	--	
IV. name agreement	-0.63**	0.37**	-0.6**	--

**p < .001 *p < .01

Table 5.4 (c). Correlations among the dependent variables for the 11-13 year olds

	I	**II**	**III**	**IV**
I. Total RT	--			
II. nameability	-0.59**	--		
III. Target RT	0.98**	-0.56**	--	
IV. name agreement	-0.6**	0.31**	-0.55**	--

**p < .001 *p < .01

Table 5.4 (d). Correlations among the dependent variables for the adults

	I	II	III	IV
I. Total RT	--			
II. nameability	-0.61**	--		
III. Target RT	0.98**	-0.61**	--	
IV. name agreement	-0.51**	0.34**	-0.48**	--

**p < .001 *p < .01

These lower correlations of the production measures (also reported in previous picture naming studies of adults, e.g., Snodgrass, et al., 1996; D'Amico et al., 2001) are evidence that for the adults in this study, there was a ceiling effect, therefore there was a truncation of range. This truncation in range is expected because of the items, which were selected for this study was relatively easy for the adults, and there was less variance in the adults' performance. For reasons that will be explained later, truncation of range or ceiling effects in the older age groups applies only to the naming production measures and not to naming latencies, as one can see that the overall RT is very highly and positively correlated with the target RT across the four age groups.

Table 5.5 (a & b). Summary table of the correlational analyses among the dependent variables (within each age group) for items with the same target response (235 items) across the 4 age groups

Table 5.5 (a). Pairwise Correlations of Mean Total RTs with nameability across the 4 age groups

	5-7 RT	**8-10 RT**	**11-13 RT**	**ADULTS RT**
5-7 nameability	-0.78**	-0.76**	-0.68**	-0.65**
8-10 nameability	-0.65**	-0.68**	-0.64**	-0.62**
11-13 nameability	-0.53**	-0.55**	-0.59**	-0.61**
Adults nameability	-0.48**	-0.54**	-0.55**	-0.61**

**p < .001 *p < .01

Table 5.5 (b) Pairwise Correlations of Mean target RTs with name agreement across the 4 age groups

	5-7 RT	**8-10 RT**	**11-13 RT**	**ADULTS RT**
5-7 name agreement	-0.69**	-0.72**	-0.67**	-0.65**
8-10 name agreement	-0.57**	-0.6**	-0.61**	-0.53**
11-13 name agreement	-0.45**	-0.5**	-0.55**	-0.47**
Adults name agreement	-0.39**	-0.46**	-0.49**	-0.48**

**p < .001 *p < .01

Characteristics of and Relationships among the Predictor Variables

Table 5.6 (a) is a summary table that reports the characteristics of the predictor variables (computed over items). Table 5.6 (b) provides a summary of the Pearson product-moment correlations conducted among the nine predictor variables, calculated over items. These correlations are largely similar to those reported in the literature on lexical access. As expected, there is a negative relationship between frequency (log frequency) and AoA (both subjective and objective AoA). Other significant and strong relationships also include an often reported association between length (syllable and character) and frequency (i.e., longer words tend to be less frequent). Therefore, not surprisingly, complex target names tend to be longer, less frequent and acquired later. Goodness of depiction measure (a subjective rating measure) seems to have some overlap with the AoA measures. Picture complexity appears to be relatively independent of the lexical predictors. Because of the confounds among these predictor variables, correlational analyses between the predictor and dependent variables need to be supplemented with regression analyses examining the independent contributions of each predictor variable when the other variables are controlled.

Table 5.6 (a). Characteristics of the dominant responses for 235 Items

SCALAR VARIABLES	Mean	Minimum	Maximum	Standard Deviation
Number of Characters	5.92	2	13	2.23
Number of Syllables	1.77	1	4	0.82
Frequency (log values)	2.51	0	6.41	1.48
Adult ratings of Age of Acquisition (AoA)	4.97	2.93	9.33	1.14
Goodness of Depiction ratings	6.08	4.3	6.75	0.44
Visual Complexity	16225	3730	52543	7487
ORDINAL & NOMINAL VARIABLES	**Coding**	**Number of items**	**Percent of Items**	
Objective AoA from MacArthur CDI Parent Reports	8-17 months = 1 18-30 months = 2 >30 months = 3	81 31 123	35% 13% 52%	
Word Initial Fricatives	No = 0 Yes = 1	166 69	71% 29%	
Semantic Category	Animals Body parts Food Large artifacts Objects & Phenomenon in nature People Small artifacts Things to wear Vehicles	53 13 16 32 9 6 68 19 19	23% 6% 7% 14% 4% 3% 29% 8% 8%	

Table 5.6 (b). Correlations among the 8 predictor variables

	I	II	III	IV	V	VI	VII	VIII
I. AoA (subjective AoA)	--							
II. CDI (objective AoA)	0.59**	--						
III. Frequency	-0.43**	-0.36**	--					
IV. Syll. Length	0.28**	0.19**	-0.46**	--				
V. Char. Length	0.31**	0.22**	-0.52**	0.81**	--			
VI. Frication.	n.s.	n.s.	n.s.	0.13*	n.s.	--		
VII. Visual Com	n.s.	n.s.	n.s.	n.s.	0.11^	n.s.	--	
VIII. Goodness of Depiction	-0.16**	-0.21**	n.s.	n.s.	n.s.	n.s.	n.s.	--

**p < .001 *p < .01 ^p< .05

Relationships among Dependent Measures and Independent (predictor) Variables across the Four Groups

From this point on all analyses will include the two main dependent measures, target response times and name agreement. Table 5.7 summarizes correlations among the nine predictor variables and the two dependent measures (target response latencies and name agreement). Although the correlations reveal some important similarities, there appear to be some subtle differences between the four age groups.

Next, if we look at the results of the correlational analyses among the predictor variables and name agreement, here again AoA measures (both subjective and objective), frequency, syllable and character length and goodness of depiction are all significantly correlated with name agreement (percent producing target name) for all the four age

Table 5.7. Correlations among the predictor variables and the dependent measures (target RT and name agreement)

	TARGET RT				NAME AGREEMENT			
	5-7	8-10	11-13	ADULTS	5-7	8-10	11-13	ADULTS
AoA	0.6**	0.58**	0.5**	0.59**	-0.51**	-0.32**	-0.23**	-0.25**
Frequency	-0.27**	-0.34**	-0.4**	-0.4**	0.35**	0.29**	0.31**	0.3**
CDI Index	0.32**	0.28**	0.3**	0.37**	-0.36**	-0.19*	-0.15^	-0.16^
Syllable length	0.21*	0.25**	0.2*.	0.17^	-0.26**	-0.17*	-0.16^	n.s.
Character length	0.31**	0.38**	0.31**	0.27**	-0.33**	-0.25**	-0.21*	-0.15^
Visual Complexity	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodness-of-Depiction	-0.45**	-0.44**	-0.49**	-0.46**	0.4**	0.38**	0.37**	0.38**
Frication	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

groups. However, there seems to be a stronger relationship between these variables and the younger age groups than with the older groups. As with response times, frication and visual complexity appear to have no effect on the target name production measure across the four age groups.

Stepwise Regression

To control the potential confounds among these predictors and to further test the reliability of the correlations observed among the predictors and naming behavior (i.e., target RTs and name agreement), seven stepwise-regression analyses were conducted (separately for each of the four age groups, with each of the two dependent measures). In these analyses, the contribution of each variable was computed on the final step, once the other six predictors were entered into the regression model. Table 5.8 provides a summary of the regression analyses for the two dependent measures across the four groups. Table 5.8 summarizes the total variance accounted for by all the predictors together in the model and the unique contribution of each of the independent variables once all the other predictors were controlled for the dependent measures (target latencies and name agreement) across the four age groups.

In Table 5.8, the overall equation seems to be a good fit and reaches significance for all the four groups. Looking at the individual contribution of the seven predictor variables for each of the four groups for the mean target RT, we find that for all the four groups (i.e., 5-7, 8-10, 11-13 year olds and the adults), only two variables make significant contributions after the others are controlled. The first variable was age-of-acquisition (adult ratings) [$p < .001$].

Table 5.8. Unique variance contributed on the last step of Step-wise regression analysis for the dependent measures (target RT and name agreement)

	TARGET RT				NAME AGREEMENT			
	5-7	**8-10**	**11-13**	**ADULTS**	**5-7**	**8-10**	**11-13**	**ADULTS**
% Variance	48%**	49%**	44%**	47.3%**	35%**	21%**	19.6%**	24%**
AoA	16%**	14%**	5.6%**	11.2%**	-5.2**	-1.2%**	n.s.	n.s.
Frequency	n.s.	n.s.	-1.7%^	-1.4%^	n.s.	n.s.	3.6%*	3.1%*
CDI	-1.1%^	-2.4%*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Syll.len	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Char.len	0.9%^	2.1%*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Vis.Com	n.s.	n.s.	1.2%^	n.s.	n.s.	n.s.	n.s.	n.s.
GoodDepict	-9.2%**	-9.6%**	-13.4%**	-8.7%**	8.3%**	10%**	11%**	10%**
Frication	1.1%^	n.s.	n.s.	0.9%^	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p < .05

One thing to take note of is that the significant effects of frequency seen in the raw correlations disappear when adult ratings of AoA are entered into the regression model first, a finding that has also been reported in other studies of AoA effects. The second variable was goodness of depiction, which accounted for a significant amount of variance for all the four age groups ($p < .001$). The negative sign indicates the direction of the relationship, i.e., participants were faster (lower RT) to name pictures which had a higher goodness-of-depiction rating.

On the corresponding analyses of name agreement the seven predictors together accounted for a significant amount of variance for the four groups ($p < .001$). However, a reverse pattern of the results (as compared to the total variance computed for the target RT) is reported in table 5.9, with magnitude of variance controlled, decreasing with increasing age. This lower magnitude of the variance that is controlled by the present model for the older age groups is because of the truncation of the range problem that was discussed earlier. In other words, due to the procedures used to select items for the study, there is less variance overall with the older groups on name agreement.

In this table, it becomes clear that AoA ratings and goodness of depiction ratings are the only two variables that contribute substantially to the fitness of the regression model over and above all the other variables. AoA contributed a unique variance for the two youngest age groups ($p < .001$), and did not prove to be a significant variable in controlling the variance, once all the other variables were accounted for in the regression model, in the remaining two groups (i.e., 11-13 year olds and adults). Frequency seems to independently account for some of the variance in name agreement data with the two older age groups (i.e., 11-13 year-olds and the adults), but does not reach significance with the two younger groups. Note that the unique contribution of frequency appears to reach significance for the two older age groups (11-13 year olds and adults) where the contribution of AoA ratings does not reach significance. This suggests that we may have limited the AoA contribution for older children due to principles guiding item selection, and thereby unmasked a frequency effect that is absorbed by AoA at younger ages. Goodness of depiction is the only predictor variable included in the regression model, which significantly accounts for unique variance across the four age groups ($p < .001$).

Although both subjective and objective AoA measures were significantly correlated with the dependent measures for all the four age groups, the objective AoA (taken from CDI norms) did not survive the regression analyses when the subjective AoA (adult ratings) were entered first. In addition, we also find that frequency effects are nullified when subjective AoA were entered first, for all groups in the RT analyses and for the two younger groups in the name agreement analyses. These patterns of results in the regression analyses is compatible with the claim the AoA ratings reflect a combination of factors including effects of frequency as well as age of acquisition itself (Ellis & Morrison, 1998; Iyer et al., 2001).

Factor Analyses

We measured a large sample of words on a number of independent variables. Raw correlational analyses between dependent and independent variables indicate that there were patterns of correlations among these variables that may reflect the underlying processes affecting the performance of subjects on the picture naming task. It is obvious that some of these raw predictors are redundant. Factor analyses may be a valuable statistical technique to discover those possible underlying processing patterns. In general, the goal of research using factor analysis is to reduce a large number of variables to a smaller number of factors, to concisely describe (and perhaps understand) the relationships among the observed variables, or to test some theory about underlying processes.

Factor analyses were performed for all the predictor variables to uncover the underlying processing patterns of object naming across the four age groups [see Table 5.9 (a)]. Results of the factor analyses revealed three factors: Factor 1 loaded up mainly on word form characteristics such as number of characters and syllables and word frequency; Factor 2 was determined by conceptual aspects such as word frequency, goodness of depiction ratings and age of acquisition, and Factor 3 was contributed by the phonetic features of the picture name such as frication. Therefore, word frequency appears to contribute to both Factor 1 (at the word form level) and Factor 2 (conceptual level). Stepwise regression analyses entering these three factors as the predictor variables were conducted and the resulting regression model showed that Factor 2 ("conceptual factor") was the strongest predictor of naming behavior across the four age groups. This was followed by Factor 2 ("word form" factor) with a very slight contribution of the Factor 3 ("phonetic" factor) [see Table 5.9 (b)]. These results support the view that conceptual factors, such as age-of-acquisition, goodness of depiction ratings, and frequency are the strongest predictors of picture naming. The results also indicate that there are independent effects of frequency on picture naming behavior and the locus of these effects appear to be both at the word form and at the conceptual level.

Table 5.9 (a). Factor Analyses: rotated component matrix (principal components analysis)

	Factor1 (wordform)	Factor2 (conceptual)	Factor3 (phonetic)
Char.len	**.907**	.087	.031
Syll.len	**.894**	.052	-.091
Frequency	**-.64**	**-.407**	-.066
Vis.Com	.288	-.234	.153
AoA	.316	**.781**	.048
CDI	.209	**.781**	.074
GoodDepict	.209	**-.571**	.171
Frication	-.017	-.013	**.972**

Table 5.9 (b). Unique variance contributed by the 3 factors on the last step of step-wise regression analysis for the dependent measures (target RT and name agreement)

	TARGET RT				NAME AGREEMENT			
	5-7	8-10	11-13	ADULTS	5-7	8-10	11-13	ADULTS
% Variance (R square)	30.4%**	29.1%**	28.3%**	35.2%**	28.8%**	12.6%**	9.1%**	9.6%**
Factor1 (wordform)	3.4%*	6.6%**	4.7%**	3.1%*	-5.2%**	-2.9%^	-2.2%^	n.s.
Factor2 (conceptual)	22.2%**	18.5%**	19.3%**	27.1%**	-20.9%**	-9.2%**	-6.8%**	-9.3%**
Factor3 (phonetic)	1.7%^	n.s.	1.4%^	1.5%^	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p < .05

Semantic Category Effects

In our final comparison of the four groups, we looked at the contribution of semantic category (a nominal variable) that could not be included in the regression analyses. The pictures have been divided into nine semantic categories [see Tables 5.10 (a) and (b)]. Most of these categories also been used in brain-injured adults, and there are numerous reports of selective sparing or impairment in semantic categories that have been used (for a review see Goodglass, 1993). In view of the findings in the literature regarding the effects of age of acquisition of these concepts on naming in both normal and brain-injured adults, we thought that it might be useful to determine whether responses differ across the categories for the four age groups. Tables 5.10 (a) and (b) summarizes the means (target response times and target name agreement) and standard deviations for the four groups [see Figures 5.1 (a) and (b)]. From both the tables and the figures, it is clear that the four groups show similar pattern of naming behavior across the nine categories. What we see is that older groups are faster and more accurate across the nine categories than the younger groups and there does not seem to be any effect of semantic category on naming behavior. That is, there does not appear to be any developmental pattern that emerges across these nine semantic categories. These results again to some extent could be attributed to the truncation of range of the stimulus set, as we wanted items that would be of easy to moderate level difficulty to avoid floor effects with the younger groups. The raw scores were entered into a 4 x 9 analysis of variance over items treating age as the between participant variable and the nine semantic categories as levels of a within participant variable. There were significant main effects of age [$F(3, 224) = 104.78$, $p < 0.001$] and category [$F(8, 224) = 5.34$, $p < 0.0001$]. However, the most important for our purposes, the interaction between age and semantic category did not reach significance.

Table 5.10 (a). Semantic Categories: Summary table of mean target RT (and standard deviations) across the 9 categories

	NO. OF ITEMS	5_7	8_10	11_13	ADULT
Animals	53	1187 (165)	1068 (158)	1049 (146)	925 (139)
Body Parts	13	1331 (316)	1134 (238)	1000 (188)	860 (149)
Foods	16	1230 (215)	1071 (132)	1029 (178)	824 (101)
Large Artifacts	32	1345 (212)	1180 (203)	1073 (163)	892 (130)
Objects & Phenomena in nature	9	1163 (109)	1029 (133)	1021 (93)	817 (81)
People	6	1346 (439)	1138 (367)	1055 (211)	865 (146)
Small Artifacts	68	1376 (271)	1162(213)	1091 (174)	939 (186)
Things to wear	19	1293 (230)	1090 (183)	1046 (193)	854 (170)
Vehicles	19	1279 (206)	1150 (214)	1099 (180)	940 (172)

Table 5.10 (b). Semantic Categories: Summary table of mean name agreement (and standard deviations) across the 9 categories

	NO. OF ITEMS	5_7	8_10	11_13	ADULT
Animals	53	86% (15)	88% (15)	90% (13)	89% (13)
Body Parts	13	83% (21)	86% (18)	89% (13)	92% (11)
Foods	16	91% (13)	92% (13)	93% (12)	93% (13)
Large Artifacts	32	80% (22)	84% (18)	87% (16)	87% (16)
Objects & Phenomena in Nature	9	83% (22)	86% (18)	91% (12)	87% (18)
People	6	76% (38)	85% (22)	93% (10)	93% (12)
Small Artifacts	68	80% (20)	85% (16)	88% (14)	90% (14)
Things to Wear	19	88% (14)	89% (13)	92% (11)	95% (11)
Vehicles	19	81% (18)	85% (15)	85% (15)	85% (15)

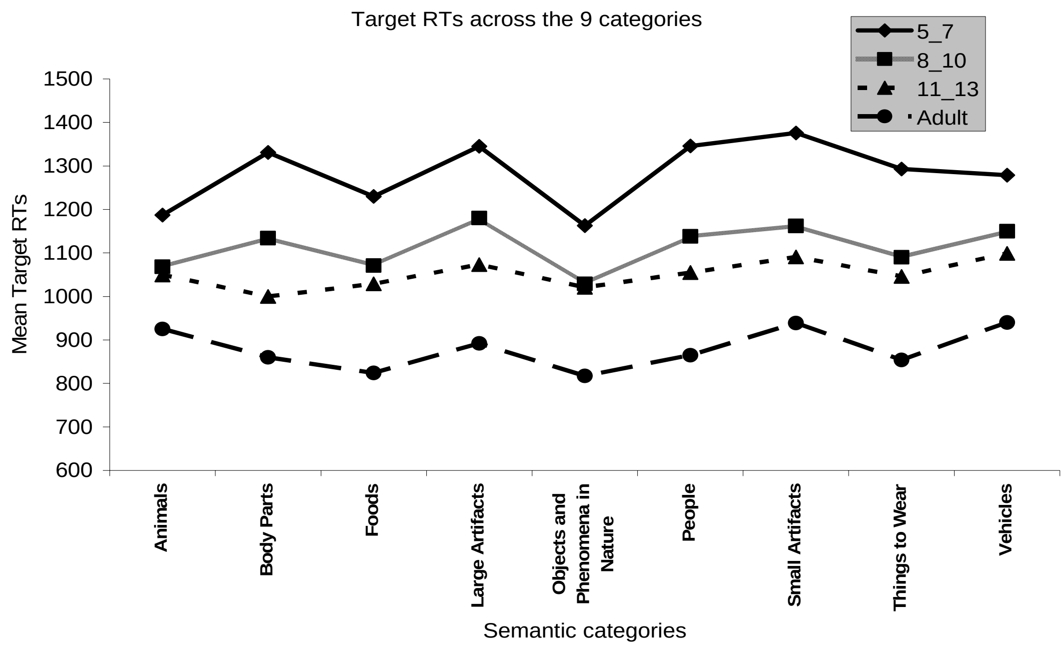

Figure 5.1 (a). Developmental trends of target RTs for 4 age groups across the 9 semantic categories

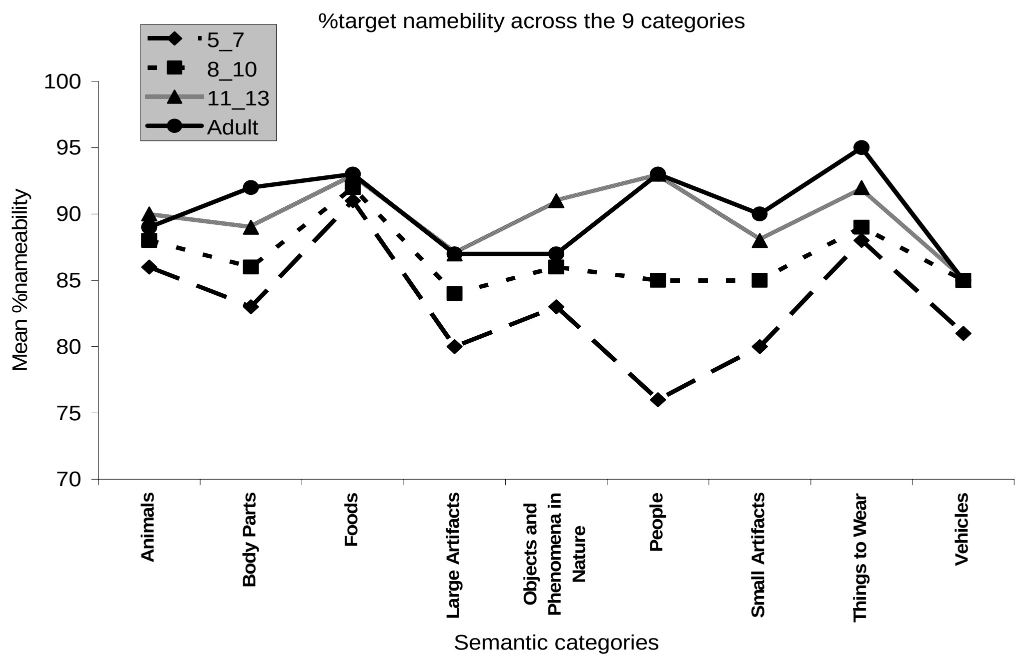

Figure 5.1 (b). Developmental trends of name agreement for 4 age groups across the 9 semantic categories

4. Summary and Future Directions

This on-line picture naming study comparing monolingual English adults and children between the ages of 5-13 years is one of the few studies to assess lexical retrieval through picture naming across the early life span using a relatively large stimulus set. The study served several purposes.

First, we wanted to obtain normative data from adults and children for a timed picture naming study to enable us to understand the developmental trajectory of lexical access processes of use for comparisons with clinical populations. To this end, we collected picture naming times and naming data from children ranging from 5–13 years of age and college undergraduates. The results indicate that all the participants, including the youngest age group (5-7 year-olds), were able to complete the task without difficulty even though the number of items was very large. Small but significant fatigue effects were evident for naming latencies (though did not affect the naming accuracy) in two of the four groups, but all the participants maintained more or less the same level of performance across the entire session.

Secondly, we wanted to identify age-related changes in performance by children and adults on the picture naming task. We found that speed and accuracy increased monotonically across the four age groups in the study. On average, there is a 100 ms gap between each group, with the adults about 300-400 ms faster than the youngest 5-7 year-olds. In addition, the younger children made a higher proportion of non-responses. This is consistent with the findings reported in previous studies with children (Cycowicz et al., 1997; Berman et al., 1989; Johnson et al., 1992), but the present study adds a degree of "developmental grain" to this picture. Another finding that is commonly reported in the developmental literature is that children produce higher proportion of alternative naming responses. This finding was not replicated in our study. One reason that we did not obtain this pattern in the children's data is probably because of the items selected for this study. We had pre-selected items that would be relatively easy to name and had high target nameability, and we eliminated the 25 items that elicited different target names from different age groups. Despite the developmental differences in speed and accuracy, the performance measures (i.e., target response times and name agreement) are highly correlated, thereby ensuring the reliability of these measures. We must underscore, however, that we were forced to deal with the same truncation of range problem that has also been reported in previous picture naming studies (D'Amico et al., 2001), wherein older participants (especially adults) have lesser variability in their naming accuracy responses, leading to lower correlations with other variables.

Third, we wanted to investigate relationships among children and adults' dependent measures (target naming times and target naming responses) with various predictor variables including frequency, age-of-acquisition, word length that have been reported in the literature. Here, we found that in the initial correlational analyses, age-of acquisition, frequency, character and syllable length, and goodness of depiction seemed to be highly correlated with naming times and naming accuracy. This indicates that items that were learned earlier in life, that were more frequent, that had fewer syllables and characters and that were good depictions of the target name, were responded to faster and more accurately than items learned later in life, less frequent, were longer in syllable and character length and were poorer depictions of the target name. This pattern was consistently seen for all the four age groups.

Not all the predictors proved to be equally important (or independent) in the regression analyses. Age of acquisition was one of the two variables, which accounted for independent variance in the naming behavior across the four groups, once all the other predictors were accounted for, including frequency. This suggests that items that were acquired earlier in life do seem to be accessed faster and more accurately, than items that acquired later in life. In contrast, almost all the frequency effects disappeared in the regression analyses. This is consistent with the AoA literature, where the general finding is that frequency appears to be confounded with AoA, and that these adults AoA ratings reflect more than one factor including a combination of frequency and real information about age at which these words or concepts were acquired (Ellis & Morrison, 1998; Gerhand & Barry, 1998, 1999). The one interesting exception to this general pattern occurred for naming accuracy, where variance is truncated for older children and adults. For these two groups, and only on the accuracy measure, frequency makes an independent contribution after the other variables are controlled, but AoA does not. Hence, the truncation of variance problem seems to interact with the complex relationship with frequency and AoA.

Another variable that seemed to partially account for the variance in the model is the goodness-of-depiction ratings. These significantly accounted for the variance in the model for all the four age groups for both name agreement and naming latency. This indicates that pictures that were rated as being good renderings of the target name were more accurately and faster named than pictures that were rated as being less representative of the target name.

The results obtained here in turn validate the picture naming paradigm and the items used in the study, which then allows us to extend the paradigm to bilingual populations and clinical populations such as children with language impairments and adults with aphasia. In the following chapters, I present the studies and results from the bilingual experiments, where I used the same on-line picture naming paradigm and also added another task (on-line word reading). The main reasons to extend our studies to study bilingual populations was to examine lexical access processes in bilinguals (Hindī-English) and look at how varying levels of reading and language proficiency affect performance on these language production tasks.

CHAPTER 6

AGE OF ACQUISITION AND FREQUENCY RATINGS IN HINDĪ-ENGLISH BILINGUALS

1. Rationale

Several studies in the psycholinguistic literature have examined the role of word frequency as a variable influencing lexical access. As mentioned in the previous sections, many models of word recognition have incorporated word frequency effects in their basic architecture (e.g., Forster's search model, 1978; Morton's logogen model, 1982; Balota & Chumbley, 1984).

Age of acquisition is another variable that has received considerable attention in recent times and that has been strongly implicated as a predictor of picture or word naming latency (Snodgrass et al, 1996; Iyer et al., 2001; Morrison & Ellis, 1995; Gerhand & Barry, 1998, 1999b, 1999a). While there are overlapping effects of both word frequency and age of acquisition in lexical access, several studies which have shown that there are strong and independent effects these variables. In the previous chapters (chapters 3, 4 and 5), I have demonstrated how word learning age and word frequency are two of the strongest variables that affect lexical access in monolinguals. In the current and next chapters, the goal is to examine the relationship between these lexical predictors with bilingual populations.

The aim of the current study was to obtain measures of frequency and word learning age, given that there are no objective frequency and age-of-acquisition measures available in Hindī or Indian English for the stimuli used the bilingual studies. To this end, two rating studies were conducted, wherein frequency ratings and age of acquisition ratings were obtained from two groups of college students in both English and Hindī.

2. Method

2.1. Subjects

All participants (college-age adults) were native Hindī speakers who were exposed to English before the age of 5 years, with normal language status. All the participants were recruited from urban colleges in Bangalore and Delhi. In India, typically, the medium of instruction in urban schools is English. Formal instruction in the Indian languages, taught as a second language commences from first grade for most schools. Therefore, the typical profile of an adult coming out of the Indian public school system is that they would be dominant in English (in spoken and written form). Two separate groups of subjects were recruited for the frequency and AoA rating studies.

Frequency Ratings: One group of seventy-one college age Hindī-English bilinguals (male= 47, female = 24) participated in this study. All the subjects who participated in the study filled out an initial screening questionnaire to verify that they met selection criteria for participation in this experiment. The selection criteria were that all subjects must be native Hindī speakers and who were exposed to English before 5 years of age. In addition, the subjects had to be right handed with no hearing impairments or cognitive deficits. All the subjects were recruited from the Bangalore University community (Bangalore) and the Delhi University community (Delhi) and they received a payment of INR 100 (approximately US $ 2.00) for participating in the experiment. The subjects ranged in age from 18-24 years (Mean age = 20 years).

Age of Acquisition Ratings: A separate group of seventy-three college age Hindī-English bilinguals (male = 39, female = 34) participated in this study. Participants filled out an initial screening questionnaire to verify that they met selection criteria for participation in this experiment. To be eligible to participate, subjects were to be native Hindī speakers who were exposed to English before 5 years of age. In addition, the subjects had to be right handed with no hearing impairments or cognitive deficits. All the subjects were recruited from the Bangalore University community (Bangalore) and the Delhi University community (Delhi) and received a payment of INR 100 (approximately US $ 2.00) for participating in the experiment. The subjects ranged in age from 18-24 years (mean age = 20 years).

2.2. Materials

A total of 352 words, presented in both Hindī and English comprised the stimuli for the age of acquisition and frequency rating studies. The stimulus set was obtained from the International Picture Naming (IPN) project (Bates et al, 2000). The Hindī picture names for the 352 items were obtained from an initial pilot picture naming study, where the aim was to select items from the list of 520 items in the IPN database items that were nameable and identifiable by the subjects in the pilot. In addition, the pilot study was also undertaken to obtain Hindī names for the list of items that were going to be used in both the bilingual rating studies and lexical access experiments (see Appendix A for a list of stimuli used).

2.3. Design and Procedure

Frequency Rating Study: Instructions for the frequency ratings were adapted from the IPN studies (Bates et al., 2000), wherein frequency ratings were previously collected. Participants were given two lists of 352 words (one in Hindī and the other in English). They were instructed to rate each word on its frequency of use, on a 7-point scale (1 = not frequent, 7= very frequent), in their regular (either spoken or written form) use of (a) the English language (for the English word list) and (b) Hindī language (for the Hindī word list). The dependent measure was the frequency ratings given by the participants.

Age of Acquisition Rating Study: Instructions for the AoA ratings were adapted from Carroll and White (1973b) and Iyer and colleagues (2001). Participants were given two lists of 352 words (one in Hindī and the other in English). They were instructed to rate each word, in each list, on a 9-point scale (2, 3, 4, 5, 6, 7-8, 9-10, 11-12, 13+ years). The subjects were asked to estimate the age at which they learned the word, in either spoken or written form in (a) the English language (for the English word list) and (b) Hindī language (for the Hindī word list). The dependent measure was the age of acquisition ratings obtained from the participants.

3. Results and Discussion

The main goal of this rating study was to collect frequency and age-of-acquisition norms. This study is part of a larger project to examine processes of lexical access and literacy in Hindī-English populations. In the present study, we validated the data obtained with pre-existing frequency norms (objective) and age-of-acquisition norms (both subjective and objective). The validation of the obtained bilingual ratings (frequency and AoA) was done with pre-existing norms in English. It would have been ideal to compare these ratings not only with previously obtained English frequency (objective) and AoA data (subjective and objective), but also in Hindī. However, there have been no previous studies which have reported similar norms in Hindī for either frequency or AoA. The underlying assumption that is being made when comparing both Hindī and English ratings (frequency and AoA) with existing English norms is that there is a some conceptual overlap between the words in the two languages. So words that are more frequent and acquired earlier in one language are also more frequent and acquired early on in the other language.

In the case of the frequency ratings, correlational analyses were conducted for both the English and Hindī ratings with the objective English frequency measure (natural log values) of the object names in the IPN database, from spoken sources (CELEX database, Baayen, Piepenbrock, & Gulikers, 1993). The results of the correlational analyses of the objective word frequency data with the word frequency ratings from Hindī-English bilinguals, were $\underline{r = 0.57}$ ($p < 0.001$; with English word frequency ratings) and $\underline{r = 0.47}$ ($p < 0.001$; with Hindī word frequency ratings).

A comparison of the AoA ratings collected in the present study with our earlier monolingual study clearly indicate that we were able to replicate the effects found in the previous study. We compared our AoA ratings obtained from Hindī-English bilinguals to AoA ratings obtained from monolinguals, and obtained significant correlations for both English ratings $\underline{r = 0.66}$, $p< 0.0001$ and Hindī ratings $r = 0.5$, $p< 0.0001$. In addition, there was also a significant correlation between the Hindī and English AoA ratings, $\underline{r = 0.71}$, $p < 0.001$, thereby reinforcing our belief about the reliability of these AoA ratings and the consistency of the subjects' responses.

Second, a comparison of the AoA ratings with data from parental reports (i.e., using MacArthur Communicative Development Inventory developed by Fenson et al.,

1994) and objective AoA data (based on vocabulary tests from children, Morrison et al, 1997) indicated that these adult ratings do, to a relatively large extent, reflect real word learning age. The results of correlational analyses with the two developmental data sets were $r = 0.48$ (for English AoA) and $r = 0.42$ (for Hindī AoA) [$p < 0.001$; with Fenson et al., 1994)] and $r = 0.41$ (for English AoA) and $r = 0.41$ (for Hindī AoA) [$p < 0.001$; with Morrison et al., 1997]. While most of the concepts represented by the pictures/words used in this study were learned at an early age, participants used the entire scale, placing age of acquisition for some items as late as 13 years. This suggests that the younger children may not have acquired some of the stimulus items used.

The results from these two rating studies indicate that the ratings obtained can serve as a substitute for both objective word learning age and objective word frequency data. Typically, in the literature, in the case of word learning age and frequency, there have been attempts to tease apart the differences in spoken and written form of the word. In this rating study, no attempt was made to separate or tease apart the written and spoken components in both AoA and frequency ratings, and in fact the instructions given to the subject specified that he/she should consider the word in either its spoken or written form. For this reason, both AoA and frequency ratings likely reflect more generalized, global aspects of word learning age and word frequency, which includes both the spoken and written components.

Ideally, one should attempt to obtain actual, objective age of acquisition or word frequency data irrespective of the language one might be studying (using both written and spoken forms of a word). However, in many situations, it is quite difficult and time consuming to obtain objective age of acquisition data or objective word frequency data. In those situations, rating studies appear to be an adequate replacement.

4. Future Directions

Future studies should seek to understand effects of age-of-acquisition ratings and frequency ratings with bilingual and multilingual populations on lexical access tasks. In addition, it would be interesting to explore cross-language effects between these psycholinguistic variables and naming behavior (picture and word naming) in the bilingual populations. In the next chapter, I report results of a bilingual on-line study wherein I examined lexical access processes in Hindī-English bilinguals (both children and adults) on two language production tasks (picture and word naming). This was an exploratory study to examine the landscape of lexical access using a large stimulus set across different age groups of bilinguals and biliterates.

CHAPTER 7

PICTURE NAMING AND WORD READING IN HINDĪ-ENGLISH BILINGUAL ADULTS AND CHILDREN: AN ON-LINE BEHAVIORAL STUDY

1. Rationale

Bilinguals are the majority of language users viewed globally and it would be shortsighted not to consider their language functioning and focus only on monolinguals. The study reported in this chapter is an extension of my monolingual work. It had several aims: (1) to collect normative data on bilinguals using a large stimulus set, (2) to compare the performance profiles on lexical access tasks across the early life-span, (3) to examine the predictor-outcome relationships for age of acquisition, word frequency, visual complexity and syllable length on naming behavior, (4) to examine the effects of proficiency on performance on lexical access tasks, (5) to investigate the relationship between picture naming and word reading tasks, and (6) to examine the nature of cross-language effects of predictors on naming behavior.

2. Method

2.1. Subjects

All participants were native Hindī speakers who were exposed to English before the age of 5 years, with normal language status. All adults and children were recruited from urban colleges and schools. In India, typically, the medium of instruction is English, with the formal instruction in the Indian languages, taught as a second language, commencing from first grade for most schools. The typical profile of an adult or a child coming out of the Indian public school system is that they would be dominant in English (in spoken and written form).

Adults. 131 college undergraduates from Bangalore and Delhi participated in this study. Participants filled out an initial screening questionnaire to verify if they satisfied the criteria for participation in this experiment. In addition, a language history questionnaire was used to get some information about their language history and usage. The selection criteria were that the participants in the study should be native Hindī language speakers and exposed to English before the age of 5 years, right-handed with no hearing impairments or any known cognitive deficits. All participants received $2.00 (INR 100.00) for participating in the experiment. Their ages ranged from 18-24 years (M age = 20 years).

Children. 161 children ranging from 8 years to 13 years participated in the study. All the children were from urban middle class to upper middle class families. The children recruited for the study were from Indian public school system where the medium of instruction is English and the Indian languages are taught as a second language. Formal instruction of English is introduced in pre-school and the formal instruction of Indian languages begins in first grade. Therefore, the youngest group in the study (8-10 year olds) had a minimum of two years of reading experience in Hindī and 3-4 years in English. These children were divided into the two age groups (8-10 and 11-13 year olds). All the children were pre-screened to see if they satisfied the criteria for the experiment. A phone screen medical and language history questionnaire was used to determine their normal language and cognitive status. For the children, the parents were asked to fill out an initial screening questionnaire to verify if they were without any hearing impairments, cognitive or neurological deficits and to determine if they were native Hindī speakers and a brief report on their child's language history. Informed consent forms were obtained from the parents and the children. After task completion, children received either a small gift or money for their participation.

2.2. Materials

A subset of 352 picturable nouns based on the results of the pilot picture naming study with Hindī-English college students were used as the stimulus materials for this study. The pilot study was conducted on 30 Indian Hindī-English college-age bilinguals, to select those items from IPN database, which were nameable by Indian Hindī-English bilinguals. In addition, we wanted the Hindī names for all the items that were being used. All the items that were identifiable and nameable in both Hindī and English were selected for the study. The stimulus set was obtained from the International Picture Naming (IPN) database [Bates et al., 2000]. These 352 items were then divided into four lists of 88 items with items matched for word length, hard/easy (i.e., using response times and name agreement data obtained from pilot study), visual complexity (an objective measure of picture complexity in the IPN database). The aim was to obtain four balanced lists with items matched on these abovementioned criteria.

In addition, age-appropriate comprehension passages in both Hindī and English were selected from Indian public school curriculum materials. These measures were administered to all the subjects in order to obtain an objective measure of language proficiency in the two languages being examined (i.e., Hindī and English). Therefore, children in the 8-10 age range received two passages one in Hindī and other in English which were at a 2^{nd} – 3^{rd} grade competency level. Children in the 11-13 age range received two language passages, which were at a 5th – 6th, grade competency level. The college age students received the two language passages that were at a 12^{th} grade competency level.

2.3. Design

The three age groups (adults, 11-13 year olds, 8-10 year olds) of subjects were tested on two tasks (picture naming and word reading) in two languages (Hindī and English). The design uses a combination of between and within subject design paradigms: 3 age groups (between subject) x 2 languages (within subject) x 2 tasks (within subject). This is a blocked design paradigm blocked for both language and task. Therefore, each subject, participated in four blocks/ conditions: English picture naming, English word reading, Hindī picture naming and Hindī word reading (see Table 7.1). That is, each participant will see all the 352 items (divided into 4 lists) once. No items were repeated for any subject. Order and language effects were controlled by counterbalancing the order of tasks, assignment of lists to the 4 conditions, and languages. In addition, fatigue effects were controlled by using randomized lists and providing a break for the participant after each condition.

Table 7.1. Experiment design: A within and between subject design

Age groups	8-10 year olds				11-13 year olds				Adults (18-30 yrs)			
Language	Hindī		English		Hindī		English		Hindī		English	
Task	WR	PN	WR	PN	WR	PN	WR	PN	WR	PN	WR	PN
	N = 96				N = 96				N = 96			

In each block/ condition of the naming tasks (for the two languages) items (either pictures or words) were presented randomly on the center of an Apple Macintosh monitor, using a simple script in PsyScope 1.1 (Cohen, MacWhinney, Flatt, & Provost, 1993). During testing, participants wore headphones with a sensitive built-in microphone (adjusted to optimal distance from the participant's mouth) that was connected to a button box, a measuring device, designed for use with Macintosh computers. Voice-onset times were recorded via a button-box connected to the Apple Macintosh, running a simple script written in PsyScope 1.1 (Cohen, MacWhinney, Flatt, & Provost, 1993). Verbal responses were recorded with a cassette recorder. In addition, an experimenter sitting next to the participant recorded any false triggers of the voice key and any naming errors. There were four randomized lists used in the study. The order of presentation of lists, task and language were counterbalanced to minimize order, task and language effects. On each trial, initially, a fixation symbol ("+") for the duration of 500 msec was presented on the monitor. This was a signal for the participants to focus and get ready for the picture or word. The target item would remain on the screen for a maximum of 3 seconds (3000 ms). The stimulus would disappear from the screen as soon as the microphone registers a vocal response. If there is no response, the stimulus would disappear after 3000 ms and the inter-stimulus interval (ISI) was 1000 ms. The ISI will be added to the total response window just in case speakers initiate a response right before the item on the screen disappears. Hence, the total window within which a response could be made is 4000 ms.

2.4. Procedure

The experiment was conducted in two separate sessions. All participants were tested individually, in a quiet room. In the first session, they were asked to name pictures or read words in both Hindī and English. They were instructed (in the language being tested) to name the pictures or words that appeared on the screen as quickly as they could without making a mistake, and they were also cautioned to avoid coughs, false starts, hesitations (e.g., "uhmm"), articles or any other extraneous material (e.g., "a dog" or " that's a dog"). To familiarize participants with the experiment, a practice set of eight items (not included in the stimulus set): two items per condition were shown as examples. The practice items were repeated until the experimenter felt that the subjects clearly understood the procedure. The dependent measures in the study were the subjects' naming responses and naming times (in both picture naming and word reading tasks). Therefore, subjects would see each item only once during the entire testing session and will be asked to name the items (pictures and words) in each of the languages (Hindī and English).

In the second session, all the participants in the three age groups were given two age-appropriate comprehension passages, one in Hindī and the other in English. So the youngest age group (8-10 year-olds) received second grade level passage, the 11-13 year-olds received fifth grade level passage, and the adults received twelfth grade level passage. The two older groups also received a baseline passage (the second grade level passage) in each of the two languages. All the subjects were instructed to read the English and Hindī passages given to them and then to answer the questions following the passages. The subjects were asked to respond to the questions in the corresponding language. The aim was to obtain an objective measure of language (reading) proficiency for each subject in English and Hindī and in the case of the two older groups, also as a screening procedure to include only those participants with some basic proficiency in the two languages being tested.

2.5. Scoring

The scoring criteria used for the present study were modeled closely on procedures adopted by the International Picture Norming study (Bates et al., 2000).

I. The data coding for each picture or word was determined empirically, in two steps. The first step was the same for both picture naming and word reading data. First, the data was error coded to determine which responses could be retained for both naming and RT analyses. Three error codes were possible:

a. Valid response. Refers to all the responses with a valid (codable) name and usable, interpretable response times (no coughs, hesitations, false starts, or pronominal verbalization like "that's a ball").

b. Invalid response. Refers to all the responses with an invalid RT (i.e. coughs, hesitations, false starts, pronominal verbalizations) or a missing RT (the participant did produce a name, but it failed to register with the voice key).

c. Nonresponse. Refers to any trial in which the participant made no verbal response of any kind.

II. All valid responses and all the invalid RTs with a codable response were coded and sorted into different lexical categories in relation to the target name, using the same criteria adopted for the monolingual study. However, in the bilingual studies, two additional lexical categories were added. In the picture naming data, there are six possible lexical categories that the data could be coded for, but for the word reading data only lexical codes 1, 4, 5 and 6 were applicable.

a. Lexical Code 1. (for both word reading and picture naming data) The target name (dominant response operationally defined as the modal response i.e., most frequent response for each group).

b. Lexical Code 2. (only for picture naming data) Any morphological or morpho-phonological alteration of the target name, defined as a variation that shares the word root or a key portion of the word without changing the word's core meaning. Examples would include diminutives (e.g. 'bike' for 'bicycle'; 'doggie' for 'dog), plural/singular alterations (e.g. 'cookies' when the target word was 'cookie'), reductions (e.g. 'thread' if the target word was 'spool of thread') or expansions (e.g. 'truck for firemen' if the target word was 'fire truck').

c. Lexical Code 3. (only for picture naming data) Synonyms for the target name (which differ from Code 2 because they do not share the word root or key portion of the target word). With this constraint, a synonym was defined as a word that shared the same truth-value conditions as the target name (e.g., 'couch' for 'sofa' or 'chicken' for 'hen').

d. Lexical Code 4. (for both word reading and picture naming data) This category was used for all names that could not be classified in codes 1-3, including hyponyms (e.g. 'animal' for 'dog'), semantic associates that share the same class but do not have the target word's core meaning (e.g. 'cat' for 'dog'), part-whole relations at the visual-semantic level (e.g. 'finger' for 'hand'), and all frank visual errors or completely unrelated responses.

e. Lexical Code 5. (for both word reading and picture naming data) This category was used for all the subjects' responses where there were language interference effects from the other language (e.g., "gilaas" for "glass", "gulab" for "rose", "plate" for "thali").

f. Lexical Code 6. (for both word reading and picture naming data) This category was used for all the naming responses that were typically pronunciation errors (e.g., "beer" for "bear").

2.6. Data Reduction

For each picture, seven dependent variables were derived and for each word, five dependent variables were derived, for analyses from the two raw dependent measures.

a. Nameability of the picture (percent of all participants who were able to produce a codable response with a valid RT) [obtained for both word reading and picture naming tasks].
b. Percent name agreement (percent of participants producing the target names out of all codable responses with a valid RT) [obtained for both word reading and picture naming tasks].
c. Mean reaction times across all valid trials (i.e. mean latency for all participants who produced a valid response on that item, regardless of the content of that response) [obtained for both word reading and picture naming tasks].
d. Mean reaction times on target naming (i.e. mean latency only for those participants who produced the target name for that item) [obtained for both word reading and picture naming tasks].
e. Percent of participants producing a codable response classified as a morphological variant (Lexical Code 2) [obtained only for picture naming data]

f. Percent of participants producing a codable response classified as a synonym (Lexical Code 3) [obtained only for picture naming data]

g. Percent of participants producing a codable response that failed to meet criteria for Lexical Codes 1-3 (Lexical Code 4, including frank visual errors, more ambiguous superordinate category names like “animal” or “food”) [obtained for both word reading and picture naming tasks].

In addition to these measures of performance, several predictor/independent variables were considered in attempting to account for the variance in the naming accuracy and latency. These variables were selected based on (1) their availability (2) their successful use in previous picture-naming studies (3) their theoretical rationale in accounting for the process of picture naming. The nine predictor variables that were selected here for the analyses are:

1. Age-of-Acquisition norms. (a) An objective measure of age-of-acquisition (AoA) was derived from published norms for the American version of the MacArthur Communicative Inventory (Fenson et al, 1994), a parental report form that provides valid and reliable data about lexical development in children from 8-30 months. For our purposes here, the CDI yields a simple 3-point scale: 1=words acquired on average between 8-16 months; 2= words acquired between 17-30 months, 3= words that are not acquired in infancy (>30 months). (b) A subjective AoA measure in both English and Hindī, i.e., a rating study where adults were asked to rate each of the items on a 9-point scale corresponding to age in years ranging from <2, 3, 4, 5, 6, 7-8, 9-10, 11-12, 13+> (for more details see chapter 6).

2. Frequency norms: (a) Objective frequency (natural log values) of the target names from spoken sources (Baayen, Piepenbrock, & Gulikers, 1993). (b) Subjective frequency ratings in both Hindī and English, i.e., a rating study where adults were asked to rate each of the items on their frequency on a 7-point scale (1= not frequent, 7 = very frequent), in their regular use of the language (for more details see chapter 6).
3. Word length, which was measured in number of syllables for both Hindī and English.
4. Rough estimates of visual complexity for each of the pictures were obtained, based on the format of digitized picture files (Szekely & Bates, 2000).
5. Goodness of depiction ratings were made by American college students, who were asked to determine (on a 7-point scale, from good to bad) whether the picture was a good representation of the concept to which the target name (English) refers.
6. Presence/absence of a fricative or affricate in the initial consonant (0 = no fricative or affricate; 1 = fricative or affricate), for both Hindī and English, a variable that has been reported to influence the time required for a response to register on the voice key.
7. Animacy (0 = animate, for persons or animals; 1 = inanimate, for all other referents including plants, body parts, foodstuffs).
8. Pictures were further grouped into one of 6 lexical categories, to explore possible differences in word retrieval that do not form a scale: objects, food, animals, persons, mobile objects, body parts.
9. An objective measure of language proficiency in each language was obtained using language comprehension passages, where all the participants in the study were asked

to read the age-appropriate Hindī and English passages and answer the questions that followed in the corresponding language. In addition, the two older age groups also received a baseline comprehension passage in each language. The scoring for both the English and Hindī passages were done by two independent English and Hindī language school teachers, who graded all the responses on the maximum score of 20 points. The subjects' responses were scored for quality of answers, spelling and grammar errors, and accuracy of responses. All the subjects in the two older groups had to obtain a basic minimum of 50% on the baseline comprehension passage to be included in the study.

3. Results and Discussion

Appendix A presents the stimuli, listed in alphabetical order, used in the bilingual experiments. In the first stage of lexical coding across the four task conditions, English picture naming (EPN), Hindī picture naming (HPN), English word reading (EWR), and Hindī word reading (HWR), the target name for each word and picture (in both Hindī and English) is empirically derived. However, in the case of picture naming in English and Hindī (but not for word reading), the target (modal) responses differed across the three age groups for 97 out of 352 items, i.e., the three groups provided the same target name for 255 of the 352 items. Looking at the differences in target responses across the three groups for 97 of the 352 items, there are no patterns of responses that emerge across the three age groups. Typically, the differences are due to subjects responding in the non-target language (for example, in the English picture naming condition, responding in Hindī with "gilaas" for "glass"), or use of synonyms in the target language (i.e., in the English picture naming condition, responding with "bird" for "ostrich"). However, we did note that for a few pictures, subjects across all the age groups sometimes used the function of the object to name a picture where they were unable to produce the name. For example, subjects in the English picture naming condition would sometimes respond with "wiegher" for a "scale", "roller" for "rolling pin", etc., (and similarly in Hindī also).

In order to focus on the developmental differences across these three groups (8-10 year-olds, 11-13 year-olds, adults) across the four conditions, i.e., English picture naming(EPN), English word reading (EWR), Hindī picture naming (HPN) and Hindī word reading (HWR), when the target items were held constant, these 97 items were excluded; and all correlational and regression analyses are based on the remaining 255 items (see Appendix A for all the items not included in the quantitative analyses).

Mean Performance by Age, Language and Task

Tables 7.2 (a, b, c, d) provide the descriptive statistics of the four dependent measures (i.e., total RT, nameability, target RT, and name agreement) for the three age groups, computed over items, across the four task conditions. Looking at the means for both nameability and response times, there is a general trend wherein the older age groups are more accurate and faster than the younger age groups in all but EPN task. In the English picture naming task, all the three age groups appear to perform at more or less the same level. Next, if you compare across the four task conditions, for all the three age groups, there appears to be a general trend of fastest naming times and highest nameability in the EWR condition. However, for the other three task conditions, adults and the two children's group, performances vary. Adults seem to follow the expected trend, where in they are fastest and most accurate in EWR, followed by HWR, EPN and lastly HPN. In the case of the two younger groups, as expected both of groups are the fastest and most accurate in EWR condition, but on the other hand, they perform better in the EPN condition, followed by their performance in the EWR condition, and lastly the HPN condition.

Simple post-hoc t-tests over items indicate that on nameability and name agreement, in Hindī picture naming and word reading, there are significant differences ($p < .001$) between the three groups, with accuracy in naming increasing with age. However, with English picture naming and word reading, on nameability and name agreement, there is not any discernable statistically significant trend that one can see and all the age groups' performance is more or less at the same level with some differences [see Tables 7.2 (a), (b), (c) and (d)].

In the case of naming latency (both for valid and target RT), in Hindī word reading, there is a significant age advantage ($p < .001$), where the older age groups are faster than the younger age groups. In the case of Hindī picture naming and English word reading, there is a slightly significant age advantage ($p < .05$) and no discernible trend is evident in the case of English picture naming where there are slight differences between the groups, but not in any consistent pattern.

Table 7.2 (a). Summary statistics of valid (RT with codable response) and nameability(percent valid naming responses) for the three age groups for Picture Naming in English and Hindī (computed over items)

	ENGLISH PICTURE NAMING						HINDĪ PICTURE NAMING					
	VALID RT			NAMEABILITY			VALID RT			NAMEABILITY		
	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
N	352	352	352	352	352	352	352	352	352	352	352	352
Mean	1351	1264	1360	87%	91%	88%	1761	1696	1582	59%	68%	83%
SD	303	287	325	15%	12%	13%	348	353	342	22%	20%	15%
SE	16	15	17	1%	1%	1%	19	19	18	1%	1%	1%
Median	1316	1236	1336	90%	95%	93%	1768	1683	1571	61%	71%	86%
Min	787	754	756	24%	30%	19%	933	852	865	4%	6%	22%
Max	2769	2147	2499	100%	100%	100%	3001	2882	2633	100%	100%	100%

Table 7.2 (b) Summary statistics of valid (RT with codable response) and nameability(percent valid naming responses) for the three age groups for Word Reading in English and Hindī (computed over items)

	ENGLISH WORD READING						HINDĪ WORD READING					
	VALID RT			NAMEABILITY			VALID RT			NAMEABILITY		
	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
N	352	352	352	352	352	352	352	352	352	352	352	352
Mean	823	701	677	97%	98%	98%	1515	1159	770	83%	92%	98%
SD	191	139	130	6%	4%	3%	335	318	166	16%	9%	4%
SE	10	7	7	0%	0%	0%	18	17	9	1%	0%	0%
Median	759	658	636	100%	100%	100%	1516	1102	724	88%	95%	100%
Min	600	546	520	57%	71%	81%	814	653	541	18%	48%	44%
Max	1798	1689	1434	100%	100%	100%	2545	2764	1525	100%	100%	100%

Table 7.2 (c). Summary statistics of target RT (RT with target response) and namea agreement (percent target naming responses) for the three age groups for Picture Naming in English and Hindī (computed over items)

	ENGLISH PICTURE NAMING						HINDĪ PICTURE NAMING					
	TARGET RT			NAME AGREEMENT			TARGET RT			NAME AGREEMENT		
	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
N	351	352	352	351	352	352	346	350	352	346	350	352
Mean	1312	1225	1310	67%	69%	65%	1697	1630	1551	38%	44%	60%
SD	296	278	304	25%	24%	24%	424	437	356	26%	25%	26%
SE	16	15	16	1%	1%	1%	23	23	19	1%	1%	1%
Median	1288	1167	1280	71%	71%	68%	1627	1572	1530	32%	41%	59%
Min	787	738	732	5%	5%	3%	925	205	871	4%	4%	5%
Max	2820	2056	2329	100%	100%	100%	3424	3376	3067	100%	100%	100%

Table 7.2 (d). Summary statistics of target RT (RT with target response) and namea agreement (percent target naming responses) for the three age groups for word reading in English and Hindī (computed over items)

	ENGLISH WORD READING						HINDĪ WORD READING					
	TARGET RT			NAME AGREEMENT			TARGET RT			NAME AGREEMENT		
	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
N	352	352	352	352	352	352	352	352	352	352	352	352
Mean	819	698	674	95%	97%	96%	1512	1147	767	72%	85%	96%
SD	187	135	126	9%	6%	6%	356	325	165	21%	15%	8%
SE	38	28	26	0%	1%	1%	73	17	34	1%	1%	0%
Median	754	658	637	96%	100%	100%	1510	1084	721	76%	90%	97%
Min	600	546	520	35%	65%	65%	814	659	541	11%	14%	44%
Max	1798	1700	1441	100%	100%	100%	2534	3073	1525	100%	100%	100%

Next, a comparison was done using simple post-hoc t-tests across the four task conditions within each age group. With the youngest age groups, i.e., 8-10 and the 11-13 year olds, on nameability and name agreement, as expected performance was better on the EWR task ($p < .001$), as compared to the other tasks. However, the youngest group of children did better on the EPN task when compared to their performance on the HWR task, and their lowest accuracy was on the HPN task. However, in the case of the 11-13 year olds, the pattern changes slightly wherein their performance is slightly better in HWR, followed by EPN and lowest in HPN ($p < .001$). In the case of the adults, both on nameability and name agreement, their performance is best on the EWN, HWN, EPN and lastly the HPN task condition ($p < .001$). In the adults, there is no significant difference in performance on the word reading tasks in the two languages.

Looking at the comparison across the four task conditions, on naming latency (valid and target RTs), within each age group, we find a similar pattern as observed naming responses. The younger children (8-10 year olds) were the fastest on the EWR task, followed by the EPN, HWR and lastly HPN ($p < .001$). In the case of the 11-13 year olds, while they also had the fastest naming times in the EWR condition, there was shift wherein, their second best naming times was in the HWR condition, followed by EPN and lastly HPN ($p < .001$). With the adults, as expected, they were the fastest in EWR, HWR, EPN and lastly HPN ($p < .001$).

The summary tables7.3 (a) and (b) [over items] shows the different response types across the four task conditions, for all the three age groups. We find that in the picture naming task (in Hindī and English), the subjects across the three age groups did better in the English picture naming task, with higher accuracy than in the Hindī picture naming task. However, for the other response types, i.e., synonyms and modified target, there seem to be more occurrences in the EPN task than in the HPN task. In the case of incorrect responses, all the three age groups seem to show a more or less a similar pattern.

One interesting type of error seen in HPN condition only is the language interference effects, where the subjects responded in English instead of Hindī. Looking at the naming responses within each age group, across the four task conditions, we find that for the two younger age groups, the highest response accuracy is in EWR, HWR, EPN and lastly HPN conditions. In the case of adults, while they have the highest accuracy in EWR, they also seem to have, more or less the same accuracy in HWR, but show a higher number of incorrect responses, which is not the case in EWR. In the remaining two conditions, i.e., EPN and HPN, have a better performance in EPN and lastly in HPN condition. From these results, a pattern emerges, wherein we see that all the subjects perform as expected in the English picture naming and word reading task. While there appears to be an age advantage in the EWR task, in the EPN task, it appears that by the age of 8-10 years, these children already seem to have acquired adult like proficiency, where their distribution of responses and their errors are more or less identical to their older counterparts. In addition, we also see that while the youngest age-group appears to do better in the EPN task when compared to the HWR task and the opposite is true for the adults. The cross-over or the transition from the EPN advantage with the younger group to the HWR advantage that we see with adults, seems to be taking place with the 11-13 year-olds, whose performance on both the HWR and EPN tasks (RTs and naming responses) is very close.

Table 7.3 (a). Distribution of % nameability for the different response types for the three groups

	PICTURE NAMING						WORD READING					
	ENGLISH			HINDĪ			ENGLISH			HINDĪ		
	8-10	11-13	ADULT	8-10	11-13	ADULT	8-10	11-13	ADULT	8-10	11-13	ADULT
Target	67%	69%	65%	38%	44%	60%	95%	97%	96%	72%	85%	96%
Modified target	3%	3%	3%	1%	1%	0%	0%	0%	0%	0%	0%	0%
Synonym	4%	3%	5%	2%	2%	3%	0%	0%	0%	0%	0%	0%
Incorrect	13%	15%	15%	12%	14%	15%	1%	1%	0%	11%	8%	1%
Lang. switch	0%	0%	0%	7%	7%	3%	0%	0%	0%	0%	0%	0%
Accent Error	0%	0%	0%	0%	0%	0%	1%	1%	1%	0%	0%	1%
Good RT	87%	91%	88%	59%	68%	83%	97%	1%	98%	83%	93%	98%

Table 7.3 (b). Distribution of invalid responses across the 3 age groups

	PICTURE NAMING				WORD READING			
	ENGLISH		HINDĪ		ENGLISH		HINDĪ	
	NR	INVALID RT	NR	INVALID RT	NR	INVALID RT	NR	INVALID RT
8_10	9%	4%	37%	5%	1%	2%	11%	6%
11_13	6%	3%	28%	4%	0%	1%	4%	4%
Adult	8%	3%	12%	5%	0%	1%	0%	1%

Relationship among the Dependent Variables

To examine the relationship between the target naming responses and target naming times, correlational analyses were done across the dependent variables (all calculations computed over items). The resulting correlation co-efficient for the three age groups, for each of the four task conditions are reported in Tables 7.4 (a), (b), (c), and (d). We see that there are significant correlations among the dependent variables for each task, among the three age groups. As we would expect, production measures (name agreement) and naming latencies (target RTs) are negatively correlated, i.e., items that are easier to name have lower RTs. The direction of the correlation was the same in the three age groups for all the four task conditions. In these tables, we expected to see high correlations among the dependent measures (naming times and target nameability) within each age group, similar to the results obtained in the monolingual data. One possible reason for the lower correlations could be the greater variability in the bilingual data given the heterogeneous nature of the population. Another interesting pattern we see is that in the English language condition, the correlations are higher in the picture naming task than in the word reading task. However, we do not have such a clear picture in the Hindī language condition, where the correlations in the two tasks are more mixed with no clear pattern emerging [Tables 7.4 (c) and (d)].

Table 7.4 (a, b, c & d). Summary table of the correlational analyses among the dependent variables for items with the same target response (255 items) across each of the 3 age groups, and across the 4 tasks

Table 7.4 (a). Pairwise correlational analyses of %target nameability with itself across the 3 age groups

	PICTURE NAMING						WORD READING					
	ENGLISH			HINDĪ			ENGLISH			HINDĪ		
	I	I	III	I	II	III	I	II	III	I	II	III
I. 8-10 % name agreement	--			--			--			--		
II. 11-13 % name agreement	0.83**	--		0.84**	--		0.68**	--		0.68**	--	
III. Adult % name agreement	0.75**	0.84**	--	0.65**	0.7**	--	0.47**	0.55**	--	0.33**	0.37**	--

**p < .001 *p < .01

Table 7.4 (b). Pairwise correlational analyses of Mean target RTs with itself across the 3 age groups

	PICTURE NAMING						WORD READING					
	ENGLISH			HINDĪ			ENGLISH			HINDĪ		
	I	I	III	I	II	III	I	II	III	I	II	III
I. 8-10 Target RTs	--			--			--			--		
II. 11-13 Target RTs	0.76**	--		0.43**	--		0.83**	--		0.72**	--	
III. Adult Target RTs	0.72**	0.76**	--	0.48**	0.55**	--	0.86**	0.8**	--	0.63**	0.52**	--

**p < .001 *p < .01

Table 7.4 (c). Pairwise correlations of % Target name agreement with Mean Target RTs across the 3 age groups and picture naming in English and Hindī

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10 TARGET RT	11-13 TARGET RT	ADULT TARGET RT	8-10 TARGET RT	11-13 TARGET RT	ADULT TARGET RT
8-10 %name agreement	-0.73**	-0.7**	0.62**	-0.5**	-0.49**	-0.66**
11-13 % name agreement	-0.66**	-0.65**	-0.62**	-0.51**	-0.55**	-0.68**
Adult %name agreement	-0.64**	-0.62**	-0.72**	-0.32**	-0.46**	-0.7**

**p < .001 *p < .01

Table 7.4 (d). Pairwise correlations of % Target name agreement with Mean Target RTs across the 3 age groups and word reading in English and Hindī

	WORD READING					
	ENGLISH			HINDĪ		
	8-10 TARGET RT	11-13 TARGET RT	ADULT TARGET RT	8-10 TARGET RT	11-13 TARGET RT	ADULT TARGET RT
8-10 %name agreement	-0.64**	-0.6**	-0.6**	-0.63**	-0.58**	-0.56**
11-13 % name agreement	-0.55**	-0.49**	-0.56**	-0.58**	-0.55**	-0.5**
Adult %name agreement	-0.47**	-0.48**	-0.51**	-0.37**	-0.29**	-0.39**

**p < .001 *p < .01

Predictor Variable Effects

Table 7.5 (a) is a summary table that reports the characteristics of the predictor variables (computed over items). Table 7.5 (b) provides a summary of the Pearson product-moment correlations conducted among the thirteen predictor variables, calculated over items. These correlations are largely similar to those reported in the literature on lexical access. As expected, there is a strong relationship between the AoA ratings collected in Hindī and English, in addition to also correlating highly with monolingual ratings and objective AoA data (CDI norms). These correlations reinforce our belief that the subjective AoA ratings are a good tool that can be used to collect information on word learning age in the absence of objective AoA data. Similarly, looking at the frequency variables, there is a strong relationship between the Hindī and English ratings, in addition to both these sets of ratings being highly correlated with objective frequency norms (CELEX database). In the table, we can also see that there strong correlations between frequency (ratings and objective) and AoA (both subjective and objective AoA) across both languages. Other significant and strong relationships also include an often reported association between length (syllable) and frequency (i.e., longer words tend to be less frequent). Therefore, not surprisingly, complex target names tend to be longer, less frequent and acquired later. Goodness of depiction measure (a subjective rating measure), picture complexity appears and word frication (both in Hindī and English) appear to be relatively independent of the lexical predictors. Because of the confounds among these predictor variables, correlational analyses between the predictor and dependent variables need to be supplemented with regression analyses examining the independent contributions of each predictor variable when the other variables are controlled.

Table 7.5 (a). Charactersitics of the Dominant Responses for 255 Items

SCALAR VARIABLES	**Mean**	**Minimum**	**Maximum**	**Standard Deviation**
Number of Syllables (English/ Hindī)	1.57 / 2.68	1 / 2	4 / 7	0.74 / 0.92
Frequency (log values)	3.03	0	7.4	1.47
Adult ratings of Age of Acquisition (AoA) English/Hindī	5.74 / 5.46	4.15 / 4.03	7.56 / 8.03	0.78 / 0.82
Adult ratings of Frequency: English/Hindī	4.04 / 4.05	2.37 / 2.96	5.93 / 5.27	0.89 / 0.47
Goodness of Depiction ratings	5.89	3.75	6.85	0.62
Visual Complexity	4042	2007	12792	1419
ORDINAL & NOMINAL VARIABLES	**Coding**	**Number of items**	**Percent of Items**	
Objective Age of Acquisition (AoA) from MacArthur CDI Parent Reports	8-17 months = 1 18-30 months = 2 >30 months = 3	96 31 128	38% 12% 50%	
Word Initial Fricatives: English/Hindī	No = 0 Yes = 1	192 / 189 63 / 66	75% / 74% 25% / 26%	
Semantic Category	Animals Body parts Food Large artifacts Objects & Phenomenon in nature People Small artifacts Things to wear Vehicles	16 48 21 14 24 19 75 23 15	6% 19% 8% 5% 9% 7% 29% 9% 6%	

Table 7.5 (b). Correlations among the 13 predictor variables

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
I. Eng AoA ratings	--												
II. Hin AoA ratings	0.68**	--											
III. AoA ratings (mono)	0.66**	0.5**	--										
IV. CDI (objective AoA)	0.48**	0.42**	0.6**	--									
V. Eng. Freq ratings	-0.61**	-0.45**	-0.5**	-0.43**	--								
VI. Hin Freq. ratings	-0.4**	-0.46**	-0.56**	-0.39**	0.71**	--							
VII. Frequency (objective)	-0.41**	-0.51**	-0.35**	-0.35**	0.57**	0.42**	--						
VIII. Eng. Syll. length	0.35**	0.25**	0.29**	0.2**	-0.46**	-0.21**	n.s.	--					
IX. Hindī Syll. length	0.18**	0.36**	n.s.	n.s.	n.s.	-0.24**	-0.19**	0.34**	--				
X. Eng. Frication	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--			
XI. Hindī Frication	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--		
XII. Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--	
XIII. Goodness of Depiction	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--

**p < .001 *p < .01 ^p< .05

Predictor Variable Effects on Naming Behavior (by Age, Language and Task)

From this point on all analyses will only include the two main dependent measures, target response times and name agreement. Tables 7.6 (a), (b), (c), and (d) summarize correlations among the nine predictor variables and the two dependent measures (target response latencies and name agreement) for the two tasks (picture naming and word reading). Although the correlations reveal some important similarities across age groups, and across languages, there appear to be some subtle differences.

If we look at the correlations among target response times and the predictor variables, across the three age groups (8-10, 11-13 and adults) and four task conditions (EPN, HPN, EWR, HWR), AoA measures (both subjective and objective), frequency (both subjective and objective) are strongly correlated with target response times for all the three age groups across both languages. However, both AoA and frequency measures appear to have stronger correlations with picture naming times than word reading times (for both the languages). Syllable length (both Hindī and English) appear to be correlated with word reading times in both languages correspondingly and does not seem to be correlated with picture naming times. Frication and visual complexity appear to have no little or no effect on the response times for any of the three age groups across the four tasks. Goodness of depiction ratings seems to be strongly correlated with EPN response times and less so with HPN response times, but appears to have to no significant effect on word reading times in both the languages.

Next, if we look at the correlations among target name agreement and the predictor variables, across the three age groups (8-10, 11-13 and adults) and four task conditions (EPN, HPN, EWR, HWR), AoA measures (both subjective and objective), frequency (both subjective and objective) are strongly correlated with target name agreement for all the three age groups across both languages. However, both AoA and frequency measures appear to have stronger correlations with picture naming times than word reading times (for both the languages). In addition, the CDI measure (objective AoA) does not seem to be highly correlated with name agreement in the EWR condition. Syllable length (both Hindī and English) appears to have stronger correlations with word reading responses in both languages correspondingly but not with picture naming times. However, in the case of syllable length in Hindī, the correlation does not reach significance with adults in the word reading task. Frication and visual complexity appear to have no little or no effect on the response times for any of the three age groups across the four tasks. Goodness of depiction ratings seems to be strongly correlated with EPN nameability and less so with HPN nameability, but appears to have to no significant effect on word reading responses in both the languages.

Table 7.6 (a). Correlations between the predictor variables and target RTs for picture naming, across the three age groups

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
Eng AoA ratings	0.42**	0.42**	0.49**	--	--	--
Hin AoA ratings	--	--	--	0.24**	0.3**	0.51**
AoA ratings (mono)	0.48**	0.46**	0.43**	--	--	--
CDI(obj. AoA)	0.4**	0.38**	0.41**	--	--	--
Eng. Freq ratings	-0.3**	-0.3**	-0.42**	--	--	--
Hin Freq. ratings	--	--	--	-.23**	-.25**	-.34**
Frequency (objective)	-0.19*	-0.23**	-0.25**	--	--	--
Eng. Syll. length	n.s.	n.s.	n.s.	--	--	--
Hindī Syll. length	--	--	--	n.s.	n.s.	n.s.
Eng. Frication	n.s.	n.s.	n.s.	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodnessof Depiction	-0.45**	-0.43**	-0.43**	-0.16^	-0.21^	-.33**

**p < .001 *p < .01 ^p< .05

Table 7.6 (b). Correlations between the predictor variables and target RTs for word reading, across the three age groups

	WORD READING					
	ENGLISH			HINDĪ		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
Eng AoA ratings	0.53**	0.51**	0.56**	--	--	--
Hin AoA ratings	--	--	--	0.46**	0.4**	0.49**
AoA ratings (mono)	0.47**	0.44**	0.47**	--	--	--
CDI(obj. AoA)	0.29**	0.26**	0.29**	--	--	--
Eng. Freq ratings	-0.3**	-.35**	-0.42**	--	--	--
Hin Freq. ratings	--	--	--	-0.25**	-0.25**	-0.34**
Frequency (objective)	-.44**	-.44**	-.52**	--	--	--
Eng. Syll. length	0.45**	0.45**	0.56**	--	--	--
Hindī Syll. length	--	--	--	0.37**	0.37**	0.44**
Eng. Frication	0.15*	0.2*	0.17*	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodnessof Depiction	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

Table 7.6 (c). Correlations between the predictor variables and % name agreement for picture naming, across the three age groups

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
Eng AoA ratings	-.44**	-.38**	-.46**	--	--	--
Hin AoA ratings	--	--	--	-.52**	-.52**	-.5**
AoA ratings (mono)	-.49**	-.41**	-.34**	--	--	--
CDI (objective AoA)	-.35**	-.27**	-.27**	--	--	--
Eng. Freq ratings	0.3**	0.32**	0.36**	--	--	--
Hin Freq. ratings	--	--	--	0.45**	0.46**	0.3**
Frequency (objective)	0.25**	0.25**	0.31**	--	--	--
Eng. Syll. length	-.16^	n.s.	n.s.	--	--	--
Hindī Syll. length	--	--	--	n.s.	n.s.	n.s.
Eng. Frication	n.s.	n.s.	n.s.	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	-.13^	n.s.	n.s.
Goodness-of Depiction	0.39**	0.33**	0.36**	0.23**	0.18^	0.29**

**p < .001 *p < .01 ^p< .05

Table 7.6 (d). Correlations between the predictor variables and % name agreement for word reading, across the three age groups

	WORD READING					
	ENGLISH			HINDĪ		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
Eng AoA ratings	-.32**	-.31**	-.29**	--	--	--.
Hin AoA ratings	--	--	--	-.38**	-.35**	-.25**
AoA ratings (mono)	-.29**	-.29**	-.22**	--	--	--
CDI (objective AoA)	n.s.	-.2*	-.16^	--	--	--
Eng. Freq ratings	0.17*	0.25**	0.23**	--	--	--
Hin Freq. ratings	--	--	--	0.18*	0.24**	0.25**
Frequency (objective)	0.13^	0.22**	0.21*	--	--	--
Eng. Syll. length	-.29**	-.18*	-.2^	--	--	--
Hindī Syll. length	--	--	--	-.39**	-.33**	n.s.
Eng. Frication	-.16^	n.s.	n.s.	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodness-of Depiction	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

**p < .001   *p < .01   ^p< .05

Stepwise Regression Analyses

To control the potential confounds among these predictors and to further test the reliability of the correlations observed among the predictors and target RTs and name agreement, regression analyses was done. In the English language condition (PN and WR) eight stepwise-regression analyses were conducted (separately for each of the three age groups, with each of the two dependent measures) and in the Hindī language condition (PN and WR) six stepwise-regression analyses were conducted (separately for each of the three age groups, with each of the two dependent measures). In these analyses, the contribution of each variable was computed on the final step, once the other predictors were already entered into the regression model. Tables 7.7 (a), (b), (c), and (d) provide summaries of the regression analyses for the two dependent measures across the three age groups and four task conditions. Tables 7.7 (a), (b), (c), and (d) summarize the total variance accounted for by all the predictors together in the model and the unique contribution of each of the independent variables once all the other predictors were controlled for the dependent measures (target latencies and name agreement) across the three age groups and four task conditions.

Table 7.7 (a). Unique variance contributed on the last step of step-wise regression analysis for Target RTs, for picture naming, across the three age groups

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	36%**	34%**	43%**	7%**	13%**	36%**
Eng AoA ratings	2.7%*	2.5%*	3.7%**	--	--	--
Hin AoA ratings	--	--	--	1.7%^	2.3%^	10.2%**
CDI (objective AoA)	2%*	1.7%^	1.1%^	--	--	--
Eng. Freq ratings	n.s.	n.s.	-2.4%*	--	--	--
Hin Freq. ratings	--	--	--	-1.7%^	n.s.	-.13%^
Frequency (objective)	n.s.	n.s.	n.s.	--	--	--
Eng. Syll. length	n.s.	n.s.	n.s.	--	--	--
Hindī Syll. length	--	--	--	n.s.	n.s.	n.s.
Eng. Frication	n.s.	n.s.	1.1%^	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	1%^
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodnessof Depiction	-13.2%**	-11.3%**	-11.2%**	-1.9%^	-3.5%*	-8.9%**

**p < .001 *p < .01 ^p< .05

Table 7.7 (b). Unique variance contributed on the last step of step-wise regression analysis for Target RTs, for word reading, across the three age groups

	WORD READING					
	ENGLISH			**HINDĪ**		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	43%**	42%**	54%**	31%**	25%	37%**
Eng AoA ratings	8.3%**	6.2%**	5.4%**	--	--	--
Hin AoA ratings	--	--	--	10%*	5.7%**	8.8%**
CDI (objective AoA)	n.s.	n.s.	n.s.	--	--	--
Eng. Freq ratings	n.s.	n.s.	n.s.	--	--	--
Hin Freq. ratings	--	--	--	n.s.	n.s.	n.s.
Frequency (objective)	-3.2%**	-2.6%*	-3.3%**	--	--	--
Eng. Syll. length	6.8%**	7.2%**	12%**	--	--	--
Hindī Syll. length	--	--	--	7.3%**	6.8%**	10.4%**
Eng. Frication	2.2%*	3.8%*	2.4%*	--	--	--
Hindī Frication	--	--	--	1.2%^	2.5%*	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	-1.2%^	n.s.
Goodnessof Depiction	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

Table 7.7 (c). Unique variance contributed on the last step of step-wise regression analysis for %name agreement for picture naming, across the three age groups

	PICTURE NAMING					
	ENGLISH			**HINDĪ**		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	31%**	24%**	34%**	35%**	34%**	30%**
Eng AoA ratings	-3.3%*	-3.1%*	-5.4%**	--	--	--
Hin AoA ratings	--	--	--	-8.5%**	-8.5%**	-12.4%**
CDI (objective AoA)	n.s.	n.s.	n.s.	--	--	--
Eng. Freq ratings	n.s.	n.s.	n.s.	--	--	--
Hin Freq. ratings	--	--	--	5.5%**	5.4%**	n.s.
Frequency (objective)	n.s.	n.s.	1.4%^	--	--	--
Eng. Syll. length	n.s.	n.s.	1.4%^	--	--	--
Hindī Syll. length	--	--	--	n.s.	n.s.	n.s.
Eng. Frication	n.s.	n.s.	n.s.	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodness-of-Depiction	9.3%**	6.7%**	9.1%**	3.2%*	1.7%^	5.3%**

**p < .001 *p < .01 ^p< .05

Table 7.7 (d). Unique variance contributed on the last step of Step-wise regression analysis for %name agreement for word reading, across the three age groups

	WORD READING					
	ENGLISH			**HINDĪ**		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	15%**	10%**	8%**	26%**	19.7%**	7.4%**
Eng AoA ratings	-4.6%**	-2%^	-1.8%^	--	--	--
Hin AoA ratings	--	--	--	-6.7%**	-3.9%*	-2.4%^
CDI (objective AoA)	n.s.	n.s.	n.s.	--	--	--
Eng. Freq ratings	n.s.	n.s.	n.s.	--	--	--
Hin Freq. ratings	--	--	--	n.s.	n.s.	2.1%^
Frequency (objective)	n.s.	n.s.	n.s.	--	--	--
Eng. Syll. length	-4.5%**	n.s.	n.s.	--	--	--
Hindī Syll. length	--	--	--	-10.7%**	-7.5%**	n.s.
Eng. Frication	-2.3%^	n.s.	n.s.	--	--	--
Hindī Frication	--	--	--	n.s.	n.s.	n.s.
Visual Com	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Goodness-of-Depiction	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

In Tables 7.7 (a) and (b), looking at English picture naming and word reading, the overall equation seems to be a good fit and reaches significance for all the three age groups, with the model accounting significant amount of variance in target RTs. In addition, the regression model seems to better account for the variance in the word reading times across the three age groups than for the picture naming times. Looking at the individual contribution of the eight predictor variables for mean target RTs in each of the tasks (EPN and EWR) across the three age groups (i.e., 8-10, 11-13 year olds and the adults), we see a slightly different picture emerging for the two tasks. In the case of EPN, only three variables make significant contributions after the others are controlled. The first variable was goodness of depiction ratings (adult ratings), which accounted for highest variance for the three age groups ($p < .001$). The negative sign indicates the direction of the relationship, i.e., participants were faster (lower RT) to name pictures which had a higher goodness-of-depiction rating. The second most important variable was age of acquisition ratings (adult ratings) which was significant in accounting for variance for all the three groups ($p < .001$). One thing to take note of is that the significant effects of frequency seen in the raw correlations disappear when adult ratings of AoA are entered into the regression model first, a finding that has also been reported in other studies of AoA effects. The third significant variable was CDI data (objective AoA data) ($p < .001$).

In the case of the EWR task, four variables make significant contributions after the others are controlled. There were two variables, which were both independently strong predictors and accounted for the highest variance, i.e., AoA ratings and syllable length. The first variable was AoA ratings, which accounted for the highest variance for all the three age groups ($p < .001$). The second most important variable was syllable length, which accounted for a significant amount of variance across the three age groups ($p < .001$). The third variable was frequency (objective), whose effects were not significant in the EPN task (response times), but appears to be another important variable in controlling variance for all the three groups ($p < .001$) in the word reading task. The fourth significant variable is frication ($p < .001$).

On the corresponding analyses of name agreement in the EPN and EWR task conditions, the predictors together accounted for a significant amount of variance for the three groups in the EPN task but did not seem to be a good fit to account for the variance in the EWR task condition [see Tables 7.7 (c) and (d)]. However, here again we see a slightly different pattern emerging for name agreement for the two task conditions across the three age groups. In the case of EPN, only two variables make significant contributions after the other predictors are controlled. The first variable was goodness of depiction ratings and the second strongest predictor in the model was AoA ratings ($p < .001$).

In the case of name agreement in the EWR task, the regression model does not seem to be a good fit for the data and the model does not seem to account for much of the variance in the data. This lower magnitude of the variance that is controlled by the present model for word reading task could be due the fact that there is less variance overall, on name agreement across the three age groups, i.e., accuracy was relatively high across the groups. In this table, it becomes clear that AoA ratings is the only variable that contributes substantially in controlling the variance in the regression model, over and above all the other variables ($p < .001$). Two other variables syllable length and frication accounted for some of the variance ($p < .001$) in the youngest age group but did not contribute significantly for the older two age groups.

Moving to the Hindī picture naming (HPN) and word reading (HWR) tasks, there were six independent variables used in the regression model. The overall equation was a reasonably good fit and reached significance for all the three age groups, with the model accounting for a significant amount of the variance in target RTs for the HWR and HPN tasks [Tables 7.7 (a) and (b)]. In addition, similar to the English language tasks, the regression model seems to better account for the variance in the Hindī word reading times across the three age groups than for the Hindī picture naming times. In the case of HPN, two variables make significant contributions after the other predictors are controlled, both accounting for the highest amount of variance in the model. The first variable was AoA ratings and the second variable that contributes significantly to the model was goodness of depiction ratings ($p < .001$).

In the case of HWR also, there are two variables that make significant contributions after the other predictors are controlled, both independently accounting for highest amount of variance in the regression model. The two variables are AoA ratings, and syllable length ($p < .001$). One of the other predictors, frication accounted for some of the variance, with the two younger age groups (i.e., 8-10 year-olds and 11-13 year-olds). Another variable, visual complexity accounted for some of the variance with the 11-13 year-olds.

On the corresponding analyses of name agreement in the HPN and HWR task conditions, the six predictors together accounted for a significant amount of variance for the three groups in the EPN task but did not seem to be a good fit to account for the variance in the EWR task condition [see Tables 7.7 (c) and (d)]. Here, we also see a reverse scenario (when compared to naming times) emerging with the regression model being a better fit for the HPN than HWR, for the name agreement data for all the three groups. However, here again we see a slightly different pattern emerging for name agreement for the two task conditions across the three age groups. In the case of HPN task condition, there are three variables that seem to be the strongest predictors of the data and account for the highest amount of variance in the model once the other variables are controlled. The first variable was AoA ratings, which accounted for the highest amount of variance ($p < .001$). The second and the third variables were goodness of depiction ratings and frequency ratings ($p < .001$).

Next, in the case of HWR, we can see that AoA was the only variable that significantly accounts for the variance in the model, across all the age groups ($p < .05$). Syllable length is another variable that accounts for a significant amount of variance but only with the two younger groups ($p < .001$). Frequency ratings are another variable that accounts for some of the variance in the model, but only in the case of adults ($p < .05$).

From these four tables [Tables 7.7 (a), (b), (c) and (d)], it becomes clear that AoA is the only variable that contributes substantially to the fitness of the regression model over and above all the other variables, across the four tasks and across the three age groups. Goodness of depiction seems to be the strongest predictor, accounting for the highest variance but only in the case of the picture naming task (both Hindī and English) and not for the word reading tasks (as is expected). Frequency seems to independently account for some of the variance in picture naming times data but not consistently across the three age groups and there is no clear pattern that emerges. It appears as if the frequency effects have been washed out or diluted, when AoA ratings are entered into the regression model first. These patterns of results in the regression analyses is compatible with the claim that AoA ratings reflect a combination of factors including effects of frequency as well as age of acquisition itself (Ellis & Morrison, 1998; Iyer et al., 2001). However, in the case of HPN, there does seem to be a stronger effect of frequency on both naming (for the younger two groups) and naming times data (for the youngest and oldest groups). In the case of word reading, frequency appears to have some effect on EWR reading times but no effects in the HWR reading times and there appear to be no frequency effects on name agreement (for both Hindī and English).

Factor Analyses

As previously explained (chapter 5), factor analysis is a useful statistical technique to discover the possible underlying patterns for the independent variables. While raw correlational analyses between dependent and independent variables indicate that there were patterns of correlations among these variables that may reflect the underlying processes implicated in lexical access tasks, it is also obvious that some of these raw predictors are redundant. To put it more simply, factor analysis helps reduce a large number of variables to a smaller number of factors, to concisely describe (and perhaps understand) the relationships among the observed variables, or to test some theory about underlying processes. In the present section, we performed factor analyses for all the predictor variables used in the Hindī and English language tasks (see Table 7.8).

In the case of the English language tasks, eight predictor variables were included in the factor analyses. Results revealed three factors: Factor 1 loaded up mainly on word form characteristics such as number of syllables and word frequency and conceptual aspects such as word learning age; Factor 2 was determined by conceptual aspects such as word learning age (CDI norms) and goodness of depiction ratings, and factor 3 was contributed by the phonetic features of the picture name such as frication.

Table 7.8. Factor Analyses: rotated component matrix (principal components analysis

	English			Hindī	
	Factor1 (wordform/ conceptual)	**Factor2 (conceptual)**	**Factor3 (phonetic)**	**Factor1 (conceptual/ wordform)**	**Factor2 (conceptual/ phonetic)**
Eng.AoA	**.756**	-.319	.151	--	--
HinAoA	--	--	--	**.828**	-.191
Eng Freq.	**.763**	.154	-.160	--	--
Hindī Freq	--	--	--	**-.774**	.006
CDI	**.541**	**-.537**	.036	--	--
Freq (obj)	**-.778**	-.030	-.016	--	--
GoodDepict	-.027	**.829**	.139	-.035	**.780**
Vis. Com.	.179	.190	.367	.248	.028
Eng Fric	-.079	-.056	**.915**	--	--
Hindī Fric	--	--	--	.031	**.7 30**
Eng Syll.	**.633**	.336	-.130	--	--
Hindī Syll	--	--	--	**.594**	.051

In the case of the Hindī tasks, six predictor variables were included in the factor analyses. Results revealed two factors: Factor 1 loaded up mainly on word form characteristics such as syllable length and word frequency, and secondly on conceptual aspects such as age of acquisition; Factor 2 was contributed by both conceptual and phonetic aspects. Looking at the results of the factor analyses, for both sets of predictor variables in English and Hindī, there appears to be a different picture emerging in each language. In the case of English language predictors, Factor 1 seemed to be determined by both conceptual and word form aspects, Factor 2 by only conceptual aspects and Factor 3 by only phonetic aspects. In the case of the Hindī language predictors, the picture becomes murkier, with Factor 1 determined by both conceptual and word form aspects (as was the case in English), but in the case of Factor 2 there seem to two different variables contributing: conceptual and word form aspects. While these reduced set of factors does give us clearer idea of the variables that are important, it is somewhat unclear what exactly these factors mean theoretically.

Stepwise regression analyses entering these factors as the predictor variables were conducted for the dependent measures in English language tasks (EPN and EWR) and Hindī language tasks (HPN and HWR) separately. The summary of the results is provided in Table 7.9 (a), (b), (c) and (d). In the case of EPN, Factor 2 ("conceptual" factor) was the strongest predictor of naming behavior across the three age groups, which was followed by Factor 1 ("word form/ conceptual" factor), and with no significant contributions from Factor 3 ("phonetic" factor). With the EWR task, we see a different pattern emerging. While Factor 1 ("word form/conceptual factor") was the strongest predictor of naming behavior across the age groups, the second significant variable was Factor 3 ("phonetic" factor) and this seemed to a better predictor only for word reading times and not word reading responses, and there was no significant contribution from Factor 2 ("conceptual" factor).

Moving onto the Hindī language tasks (HPN and HWR), Factor 1 ("word form/conceptual" factor) was the strongest predictor of naming behavior for both picture naming and word reading across the three age groups. However, Factor 2 ("word form/phonetic" factor) while significant predictive power for picture naming behavior across the three age groups, did not seem significantly effect/predict word reading behavior (both reading times and name agreement).

The results indicate that word form characteristics and conceptual factors, such as age-of-acquisition, word frequency, syllable length, are the strongest predictors on naming behavior both for words and pictures. Purely conceptual factors such as goodness of depiction ratings and objective word learning age were significant predictors only in the case of picture naming behavior (as seen in the English language tasks). Both these pattern of results reported here are consistent with the popular view and support the evidence in the literature (Liu, 1996; Bates et al, 2003; for a more detailed review, see Balota, et al., 1991).

Table 7.9 (a). Unique variance contributed on the last step of Step-wise regression analysis for the dependent measure: Target RTs for picture naming across the three age groups

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
% VARIANCE	36%**	33%**	42%**	7%**	14%**	28%**
Eng Factor1 (wordform/conceptual)	9.9%**	12.4%**	16%**	--	--	--
Eng Factor 2 (conceptual)	-25%**	-19.5%**	-24%**	--	--	--
Eng Factor 3 (phonetic)	n.s.	n.s.	2.7%*	--	--	--
Hindī Factor 1 (wordform/conceptual)	--	--	--	5%**	10%**	23%**
Hindī Factor2 (conceptual/phonetic)	--	--	--	n.s.	-3.4%*	-6%**

**p < .001 *p < .01 ^p< .05

Table 7.9 (b). Unique variance contributed on the last step of step-wise regression analysis for the dependent measure: Target RTs for word reading across the three age groups

	WORD READING					
	ENGLISH			HINDĪ		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
% VARIANCE	33%**	35%**	47%**	25%**	19%**	33%**
Eng Factor1 (wordform/conceptual)	31%**	32%**	45%**	--	--	--
Eng Factor 2 (conceptual)	n.s.	n.s.	n.s.	--	--	--
Eng Factor 3 (phonetic)	1.5%^	3.2%*	2.7%*	--	--	--
Hindī Factor 1 (wordform/conceptual)	--	--	--	25%**	19%**	33%**
Hindī Factor2 (conceptual/phonetic)	--	--	--	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

Table 7.9(c). Unique variance contributed on the last step of step-wise regression analysis for the dependent measure: % name agreement for picture naming across the three age groups

	PICTURE NAMING					
	ENGLISH			HINDĪ		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	31%**	25%**	31%**	32%**	33%**	25%**
Eng Factor1 (wordform/conceptual)	-14%**	-9%**	-13%**	--	--	--
Eng Factor 2 (conceptual)	16%**	14%**	17%**	--	--	--
Eng Factor 3 (phonetic)	n.s.	n.s.	n.s.	--	--	--
Hindī Factor 1 (wordform/conceptual)	--	--	--	-28%**	-29%**	-17%**
Hindī Factor2 (conceptual/phonetic)	--	--	--	4.7%**	4%**	7.8%**

**p < .001 *p < .01 ^p< .05

Table 7.9(d). Unique variance contributed on the last step of step-wise regression analysis for the dependent measure: %name agreement for word reading across the three age groups

	WORD READING					
	ENGLISH			HINDĪ		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
% VARIANCE	10%**	12%**	9.5%**	20%**	17%**	7%**
Eng Factor1 (wordform/conceptual)	-8%**	-9.6%**	-8.8%**	--	--	--
Eng Factor 2 (conceptual)	n.s.	n.s.	n.s.	--	--	--
Eng Factor 3 (phonetic)	-2.2%^	n.s.	n.s.	--	--	--
Hindī Factor 1 (wordform/conceptual)	--	--	--	-20%**	-17%**	-7%**
Hindī Factor2 (conceptual/phonetic)	--	--	--	n.s.	n.s.	n.s.

**p < .001 *p < .01 ^p< .05

Semantic Category Effects

In another set of comparisons among the three age groups, we looked at the contribution of semantic category (a nominal variable) that could not be included in the regression analyses. The items used in the study were divided into nine semantic categories [see Tables 7.10 (a) and (b)]. As mentioned in the previous section (monolingual PN study), in view of the findings in the literature regarding the effects of age of acquisition of these concepts on naming in both normal and brain-injured adults, we thought that it might be useful to determine whether responses differ across the categories for the three age groups across the four tasks. Tables 7.10 (a, b) summarizes the means (target response times and target name agreement) and standard deviations for the four groups. From both the tables, it is clear that the three groups show similar pattern of naming behavior across the nine categories. The older groups are faster and more accurate across the 9 categories than the younger groups and there does not seem to be any effect of semantic category on naming behavior. That is, no developmental pattern emerges across these nine semantic categories. These results again to some extent could be attributed to the truncation of range of the stimulus set as we wanted items that would be of easy to moderate level difficulty to avoid floor effects with the younger groups. The raw scores were entered into 3 x 9 analyses of variance for each of the dependent measure over items treating age as the between participant variable and the nine semantic categories as levels of a within participant variable. There were significant main effects of age and category across all the four tasks (both naming times and name agreement), except in the case of naming for EWR and EPN, where there were no effects of age or semantic category. However, the most important for our purposes, the interaction between age and semantic category did not reach significance for any of the eight dependent measures across the four task conditions.

Table 7.10 (a). Semantic Categories: Summary table of mean target RT (and standard deviations) across the 9 categories, for the four tasks, across the three age groups

		PICTURE NAMING						WORD READING					
		ENGLISH			**HINDĪ**			**ENGLISH**			**HINDĪ**		
	NO. OF ITEMS	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
Animals	48	1204 (247)	1132 (185)	1297 (293)	1668 (376)	1682 (472)	1427 (302)	747 (134)	665 (87)	654 (99)	1432 (355)	1079 (257)	748 (157)
Body Parts	21	1252 (351)	1170 (306)	1193 (333)	1502 (375)	1350 (360)	1244 (262)	765 (168)	654 (70)	621 (78)	1299 (293)	991 (228)	658 (71)
Foods	24	1363 (230)	1265 (281)	1379 (289)	1775 (443)	1822 (350)	1723 (388)	802 (183)	679 (75)	682 (130)	1549 (415)	1250 (509)	786 (191)
Large Artifacts	23	1450 (396)	1320 (336)	1319 (294)	1812 (441)	1744 (515)	1505 (308)	863 (202)	708 (137)	683 (129)	1558 (303)	1159 (311)	754 (124)
Objects&Phenomena in Nature	15	1227 (378)	1104 (275)	1201 (288)	1570 (380)	1411 (374)	1373 (335)	722 (138)	647 (113)	622 (81)	1319 (323)	949 (204)	695 (118)
People	16	1308 (243)	1202 (193)	1339 (274)	1636 (424)	1461 (306)	1538 (353)	834 (191)	698 (117)	662 (102)	1368 (398)	1042 (297)	704 (128)
Small Artifacts	75	1240 (236)	1184 (256)	1233 (294)	1740 (425)	1543 (323)	1518 (353)	811 (179)	680 107)	663 (115)	1521 (297)	1145 (261)	748 (141)
Things to Wear	19	1308 (245)	1142 (229)	1228 (247)	1567 (366)	1438 (301)	1434 (295)	793 (104)	657 (72)	654 (86)	1435 (314)	1056 (226)	729 (91)
Vehicles	14	1155 (255)	1102 (267)	1173 (395)	1524 (279)	1493 (290)	1461 (284)	797 (177)	728 (164)	674 (96)	1424 (345)	1089 (261)	789 (118)

Table 7.10 (b). Semantic Categories: Summary table of mean target RT (and standard deviations) across the 9 categories, for the four tasks, across the three age groups

		PICTURE NAMING						WORD READING					
		ENGLISH			HINDĪ			ENGLISH			HINDĪ		
	NO. OF ITEMS	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT	8_10	11_13	ADULT
Animals	48	75% (20)	73% (22)	72% (22)	41% (27)	46% (27)	72% (23)	97% (7)	98% (4)	96% (6)	78% (19)	87% (13)	97% (4)
Body Parts	21	72% (24)	75% (19)	74% (19)	57% (28)	64% (22)	77% (18)	96% (6)	97% (6)	95% (6)	79% (17)	88% (12)	99% (2)
Foods	24	75% (18)	77% (22)	65% (22)	40% (26)	46% (25)	54% (29)	94% (13)	97% (5)	96% (7)	70% (25)	84% (19)	94% (12)
Large Artifacts	23	63% (27)	70% (21)	71% (24)	33% (24)	40% (25)	64% (22)	93% (11)	95% (5)	99% (2)	69% (20)	83% (16)	97% (3)
Objects & Phenomena in Nature	15	76% (25)	75% (22)	72% (28)	57% (24)	63% (26)	78% (22)	98% (2)	99% (2)	99% (2)	78% (20)	90% (10)	98% (2)
People	16	71% (22)	73% (19)	63% (23)	49% (29)	57% (28)	69% (28)	93% (8)	95% (9)	95% (7)	79% (22)	89% (10)	95% (6)
Small Artifacts	75	73% (21)	75% (20)	72% (22)	41% (24)	48% (23)	67% (25)	95% (10)	97% (6)	97% (5)	73% (18)	86% (11)	96% (7)
Things to Wear	19	68% (24)	73% (20)	71% (20)	41% (27)	49% (26)	67% (22)	97% (4)	96% (6)	97% (3)	81% (12)	91% (8)	99% (2)
Vehicles	14	74% (25)	78% (26)	76% (27)	45% (26)	50% (23)	66% (27)	94% (8)	98% (6)	96% (9)	74% (23)	89% (10)	96% (4)

4. Summary and Future Directions

The study comparing bilingual Hindī-English adults and children (between the ages 8-13 years) is one of the few studies that have examined two lexical access tasks (picture naming and word reading) across the early life-span using a relatively large stimulus set. All the subjects who participated in the study were exposed to Hindī at birth and to English by the age of 5 years. In addition, based on the demographic profile of the participants, subjective language history questionnaire and objective language proficiency measures, we were able to assess all the subjects as being more English than Hindī dominant. The findings in this study complement the data from our monolingual studies and provide some interesting insights into bilingual lexical processing.

This bilingual study served several purposes. First, we wanted to obtain normative data from the adults and children for on-line lexical access tasks, which are lacking. The norms would also enable us to understand the developmental trajectory of performance on the lexical access tasks. The general finding was that, overall, there was an increase in speed and accuracy in all the four tasks across the three age groups. However, the performance profile on the four tasks varied for all the three age groups. In the adults, there was dominant language advantage and a task advantage (i.e., EWR > HWR > EPN > HPN). In the youngest age group (8-10 year olds), there was more of a dominant language advantage (i.e., EWR > EPN > HWR > HPN). Interestingly, in the case of the 11-13 year olds, we see a clear cross-over where their performance in the transitional stages, moving from the pattern seen in the youngest group to the adult performance profile (i.e., EWR > EPN = HWR > HPN). In these results, we see the developmental changes in the performance on the four tasks because of the increasing language proficiency and increasing degree of automaticity on the reading tasks. These results reported here and the shift in the performance profile of the 11-13 year olds are compatible with other bilingual studies that report similar results (Kohnert et al., 2000).

Second, we sought to investigate predictor-outcome relationships between the dependent measures (naming behavior on PN and WR tasks) in both the languages of the bilingual, across development, with various predictor variables including frequency, age-of-acquisition, word length that have been reported in the literature. Here, we again found some interesting similarities and differences between the two tasks and between the two languages being tested. In the initial correlational analyses, in the case of picture naming, goodness of depiction ratings, age of acquisition, and frequency were highly correlated with naming behavior in both the languages of the bilingual. However, interestingly, in the case of the word reading tasks, age of acquisition ratings, frequency and syllable length were all strongly correlated with word reading data. This indicates that items that were learned earlier in life, more frequent, good depictions of the target name (in picture naming) and had fewer syllables (in the case of word reading) were typically responded to faster and more accurately than items that were learned later in life, less frequent, poorer depictions of the target name (in picture naming) and had longer in syllable length (in word reading). This pattern was seen consistently across the three age groups for both the naming tasks.

Not all the predictors proved to be equally important (or independent) in the regression analyses. In picture naming, age of acquisition and goodness of depiction ratings were the strongest predictors of naming behavior in both the languages and across the three age groups. In word reading, age of acquisition and syllable length were the strongest predictors of word reading data (especially reading times) for both languages and for all the three age groups. This suggests that items that were acquired earlier in life do seem to be accessed faster and more accurately than items that acquired later in life. In contrast, almost all the frequency effects disappeared in the regression analyses. This is consistent with the AoA literature, where the general finding is that frequency appears to be confounded with AoA, and that these adults AoA ratings reflect more than one factor including a combination of frequency and real information about age at which these words or concepts were acquired (Ellis & Morrison, 1998; Gerhand & Barry, 1998, 1999). In addition, a possible reason for diminishing syllable length effects and frication effects with increasing age, especially with word reading accuracy, could be due to the overall lower variability in the word reading accuracy data, especially with the older age groups. In addition, there seems to be speed-accuracy trade off where the younger age groups while slower, performed at more or less adult levels of accuracy.

In the present study, we examined lexical access and literacy in Hindī-English bilinguals across three age groups. While the main aim of this study was to explore the bilingual landscape for lexical access in these Hindī-English bilinguals and how the different psycholinguistic variables affect it, an additional goal, was simply to develop bilingual norms. However, the journey does not end here. More in-depth qualitative analyses need to be done to understand the different types of errors that are made. In addition, the qualitative analyses also give us a unique opportunity to address questions of more theoretical importance about lexical access in bilinguals.

The results reported here while revealing some interesting patterns, complement the findings from the monolingual study and thus validate our use of on-line tasks (both picture naming and word reading) in order to investigate the processes involved in lexical access in bilinguals, thereby enabling us to extend our study to bilingual clinical populations.

CHAPTER 8

COMPARISON OF MONOLINGUALS AND BILINGUALS ON LEXICAL ACCESS TASKS

So far, in this dissertation, I have presented data from studies of lexical access from monolingual and bilingual populations separately. In this chapter, I present the results of a comparison of the populations, including proficiency effects both between the two groups and within the bilinguals' two languages. In addition, I also present results of the cross-language comparisons to determine the language universal and language specific contributions of the two languages of the bilingual.

1. Comparison of Monolingual and Bilingual Populations

From an inspection of the mean performance of bilinguals vs. that of monolinguals [Tables 8.1 (a) and (b)], it would appear that monolinguals are faster and more accurate in picture naming or word reading, regardless of the age group. Similar findings have been reported in the literature, where the bilinguals are slower and less accurate in lexical access or lexical decision tasks, when compared to their monolingual counterparts, and has been attributed to language interference effects and/or the effect of bilinguals' having more lexical competitors (Ransdell & Fischler, 1987, Michael & Gollan, 2005).

Another factor that might also underlie some of the effect observed is cultural differences in object names. Despite the fact that the items were selected to be free of cultural bias, since we selected those items that were familiar in the Indian context, it might be impossible to remove this bias altogether since these items were normed with English monolinguals in North America, and bilingual subjects were tested in India.

For example, some of the items were actually less familiar in the Indian context, like "stove" which was often mistakenly called "washing machine". Another example is "pitchfork", a gardening tool, which was more often named as "fork" or "trishul" (the Indian English term for "trident") [see Appendix A].

Table 8.1 (a). Summary of mean target RTs and name agreement on the picture naming tasks for monolinguals an bilinguals

	TARGET RTS			NAME AGREEMENT		
	HPN	**EPN**	**MONO-PN**	**HPN**	**EPN**	**MONO-PN**
5-7 years	--	--	1310	--	--	78%
8-10 yers	1696	1312	1144	37%	66%	83%
11-13 years	1630	1225	1084	44%	69%	86%
Adults	1551	1310	919	60%	65%	87%

Table 8.1 (b). Summary of mean target RTs and name agreement on the word reading tasks for monolinguals an bilinguals

	TARGET RTS			NAME AGREEMENT		
	HWR	**EWR**	**MONO-WR**	**HWR**	**EWR**	**MONO-WR**
5-7 years	--	--	--	--	--	--
8-10 yers	1512	819	--	72%	95%	--
11-13 years	1147	698	--	85%	97%	--
Adults	767	674	530	96%	97%	100%

2. Effects of different Proficiency Levels and Languages on Lexical Access Tasks

One of the questions that interested me in studying bilinguals was given the heterogeneity in the bilingual population and given the different levels of language proficiency in the two languages of the bilingual, what are the effects on the two lexical access tasks. In order to answer these questions a two pronged comparison was done. In the first set of comparisons, I examined the differences in performance on the two lexical access tasks between the languages being tested (where the subjects' proficiency in each language is different). Looking at tables 8.1 (a) and (b), we see that on both tasks (PN and WR), across all the age groups, subjects' performance was faster and more accurate in English than in the Hindī. One could interpret this result as an indication that all the subjects, across the three age groups were more fluent in English. This interpretation is also consistent with the typical language profile of urban Indian bilingual, who typically, coming out of the Indian public school system are dominant in English.

In the second set of comparisons, I examined the differences between varying proficiency levels within each language. In order to address this question, as part of the experimental testing procedure, subjects were given two age-appropriate comprehension passages, one in each language (i.e., Hindī and English), and they had to read the passage and give written responses to the questions. The subjects' responses were later scored on a 20-point scoring system to obtain some objective measure of the subjects' language proficiency levels in the two languages. For all three groups, a median split was done to compare low proficiency participants (those who obtained scores below 10) and high proficiency participants (those who obtained scores above 10). Considering the average RT and target name agreement for each proficiency sub-group, for all the four tasks and across all the three age groups (see Table 8.2), an interesting scenario emerges. We see that in the picture naming tasks, on both Hindī and English, the high proficiency (HP) group is faster and more accurate than the low proficiency (LP) group for the youngest group (8-10 year-olds) and the adults. However, the 11-13 year olds appear more or less at par in both the low and high proficiency groups (showing no significant differences between the two groups). In the case of the word reading task (both in Hindī and English), we see that across the three age groups, subjects in the HP group are faster and more accurate than their LP counterparts. In fact, while the gains in the EWR task are small, we see the highest gains in the HP group's performance in the HWR task for both naming times and naming responses for all three age groups. One reason for our finding an effect of proficiency mainly on the word reading tasks could be because we used a reading and writing proficiency measure to group our subjects, we are able to see the differences on the WR tasks but were not able to tease apart the differences in the groups on the PN tasks. Ideally, along with writing proficiency, a measure of spoken language proficiency should also be included in future work in order to obtain a more comprehensive measure of language proficiency.

Another pattern that becomes clear as we look at the results is that the greatest gains are seen in the HP group in the HWR task (for both naming and accuracy). A possible explanation for this pattern could be that for the most part all the subjects who participated in this experiment were from urban schools and colleges, who were for the most part English dominant (based on performance on PN and WR tasks in the two languages, information from language history and proficiency measures). Therefore, word reading in English was probably at ceiling level, i.e., was not as challenging and difficult than word reading in Hindī, for both low and high proficiency groups, across the three age groups. The basic proficiency measure that was used in the study was probably most effective in highlighting the differences between the LP and HP groups in the word reading task tested in the non-dominant language (i.e., Hindī) where the subject's proficiency in the non-dominant language was severely tested especially in the word reading task.

Table 8.2. Summary of mean target RTs and name agreement for the low and high fluency groups, for all the four tasks, across the three age group

TASK	AGE	TARGET RTS		NAME AGREEMENT	
		LOW FLUENCY	**HIGH FLUENCY**	**LOW FLUENCY**	**HIGH FLUENCY**
EWR	**8-10**	831	755	95%	95%
	11-13	708	682	96%	98%
	Adults	707	643	96%	97%
HWR	**8-10**	1657	1388	67%	76%
	11-13	1341	984	82%	88%
	Adults	819	728	95%	96%
HPN	**8-10**	1715	1698	34%	40%
	11-13	1610	1629	43%	45%
	Adults	1578	1540	57%	63%
EPN	**8-10**	1296	1281	64%	69%
	11-13	1207	1231	69%	68%
	Adults	1322	1292	63%	67%

One of the other issues that I wanted to investigate when we undertook the bilingual project was to examine language effects on lexical access tasks, i.e., how the structural and especially orthographic differences in the two languages (i.e., Hindī and English) being tested impacted on the performance on the word reading tasks. One of the predictions at the outset of this project was that given its transparent and shallow orthography we should expect a word reading advantage in Hindī, especially in the case of balanced bilinguals. However, when one compares the performance of the subjects on the two word reading tasks (EWR and HWR), we do not see a Hindī language advantage [see tables 8.1 (a) and (b)]. This result could be explained by the fact that typically all the subjects that were tested were English dominant.

To further explore this issue and look for a Hindī word reading advantage, I compared performance of the subjects in the two languages in the HP group. Looking at Table 8.2, we see that even in the case of the high proficiency group, all the subjects were faster and more accurate in the EWR task than the HWR task. One possible reason that we did not find the Hindī WR advantage could be due the fact all the subjects were more proficient in English. However, another possibly significant factor responsible for the lack of the Hindī WR advantage could be because of the fact that on avarage the Hindī words were longer (average syllable length = 2.68) than English words (average syllable length = 1.57).

3. Lexical Access and Literacy: Relationship between PN and WR

As mentioned in the earlier chapters, in the literature review sections (chapter 3), many studies have examined the relationship between naming speed and reading ability. The findings reported from these large groups of cross-sectional studies in both reading and neuropsychology have demonstrated that continuous naming-speed tasks are strongly correlated with reading performance (Ackerman, Dykman, Gardner, 1990; Blachman, 1984; Bowers, Steffy & Swanson, 1986; Ellis, 1981; Spring & Capps, 1974; Spring & Farmer, 1975; Spring & Davis, 1988). In order to explore this relationship with the bilingual data reported in the dissertation, a correlational analyses was done between the picture naming times and word reading times and word reading accuracy.

Table 8.3 provides a summary of the correlational analyses between picture naming measures and word reading measures (in both languages) for all the three age groups. In the first two columns, the results of the correlations between the picture naming RTs and accuracy and their corresponding word reading times and accuracy are presented for the two languages and for all the three age groups. From the results, we can see that picture naming behavior does seem to have correlations with the word reading behavior. The strongest correlations seem to be within the Hindī language, where HPN appears to have a strong relationship with HWR across the three age groups for both naming times and naming accuracy. However, in the case of the youngest age group (8-10 year-olds), while there is a significant relationship between PN times and accuracy with WR times in both English and Hindī, the relationship seems much weaker or not significant at all in the case of picture naming times and word reading naming for both Hindī and English.

In order to obtain a clearer picture of the relationship between picture naming and reading performance, the subjects and the corresponding data were grouped into the low and high proficiency groups based on their scores obtained from the screening comprehension measures. Next, a correlational analysis was conducted between the picture naming and the corresponding word reading data within each sub-group, for both the languages and for all the three age groups. A summary of the results of the correlational analyses is presented in Table 8.3. As we can see, the strongest relationships are observed between picture naming times and accuracy with the corresponding word reading times in the low proficiency group, for all the three age groups and in both languages. However, with regard to word reading naming responses in the low proficiency group, there do not seem to be strong correlations either with picture naming times or with accuracy measures, except with Hindī PN accuracy measures and corresponding WR accuracy measures for the three age groups. In the case of the high proficiency group, there are some significant relationships between picture naming measures and their corresponding word reading measures, but no clear picture emerges. It appears as if the correlations that were observed in the group as a whole (low and high proficiency together) were washed out when divided into the two sub-groups. But an interesting pattern that seems to emerge, is that picture naming measures (especially RTs) seem to have significant correlations with word reading measures (especially RTs) in the low proficiency group, while the results are murkier in the case of the high proficiency group. It appears; as if picture naming performance is strongly correlated with reading performance and this seems especially true in the case of the less fluent group of subjects. In the more fluent subjects, no clear pattern emerges, but we see some strong correlations between picture naming and their corresponding word reading measures. One reason for this could be that dividing the raw data to two sub-groups, would have decreased the number of subjects in each group, thereby lessening the power. The results might provide a clearer picture once the number of subjects is increased in

Table 8.3. Summary of correlational analyses between PN and WR tasks, for both the languages, across the three age groups, for the entire group, and low and high proficiency groups

TASK	AGE	WR-TARGET RTS			WR-NAME AGREEMENT		
		TOTAL	LOW-WR	HIGH-WR	TOTAL	LOW-WR	HIGH-WR
EPN target RTs	**8-10**	0.27**	0.16^	0.15^	-0.18^	n.s.	-0.21^
	11-13	n.s.	0.24**	n.s.	n.s.	-0.16^	-0.16^
	Adults	0.19^	0.29**	0.19^	-0.16^	-0.2^	n.s.
HPN target RTs	**8-10**	0.21**	0.18^	n.s.	n.s.	-0.19^	n.s.
	11-13	0.23**	0.23**	n.s.	-0.25**	-0.21^	n.s.
	Adults	0.31**	0.28**	0.25**	-0.24**	-0.18^	-0.24**
EPN name agreement	**8-10**	-0.4**	-0.4**	34%	0.24**	0.19^	0.25**
	11-13	n.s.	-0.28**	43%	n.s.	n.s.	n.s.
	Adults	n.s.	-0.27**	57%	n.s.	0.17^	n.s.
HPN name agreement	**8-10**	-0.36**	-0.32**	-0.29**	0.36**	0.35**	0.26**
	11-13	-0.27**	-0.22**	-0.26**	0.31**	0.28**	0.21^
	Adults	-0.35**	-0.34**	-0.33**	0.29**	0.25**	0.21^

**p < .001   *p < .01   ^p< .05

each sub-group. Another possible reason that might explain the weaker relationships in the high proficiency group could be due to the increased floor effects in this group, as a result of which the predictive power of the picture naming measures (especially RTs) is weakened. However, there is an alternative explanation, which is more interesting, which might explain why there are strong correlations between PN and WR in the less fluent language (Hindī), younger age groups (in English) and in the low-proficiency groups, is that in these cases. It could be that word reading is still not as automatized and there is greater access into the semantic and grammatical representations, i.e., the subjects rely on processes that have more in common with picture naming. These results reported here are also compatible with studies that have previously reported a link between PN times and reading performance. Most of the studies that have reported this strong link have been conducted on reading impaired adults and children (i.e., those populations where reading is not yet as automatized as in their normal counterparts) (Ackerman, Dykman, Gardner, 1990; Blachman, 1984; Bowers, Steffy & Swanson, 1986; Ellis, 1981; Spring & Capps, 1974; Spring & Farmer, 1975; Spring & Davis, 1988).

4. Cross-language Relationships

Are there any universal contributions to naming behavior or only language specific contributions? Can one set of language predictors (e.g., English language predictors) be used meaningfully to predict naming behavior in the other language (e.g, Hindī) of the bilingual? If one looks at a word across languages, word forms most often bear little resemblance to the concepts that they represent, sometimes even within the same language family. The same "furry four-legged animal" is called *dog* in English, *perro* in Spanish, *Hund* in German, *cane* in Italian, *chien* in French, and *kutta* in Hindī. However, despite these well-known cross-language differences in the shape of the words, psycholinguists studying the process of lexical access and word retrieval generally believe that people access their mental lexicon in the same way in every natural language. This assumption rests crucially on the belief that the relationship between meaning and form is arbitrary. Therefore, the process of lexical selection, progressing from concept, is not affected by the shape of the words and word forms per se or the processing required to map a concept onto its associated sound are not affected by their meanings (Bates et al, 2003). Bates and her colleagues (2003) compared the timed picture naming task in seven languages (from monolinguals) that vary along dimensions known to affect lexical access. Analyses over items focused on factors that determine cross-language universals and cross-language disparities. For all the languages, they found word frequency and goodness of depiction had large effects, but objective picture complexity did not. Effects of word structure variables (length, syllable structure, compounding and initial frication) varied markedly across languages. Strong cross-language correlations were found in naming latencies, frequencies and length. Other language effects were observed (e.g., Chinese frequencies predicting Spanish RTs) even after within-language effects were controlled (e.g., Spanish frequencies predicting Spanish RTs). The authors used the results to challenge widely held assumptions about the lexical locus of length and frequency effects, suggesting instead that they may (at least in part) reflect familiarity and accessibility at a conceptual level that is shared over languages.

So what can we expect to see in the case of a bilingual, where we are comparing languages within the same individual, with varying fluency levels in the two languages being compared? In order to answer this question, we did a series of analyses to compare the subjects' performance in the two languages, and examine the other-language effects.

4.1. Cross-language Correlations for Dependent Measures

Tables 8.4 (a) and (b) present the cross-language correlations for target RTs and name agreement for both picture and word reading, across the three age groups. In the case of word reading, we see no clear or strong correlations that are evident. So one conclusion that can be drawn is that different factors influence the word reading behavior (target RT and name agreement) in the two languages that are so typologically varied,

Table 8.4 (a). Summary of cross-language correlational analyses between the two picture naming tasks across the three age groups

	HINDĪ WORD READING					
ENGLISH WORD READING	**I**	**II**	**III**	**IV**	**V**	**VI**
I. 8-10 Target RTs	0.16*	--	--	-0.28**	--	--
II. 11-13 Target RTs	--	0.13^	--	--	-0.15^	--
III. Adult Target RTs	--	--	0.36**	--	--	n.s.
IV. 8-10 % name agreement	n.s.	--	--	0.16*	--	--
V. 11-13 % name agreement	--	-0.14^	--	--	n.s.	--
VI. Adult % name agreement	--	--	n.s.	--	--	n.s.

**p < .001 *p < .01 ^p< .05

Table 8.4 (b). Summary of cross-language correlational analyses between the two word reading tasks across the three age groups

	HINDĪ PICTURE NAMING					
ENGLISH PICTURE NAMING	**I**	**II**	**III**	**IV**	**V**	**VI**
I. 8-10 Target RTs	0.35**	--	--	-0.46**	--	--
II. 11-13 Target RTs	--	0.43**	--	--	-0.47**	--
III. Adult Target RTs	--	--	0.64**	--	--	-0.6**
IV. 8-10 % name agreement	-0.34**	--	--	0.46**	--	--
V. 11-13 % name agreement	--	-0.29**	--	--	0.46**	--
VI. Adult % name agreement	--	--	-0.53**	--	--	0.59**

**p < .001 *p < .01 ^p< .05

that are idiosyncratic and specific to the language itself, not some universal, underlying conceptual variables. However, in the case of picture naming, all the correlations (target RTs and % name agreement) are significant ($p < .001$), with a developmental increase in the magnitude of the correlations. The strong correlations in the case of naming latencies suggest that they are influenced by universal stages and processes shared by the two widely varying languages, within the same individual, with different levels of fluency in both of the languages. In the case of name agreement, the strong correlations suggest that there was some cross-language generalization in the relative difficulty (nameability) of the picture stimuli. These results reported here are similar to the results reported in the Bates et al. (2003) study mentioned earlier.

So, how does one resolve this supposed discrepancy in the results between WR and PN tasks? One way to interpret these differences could be that WR and PN involves use of different mechanisms of lexical access, which has been discussed in the earlier chapters (chapter 3). Another, not so interesting, statistical interpretation is that typically, one finds greater correlations between two sets of data if there is greater variability in the data (Hays, 1994). And clearly, in WR there is much less spread and variability in the subjects' performance, than when compared with performance on the PN tasks.

4.2. Cross-language Relationships among Predictors and Naming Behavior

Another cross-language effect of interest would be to examine the relationships between the predictor variables in the two languages and examine the impact of the predictors in one language on naming behavior in the other language. Table 8.5 presents the correlations between the predictor variables in the two languages. All the correlations between predictors in the two languages are significant, suggesting that there might be some common underlying mechanisms determining these factors even for such two diverse languages. So typically, words that are learned earlier and more frequent in one language are also likely to have been acquired earlier and are more frequent in the other language.

Table 8.5. Cross-language correlations between the predictors in the two languages

	I	II	III	IV	V	VI	VII
I. Eng AoA ratings	--						
II. Hin AoA ratings	0.68**	--					
III. AoA ratings (mono)	--	0.5**	--				
IV. CDI (objective AoA)	--	0.42**	--	--			
V. Eng. Freq ratings	--	-0.45**	--	--	--		
VI. Hin Freq. ratings	-0.4**	--	-0.56**	-0.39**	0.71**	--	
VII. Frequency (objective)	--	-0.51**	--	--	--	0.42**	--

**p < .001 *p < .01 ^p< .05

Tables 8.6 (a) and (b) present the correlations between one set of language predictors with the dependent measures in the other language, for both Hindī and English, for all the three age groups. It is clear from the tables that there are strongest cross-language correlations are between AoA (both objective and subjective) variables and naming behavior (both naming times and accuracy) for both the tasks (PN and WR). There are also significant cross-language correlations with frequency (both objective and subjective) and naming behavior (both naming times and accuracy) for both the tasks (PN and WR). However, given that, there are strong correlations and overlap among the predictors themselves, the next step would be to look for independent contributions of each the cross-language variables when the within-language variable effects are controlled.

Table 8.6 (a). Summary of cross-language correlations between predictors and target RTs, for all the three age groups

	PICTURE NAMING						**WORD READING**					
	ENGLISH			**HINDĪ**			**ENGLISH**			**HINDĪ**		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
I. Eng AoA ratings	--	--	--	0.29**	0.34**	0.47**	--	--	--	0.29**	0.29**	0.33**
II. Hin AoA ratings	0.34**	0.35**	0.39**	--	--	--	0.42**	0.39**	0.41**	--	--	--
III. CDI (objective AoA)	--	--	--	0.24**	0.25**	0.21**	--	--	--	n.s.	n.s.	n.s.
IV. Eng. Freq ratings	--	--	--	-.25**	-.35**	-.32**	--	--	--	-.18*	-.2*	-.22*
V. Hin Freq. ratings	-0.19^	-0.21*	-0.3**	--	--	--	-.23**	-.23**	-.32**	--	--	--
VI. Frequency (objective)	--	--	--	-.25**	-.29**	-.29**	--	--	--	-0.2**	0.28**	-0.34**

**p < .001 *p < .01 ^p< .05

Table 8.6 (b) Summary of cross-language correlations between predictors and name agreement for all the three age groups.

	PICTURE NAMING						WORD READING					
	ENGLISH			HINDĪ			ENGLISH			HINDĪ		
	8-10	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**	**8-10**	**11-13**	**ADULTS**
I. Eng AoA ratings	--	--	--	-.49**	-.48**	-.42**	--	--	--	-.26**	-.23**	n.s.
II. Hin AoA ratings	-.34**	-.28**	-.31**	--	--	--	-.26**	-.19*	-.13^	--	--	--
III. CDI (objective AoA)	--	--	--	-.34**	-.4**	-.28**	--	--	--	n.s.	-.19^	-.2^
IV. Eng. Freq ratings	--	--	--	0.41**	0.44**	0.24**	--	--	--	0.18*	0.24**	0.25**
V. Hin Freq. ratings	0.21*	0.22*	0.25**	--	--	--	0.15^	0.16^	0.14^	--	--	--
VI. Frequency (objective)	--	--	--	0.37**	0.34**	0.17^	--	--	--	0.24**	0.23**	n.s.

**p < .001 *p < .01 ^p< .05

In order to determine the unique contribution of each of the cross-language variables, stepwise regression analyses were conducted for the dependent measures for picture naming and word reading, within each language, for all the three age groups separately, with all the within-language predictors already entered into the regression model, and the other language variable (frequency and age of acquisition- both subjective and objective) entered in the last step of the regression analyses. In the case of EPN, EWR and HWR, the cross-language predictors did not have significant unique effects on the dependent measures. Table 8.7 provides the summary of the separate step-wise regressions only for HPN naming behavior for each of the three age groups, with all the Hindī language predictors (six variables) entered into the regression model, and each of the English language predictors (both objective and subjective frequency and age of acquisition) entered in the last of the regression analyses. In table 8.7, we see that

Table 8.7. Unique variance controlled by cross-language predictors on picture naming task (Hindī)

	HINDĪ PICTURE NAMING					
	TARGET RTS			NAME AGREEMENT		
	8-10	11-13	ADULTS	8-10	11-13	ADULTS
% VARIANCE (6 HINDĪ + 1ENG AOA)	9.2%**	15.7%**	37.1%**	36.4%**	34.4%**	--
Eng AoA ratings	2.4%*	2.9%*	1.5%*	-2%*	-1%*	n.s.
% VARIANCE (6 HINDĪ + 1ENG AOA)	--	--	--	--	35.3%**	--
CDI (Objective AoA)	n.s.	n.s.	n.s.	n.s.	-1.8%*	n.s.
% VARIANCE (6 HINDĪ + 1 ENG FREQ)	--	17.5%	--	--	35.1%**	--
Eng. Freq ratings	n.s.	-4.7%**	n.s.	n.s.	1.7%*	n.s.
% VARIANCE (6 HINDĪ + 1 ENG FREQ)	9.6%**	15.8%**	36.6%**	36.9%**	34.2%**	--
FREQUENCY (Objective)	-2.8%*	-3%*	-1%*	2.4%*	1.4%*	n.s.

**p < .001 *p < .01 ^p< .05

the AoA ratings (English) and objective frequency (English) both make significant contributions ($p < .01$) to the regression model for both HPN response times and naming accuracy, after six Hindī language predictors are already accounted for in the model. However, in the case of adults, the contributions of both these variables do not reach significance. The frequency ratings (English) and objective AoA (CDI norms) only made some significant contributions ($p < .01$) in the 11-13 year-olds naming behavior data but not for the other age groups. The results reported here support the findings in the cross-linguistic study by Bates and her colleagues (2003), where they questioned the level at which frequency (and perhaps AoA) effects apply. Bates and her colleagues argued that the between-language frequency effects are just as strong as within-language effects on picture naming latencies. They argued that a significant portion of the variance in word frequency (at least the portion that is most important for picture naming) might actually reflect conceptual frequencies that are similar over languages. In the case of bilinguals, this might be truer since we are looking at the relationships between the two languages embodied within the same individual, and this is definitely reflected in not only the word frequency effects but also age of acquisition effects on picture naming behavior. However, these cross-language relationships seem to be the strongest with the dominant language predictors (i.e., English) and their relationship with dependent measures in the non-dominant language (i.e., Hindī), in the picture naming task. The same cross-language effects were not observed in the English picture naming task or in the word reading tasks (both Hindī and English). These patterns of results suggest the co-existence of L1 and L2 based conceptual domains. These findings of strong cross-language effects, mostly in one direction (from dominant to non-dominant language) find support in the studies which have reported that, there is more L1 based conceptual transfer experienced by beginning and intermediate L2 learners (Boroditsky, 2001; Pavlenko & Jarvis, 2002; Pavlenko, 2005). This can be used to explain the results of the cross-language effects in the case of the Hindī-English bilinguals in this study where their proficiency in Hindī is much lower than in English.

The lack of corresponding cross-language relationships in the case of the two word reading tasks is not surprising, since there have been numerous studies in the psycholinguistic literature emphasizing the fact that there might more word form, language structural features that impact word reading tasks, more so than common conceptual factors. This is probably even more so in the case of the two languages in question, which different in orthography, phonology and morphology (Coltheart, Curtis, Atkins & Haller, 1993; Plaut, McClelland, Seidenberg & Patterson, 1996, see Balota et al., 1991, for a detailed review). This is also compounded by the varying fluency levels of the subjects in their two languages, which probably results in them using different strategies on the word reading tasks.

5. Summary

In the present chapter, I present the results of the comparisons between monolinguals and bilinguals and within the bilingual group (between the two languages of the bilingual). The results of these comparisons are summarized briefly. First, in comparing the performance (speed and accuracy) on the naming tasks for all the common items between the monolinguals and bilinguals, the results showed that the monolinguals had a task advantage where there were both faster and more accurate when compared to their bilingual counterparts.

Second, I compared the effects of proficiency on two lexical access tasks both between the two languages and within each language of the bilinguals. In the between language comparison, the bilinguals were faster and more accurate in the English language condition on both naming tasks. In the within language comparison, the high fluency bilinguals (all groups) performed better in the Hindī naming tasks. However, in the English naming tasks, there appears to be a speed-accuracy trade off, with all the high fluency subjects faster on both the naming tasks but with more or less the same accuracy levels when compared to the low fluency groups.

Third, when comparing the effects of the varying orthography (Hindī and English), on word reading performance, we did not find the predicted Hindī orthography advantage.

Fourth, in examining the relationship between picture naming and word reading performance, the results showed that the strongest correlations in the youngest age groups for English, the less proficient language i.e., Hindī, and in the low proficiency groups (both English and Hindī) for all age groups.

Lastly, exploring the cross-language effects, the results showed that there was a strong correlation in naming latency across the two languages. In addition, there was considerable overlap in the case of predictors such as age of acquisition and frequency variables in the two languages. However, in exploring the cross-language predictor-outcome relationships, we find that the significant relationships are between dominant language predictors and dependent measures in the non-dominant language.

In the next chapter, I present my concluding remarks, along with the main goals and highlights of the results of my dissertation research, including some limitations of my research and some future directions.

CHAPTER 9

CONCLUSIONS AND FUTURE DIRECTIONS

In one of the earlier chapters of this dissertation (chapter 1), I included a 1974 quote on speech production by Fodor, Bever and Garrett, who had a very negative and critical outlook about the then current research in language production. However, at present there is a substantial and rapidly growing body of empirical data that allows researchers to specify the component processes of language production. This dissertation was an exploratory endeavor, which focused on one of the component processes of language production, i.e., lexical access, examining it in monolinguals and bilinguals, using two language production tasks, picture naming and word reading. The dissertation aimed to investigate and explore four main questions: 1) In the two language production tasks, what are the developmental response profiles for both mono- and bilinguals? 2) What are the relationships among the lexical predictors (such as age of acquisition and frequency) and naming behavior on the two lexical access tasks? In addition, will similar profiles be observed developmentally in both the monolinguals and bilinguals and across the two languages of the bilingual group? 3) In bilinguals of varying language proficiency (i) Will the same response profiles be observed in adults and children and if not, how will these profiles differ?; (ii) How will differences in orthography in the two target languages interact with proficiency to affect performance on the word reading task? 4) Is there a link between lexical access and literacy? Can we use performance on the lexical access especially picture naming task as a predictor of an individual's reading proficiency in the language?

<u>Question 1: In the two language production tasks, i.e., picture naming and word reading, what are the developmental response profiles for both mono- and bilinguals?</u>

On-line picture naming and word reading tasks were used to examine the processes involved in lexical access across the life span. In the monolingual studies, picture naming data has been obtained from four age groups (5-7, 8-10, 11-13 year-olds, and college-age adults), and word reading data only from college-age adults. However, in the bilingual studies, picture naming and word reading data have been obtained from three age groups (8-10, 11-13 year-olds, and college-age adults) of Hindī-English bilinguals. The goal here was to collect normative data using on-line language production tasks to understand the developmental trajectory of lexical access processes in both monolinguals and bilinguals. To the best of my knowledge, these are among the largest on-line studies examining the processes of lexical access using two language productions tasks and a large set of stimuli across the early life span.

In both the monolingual and bilingual studies, there is a general trend where we find developmental gains in speed and accuracy in the lexical access tasks. In the monolingual picture naming study, the pattern of results reveal clear developmental gains, with the older age groups performing more accurately and especially faster on the picture naming task. However, in the bilingual studies, the results are less clear, especially in the English picture naming task. With Hindī picture naming, and English and Hindī word reading, the results indicate that there is a developmental improvement on the tasks on accuracy and especially on naming speed. However, the interesting variation is in the case of the English picture naming task, where there does not seem to be a clear pattern of gains with development. The 11-13 year olds were the fastest, with the highest naming accuracy when compared to both the youngest (8-10 year olds) and the oldest (adult) age groups. The youngest and the oldest performed more or less at par with no significant differences between them on both naming times and accuracy. One possible reason to explain this interesting anomaly could be that younger age groups' fluency in English is more or less at par with the adults. This is reinforced by the fact that all the three age groups on the EWR task performed more or less with the same level of competence especially in naming accuracy. If anything, in the EWR task, developmental gains were more in the case of naming speed. One possible explanation is that in the case of the English tasks (both WR and PN) the adults' performance had a higher degree of variability, i.e., higher standard deviations in the case of adults on both EWR and EPN when compared to the other age groups. This could be one of the reasons why we do not find clear developmental gains on the EPN and EWR tasks across the three age groups. While there are some gains in performance, when we compare the two younger age groups, in the case of the adults, due to the greater variability and heterogeneity of the adults, the developmental improvement in naming behavior, when compared to the younger age groups, is not clearly visible.

These findings indicate that in the case of bilinguals lexical processing seems more complicated. Factors such as fluency levels of the participants in the languages being tested, language similarity and differences have to be controlled or accounted for when trying to understand the processes involved in lexical access in the two languages of the bilingual. The heterogeneous nature of bilinguals is an inevitable fact. However, investigators should be better able to understand what factors are contributing to the heterogeneity of the population being tested, and ensure that he/she is able to account for these factors when analyzing and interpreting the data.

Question 2: What is the nature of the relationship between lexical predictors (especially word learning age and frequency) and the two lexical access tasks for both monolinguals and bilinguals?

One of the aims in undertaking this study was to examine the nature of the relationship between the dependent measures (naming behavior) and predictor variables including age of acquisition, word frequency, word length that have been reported as being significant predictors of naming behavior in the literature, for both monolinguals and bilinguals. Several studies in the literature have repeatedly reported independent effects of AoA and word frequency effects on naming behavior (see chapter 4). One of the highly debated issues, however, is about the loci of these effects.

In the monolingual picture naming study, goodness of depiction ratings and age of acquisition were the strongest predictors of picture naming behavior across the four age groups, after the effects of the other variables were controlled, including frequency. In contrast, almost all the frequency effects disappeared or were diluted in the regression analyses. However, in the factor analyses, we find that frequency (and AoA to some extent) loaded on two factors, i.e., "word form" factor and "conceptual" factor. The results of the factor analyses indicate that these variables probably operate at two levels. In the case of frequency, the greater effect appears to be at the word form level, but also seems to contribute at the conceptual level. In the case of word learning age (AoA ratings), there appears to be a greater impact at the conceptual level but based on the factor analyses results, it appears that we cannot discount its contribution at the word form level.

In the case of the bilingual study, the relationship between predictors and naming behavior is very similar to that of the monolingual picture naming study. In the picture naming tasks (both Hindī and English), the strongest predictors of naming behavior were goodness of depiction and age of acquisition ratings across the three age groups. Frequency effects (both objective and subjective) were washed out in the regression analyses, and seem to have weak effects on naming speed in English picture naming with adults and for the three age groups in Hindī picture naming, but no clear pattern that emerges. These weakened frequency effects in picture naming (for both monolinguals and bilinguals) are consistent with the AoA literature, where the general finding is that frequency appears to be confounded with AoA, and these adult AoA ratings reflect more than one factor including a combination of frequency and real information about the age at which these words or concepts were acquired (Ellis & Morrison, 1998; Gerhand & Barry, 1998, 1999).

As for the word reading tasks (both Hindī and English), a different pattern emerges between the predictors and dependent measures. Age of acquisition ratings and syllable length were the strongest predictors of word reading measures in both Hindī and English for all three age groups, although syllable length effects were seen only in the younger age groups in word reading accuracy. In the case of word frequency, there are significant effects of frequency observed in the English word reading response times only (and not for Hindī), across the three age groups. There were no significant effects of frequency ratings (both Hindī and English) on word reading behavior observed for all the three age groups. Similarly, there are some weak effects of frication word reading times (Hindī and English). With regard to the frequency effects, it is a fairly well established finding that word frequency along with other psycholinguistic variables is one of the most important predictors of word naming in English and that similar variables affect performance on both picture and word naming tasks. This finding is supported by the results reported here where frequency is one of the important predictors in word reading times. However, with regard to Hindī, while there is no direct evidence, there have been a few unpublished studies (Rao, 1994; Matthew, 1995; Kurien, 1996; cited in Karanth, 2002) that have reported no effects of frequency on word naming i.e., rapid reading tasks in Kannada (a Dravidian language that is transparent and alphasyllabic in nature like Hindī). These studies have reported that word attributes such as word length are the only significant predictors of performance on word naming tasks. So it appears that the results from the Hindī word reading task actually support this finding, given that we observed that word length rather than frequency was a better predictor of word reading performance in Hindī (and by extension, other transparent alphasyllabic scripts). However, Karanth (2004) modified her earlier argument to say that in transparent languages like Kannada, while there are no effects of frequency seen on shorter and simple words, one might see effects of these variables on longer, more complex words. This statement is also consistent with our findings since all the Hindī words used in the bilingual experiments were relatively simple and not very long (average syllable length is 2.68). In future work with Hindī word reading, the variables of word length, syllable structure and frequency should be examined more systematically.

With goodness of depiction, one of the strongest predictors in the picture naming tasks, in terms of theoretical models of picture naming, it seems reasonable to assume that it pertains primarily to the stages of visual decoding and object recognition (apparently independent of objective visual complexity, which makes no contribution to performance at all).

In contrast, it is generally assumed that AoA and frequency are properties of the lexical item rather than the object concept. To the extent that this is true, we might conclude that the adult profile of predictor-outcome relationships is largely established by age 5, and does not change despite clear developmental improvements in speed and accuracy. This is evident in both the monolingual and bilingual data. However, from the results reported here, it would appear, that the level at which frequency and perhaps AoA effects apply maybe at both the conceptual and lexical levels.

Comparing the predictor-outcome relationships in picture and word reading, we find that word learning age is a significant predictor for both tasks as previously noted (Carroll & White, 1973, Iyer et al., 2001). At the risk of being repetitive, with regard to why word learning age is important, some investigators have proposed a "first-in" approach in which the earliest acquired words have a privileged status in the mental/neural lexicon. In some computational models of word learning, the first acquired words help to define and constrain all subsequent learning, influencing the 'first principal components' in a high-dimensional vector space of sound and meaning (Ellis et al, 2000; Zevin et al, 2002; Smith, et al., 2001). However, given the importance of age of acquisition as a critical psycholinguistic variable affecting lexical access, there are no current models of monolingual and bilingual language processing that have fully accounted for this variable. In fact, most models are based on stable-state adults in the case of monolinguals and do not examine or fully take into account the developmental trajectory. In the case of bilingual models, the situation is not very different, as all the models are based on adults and especially adult second language learners. None of the current models addresses the issue of varying age of language acquisition, and how that interacts with the other psycholinguistic variables (i.e., frequency, fluency, etc.) and affects language processing.

Finally, results strongly suggest that the subjective AoA ratings were the best predictors of performance on naming tasks (RTs and naming responses), i.e., higher correlation with picture naming latency, than word attributes such as frequency and familiarity norms. However, results from regression analyses showed that there were independent and significant contributions of both frequency and AoA (see results section in chapter 5 and chapter 7 for more details). These results support the generally held view by researchers in the field, that, despite the overlap in AoA and frequency, the two have independent effects on picture naming behavior (Iyer et al., 2001).

It seems relevant at this point to speculate about the reasons why these adult ratings are among the most powerful predictors of picture-naming times. The reason for this strong relationship is still unknown. However, several accounts have been offered to explain the relative advantage of AoA ratings over other word attributes such as frequency and familiarity. There doesn't appear to be a single obvious mechanism to explain these results. Some researchers have suggested that AoA (ratings collected from adults) is a composite variable that embodies elements of frequency, familiarity, imageability and so on. For example, Paivio et al. (1989) found that rated AoA loaded on

3 out of 7 factors in a factor analysis of naming and imaging whereas the Kučera-Francis frequency norms loaded on only a single factor. The viability of this approach has been demonstrated in computational models of word learning in which the variance contributed by age-of-acquisition is separate from the variance contributed by frequency (Ellis et al, 2000; Zevin et al, 2002; Smith, et al., 2001). If this approach were correct, it would justify further investments in age-of-acquisition measures for the study of word learning in children and lexical processing in adults.

These results exploring the performance profile across different age groups and examining the predictor-outcome relationships across these different age groups on the lexical access tasks provide us with interesting insights into the nature of the developing and the mature lexicon. In the case of both monolinguals and bilinguals, we find similar predictor-outcome relationships across the different age groups. However, the response profile in the naming tasks differs within each population group across the different age groups and between the two population groups (monolinguals and bilinguals). This implies that the adult profile of predictor-outcome relationships is largely established in childhood (by the age of 5) and does not change despite clear developmental improvements in speed and accuracy. In accord with this view, some researchers have suggested that organizational factors and the representation of items in memory are similar in children and adults (Cirrin et al., 1981; Nelson et al., 1975). Conversely, the developmental differences appear to be a result of the qualitative differences that exist in the strategies used to access stored information by children and adults (Chi, 1977; Cirrin, 1983).

<u>Question 3: (i) In subjects of varying language fluency (between monolinguals and bilinguals, between the two languages of the bilingual), what are the response profiles across the different age groups and for the two language tasks? (ii) In addition, how do differences in orthography interact with varying proficiency levels in the two languages affect performance on lexical access tasks (especially word reading)?</u>

One of the goals of the present dissertation was to examine the effects of varying proficiency and its impact on lexical access tasks. Putting the monolinguals and bilinguals performance on a single continuum, we find that monolinguals are faster and more accurate and bilinguals are slower and less accurate in both the languages on both picture and word naming tasks, when compared on their performance on the items in common. This is not a surprising finding, as these findings have been reported in other studies where monolinguals and bilinguals have been compared on lexical tasks (Ransdell & Fischler, 1987; Micheal & Gollan, 2005). One possible reason for the monolingual advantage on the lexical access tasks is interference from competing lexical items from two languages. Such interference is probably even stronger in the less fluent language (for e.g., Hindī naming tasks, as evidenced by the slower and lower accuracy in the naming tasks, when compared to English). However, another factor that might be responsible for monolingual advantage, even when you compare it with the bilingual's dominant language, could be the appropriateness of the items used in the bilingual study. The items were selected from a large database normed in the west, and even if efforts were made to control for cultural bias, it may not have been completely removed.

Looking at the differences in response profiles in the two languages of the bilingual, there are slightly different patterns seen for all the three different ages. In the oldest age group, there is a clear word reading advantage over picture naming (for both the languages), and a dominant language advantage (EWR > HWR > EPN > HPN). With the youngest age group, the performance profile is slightly different, where in we see a dominant language advantage, but not so much task advantage (i.e., EWR > EPN > HWR > HPN). With the 11-13 year olds, we see the transition happening at this stage, where they seem to be closer to adult like performance on all the tasks (i.e., EWR > EPN = HWR > HPN). These results are again consistent with the results reported by Kohnert and her colleagues (1999), where the developmental cross-over, in this case of language dominance, happening in the middle childhood, where these children were going through whatever changes in strategies, consolidation of knowledge, so that they seemed closer to the adult levels of performance on the lexical production tasks.

Proficiency in a language has been repeatedly implicated as a significant factor that influences performance on language processing tasks in bilinguals. In the present bilingual study, my aim was to explore the nature of proficiency effects on lexical access tasks. All the bilingual participants were grouped into low or high proficiency groups, based on their scores obtained on a basic age-appropriate written comprehension passage measure. Comparing the performances between the two groups (for all the three age groups) on their performance on the two language production tasks, the findings indicated that the greatest differences were observed between the word reading tasks, especially in the non-dominant language (Hindī), for all the three age groups. There was not much of a difference seen in the picture naming tasks. There are two possible reasons for this. First, the comprehension measure used may not have been sensitive enough or comprehensive enough to give us a clear distinction between the low and high proficiency groups. Another reason could be that processing pictures involves different skills which may not be the ones tested on the language fluency measure utilized in this study.

Another question that I attempted to answer in this research was how differences in the orthographic structure of the two languages in question interacted with language proficiency to affect the performance on the word reading tasks. I predicted that given that Hindī is a transparent language with shallow orthography, we would find a word reading advantage in Hindī, in the case of the balanced bilinguals. However, the results did not reflect any Hindī WR advantage even in the high proficiency group. There are a couple of reasons that could explain the lack of Hindī WR advantage. First, most of the subjects were probably English dominant even in the high proficiency group. Another factor could be that on average the Hindī words were longer than the English words. One resolution of the word length problem would be to first control for word length and other psycholinguistic variables in the two languages and compare the performance on all the items that are matched on word length, frequency, AoA etc. Secondly, a more controlled strategy would be comparing the WR performance in Hindī and English on novel words.

Question 4: What is the relationship between picture naming and word reading?

There have been many cross-sectional studies in both reading and neuropsychology that have demonstrated that continuous naming-speed tasks are strongly correlated with reading performance (Ackerman, Dykman, Gardner, 1990; Blachman, 1984; Bowers, Steffy & Swanson, 1986; Ellis, 1981; Spring & Capps, 1974; Spring & Farmer, 1975; Spring & Davis, 1988). To test this relationship in the bilingual data, correlational analyses was done between the picture naming and word reading measures. The results indicated that the strongest relationship was between Hindī picture naming and word reading tasks, while in the English language tasks, the relationship was much weaker (with the youngest age group) or not significant at all in the case of the older two age groups. When the subjects were divided into the low and high proficiency groups, here again we find that the strongest relationships are in the low fluency group between the picture naming and word reading tasks while in the higher fluency group, the correlations between the two tasks was much weaker.

These patterns of results seem to indicate that the degree of proficiency in the language and degree of automaticity in the task are the key determinants of strength of the relationship between picture naming and word reading tasks. In the present bilingual study, the results clearly suggest that there is a greater reliance on skills that overlap with picture naming processes, such as tapping into the conceptual representations or word meaning, in the case of the less fluent bilinguals, and the younger age groups. As a result, there seems to be a stronger correlation between picture naming and word reading tasks in these groups. However, in the older age groups and high proficiency group, the word reading task is much more automatized with possibly more reliance on phonetic and orthographic cues, and therefore it would have less in common with picture naming tasks. These results reported here are also consistent with findings in the reading and neuropsychological literature, where most of the studies reporting a relationship between naming tasks and reading performance have been conducted on reading impaired children and adults, whose reading skills would be less automatized when compared to their normal counterparts.

Future Directions

The research and findings presented here have examined lexical access processes in monolinguals and bilinguals using two language production tasks. The findings serve as a point of departure for further explorations of bilingual language processing issues. My dissertation research besought primarily to develop a normative database and extend the monolingual paradigm to the bilingual subjects to gain some insights into lexical processing. There is a dearth of information for researchers and clinicians alike about normal language processing in bilinguals. To this end, the aim of my research, which used a large stimulus set, across different age groups, using two different tasks, two very different languages, was to provide norms that would assist researchers and clinicians in developing other studies using the information from this database. The data and results reported here have provided us with some interesting insights. Although several quantitative analyses were undertaken and form the bulk of the dissertation findings, further work would benefit from qualitative analyses such as error analyses in naming, and latencies for naming cognates vs. non-cognates, and words with simple vs. complex syllable structure, to name just a few comparisons of interest. An in depth qualitative analyses may also provide better insights into the nature and differences between the immature and mature lexicon. There is definitely need for more comprehensive models of lexical access that can address and fully explain how the principles underlying the structure of the immature lexicon differ from those of the mature lexicon, and how and when these factors change over time.

In addition, these qualitative analyses will also help address the relevance of the current existing models of lexical access. For example, one interesting error observed in the bilingual data, was in the Hindī PN task, where in the target picture shown was that of a "cow", and expected response of the subject was <u>गाय</u> (pronounced as "gaay"), which is "cow" in Hindī. However, the subject's response was <u>कौआ</u> (pronounced as "cowwa") which means "crow" in Hindī. What is particularly interesting about this type of error is that not only does the target response have a phonological overlap with the non-target language (i.e., English "cow") but there is also a semantic overlap with the non-target language (i.e., English "cow"). These types of responses provide us with glimpses of how information is processed and that a simple, modular model with sequential stages of processing may not be the most accurate. In addition, these types of errors reinforce the theory that the bilingual lexicon is a highly interactive one, which might in fact be subserved by a common conceptual store. In the case of bilingual lexical access, there is again no single model that fully explains all the results reported here. However, there are different aspects of various models that can be used to explain the bilingual data. For example, the results reported in this dissertation, if anything, strengthen the "common conceptual store" and the highly "interactive network" argument in bilingual lexical access. In addition, from the type of error mentioned earlier, there is support for a "language non-selective" model. Poulisse and Bongaerts' (1994, 1997) "language non-selective" model appears to be one of the more comprehensive models. The model's basic underlying philosophy which Heij (2005) stated aptly is, "complex access and simple selection". Here the assumption is that lexical access is a complex process, in the sense that all the relevant information is contained in the preverbal message, including the language cues. So, during lexical access, not only does the relevant word become activated but also all the other semantically related words, including words in the non-intended language. However, selection is a simple, local process that is only based on the activation levels of the words. However, while Poulisse and Bongaerts's model falls under the category of "language non-selective" models, it is originally based on Levelt's (1989) model which is a prototype of the serial access models. This strengthens my argument that while all models of language production and lexical access that have been developed describe certain aspects of speech production, in either monolinguals or bilinguals, there is no one single comprehensive model that can encapsulates and addresses all aspects of speech production in different types of populations (monolinguals/bilinguals, children/adults, normal/impaired).

The results reported here enrich our understanding of bilingual language processing and provide us with interesting insights into bilingual lexicon. Results from these studies enable us to extend the paradigm to bilingual clinical populations such as children with language impairments and adults with aphasia, and in examining how languages that are structurally and orthographically different affect lexical access. Only a few studies have looked at these issues in the clinical populations in the Indian languages (for e.g., Gupta, 2004). Gupta (2004) examined the nature of reading disabilities in Hindī dyslexics. The reading performance of the dyslexic readers was compared with that of reading aged and chronologically aged matched controls. Results showed that the dyslexics were significantly poorer (in accuracy and speed) than their age-matched controls and were worse in reading accuracy than their reading matched controls. Overall, the findings reveal that, despite the transparency of the Hindī script, dyslexic readers of Hindī have difficulty developing high-quality, segmentally organized phonological representations of words and display poor blending skills. While these studies provide us with valuable insights into the nature of bilingual lexical access and reading skills in both clinical and normal populations, there needs to more efforts made to test larger groups, different ages, using larger set of items.

To conclude, when undertaking these studies especially with bilingual populations, care needs to be taken in subject selection (to reduce heterogeneity or at least account for the factors that contribute to the heterogeneity of the sample being tested). In addition, investigators should utilize more comprehensive measures to determine language proficiency (both subjective and objective). Finally, more attention should be focused on qualitative analyses (i.e., different strategies used, error analyses etc).

APPENDIX A: LIST OF STIMULI

Following table lists the target names (modal response) for items used in both the monolingual (English US) and bilingual (English & Hindī, India) studies. All the items with more than one target name are also listed. These items with multiple target names have been excluded in the final quantitative comparative analyses.

English (US)	English(India)	Hindī (India)
airplane	airplane	हवाई जहाज़
alligator	crocodile	मगरमच्छ
ant	ant	चींटि
antlers	antlers/horns	सींग/हाथ
apple	apple	सेब
	hand	बाँह
arrow	arrow	तीर
ax	axe	कुल्हाड़ी
baby	baby	बच्चा
bottle	bottle	बोतल
backpack	bag	थैला/बस्ता/bag
	bag/packet	थैला
balcony/door	balcony	दरवाज़ा
	ball	गेंद
balloon	balloon	गुब्बारा
banana	banana	केला
bandaid	bandaid/bandage	पट्टी/bandaid
basket	basket	टोकरी
bat	bat	चमगादड़
bear	bear	भालू
	beard	दाढ़ी
bed	bed	पलंक/बिस्तर
bee	bee	भंवर/मक्खी
	bug	कीड़ा/मकड़ी/मच्छर
bell	bell	घंटी
belt	belt	बेल्ट
	bench	बेंच/कुर्सी
bicycle/bike	cycle	साइकिल
binoculars	binoculars	दूरबीन
	bird	चिड़िया
	wood	लकड़ी
boat	boat	नाव/जहाज़
	bomb	बम
	bone	हड्डि
book	book	किताब
	boot/shoe	जूता
bottle	bottle	बोतल
bowl	bowl	कटोरी
bow	bow	ribbon/bow
	box	डिब्बा
	boy	लड़का

	branch	पेड़/ढाल
bread	bread	डबलरोटी/bread
	bride	दुल्हन/लड़की
	bridge	पुल/bridge
broom	broom	झाड़ू
bus	bus	बस
	butter	मक्खन
butterfly	butterfly	तितली
button	button	बटन
	cactus	नागफनी/cactus
	cage	पिंजरा
cake	cake	केक
camel	camel	ऊँट
camera	camera	कैमरा
	can	डिब्बा
candle	candle	मोमबत्ती
	stick	छड़ी
cannon	cannon	तोप
canoe	boat	नाव
	cap	टोपी
car	car	गाड़ी
carrot	carrot	गाजर
	cassette	कैसेट
cat	cat	बिल्ली
	chain	ज़ंजीर
chair	chair	कुर्सी
	cheese	पनीर
cherry		
	chest/body	छाती
chicken	hen	मुर्ग़ी
	church	चर्च
cigarette	cigarette	सिगरेट
	city	शहर
clock	clock	घड़ी
	cloud	बादल/cloud
clown	joker	जोकर
	coat	कोट
dime	coin	पैसा/सिक्का
	pillar	खंभा
comb	comb	कंघी
cork		
corn	corn	भुट्टा
cow	cow	गाय
crab	crab	केकड़ा
crib/bed		
cross		
	crown	ताज
	cup	प्याला/cup
	curtains	परदे

deer	deer	हिरण
	desert/cactus	रेगिस्तान
	desk/table	मेज़
dinosaur		
	doctor/man	आदमी
dog	dog	कुता
	doll	गुड़िया
dolphin		
donkey	donkey	गधा
door	door	दरवाज़ा
drawer		
dresser/drawer		
drum	drum	ढोल/ढमरू
	duck	बत्तख
eagle	eagle	बाज़
ear	ear	कान
	egg	अंडा
elephant	elephant	हाथी
envelope	envelope	लिफ़ाफ़ा/चट्ठी
eye	eye	आँख
fan	fan	पंखा
faucet	tap	नल
feather	feather	पंख
fence		
finger	finger	उंगली
fire	fire	आग
	fish	मछली
flag	flag	झंडा
flashlight		
	floor	फ़र्श/ज़मीन
	flower	फूल
	flute	बाँसुरी
fly	fly	मक्खी
foot	foot/leg	पैर
fork	fork	काँटा
	fountain	फ़व्वारा
	fox	लोमड़ी
frog	frog	मेंढक
	garbage	कचरा
	genie	जिन
ghost	ghost	भूत
giraffe	giraffe	जिराफ़
	girl	लड़की
glass/cup	glass	गिलास
glasses	spectacles/specs	चश्मा
glove	glove	दस्ताना
goat	goat	बकरी
gorilla	gorilla	गोरिला/बन्दर
grapes	grapes	अंगूर
grasshopper		

guitar		
	gun	पिस्तौल/बन्दूक
	hair	बाल
brush		
hammer	hammer	हथौड़ा
	hand	हाथ
	handcuffs	हथकड़ी
hanger		
harp		
hat	hat	टोपी
	hay	घांस
	heart	दिल
heel/shoe		
helicopter		
highchair		
	hippopotamus	दरियाई घोड़ा/hippopotamus/गेन्डा
hoof		
horse	horse	घोड़ा
hose		
house	house	घर
igloo		
	iron	इस्त्री
ironing-board/table	table	मेज़/table
jar	jar/bottle	जार/bottle/बोतल
	puzzle	पहेली
	skipping rope	रस्सी
kangaroo	kangaroo	कंगारू
	key	चाभी
	king	राजा
kite	kite	पतंग
knife	knife	चाकू
	knight/warrior	सिपाही
	knot/rope	रस्सी
ladder	ladder	सीढ़ी
	spoon	चम्मच
ladybug		
lamp	lamp	लैंप
lawnmower		
leaf	leaf	पत्ता
	leg	पाँव/पैर
	lemon	नींबू
leopard/cheetah	leopard/tiger	चीता
	letter/papers	पत्र/चिट्ठी
lightbulb	lightbulb	बल्ब
	lightning/thunder	बिजली
	switch	स्विच
lion	lion	शेर
lips	lips	होंट
	lipstick	lipstick
	lizard	छिपकली

lock	lock	ताला
log		
	magnet	चुंबक
	mailbox/letterbox	डाक का डिब्बा/mailbox
	man	आदमी
	map	नक्शा
mask	mask	नक़ाब
	matchstick	माचिस
medal	medal	पदक
	mike	माइक
microscope	microscope	सुक्ष्मदर्शी/microscope
	mirror	शीशा
mixer/beater		
	priest	आदमी/पुजारी
monkey	monkey	बंदर
moon	moon	चाँद
moose		
	mosquito/fly	मच्छर
motorcycle	motorbike	मोटर साइकिल
	mountain	पहाड़
	mouse	चूहा
mousetrap		
mushroom	mushroom	कुकुरमुत्ता/mushroom
music/notes	music	संगीत/गाना
nail	nail	कील
	neck	गर्दन
	necklace	माला
	needle	सुई
nest	nest	घोंसला/अण्डा
net	net	जाल
nose	nose	नाक
	nurse	नर्स/लड़की
octopus		
	onion	प्याज़
	orange	संतरा
	ostrich	शुतुरमुर्ग/ostrich
owl	owl	उल्लू
	package/parcel	पार्सल
bucket	bucket	बालटी
paintbrush	paintbrush	brush
	paint	पेंट
palmtree	palmtree/coconut tree	पेड़
	pan	बरतन/pan
panda		
pants	pants	पतलून/pant
	paper	कागज़
paperclip		
	parachute	पैराशूट
parrot	parrot	तोता
	paw	पंजा

	peach/orange	आड़ू/फल
	peacock	मोर
peanut	peanut	मूँगफली
peas	peas	मटर
	pelican/bird	पंची/चिड़िया
	pen	क़लम
pencil	pencil	पेंसिल
penguin	penguin	पेंग्विन
piano	piano	पियानो
	picture/painting	तस्वीर
pig	pig	सूअर
	pigeon/bird	कबूतर/चिड़िया
piggybank		
	pillow	तकिया
pineapple	pineapple	अनन्नास
	pirate	डाकू/सिपाही
	jug	सुराही/jug
	fork	त्रिषूल/पाँचा/fork
	pizza	पिज़ा
	plate	थाली/plate
	plug	प्लग
	policeman	आदमी/पुलिस
	swimming pool	pool/swimming pool
	popcorn	popcorn
	porcupine	साही/जानवर
	box	बरतन/डिब्बा/cooker
	potato	आलू
	gift	तोफ़ा
	priest	आदमी/पुजारी
pumpkin	pumpkin	कद्दू/तरबूज़
purse	purse/bag	पर्स/bag
pyramid	pyramid	पिरामिड
	queen	रानी
rabbit	rabbit	ख़रगोश
	radish/flower	मूली/फूल
	rain	बारिश
	rainbow	इन्द्रधनुष
	razor/blade	रेज़र/blade
record player	gramaphone/cd player/tapeplayer	ग्रामोफ़ोन/taperecorder
	refrigerator/fridge	फ़्रिज
rhinoceros/rhino	rhinoceros	गैंडा
gun	gun	बंदूक
ring	ring	अँगूठी
	road	रस्ता
robot	robot	रोबोट
	rock/stone	पत्थर
rocket	rocket	अंतरिक्ष यान/rocket
rockingchair		
rolling pin/roller	rollingpin/roller	बेलन
	roof	छत

rooster/chicken	hen	मुर्ग़ा
rope	rope	रस्सी
	rose	गुलाब/फूल
rug	mat	ग़लीचा/चटाई/mat
ruler	scale	scale
saddle		
	fridge/locker/refrigerator	तिजोरी
safetypin/pin	safetypin	सेफ़्टिपिन/पिन
sailboat/boat	boat	नाव/जहाज़
sailor	man	आदमी
salt	salt	नमक
sandwich	sandwich	सैंदविच
	saw	आरी
saxophone/trumpet		
scale/weigher	weighing machine/balance	तराज़ू
scarf	scarf	स्कार्फ़/muffler
	scissors	कैंची
scorpion	scorpion	बिच्छू
screw	screw/nail	स्क्रू/कील
screwdriver	screwdriver	पेंचकस/screwdriver
seahorse		
	seal	सील
seesaw	see-saw	सीसॉ/झूला
	sewing machine	सिलाई मशीन
shark	shark/fish	मछली
sheep	sheep	भेड़
shell	shell	सीप/शंख
	ship	जहाज़
shirt	shirt	कमीज़/कपड़ा
shoe	shoe	जूता
shoulder	shoulder/arm	कंधा/हाथ
	spade	खोदने वाली चीज़/कुल्हाड़ी/spade
shower	shower	फुहारा स्नान/फुहारा
sink		
skateboard		
skeleton	skeleton	कंकाल/skeleton
	skirt	स्कर्ट/कपड़ा
	sledge	स्लेज
slide		
slingshot		
slipper	shoe	जूता
	smoke	धुआँ
snail	snail	घोंघा/snail
snake	snake	साँप
sock	sock	मोज़ा
	sofa	सोफ़ा
	soldier	सिपाही
	noodles	नूडल
spider	spider	मकड़ी
thread/string	thread	धागा

spoon	spoon	चम्मच
squirrel	squirrel	गिलहरी
stairs	stairs/staircase	सीढ़ी
	statue	मूर्ती
steeringwheel		
sthetoscope		
stove/oven	oven/washing machine	स्टोव/gas
strawberry	strawberry	स्ट्राबेरि
submarine		
sun	sun	सूरज
swan	swan	बत्तख
sweater/shirt/sweatshirt		
	swing	झूला
sword	sword	तलवार
needle/shot	syringe/injection	सुई/injection
table	table	मेज़
	tail	पूंच
taperecorder		
teapot		
	tears	आँसू
teepee		
teeth	teeth	दाँत
telephone		
telescope	telescope	दूरबीन
TV		
tennisracket		
tent		
tiger	tiger	शेर
tire	tire	पहिया/tire
toilet		
	tomato	टमाटर
	grave	कब्र
toothbrush		
	top	लट्टू
	towel	तौलिया
	railway track/track	रेलपट्री/पट्री
tractor		
stoplight		
train	train	रेलगाड़ी
trash can	dustbin	कचरे का डिब्बा/डिब्बा
tree	tree	पेड़
truck		
trumpet	trumpet	बाजा
chest/box	trunk/box	बक्सा/डिब्बा
turtle	turtle/tortoise	कछुआ
typewriter		
umbrella	umbrella	छतरी
unicorn		
vacuum		
vase	vase/pot	गमला

violin/guitar		
waiter		
bricks/wall		
wallet/book	wallet	बटुआ
	walnut/nut	अखरोट
walrus		
watch	watch	घड़ी
	watermelon	तरबूज़
spiderweb	spiderweb	जाल
	well	कुँआ
whale		
	wheat	गेंहू
wheel	wheel	पहिया
wheelbarrow		
whip	whip/fishingrod/hunter	चाबुक/रस्सी
whistle	whistle	सींटी
	wig/hair	बाल
window	window	खिड़की
wing	wing	पंख
	witch	चुड़ैल
wolf/coyote	wolf/dog	कुत्ता
	woman/lady	औरत/लड़की
worm	worm	कीड़ा/साँप
	wrench/screwdriver/spanner	पाना/wrench
	zebra	ज़ेबरा
	zipper/zip	ज़िप

APPENDIX B: SCREENING MEASURES

1. Control Subject Information Form

UCSD: #020542S
SDSU: 02-04-158C

Experiment Name:____________________ ______________ __________
Major **Minor** (leave blank if unknown) **Subject #**

____
(a.k.a. / code name)

TYPE OF SUBJECT
- ❑ College Control
- ❑ Elderly Control
- ❑ Aphasic
- ❑ Child
- ❑ __________

TEST LANGUAGE(S)
- English /__________❑
- Hindi /__________❑
- Tamizh /__________❑
- Kannada /__________❑
- Urdu /__________❑

CONTROL SUBJECT INFORMATION
All information in BOLD type must be completed by experimenter only, Please Print!

NAME ______________________________________

Street Address_________________________________ E-MAIL ADDRESS________________

City _____________________________________ State __________ Zip __________

PHONE NUMBER (____) ______________________ GENDER________ Female / Male ______

AGE______________________________ DATE OF BIRTH__________________

Occupation ______________________________ EDUCATION____________________
(enter grade level in years, e.g. H.S . =12, BA=16. etc.,)

HANDEDNESS Left / Right _______________________ **Left-Handed Family member?** Yes / No
(Circle one & Fill out Handedness Questionnaire) (Use info from Handedness Questionnaire item #2)

Where were you born? ____

What was the first language you learned as a child?________________________________

Any other language spoken in the home while you were growing up? ❑ No ❑ Yes
(If yes, ask additional questions and/or fill out Language History Questionnaire to make eligibility decision and make notes below)

What language do your parents speak? mother______________ **father**________________________
(try to determine if early language exposure may have occurred or fill out Language History Questionnaire then make eligibility decision)

Do you speak any other language(s)? ❑ No ❑ Yes
(If yes, ask additional questions to decide if Language History Questionnaire is needed, make notes below as needed)

ETHNICITY (ask subject which category applies to them then check appropriate category)

	American Indian or Alaskan Native	Asian or Pacific Islander	Black, not of Hispanic origin	Hispanic	White, not of Hispanic Origin	Other or Unknown
Female						
Male						
Unknown						

HEALTH SUMMARY

	Appears normal		Questionable (note below)	
Hearing	❑		❑	
Eyesight Glasses / Contacts	❑		❑	
Cognitive Abilities	❑		❑	
General Health	❑		❑	
Social/Emotional Stability	❑		❑	
Current or Recent Health Problems?	❑	No	❑	Yes
Medications?	❑	No	❑	Yes

NOTE: any language issues, 'questionable' or 'yes' boxes checked, please explain below.
NOTES: ____

FORM FILLED OUT BY________________________________DATE __________________
Experimenter's Name (First, Last) Please Print! (Date of Test session)

❑ **Entered into Database:** ____________________________ (Your Name: First, Last)

Iyer, June 2002

2. Assessment of Handedness Form

UCSD: #020542S
SDSU: 02-04-158C

TYPE OF SUBJECT
- ☐ College Control
- ☐ Elderly Control
- ☐ Aphasic
- ☐ Child
- ☐ ____________

TEST LANGUAGE(S)
- English /____________☐
- Hindi /____________☐
- Tamizh /____________☐
- Kannada /____________☐
- Urdu /____________☐
- _________ /____________☐

Assessment of Handedness

Name____ **Date**________________

Age______________ **Subject ID#**______________

Please indicate your preferences in the use of hands in the following activities by **putting a plus** [+] **in the appropriate column**. Where the preference is so strong that you would never try to use the other hand unless absolutely forced to, **Put two Plusses** [++]. If in any case you are really indifferent **put a plus** [+] **in both columns**.

Some of the activities require both hands. In these cases the part of the task, or object, for which hand preference is wanted is indicated in parentheses. Please try to answer all the questions, and only leave a blank if,you have no experience at all with the object or task.

		L	R			L	R
1.	Writing	______	______	11.	Tennis racket	______	______
2.	Drawing	______	______	12.	Golf club (lower hand)	______	______
3.	Throwing	______	______	13.	Broom (upper hand)	______	______
4.	Scissors	______	______	14.	Rake (upper hand)	______	______
5.	Comb	______	______	15.	Striking match (match)	______	______
6.	Toothbrush	______	______	16.	Opening box (lid)	______	______
7.	Knife (without fork)	______	______	17.	Dealing cards (card being dealt)	______	______
8.	Spoon	______	______	18.	Threading a needle (whichever is moved)	______	______
9.	Hammer	______	______	19.	Which foot do you prefer to kick with?	______	______
10.	Screwdriver	______	______	20.	Which eye do you use when using only one?	______	______

Please check:

1. Do you consider yourself:

   ______ right-handed? ______ left-handed? ______ ambidextrous?

2. Were any of the following family members left-handed: (if yes circle and indicate number)

   mother father sisters ______ brothers ________ sons ______ daughters ________

(Use this information for Handedness question on Control Subject Information, Reverse Side)

3. Did you ever change your handedness?

   ______ yes ______ no If yes, when and why?________________________________

4. Is there any activity not in this list for which you consistently use your nondominant hand?

3. Language History Questionnaire

UCSD: #020542S
SDSU: 02-04-158C

TYPE OF SUBJECT
- ❑ College Control
- ❑ Elderly Control
- ❑ Aphasic
- ❑ Child
- ❑ ____________

PRIMARY LANGUAG
English
Hindi
Tamizh
Kannada
Urdu
____

Language History Questionnaire

(Fill out only if more than one language is spoken)

Name_____________________________ Date ________________

Age________ DOB:____________ Subject ID# ____________

1. What is your native language? ____
(if more than one, please indicate)

2. Please list **all** of the languages you know, from the most proficient to the least proficient, and indicate the age at which you were first exposed to each.

Language Age at first exposure

1. ____
2. ____
3. ____

3. Was there any language spoken in your immediate environment but not included above? ____

4. How proficient are you currently in each of your languages?
Please rate them using the following scale:

1 = almost none
2 = very poor
3 = fair
4 = functional
5 = good
6 = very good
7 = like a native speaker

	Language	Speech	Reading	Writing	Comprehension
1					
2					
3					

5. Estimate how often you use your two best languages, using the following scale:

1 = always
2 = sometimes
3 = never

	Language 1________	Language 2________
a. father		
b. mother		
c. sons / daughters		
c. brothers / sisters		
d. friends		
e. yourself		
f. spouse		
g. pets		

6. In which language do you usually:

add, multiply, etc.? ______________________ watch TV? ___________________

dream? ________________________________ read? _________________

express affection? ______________________ write? ______________________

swear? _________________________________

7. How good are you at learning a foreign language?

_____ worse than average _____ average _____ better than average

8. When learning a language, what do you find the easiest?
Please rank the following (1=least difficult, 3=most difficult):

pronunciation ___________
vocabulary ___________
grammar ___________

9. What are or were the fluent languages spoken by each of the following?

Mother: ____________________ Spouse: ____________________

Father: ____________________

10. How many years have you formally studied (in a classroom or other structured situation) each of your languages including your first?

	Language	Years of study
1.		
2.		
3.		

11. If you have lived or traveled in countries where languages other than your first language are spoken, please indicate the country, the length of your stay, and the language you used most while you were in that country.

	Country	Length of stay	Language used
1.			
2.			
3.			
4.			

12. If there is anything else about you or your language that you feel is important, please comment.

4. Children's phone screen questionnaire

MEDICAL HISTORY QUESTIONNAIRE
PHONE SCREEN

Name: ______ Gender: M F DOB: __/__/__ Screen Age: ____yrs. ____mos.	Screen Date: __/__/__ Completed by: ______	ID: ______ Group: ______

Primary Contact: ______ Home Phone ______
Address ______ Cell Phone ______
City ______ State ____ Zip ____ Work Phone ______
Relationship: ☐ Mother ☐ Father ☐ Other: ______

2. What language is primarily spoken at home? ☐ English ☐ Spanish ☐ Other ______
3. Were any language other than the primary language ever spoken to this child? ☐ Yes ☐ No ☐ DK
   If Yes, how old was the child? ____ yrs How frequently was it used? ______
4. How many weeks did the pregnancy last? ______ (40 weeks is average - 38-42 normal)
5. Were there any problems with delivery? ☐ Yes ☐ No ☐ DK
   Description: ______
6. Baby's birth weight ____ lbs ____ oz. Apgar score____ @1min ____ @ 5 min.
7. At what age did this child do each of the following:
   Said single words: ______ months (other than mama or dada) First sentence: ______ months (put two words together) Walked alone: ______ months
8. Has the child had a hearing test? ☐ Yes ☐ No ☐ DK Results: ______
10. Has the child had a vision test? ☐ Yes ☐ No ☐ DK Results: ______
11. Is the child currently taking medication? ☐ Yes ☐ No ☐ DK If Yes, list age at start (in years) and Medication:
    ______
    ______
12. Has this child had any of the following?

	Yes	No	DK	Description
Seizures	☐	☐	☐	
Attention Deficit Disorder	☐	☐	☐	
Head trauma	☐	☐	☐	Any loss of conciousness? For how long?
Speech/language difficulties (articulation?)	☐	☐	☐	

ID:

MEDICAL HISTORY QUESTIONNAIRE
PHONE SCREEN

	Yes	No	DK	Description
Learning disabilities	☐	☐	☐	
Any psychological, psychiatric, emotional or behavioral problems	☐	☐	☐	What?
Neurological problems	☐	☐	☐	
Other medical conditions	☐	☐	☐	
Has child had EEG, CT scan, or MRI of the head? If Yes, please list:	☐	☐	☐	Type of test: When: Where: Why: Results:

13. Has this child had speech or language therapy? ☐ Yes ☐ No ☐ DK
    If yes, reason: ______
14. Has this child been involved in any counseling? ☐ Yes ☐ No ☐ DK
    If yes, describe: ______
15. Does this child attend school (kindergarten or later)? ☐ Yes ☐ No ☐ DK
    If yes, what grade is the child in? ______
16. Has this child been in any special classes or programs? ☐ Yes ☐ No ☐ DK If Yes, please list:
    ______
17. Has this child had any testing (IEP, Speech/language/ psychometric/psychological)? ☐ Yes ☐ No ☐ DK
    If Yes: When What tests were done Where
    ______
    ______
19. Has this child repeated a grade? ☐ Yes ☐ No ☐ DK
    If yes, why? ______
23. Can we offer the child a snack or juice? ☐ Yes ☐ No Restrictions: ______
24. What are the best days and times to schedule appointments? ______
25. Are there any other children in the household? ☐ Yes ☐ No If yes, how many and what ages?
    ______
    ______

Comments:
______
______

APPENDIX C: LANGUAGE PROFICIENCY MEASURES

1. Hindī passage 1 (for 8-10 year-old bilinguals)

नीचे लिखे गद्यांश को ध्यान से पढ़िये और नीचे लिखे प्रश्नों के उत्तर हिंदी में लिखिए। उत्तर यथासम्भव आपके अपने शब्दों में होना चाहिए।

सच्चे दोस्त

एक था वन। उसमें एक हिरण रहता था। साथ में उसका दोस्त चूहा रहा करता था। इन दोनों की दोस्ती एक कौए से थी। तीनों में पक्की मित्रता थी।

एक दिन हिरण वन में चरने गया। शाम होने पर भी जब वह नहीं लौटा तो चूहे को चिन्ता हो गई। उसने कौए से कहा, "हिरण किसी मुसीबत में न पड़ गया हो।" कौआ बोला," अच्छा, तुम यहीं रहो। मैं उड़ कर देख आता हूँ।"

कौआ उड़ कर हिरण को इधर-उधर देखने लगा। कुछ देर बाद उसने देखा कि हिरण पास में ही एक शिकारी के जाल में फँसा पड़ा था। उसने हिरण से कहा, "मित्र, घबराना नहीं। मैं चूहे को लेकर अभी आता हूँ।"

कौआ वापस लौटा। उसने चूहे को सारी बात बताई। चूहा बोला, "मुझे तुरन्त वहा ले चलो।"

कौए ने चूहे को अपने साथ लिया। दोनों हिरण के पास पहुँचे। चूहा जाल काटने लगा। कौआ एक ऊँचे पेड़ पर बैठ कर निगरानी करने लगा।

जाल काटते ही हिरण उठ कर भागा। कौआ भी घर की ओर उड़ चला। चूहा अपने रास्ते घर पहुँचा। इस प्रकार हिरण मुसीबत से छुटकारा पा गया। सच्चे दोस्त मुसीबत में काम आते हैं।

(१) चूहे को चिन्ता क्यों हो गई ?
(२) हिरण को ढूँढ़ने कौन गया ?
(३) हिरण को जाल में फाँसे देख कर कौए ने क्या किया ?
(४) हिरण को छुटकारा कैसे मिला ?

2. Hindī passage 2 (for 11-13 year-old bilinguals)

नीचे लिखे गद्यांश को ध्यान से पढ़िये और नीचे लिखे प्रश्नों के उत्तर हिंदी में लिखिए। उत्तर यथासम्भव आपके अपने शब्दों में होना चाहिए।

बसंत पंचमी

हमारे देश में वर्ष-भर में छः ऋतुएँ होती हैं। इनमें एक बसंत ऋतु भी है। बसंत ऋतु को सब ऋतुओं का राजा कहा जाता है। इन दिनों मौसम बड़ा सुहावना होता है। न अधिक गर्मी होती है, न अधिक सर्दी। कड़कड़ाती सर्दी कम होने लगती है। स्वास्थ्यप्रद हवा बहने लगती है। बाग-बगीचों और खेतों में हरियाली ही हरियाली दिखाई देती है। अधिक सर्दी या अधिक गर्मी में मनुष्य का मन काम करने को नहीं करता, परन्तु बसंत के मौसम में सभी का मन काम में खूब लगता है। बच्चों और नवयुवकों में नया उत्साह और उल्लास पैदा होता है। इन दिनों प्रातः कालीन समय स्वास्थ्यप्रद होता है। शहरों और गाँवों के बहुत-से निवासी प्रातः काल जल्दी उठकर टहलने जाते हैं।

सर्दी के कारण जाड़ों के दिनों में पेड़ों के पत्ते झड़ जाते हैं। परन्तु जब बसंत ऋतु आती है तो पेड़ों पर नए-नए अंकुर फूटने लगते हैं। चैत और वैशाक के महीनों में बसंत की बहार मनमोहक होता है। खेतों में पीली-पीली सरसों की क्यारियाँ बसंती फूलों से लद जाती हैं। इस तरह से वे बसंत का स्वागत करतीं हैं। किसान मुस्कराते ओंठों से बसंत पंचमी की अगवानी करते हैं। काली कोयल अपनी मीठी बोली से राग अलापना शुरू कर देती है। सूखे पत्ते झड़ जाते हैं। लताओं-वृक्षों में नए-नए पत्ते फूट पड़ते हैं। लगता हैं जैसे किसी ने धरती पर मखमल की हरी और पीली चादर बिछा दी हो।

माघ शुक्ल पंचमी के दिन देश-भर में बसंत उत्सव मनाया जाता है। स्थान-स्थान पर नाच-गाने, खेल-कूद के कार्यक्रम आयोजित किये जाते हैं। संगीत-सम्मेलनों और सभाओं द्वारा भी कुछ लोग अपना मनोरजंन करते हैं।

बच्चे और किशोर बड़े चाव के साथ बसंती रंग के रंगे कपड़े पहनते हैं। बहुत से परिवारों में इस दिन बसंती रंग की पूड़ियाँ और हलवा बनाया जाता है।

बसंत-उत्सव के संबंद में दो कथाएँ हैं। एक तो यह कि यह वीर बालक हकीकतराय का बलिदान दिवस है। इस दिन जगह-जगह सभाएँ करके उस बालक के त्याग और बलिदान को याद किया जाता है।

दूसरी कथा यह है कि भगवान ने सबसे पहले मनुष्य को धरती पर इसी दिन भेजा था। बंसंत ऋतु को उन्होंने स्वयं से भी सुन्दर और सुखदायी बनाया जिससे कि मनुष्य धरती को प्यार करे। तभी से बसंत पंचमी का त्योहार मनाया जाता है।

बसंत पंचमी प्रकृति का त्योहार है। बसंत पंचमी के दिन निद्या की देवी सरस्वती का विशेष रूप से पूजन किया जाता है। पुराने समय में आश्रमों में इसी दिन से पढ़ाई शुरू होती थी। आज भी विद्यालयों और पाठशालाओं में इस दिन समारोह होतें हैं।

(१) हमारे देश में कितनी ऋतुएँ होती हैं ? उनके नाम लिखो।
(२) बसंत ऋतु को ऋतोओं का राजा क्यों कहा जाता है ?
(३) बसंत पंचमी का उत्सव कब मनाया जाता है और कैसे ?
(४) बसंत उत्सव के संदर्भ में कौन सी दो कथाएँ प्रचलित है ? अपने शब्दों में लिखो।
(५) इस दिन किस देवी की पूजा विशेष रूप से की जाती है और क्यों ?

3. Hindī passage 3 (for college-age adult bilinguals)

नीचे लिखे गद्यांश को ध्यान से पढ़िये और नीचे लिखे प्रश्नों के उत्तर हिंदी में लिखिए। उत्तर यथासम्भव आपके अपने शब्दों में होना चाहिए।

पाटलीपुत्र में मणिभद्र नामक एक सेठ रहता था। दुर्भाग्य से वह निर्धन हो गया। निर्धनता से विवश सेठ एक दिन सोचने लगा कि धनहीन व्यक्ति का जीवन निरर्थक है क्योंकि तब सदाचार, शालीनता, क्षमा, धैर्य, उदारता जैसे गुण भी मात्र व्यक्ति के अवगुण बनकर रह जाते हैं। समाज तथा परिवार में उसका कोई मान-सम्मान नहीं रह जाता। ऐसी परिस्थिति से खिन्न होकर अपनी जीवन-लीला समाप्त करने का निर्णय कर वह सो गया।

अर्द्धरात्रि में सेठ ने एक विचित्र सपना देखा। सपने में पद्मनिधि बौद्ध के रूप में उससे बोले - हे सेठ ! विषम समय हिम्मत हारने से नहीं बल्कि उठकर मुकाबला करने के लिए होता है। धीर पुरुष इस प्रकार जीवन से विरक्त नहीं होते। मैं प्रातः काल इसी रूप में तुम्हारे घर आऊँगा। तुम मेरे सिर डण्डे से प्रहार करना जिससे मैं सोने का बन जाऊँगा। तदोपरान्त तुम चैन से गुज़र-बसर करना।

प्रातः काल ठीक वैसा ही हुआ। पद्मनिधि सन्यासी के रूप में उपस्थित हुए और सेठ ने मुदित हो उसके सिर पर प्रहार किया। पद्मनिधि तत्काल सोने के होकर गिर पड़े। इस सारे घटनाक्रम को एक नाई देख रहा था जो कि सेठ की पत्नी के चरणों में माहवर लगाने आया था। नाई ने इससे यह अनुमान लगाया कि हर सन्यासी के सिर पर प्रहार करने से सोने का हो जाता है।

अगले दिन ही वह नाई बौद्ध विहार-स्थल गया और वहाँ उसने प्रधान सन्यासी से पुस्तकें बाँधने योग्य रेशमी वस्त्र तथा पुस्तकें खरीदने के लिए विनम्रतापूर्वक आग्रह किया। इन दिनों वस्तुओं का लाभ स्वंरण न कर पाने के कारण सारे सन्यासी नाई के घर जा पहुँचे। नाई ने उनको घर में बंद कर डण्डे से मारना शुरू कर दिया। इसकी वजह से बहतों को जान से हाथ धोना पड़ा और बहुतों के सिर फूटे। इस अपराध में जब नाई को न्यायालय में उपस्थित किया गया तो उसने मणिभद्र के घर घटित घटना के बारे में सभी को बताया। अधिकारियों से पूछे जाने पर मणिभद्र ने सारी कथा कह सुनाई। कथा सुनने के उपरान्त नाई को शूली पर चढ़ा दिया गया।

(१) मणिभद्र कौन था और उसने आत्महत्या करने का निर्णय क्यों लिया ?
(२) मणिभद्र ने अर्द्धरात्रि में क्या सपना देखा और बौद्ध सन्यासी ने उसे क्या शिक्षा दी और क्यों ?
(३) मणिभद्र ने किसके सिर पर प्रहार किया और क्यों ? सकारण उत्तर दीजिए।
(४) नाई सेठ क्यों आया था ? उसने वहाँ क्या देखा और उसने कया अनुमान लगाया ?
(५) बौद्ध सन्यासी नाई के घर क्यों आए थे और नाई का उन्हें घर बुलाने का क्या उद्धेश्य था ?
(६) नाई के घर कौन-सी घटना घटी और इसका क्या परिणाम हुआ ?

4. English passage 1 (for 8-10 year old bilinguals)

Read the following passage and answer the questions that follow it:

Murugan's Secret

Murugan loved to sing. But he sang badly. When he began to sing, people clapped their hands over their ears and rushed away.

One day, Murugan saw a statue of a leader in the market. "Ah!" he thought. "Here is one man who cannot run away." He began to sing. He sang till his throat ran dry and he could sing no more. Then he went home happy with his great act.

The next day , the people were surprised to see the statue's hands over its ears! How did that happen? The singer was silent.

The king came with his ministers. All of them stared at the statue with fear and surprise.

"Something bad is going to happen," said the king. He offered a large reward for bringing down the statue's hands.

Murugan came forward and said that he could do it. The people brought a ladder. Murugan climbed up. He reached the top. He whispered something into the statue's ears.

And lo! The statue lowered its arms slowly.

Murugan became a hero. The king made him rich. He made him a minister in his court. Even years later, people heard Murugan mutter, "My singing has made me what I am!".

But he never told anybody what he had whispered into the statue's ears!

1. What did Murugan like to do?
2. What did the people do after hearing Murugan's songs?
3. Why did Murugan sing to the statue?
4. What did the people see the next day?
5. What did the king fear?
6. Can you guess what Murugan had whispered into the statue's ear?

5. English passage 2 (for 11-13 year-old bilinguals)

Read the following passage and answer the questions that follow it:

The cafeteria

Natisha was humming as she skipped down the hall. She was very happy. Today was Thursday, and she and her best friend Katie had the same lunch period. That meant they could sit together and talk for almost an hour.

Katie and she had so many things in common. They were on the same soccer team, so they attended all the games and practices together.

They also sang in the school choir so they went to all the rehearsals together. There was just so much to talk about. Having a really good friend made Natisha very happy.

As Natisha entered the cafeteria, she saw Katie was already in line, so Natisha picked up a tray and moved in behind her. "Hi", said Katie, and she motioned for Natisha to follow her. Katie selected a slice of pizza, a glass of milk, and piece of chocolate cake. That looked to good to Natisha, so she chose the same.

"Let's sit over by the window", suggested Katie. Natisha nodded her head in agreement. When they got to the end of the line where the cashier was sitting, they suddenly heard something crash to the ground. It was a glass bowl and it had broken into a thousand pieces.

"Oh, someone could get hurt", said the cashier. " Let me pick this up." She bent over the floor with her head beneath the counter. She started to pick up the pieces of broken glass.

At that moment, Natisha saw to her amazement that Katie walked right past the cashier's desk and over to the table area. Natisha didn't know exactly what was happening. Had Katie forgotten to pay for her lunch? Did she think she had already paid for it? Natisha stood there in confusion, not knowing exactly what to do. Should she call out to Katie and remind her to pay the cashier? Would that embarrass Katie? Or should she walk over and tell her?

When the cashier got up from the floor, she looked at Natisha' s tray and "Seventy-five cents please." Natisha paid the cashier. Somehow the cashier didn' t seem to notice that Katie had gone away without paying.

As Natisha sat down and began to eat her pizza, she said to Katie, "Katie, you didn' t pay for your lunch. Did you forget?"

"No," replied Katie. "She didn' t ask me for it."

"But you knew she was cleaning up the glass underneath the counter. She couldn' t see you after you left."

"It doesn' t matter," replied Katie. "If she had asked me, I would have paid for it, but she didn' t so I didn' t!"

Natisha toyed with her pizza. Somehow it didn' t seem so appetizing now. Even the chocolate cake had no appeal. She sat silently for a few minutes. What had gone wrong? This was supposed to be such a nice, happy time -- a time to talk about soccer, the choir practice and all the interesting things that they were doing together. Now she didn' t feel like talking about anything.

Natisha glanced over at Katie. Katie was finishing her pizza and starting on her chocolate cake. She seemed completely unconcerned.

How could she have done this, wondered Natisha. Katie stole, and she knows it. Just because the cashier was looking down was no excuse. It' s still stealing. She knows it. I know it. We both know it.

But Katie was her best friend. How could she be best friends with someone who was dishonest? Natisha made one more try. She asked Katie to return to the cashier and tell her that she forgot to pay her for lunch. In that way, they could start all over again, and maybe Katie wouldn' t do it again.

"No way," said Katie firmly. "She didn' t ask me and so I didn' t pay. I didn' t do anything wrong."

Natisha tried a few more ways to get Katie to go back and pay for the lunch because she really wanted them to stay good friends. Talking together and being together wouldn' t be fun anymore. There would be a wall between them. Finally, Natisha picked up her tray, murmured something about getting back to class, and left the cafeteria.

Natisha felt awful. The day was ruined. Was she being too hard on Katie? After all, she was right when she said that the cashier didn' t actually ask her for the money. Natisha felt confused and upset. Should she ruin a perfectly good friendship because of this one lunch?

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1. Do you think Katie was wrong in not paying for her lunch?
2. Why did Natisha feel that their friendship might be ruined because of what happened during lunch?
3. Do you think people often ignore rules when they think no one is watching?
4. What would you do if
    a. you see your best friend copy from a paper during exams?
    b. your best friend hits someone and wants you to lie to save him/her from the teacher' s scolding?

6.

English passage 3 (for college-age adult bilinguals)

Read the following passage and answer the questions that follow it:

So great is our passion for doing things for ourselves that we are becoming increasingly less dependent on specialized labor. No one can plead ignorance of a subject any longer, for there are countless do-it yourself publications. Armed with the right tools and materials, newly-weds gaily embark on the task of decorating their own homes. Men of all ages spend hours of their leisure time installing their fireplaces, laying-out their own gardens, building garages and making furniture. Some really keen enthusiasts go as far as to make their own record players and radio transmitters. Shops cater for the do-it yourself craze not only by running special advisory services for novices, but by offering customers bits and pieces which they can assemble at home. Such things provide an excellent outlet for pent up creative energy, but unfortunately not all of us are born handymen.

Wives tend to believe that their husbands are infinitely resourceful and versatile. Even husbands who can hardly drive a nail in straight are supposed to be born electricians, carpenters, plumbers and mechanics. When the lights fuse, furniture gets rickety, pipes get clogged, or vacuum cleaners fail to operate, wives automatically assume that their husbands will somehow put things right. The worst thing about the do-it yourself game is that sometimes husbands live under the delusion that they can do anything even when they have been repeatedly proved wrong. It is a question of pride as much as anything else.

Last spring my wife suggested that I call in a man to look at our lawn mower. It had broken down the previous summer, and though I promised to repair it, I had never got round to it. I would hear of the suggestion and said that I would fix it myself. One Saturday afternoon I hauled the machine into the garden and had a close look at it. As far as I could see, it only needed a minor adjustment: a turn of screw here, a little tightening up there, a drop of oil and it would be as good as new. Inevitably the repair job was not quite so simple. The mower firmly refused to mow, so I decided to dismantle it. The garden was soon littered with chunks of metal which had once made up a lawn mower. But I was extremely pleased with myself. I had traced the cause of the trouble. One of the links in the chain that drives the wheels had snapped.

After buying a new chain I was faced with the insurmountable task of putting the confusing jigsaw puzzle together again. I was not surprised to find that the machine still refused to work after I had reassembled it, for the simple reason that I was left with several curiously shaped bits of metal which did not seem to fit anywhere. I gave up in despair. The weeks passed and the grass grew. When my wife nagged me to do something about it, I told her that either I would have to buy a new mower or let the grass grow. Needless to say that our house is surrounded by a jungle. Buried somewhere in deep grass there is a rusting lawn mower which I have promised to repair one day.

1. Why do people not rely on specialized labor so much nowadays, according to the writer?

2. How do shops encourage people to do things for themselves?

3. What do wives tend to believe about their husbands?

4. Why do husbands think that they can do anything even when proved otherwise?

5. "Do it yourself" craze has its own advantage. What is that?

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