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DEVELOPMENTAL AND INDIVIDUAL DIFFERENCES IN THE INFLUENCE OF CONTEXTUAL INFORMATION ON VISUAL WORD RECOGNITION

by

Jason F. Reimer

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Psychological and Cultural Studies

Under the Supervision of Professor Brigette Ryalls

Lincoln, Nebraska

August, 2001

UMI Number: 3016324

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SUPERVISORY COMMITTEE:

	APPROVED	DATE
Signature	Brigette Ryalls	7/25/01
Typed Name	Brigette Ryalls	
Signature	Joseph LaVoie	7-25-01
Typed Name	Joseph LaVoie	
Signature	Joseph Brown	7/25/01
Typed Name	Joseph Brown	
Signature	Thomas Lorsbach	7-25-01
Typed Name	Thomas Lorsbach	
Signature	David Moshman	7-25-01
Typed Name	David Moshman	
Signature		
Typed Name		

GRADUATE COLLEGE
UNIVERSITY OF NEBRASKA

DEVELOPMENTAL AND INDIVIDUAL DIFFERENCES IN THE INFLUENCE OF CONTEXTUAL INFORMATION OF VISUAL WORD RECOGNITION

Jason F. Reimer, Ph.D.

University of Nebraska, 2001

Advisor: Brigette Ryalls

Models of visual word recognition that have adopted the general interactive activation (IA) framework (e.g., Coltheart, Curtis, Atkins, & Haller, 1993; Coltheart et al., 2001; Grainger & Jacobs, 1996) assume that visual word recognition processes are fully interactive such that activation spreads in both the forward and backward directions. The current study was designed to examine whether or not individual and developmental differences exist in the interactivity of certain visual word recognition processes. Specifically, using a mediated priming paradigm (see Reimer, Brown, & Lorsbach, 2001), two experiments were conducted to determine whether or not the influence of semantic processing on orthographic and phonological processing depends on perceptual ability and age. Third grade, sixth grade, and adult participants were tested. Orthographically mediated inhibition effects were found only with high perceptual ability readers, regardless of age. Furthermore, phonologically mediated inhibition effects were found only with young children. Based on these results, an IA account of the Context x Age/Reading Skill interaction was developed, as well as an IA account of

developmental and individual differences in mediated priming. The results of the present study suggest that the interactivity of certain visual word recognition processes change as reading skill improves across development.

Acknowledgements

There are many people who deserve acknowledgement for their involvement in this project. I would first like to thank the students, teachers, and administrators at Mary Our Queen School and St. Wenceslaus School in Omaha, NE for their participation and assistance in this study. I am especially grateful to principals Kayleen Wallace (Mary Our Queen) and Mary McGuire (St. Wenceslaus) who were very generous with both their time and resources as I collected data at their schools. I also thank Mary Bonner for her assistance in data collection.

I would like to acknowledge and thank each of the members of my supervisory committee, Dr. Brigette Ryalls, Dr. Joseph Brown, Dr. Joseph LaVoie, Dr. Thomas Lorsbach, and Dr. David Moshman, for their invaluable insight and guidance throughout this project. My advisor, Dr. Brigette Ryalls, deserves high praise for the amount of patience and support she demonstrated to me throughout this endeavor. I hope I can extend similar guidance to my own students in the future. I would also like to thank Dr. Joseph Brown for his continuous support during my time at the University of Nebraska at Omaha. His abilities as a scientist, and his enthusiasm for cognitive psychology are boundless. I hope I can carry on those traits as I begin a career in academics. Finally, I thank Dr. Thomas Lorsbach for his continued encouragement, guidance, and friendship. His exceptional mentorship throughout my entire graduate career served as the primary impetus for my development as a scholar. I

have truly enjoyed having the opportunity to work with him, and I hope he fully realizes my appreciation of his support. Even though I know that he has always considered me a colleague, I am very honored to now be able refer to him as a colleague.

I have a great deal of gratitude to all of my family members who demonstrated tremendous support and encouragement to me throughout this endeavor. I thank my brothers and sister for always motivating and challenging me. Foremost, I thank my parents for their unwavering support and belief in me. I thank my father for always reminding me of the one thing that is most important in life, and I thank my mother for fostering my intellectual curiosity and always inspiring me to succeed.

Most of all, I am grateful to my wife Sandra, and my daughter Faith, who has brought immense joy to my life. Sandra's immeasurable sacrifice, support, and love made the completion of this endeavor possible. To her I am eternally indebted, for she has shown me that although sacrifices made in order to achieve such a goal are great, sacrifices made so that someone else may achieve such a goal are far greater. Thanks "Sand", I share this with you.

For S.A.R. and F.C.R.

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INTRODUCTION

Given the large disparity that exists between the level of performance found in beginning and skilled readers, visual word recognition processes must undergo a considerable amount of change. Perhaps the most salient change that occurs as reading skill increases is in the speed with which individual words can be recognized. While visual word recognition processes can be characterized as being slow and capacity demanding for beginning readers, these same processes are fast and automatic for skilled readers (Ehri & Wilce, 1983; Share, 1995). For example, Adams (1990) has noted that skilled readers are able to read at the approximate rate of five words per second, recognize whole words as quickly and accurately as they perceive individual letters, and recognize whole phrases as quickly as medium length nonwords.

A large body of research has focused on fundamental questions concerning the psychological processes that underlie reading ability. For example, numerous studies have attempted to explain how changes in lexical processing can account for the large performance between beginning and skilled readers. The present research falls into this class of reading research. Specifically, the current research examines changes in the influence of semantic context on visual word recognition as reading skill improves across age.

CHAPTER 1.

CENTRAL SEMANTIC PRIMING EFFECTS IN ADULT VISUAL WORD RECOGNITION

An extensive research literature exists on how adult visual word recognition is influenced by semantic context. In the nearly three decades of research on contextual priming (or semantic priming), multiple types of context have been utilized including, single-word contexts (e.g., Borowsky & Besner, 1993; Neely, 1977; Stolz & Neely, 1995), sentential contexts (e.g., Schwantes, 1981; Stanovich & West, 1983), and paragraph contexts (see West, Stanovich, & Cunningham, 1995). Although the use each of these types of context has provided valuable information concerning how context affects word recognition, the present research focuses mainly on context effects within the single-word priming paradigm. In the single-word priming paradigm, participants are presented with a semantic context in the form of a single word (the prime) followed by the presentation of a letter string (the target). Participants are instructed to determine whether the target is a word or a nonword (the lexical decision task) or are required to pronounce the target aloud (the naming task). There are at least two potential advantages with using the single-word priming paradigm as opposed to other priming paradigms (Neely, 1991). First, because participants are only required to respond to single letter strings, the single-word priming paradigm is both easier for participants to perform and eliminates unnecessary theoretical complexity. Second, the

use of the single-word paradigm allows the experimenter to gain precise control over experimental timing parameters such as stimulus onset asynchronies (SOAs).

The extensive research literature that currently exists on semantic priming was initiated by the seminal experiments reported by Meyer and Schvaneveldt (1971). Meyer and Schvaneveldt reported two experiments that were designed to examine the effect of word meaning on lexical decisions. In Experiment 1, Meyer and Schvaneveldt simultaneously presented participants with pairs of letter strings. Participants were instructed to press one key if the two letter strings were English words, or to otherwise press another key. Meyer and Schvaneveldt found that participants' responses were both faster and more accurate to displays containing two semantically related words (e.g., nurse and doctor) than to displays containing two unrelated words (e.g., bread and doctor). Meyer and Schvaneveldt's second experiment was very similar to their first experiment, with the exception that participants were asked to press a "same" key if the display involved either two words or two nonwords, or to otherwise press a "different" key. As with their first experiment, Meyer and Schvaneveldt found that "same" responses were faster and more accurate when the two words were semantically related.

Effects of SOA on Facilitation and Inhibition in Priming

Although Meyer and Schvaneveldt's (1971) study clearly provided evidence of semantic priming, it was not possible to determine from their data the degree to which the priming effects were due to facilitation from related primes and/or inhibition from unrelated primes (Neely, 1991). The issue of facilitation and inhibition in priming was first addressed by Posner and Snyder (1975b) within the framework of a letter-matching task. Posner and Snyder (1975b) used a baseline condition (a neutral warning signal) to estimate the degree to which letter priming was due to facilitation when the letter prime was present in the target array and/or inhibition when the letter prime was not present in the target array.

A neutral context condition has since been utilized in multiple single-word priming studies to examine the separate time courses of facilitation and inhibition in priming (e.g., Becker, 1980; den Heyer, Briand, & Smith, 1985; Favreau & Segalowitz, 1983; Neely, 1977; Smith, Briand, Klein, & den Heyer, 1987). In these studies, the amount of priming due to facilitation and/or inhibition is assessed by separately comparing reaction times (RTs) for target words preceded by related and unrelated contexts with RTs for target words preceded by a neutral context (e.g., XXXXX). Relative to RTs observed in a neutral context condition, the presence of facilitation is characterized by faster RTs for targets that are preceded by a related context, whereas the

presence of inhibition is characterized by slower RTs for targets that are preceded by an unrelated context. Studies that have used a neutral context within the single-word priming paradigm have found separate time courses for facilitation and inhibition. Specifically, with SOAs greater than 500 ms, these studies have found that semantic priming is due to both facilitation and inhibition, whereas with SOAs less than 250 ms, semantic priming is due only to facilitation (see Neely, 1991).

Effect of Stimulus Quality on Semantic Priming

Numerous studies have shown that responses to visually degraded targets are slower and less accurate than are responses to intact targets (e.g., Becker & Killion, 1977; Meyer, Schvaneveldt, & Ruddy, 1975; Stolz & Neely, 1995). Using Sternberg's (1969) additive factors logic, multiple studies have also examined the joint effect of stimulus quality and context on target processing in the single-word priming paradigm. According to additive factors logic, if two independently manipulated factors statistically interact with one another, the two factors are taken to influence a common processing stage in a serial stage model. However, if the two factors do not interact statistically, a simple explanation is that the two factors affect different stages in a serial stage model. Studies have typically found that stimulus quality and context interact, such that larger context effects are found for degraded than for intact targets (e.g., Becker & Killion, 1977; Besner & Smith,

1992a; Borowsky & Besner, 1993, Stolz & Neely, 1995). Thus the manipulation of stimulus quality and context presumably affect a common stage.

Although the Context x Stimulus Quality interaction has been found at both long (800 ms) and short (200) SOAs (Borowsky & Besner, 1993; Besner & Smith, 1992a; Stolz & Neely, 1995), there are two conditions under which context and stimulus quality fail to interact. First, the presence of the Context x Stimulus Quality interaction has been shown to depend upon how context effects are assessed. When context effects are assessed using an unrelated word as the baseline, the effects of stimulus quality and context interact. However, when a neutral baseline (e.g., a string of Xs or the word BLANK) is used, the effects of context and stimulus quality are additive (e.g., Borowsky & Besner, 1993; den Heyer & Benson, 1988). Second, the presence of the Context x Stimulus Quality interaction has been found to depend upon the proportion of semantically related prime-target word pairs present in the experimental test list (i.e., relatedness proportion or RP). Specifically, context and stimulus quality interact only under high RP conditions (0.50). When RP is low (0.25), context and stimulus quality are additive (Stolz & Neely, 1995).

Effect of Word Frequency on Semantic Priming

Studies that have utilized the single-word priming paradigm have found that responses are faster for high-frequency

targets than for low-frequency targets (e.g., Forster & Chambers, 1973; Plaut & Booth, 2000; Scarborough, Cortese, & Scarborough, 1977). Further, studies that have examined the joint effects of context and word frequency have found that the two factors interact, such that priming effects are larger for low-frequency words than for high-frequency words (Becker, 1979; Borowsky & Besner, 1993; Plaut & Booth, 2000).

More recently, Plaut and Booth (2000) investigated potential individual differences in the effect of word frequency on priming. Plaut and Booth found that unlike high-perceptual ability participants(see below), low-perceptual ability participants failed to exhibit the typical Context x Word Frequency interaction.

Relatedness Proportion and Semantic Priming

As stated previously, relatedness proportion (RP) refers to the proportion of total prime-target word pairs that are semantically related in a test list (Neely, 1991; Stolz & Neely, 1995). A common finding in experiments that have manipulated RP within the lexical decision task is that semantic priming effects are larger when RP is high than when RP is low (e.g., de Groot, 1984; den Heyer, 1985; den Heyer, Briand, & Dannenbring, 1983; Neely & Keefe, 1989; Stolz & Neely, 1995). The Context x RP interaction, however, appears to be modulated by SOA. Specifically, the Context x RP interaction is present at long (> 500 ms), but not at short, SOAs. Furthermore, the Context x RP

interaction has been found in the naming task only when primes were category names and targets were high-category exemplars (Keefe & Neely, 1990).

Mediated Priming and Backward-Association Priming

Rather than having a direct associative relationship (e.g., lion - tiger), primes and targets in the mediated priming paradigm are related via a third mediating word (e.g., lion - [tiger] - stripes). Using this paradigm, mediated priming effects have been obtained only under certain experimental conditions. For example, mediated priming effects have been obtained in the lexical decision task when participants are instructed to withhold responses to nonword targets (den Heyer, Sullivan, & McPherson, 1987), but not when participants are instructed to respond to all targets (e.g., Balota & Lorch, 1986; De Groot, 1983; den Heyer, Sullivan, & McPherson, 1987). In addition, the presence or absence of mediated priming effects appears to be sensitive to the type of task used to assess priming. Balota and Lorch (1986) obtained mediated priming effects in a naming task under exactly the same conditions they failed to find mediated priming in the lexical decision task. Finally, McNamara and Altaribba (1988, Experiment 1) obtained mediated priming effects in the lexical decision task when prime and target letter strings were presented simultaneously, and associatively related prime-target word pairs were excluded from the test list (i.e., the test list only included unrelated and

mediated prime-target word pairs). However, when McNamara and Altaribba presented primes and targets sequentially and instructed participants to perform lexical decisions on both primes and targets (Experiment 2), they obtained mediated priming effects when associatively related prime-target word pairs were present in the test list (along with unrelated and mediated prime-target word pairs).

In backward-association priming, the prime and target are related only through a backward association. For example, with the prime-target word pair, pan - bed, the prime is not related to the target through a forward association (i.e., from pan to bed), but is related to the target through a backward association (i.e., from bed to pan). When primes are presented visually, backward priming has been found in experiments using the lexical decision task (e.g., Koriat, 1981; Seidenberg, Waters, Sanders, & Langer, 1984), but not in experiments using the naming task (Seidenberg et al., 1984, Experiment 3).

CHAPTER 2.

THEORETICAL ACCOUNTS OF CENTRAL SEMANTIC PRIMING PHENOMENA IN ADULTS

In the previous section, a number of well-known semantic priming effects associated with adult visual word recognition were reviewed. These effects represent central priming phenomena that must be accounted for by any model of adult visual word recognition that intends to provide an adequate account of how semantic information affects lexical processing (Neely, 1991; see also Plaut & Booth, 2000). Although multiple models of adult visual word recognition have been developed (see Besner & Smith, 1992a, for a description of selected models), few models have explicitly attempted to account for each of the central priming phenomena that were outlined above. Among the most fully developed word recognition models that have provided accounts of core semantic priming effects are Besner/Smith/Borowsky's Multistage Activation Model (Besner & Smith, 1992a, 1992b; Borowsky & Besner, 1993) and Plaut and Booth's distributed network model (Plaut, 1995; Plaut & Booth, 2000).

The Multistage Activation Model

The multistage activation model (Besner & Smith, 1992a, 1992b; Borowsky & Besner, 1993) is based on some aspects of Morton's (1969, 1979, 1982; Morton & Patterson, 1980; Patterson & Morton, 1985) logogen model of word recognition. According to the logogen model, semantic information is accessed during word