# GENDER-LINKED DIFFERENCES IN THE DEVELOPMENT OF INCIDENTAL AND INTENTIONAL MEMORY FOR STATIC AND DYNAMIC STIMULI

by

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Gender-linked Differences in the Development of Incidental and Intentional Memory for Static and Dynamic Stimuli

BY

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# GENDER-LINKED DIFFERENCES IN THE DEVELOPMENT OF INCIDENTAL AND INTENTIONAL MEMORY FOR STATIC AND DYNAMIC STIMULI

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University of Nebraska, 2001

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The purpose of the current study was to examine the predictions of the "hunter-gatherer" (Silverman & Eals, 1992) and gender-schema (Martin & Halverson, 1981) theories with respect to gender-linked differences in spatial and object memory of children and adults. A total of 160 five- to thirteen-year-old children and adults participated. Each participant was randomly assigned to either the incidental (INC) or the intentional (INT) memory condition. In this repeated-measures design, each participant viewed a total of 36 sex-stereotyped static and dynamic toy pictures and was asked to recall the previously seen toys after a filler task. In general, the results did not support the evolutionary hypothesis, but they did, in part, confirm gender schema theory. Congruent with the gender-schema theory, there was no overall memory advantage for males or females across the two conditions. On average, males and females remembered an equal number of objects. Overall, the participants recalled more static toy pictures than dynamic pictures. Also, with age, the participants recalled more stimuli. This pattern was significant also across memory conditions. As predicted, males and females recalled more objects in the INT than in the INC memory condition. Consistent with gender-schema theory, the results revealed a weak interaction between sex of the participant and the sex-stereotyped

toys. In the INC condition, males remembered more male stereotyped toys than female and neutral stereotyped toys, and females recalled more female and male stereotyped objects than neutral stereotyped objects. The pattern of recall was different in the INT condition, suggesting that the mechanisms of these two types of memory are somewhat distinct. According to the present findings, there is no emergence of cognitive sex differences in a task using either incidental or intentional memory that assesses static or dynamic sex-stereotyped stimuli.

**Dedication**

**To**

**Michael, Sebastien, and Raphael**

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# Chapter I

## Introduction

Despite the equivalent overall intellectual capacity of males and females, researchers have identified cognitive sex differences (Halpern, 2000; Maccoby & Jacklin, 1974). However, there is considerable controversy on the reasons for how, why, and when these differences emerge. There is also a lack of consensus regarding the role of biology, psychosocial factors, and methodology in the interpretation of results (e.g., McGivern, Huston, Byrd, King, Siegle, & Reilly, 1997). The present study proposed not only to compare two very influential theories in the field of gender development and differentiation, but also to examine each participant's performance on two cognitive sex differences (spatial and object memory), one favoring males and one favoring females (e.g., Halpern, 2000; Silverman & Eals, 1992). Furthermore, methodologically, this study was designed to provide researchers with the possibility to contrast participants' performances on two different types of memory tasks and encoding conditions, as well as comparing memory performance across a large age range.

Gender-schematic processing has been shown to be very pervasive. Gender schemata often act to bias judgments and memories for gender-related information (Liben & Signorella, 1980). One consequence that these gender schemata have is that they facilitate the encoding and retrieval of information that is relevant to one's own sex (Martin & Halverson, 1981), but they also interfere with the information that is not consistent with one's own sex. This selective memory for same-sex information, if

present in young children, would have important implications for children's processing of curriculum materials and instructions (Schau & Scott, 1984). Children would be especially likely to attend to and remember materials that contain activities, objects, attitudes or traits associated with their own sex. The present study proposed to assist researchers in understanding the development and progression of this gender-schematic processing and how it may impact the emergence of sex differences in object memory and/or spatial memory. Furthermore, the results of the present study may shed some light on the influence of computer, video, and electronic games on the development of certain cognitive skills. Of course, differential activities and interests of girls and boys cannot be used to determine if, for example, boys play more video games because they tend to excel at them or whether they tend to excel at them because they play more video games. Nevertheless, the information gained from the present study aids our understanding of the development of cognitive abilities in general.

In addition, the current study adds to our understanding of the development of incidental and intentional memory. Few studies have attempted to identify the factors affecting the development of incidental memory and in particular, no study has yet compared task performances in incidental and intentional memory for such a large age range. Having the possibility to compare the performance of children as young as 5 years of age with the performance of adults within the same study is innovative and important if researchers want to understand the underlying mechanisms of memory.

# Chapter II

## Literature Review

For years, studies across many cultures have found that men outperform women on standard tests of spatial ability such as reading maps, learning mazes, and rotating three-dimensional objects (e.g., Geary, Saults, Liu, & Hoard, 2000; Halpern & Wright, 1996; Voyer, Voyer, & Bryden, 1995). Men, on average, are superior in tasks that require transformations in visual-spatial working memory (Halpern, 1997). In contrast, women tend to outperform men on verbal tasks (e.g., Maccoby & Jacklin, 1974), fine-motor tasks (e.g., Gouchie & Kimura, 1991), memory for spatial location and object memory (e.g., Eals & Silverman, 1994; Silverman & Eals, 1992) and associative memory (e.g., Birenbaum, Kelly & Levi-Keren, 1994). Women, on average, score higher on tasks that require quick access to information in long-term memory (Halpern, 1997, 2000). Researchers have attempted to summarize the size of these cognitive sex differences using effect size measures and meta-analytic analyses. However, this assessment is a difficult endeavor because of the multiple moderating and mediating variables affecting these cognitive sex differences. Although the majority of these sex differences tend to be rather small (Bjorklund, 2000), it is crucial to examine how and why they develop. Scientists have proposed a multitude of theories to explain the sources of these variances. The present study proposes to examine the predictions of two theories with respect to sex differences in object and spatial memory: a) the evolutionary "hunter-gatherer theory" (Buss, 1995; Silverman & Eals, 1992; Eals & Silverman, 1994), and b) the cognitive gender-schema theory

(Martin & Halverson, 1981). Specifically, the current study was designed to investigate the robustness of the reported female advantage in object memory and the male advantage in spatial memory in a repeated-measures design using incidental and intentional memory conditions. At what age do cognitive sex differences emerge? What are the mechanisms of these changes? The goals of this study were to address these and other relevant questions about the development of cognitive sex differences and the factors influencing them. This study provides important tests of these two specific theories and the results have important implications for our understanding of social and developmental processes related to gender. Thus, the current study has the potential for helping researchers understand the nature and operation of stereotypes.

As Bussey and Bandura (1999) note "human differentiation on the basis of gender is a fundamental phenomenon that affects virtually every aspect of people's daily lives" (p. 676). Indeed, gender is probably the primary basis on which people tend to be differentiated. Many of the attributes and roles promoted in males and females are differentially valued in societies around the globe, with those ascribed to males being generally valued more highly than those ascribed to females (e.g., Eagly, 1995). Thus, gender development and differentiation are fundamental issues that need to be investigated not only for their contributions to science per se, but also for their political and social relevance. In their seminal book The Psychology of Sex Differences, Maccoby and Jacklin (1974) attempted to synthesize the existing literature that had reported sex differences. They noted that the sexes differed in several aspects of intellectual abilities, namely in verbal quantitative, and spatial

abilities. The researchers contended that these differences appear to emerge around puberty. For example, they reported that there were no gender differences in general verbal ability from ages 3 through 11, but they found a difference favoring girls appearing at about the age of 12. The researchers also observed that the sex differences favoring boys in mathematical and spatial abilities did not appear until adolescence. Subsequent researchers (e.g., Feingold, 1988; 1993; Hyde & Linn, 1988; Masters & Sanders, 1993) examined not merely whether the sexes differ, but whether any sex differences change in magnitude over time. Reviewing several meta-analyses on cognitive sex differences, Feingold (1993) concluded that sex differences were moderated by age for some abilities (e.g., spatial perception, mathematical problem solving), but not for others (e.g., vocabulary, mental rotations). He also noted that the differences have been diminishing with successive generations.

Considerable controversy surrounds the proper interpretation of meta-analytic syntheses of cognitive abilities (Eagly, 1995) and analyses of standardized test norms (Feingold, 1993). Some researchers maintain that their meta-analyses challenge Maccoby and Jacklin's (1974) conclusions by showing that sex differences in cognitive abilities are negligible in magnitude and that this magnitude is diminishing over time (e.g., Bjorklund, 2000; Feingold, 1988; Hyde, 1981). Other researchers argue that conclusions based on studies of standardized test norms may not be generalizable because all such studies examine only norms for adolescents (high school students) (Feingold, 1993). Moreover, a few researchers have noted that evidence for a decreasing trend comes from tests that initially show small effect sizes, with little

evidence of converging means from tests with large effect sizes (e.g., Halpern, 1997; Hedges & Nowell, 1995). For example, in a meta-analysis of sex differences in spatial ability, Voyer et al. (1995) reported that a number of cognitive skills are stable across age, at least after puberty, and that these cognitive skills have not decreased in recent years. In fact, they report that effect sizes on the mental rotation test have increased over time. Other scientists have shown that differences in favor of females are more substantial on measures of verbal fluency and object memory in older children and adults (Halpern 2000; Hyde & Linn, 1988). Taken together, these studies suggest that even though the sex differences in cognitive abilities may be small (e.g., Bjorklund, 2000), and possibly diminishing, they exist. The sources of these sex differences require further empirical examination.

Over the years, many theories have been proposed to explain gender development and the possible factors affecting sex differences in cognitive abilities such as cerebral maturation rate, genetic, hormonal, cortical lateralization, and sociocultural explanations (see Halpern, 2000). In general, the theories differ in the relative emphasis they place on psychological, biological, or sociostructural aspects, their mechanisms, and temporal scope (Bussey & Bandura, 1999). The present study proposes to examine two influential theories of gender development and differentiation, a biologically oriented theory (i.e., evolutionary theory) and a cognitively oriented theory (i.e., gender-schema theory).

Evolutionary Theory. Evolutionary psychology has enjoyed a tremendous increase in popularity in the past several years (e.g., Buss, 1995; Geary, 1998). It represents a

broad framework for understanding Darwinian-based psychological principles instead of a unified theory. Several different explanations, rooted in the idea that contemporary human sex differences have an evolutionary basis, have been proposed (Bjorklund & Pellegrini, 2000). Evolutionary theories view gender differentiation in terms of mate preferences, reproductive strategies, and parental investment in offspring (e.g., Archer, 1996; Buss, 1995). A major tenet of evolutionary psychology is that there are genetically programmed universal traits that improve the probabilities of producing many viable offsprings. Viewed from this perspective, contemporary sex differences originated in the successful adaptation to the different reproductive demands faced by men and women over time. In particular, for many evolutionary psychologists, the answer to the "why" questions of sex differences lies in the division of labor in hunter-gatherer societies (Buss, 1995; Eals & Silverman, 1994; Silverman & Eals, 1992). Silverman and Eals (1992; Eals & Silverman, 1994) suggest that male activities during the period of evolutionary adaptation likely involved hunting and navigation, whereas female activities likely involved the type of skills required for foraging/gathering. This sexual division of labor in earlier human societies may have led to the evolution of sex differences in spatial abilities and memory. For example, Gaulin (1995) hypothesized that human males developed excellent spatial abilities (along with the neuroanatomical structures for superior spatial abilities) during human evolution because they would promote males' life skills such as hunting and finding mates and consequently would improve their reproductive rates and survival.

Silverman and Eals (1992) argued that, as humans evolved, males predominantly hunted while females predominantly gathered. These differential spatial activities presumably entailed the development of distinct spatial skills: successful hunting requires superior navigational skills and the ability to orient oneself toward a moving target. For males it was therefore important to orient themselves in unfamiliar territory while pursuing their moving prey. Through the evolutionary pressures of adaptation, males developed brain structures that supported the cognitive and motor skills needed in navigating unfamiliar areas and killing animals. According to this reasoning, genes coding for spatial abilities would be an evolutionary and slight survival advantage for males.

In contrast, successful foraging requires recognition and recall of spatial configurations in a static array. Females had to locate the edible food sources within a complex array of vegetation near the family dwellings. Perceptual differences between edible and poisonous plants required females to evolve peripheral perception and incidental memory for objects and their locations (Silverman & Eals, 1992). Thus, due to the division of labor (hunter-gatherer theory), the differential search methods between men and women may have led to the evolution of spatial sex differences.

Thus, according to this evolutionary theory, the ancestral origin of differences in gender roles has led to present times cognitive sex differences. It should be noted that evolutionary psychology does not address at all the developmental changes that occur in gender conceptions and behaviors, nor does it specify the determinants and

mechanisms governing developmental changes across the life course (see Bussey & Bandura, 1999).

Taken together, evolutionary theory predicts that because males developed brain structures that supported the cognitive and motor skills needed in navigating large areas and cognition in females evolved in ways that supported effective gathering, cognitive sex differences should appear early in life. In other words, if differential abilities evolved because they are adaptive, then a strong version of the hunter-gatherer theory should predict the difference to be present in young children. The theory also predicts that because males evolved to be superior in spatial ability, and females evolved to be superior in tasks that require memory for static displays, males should outperform females in a spatial memory task, whereas females should outperform males in a static object memory task.

Gender Schema Theory. Alternative explanations for gender development and differentiation have been proposed by theories of gender-role development that stress the importance of children's comprehension of and attention to gender in the gender-role socialization process (e.g., Fagot & Leinbach, 1989, 1993; Martin & Halverson, 1981). These theories of gender-role development are built on previous cognitive developmental conceptualizations that emphasize the importance of cognitive factors within an information-processing perspective (Levy & Carter, 1989; Welch-Ross & Schmidt, 1996). These approaches, collectively referred to as gender schema theories (e.g., Bem, 1981; Martin & Halverson, 1981), suggest that children are motivated to conform to gender-based, sociocultural standards and stereotypes that are congruent

with their own sex. Gender schema theories share the assumption that individuals take an active role in perceiving and interpreting information from their environments. Rather than assuming that people are passively shaped by environmental factors, cognitively oriented scientists assume that individuals use implicit "theories" or knowledge structures to interpret environmental information and that in doing so they create environments supportive of their theories (e.g., Martin, 1993).

Unlike cognitive developmental theory (e.g., Kohlberg, 1966), gender schema theory does not emphasize the attainment of gender constancy for development of gender orientations (Bussey & Bandura, 1999; Levy & Carter, 1989). According to Martin and Halverson (1981) as soon as children have the ability to label themselves and others as males or females (i.e., gender identity), they are ready to respond to and categorize information on the basis of culturally reinforced gender roles. Because children live in a sex-typed world, this process results in schemata that guide the choices of "sex-appropriate" behaviors and the knowledge of the action patterns necessary for carrying them out. Schema formation depends on the child's own mental effort and developmental status, but the information being processed reflects the child's experience with sex typing (Fagot & Leinbach, 1989). Although viewpoints differ slightly as to the specific components of the gender schemata, most researchers agree that gender-schematic processing consists of both a knowledge component and an affective, value-laden, motivational component (e.g., Fagot & Leinbach, 1993; Liben & Signorella, 1993; Martin & Halverson, 1981; Signorella, Bigler, & Liben, 1993; Stangor & Ruble, 1987; Welch-Ross & Schmidt, 1996).

Gender schemata provide a basis for organization of general information about the traits, attributes, activities, etc. that are associated differentially with males and females. That is, gender schemata are cognitive structures that organize an individual's gender-related knowledge, preferences, beliefs, and attitudes. Through a motivational component that guides the children's attention to and selection of same-sex material, schemata function to organize information specific to one's own sex group and one's self (Martin & Halverson, 1981; Stangor & Ruble, 1987). Gender schemata are thus a mechanism whereby children acquire and maintain stereotyped views of men and women (e.g., Liben & Signorella, 1993; Martin & Halverson, 1981).

In order for the developing gender schemata to encompass the information relevant to either sex, a child must have some notion that males and females differ from one another. In other words, knowledge of one's gender is a prerequisite for development of gender schemata. Most children do not show the ability to label boys and girls, including themselves, until they are at least 24 months of age or older (Leinbach & Fagot, 1986). Empirical evidence supports the importance of gender labeling. Gender labeling affects sex-typed activity preferences (e.g., Levy, 1989). Children who can distinguish between males and females at a very young age have been shown to be more likely to adopt sex-typed behavior and stereotyped toy preferences than those children who cannot distinguish the sexes (Fagot & Leinbach, 1989; Fagot, Leinbach and Hagan; 1986). These differences emerged only after gender identity had been acquired. When researchers examined how parents interacted with their young children prior to the children's acquisition of labels, they found that