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Children's and Adults' Recall of Sex-Stereotyped Toy Pictures: Effects of Presentation and Memory Task

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Gender schema theories predict a memory bias toward sex-congruent information. The present study examined how presentation of stimuli and encoding conditions influence gender schematic processing in children and adults. One hundred and sixty 5- to 13-year olds and adult males and females viewed 36 sex-stereotyped toy pictures that were presented in a static and dynamical way. Half of the participants were asked to memorize the pictures (intentional memory) and half were not told that they would be expected to later recall the pictures (incidental memory). Weak gender schematic processing was observed only during the incidental memory task. Children and adults recalled more static than dynamic gender-stereotyped pictures, and performance was superior in the intentional than in the incidental memory condition. Gender schematic processing was similar across the age groups. In addition, participants were more likely to recall male-stereotyped toys. Implications for gender schema theories and education are discussed. Copyright © 2004 John Wiley & Sons, Ltd.

Key words: human sex differences; memory; stereotyped attitudes; gender schema

Cognitions about gender have been shown to be pervasive and to influence children's and adults' behaviours, attitudes and memories (e.g. Fagot and Leinbach, 1993; Liben and Signorella, 1993; Martin and Dinella, 2002; Martin and Halverson, 1981; Signorella *et al*., 1993, 1997; Stangor and Ruble, 1987). For example, gender schemata often act to bias judgements and memories for gender-related information (Liben and Signorella, 1980; Martin and Halverson, 1981). One consequence that these gender schemata may have is that they may facilitate the encoding and retrieval of information that is relevant to one's own sex, and consequently interfere with the information that is not consistent with one's own sex. This selective memory for same-sex information has important implications for children's processing of curricular materials and instructions

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(Schau and Scott, 1984). Specifically, children might be more likely to attend to and remember materials that contain activities, objects, attitudes or traits associated with their own sex and therefore to ignore information associated with the other sex. Thus, if children have difficulty remembering materials associated with the other sex, then textbooks, computer software and other school activities that make use of gendered materials might lead to sex differences in the retention of the material (Signorella *et al.*, 1997).

Factors and situations that may lead to gender-schematic biases need to be identified to answer some of the following questions. Are children more likely to selectively encode sex-stereotyped material when they have to memorize material or when they are merely looking at the material? Does the way gendered material is presented influence their memories for that material? Given the far-reaching knowledge children have about gender, how does new information—both stereotypical and counter-stereotypical—reach them? What are the conditions that matter and have greatest impact? The purpose of the present study was to investigate the impact of stimuli presentation and modality of memory on gender-schematic processing by comparing 5- to 13-year-old boys and girls' as well as adults' recall of gender-stereotyped toy pictures using two separate encoding conditions: intentional vs incidental memory.

Several cognitive theories on own-gender recall have been proposed. For example, people tend to recall familiar information better than less familiar information. McKelvie (1981) proposed that sex differences in memory may be mediated by the differential interest males and females have for various materials. He suggested that memory performance might be determined by initial attention and viewing strategies reflecting the interests created by differential exposure, familiarity and social conditioning. McKelvie *et al.* (1993) found that women outperformed men in recognizing children's faces and men were superior to women in recognizing cars. Similarly, research on the self-referent effect shows that people remember information that is associated with the self better than other information (e.g. Rogers *et al.*, 1977). The present study proposes to examine gendered recall within the gender schema framework (e.g. Bem, 1981; Martin, 1991, 1993; Martin and Halverson, 1981; Martin *et al.*, 2002) which stresses the importance of children's comprehension of and attention to gender in the gender-role socialization process (e.g. Fagot and Leinbach, 1989, 1993; Martin and Halverson, 1981).

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 and Halverson, 1981; Stangor and Ruble, 1987). These frameworks are known to influence memory for gender-related information (e.g. Bauer, 1993; Carter and Levy, 1988; Cherney and Ryalls, 1999; Liben and Signorella, 1980, 1993; Ruble and Stangor, 1986; Ruble and Martin, 1998; Signorella and Liben, 1984). Research suggests that as children's experiences with gender-role stereotypes increase, items that are typical of stereotyped gender roles are remembered better than atypical items (e.g. Liben and Signorella, 1980, 1993; Martin and Halverson, 1981). Consistency with the sex of the subject also has been shown to have a pronounced effect on recall. For example, 3- to 6-year-old children have better recall of toys, objects and activities labelled or stereotyped for their own relative to the opposite sex (Boston and Levy, 1991; Bradbard and Endsley, 1983; Bradbard *et al.*, 1986; Cherney and Ryalls, 1999). For example, Cherney and Ryalls (1999) exposed 3- to 6-year-old children and adults to various gendered objects which they were later asked to recognize or recall. The findings revealed gender-schematic processing for all age groups. Males tended to recall more male-stereotyped objects than female- or neutral-stereotyped objects and conversely, females were more likely to recall female-stereotyped objects than male- or neutral-stereotyped objects. In line with these findings, preschool-age and older children have been shown to have better memories for sex-role stereotype consistent information than for inconsistent information (e.g. Carter and Levy, 1988; Levy, 1989; Liben and Bigler, 2002).

Similarly, research on stereotypes has shown that individuals access stereotypic information more easily than non-stereotypic information under certain conditions. Fiske (1995) and Devine (1989) reported that under conditions of ambiguity, cognitive overload or during heuristic processing, stereotypes are likely to be evoked. They tend to be governed by automatic processes (Schneider and Shiffrin, 1977; Shiffrin and Schneider, 1977) and thus be initiated by the presence of relevant environmental cues without requiring conscious attention (Shiffrin and Dumais, 1981). Since stereotypes are frequently activated, it is plausible that stereotypes (as well as gender schemata) would be more likely activated during unconscious (or incidental) learning conditions (Devine, 1989) than during conscious (or intentional) learning conditions.

How are these information processing biases formed? Children's social environments are assumed to be one source that shape later sex differences in cognitive abilities and schemata (e.g. Martin and Dinella, 2002). Sex differences in children's activities and preferences emerge early. Preschool boys spend substantially more time playing in outdoor settings and participate in more active and dynamic play than preschool girls (Eaton and Enns, 1986; Harper and Sanders, 1975). Conversely, preschool girls tend to play indoors more frequently and to engage in more static types of play than preschool boys (Harper and Sanders, 1975). Girls tend to prefer playing with dolls, stuffed animals and art supplies, whereas boys enjoy playing with vehicles, tools and construction blocks (Cherney and London, 2003). During middle childhood and early adolescence, girls spend more time socializing, doing indoor chores and engaging in personal care, whereas boys spend more time in leisure activities, performing outdoor chores and sports (Richards and Larson, 1989; Timmer *et al.*, 1985). Moreover, boys spend more time playing with video- and computer games than girls do (Cherney and London, 2003; Funk and Buchman, 1996; Lockheed, 1985). These differences in activities and early experiences may shape boys' and girls' gender schemata in different ways by providing each sex with different amounts and types of gendered expertise. That is, each sex has more practice with different sorts of tasks, resulting in the enhanced development of different expertise. Taken together, these studies suggest that early experiences, such as differential exposure to different objects (e.g. toys) and activities (e.g. computer games, sports) may lead males and females to different forms of expertise and familiarity.

This selective memory for same-sex information has important implications for children's processing of curricular materials and instructions (Schau and Scott, 1984). If children are more likely to attend to and remember materials that contain activities, objects, attitudes or traits associated with their own sex they are also likely to ignore information associated with the other sex. The use of gendered materials might consequently lead to sex differences in the retention of the material (Signorella *et al.*, 1997). It is therefore important to identify the factors and situations that may lead to gender-schematic biases. Two such factors are being investigated in the current study: (a) type of display: static vs dynamic and (b) memory condition: incidental vs intentional.

Much of the gender-related information to which children are exposed over the years is learned unconsciously or incidentally (Schneider and Pressley, 1997). Children learn through direct observation, assimilating and accommodating the gender information, forming mental structures based on gender (Welch-Ross and Schmidt, 1996). These frameworks are used as guides in making inferences about the social world, organize and direct attention to certain information. Thus, it is important to assess how gender schematic processing develops under incidental learning conditions compared to intentional learning conditions.

Incidental and intentional memory: Memory researchers typically distinguish between voluntary (intentional) and involuntary (incidental) memory systems (e.g. Schacter, 1987). Most research on the development of memory has focused on intentional or explicit memory, whereas the development of unintentional or incidental memory and the variables that affect it have received less attention (Bjorklund, 2000; Schneider and Pressley, 1997). Incidental memory, as measured in the current study, refers to information that was encoded incidentally (without conscious awareness or unintentionally) which was later made explicit by asking individuals to remember what they had seen. In contrast, intentional memory refers to information encoded consciously. In other words, during incidental memory tasks, participants are unaware that they will be later asked to recall the stimuli, whereas during intentional memory tasks, they are instructed to memorize the stimuli. Incidental and intentional memory conditions were used to differentiate between non-strategic and strategic encoding mechanisms. Half of the participants were not explicitly told that their memory would be tested later (incidental memory task) and half of the participants were told that their memory would be tested (intentional memory task).

In general, studies on intentional memory development have shown that very young children show some difficulties in explicit memory performance depending on the experimental circumstances (see Schneider and Pressley, 1997 for a review). This type of memory develops from childhood to adulthood depending on the elaboration of individuals' semantic and knowledge structures and mnemonic strategies (e.g. Bjorklund, 2000; Chi, 1978; Kail, 1979). Voluntary memory seems to develop relatively late, increase with age, and be task dependent (e.g. Kail, 1990; Pressley and Schneider, 1997; Schneider and Pressley, 1997).

Studies on the development of incidental memory, on the other hand, indicate that this type of memory may not be dependent on strategies (e.g. Newman, 1990; Russo *et al.*, 1995), may develop at a younger age than intentional memory, and may change very little across the course of development (e.g. Greenbaum and Graf, 1989; Naito, 1990). For example, Newman (1990) examined differences in performances on tasks in which 4- and 5-year-old children were asked to either 'remember' or 'play with' a set of pictures or toys. The findings showed that instructions to 'play with' toys promoted better retention than instructions to 'remember' toys (Newman, 1990). These results suggest that memory performance for incidentally encoded information may, under certain circumstances, be superior to the performance of intentionally encoded information.

When comparing the results from several studies, contradictory patterns emerge, with most studies indicating only small (e.g. Cherney and Ryalls, 1999; 2000; Hale and Piper, 1973; Maccoby and Hagen, 1965; Sophian and Hagen, 1978) or no (e.g. Hagen, 1967; Hale and Piper, 1974; Naito, 1990) age differences in incidental memory. For example, Naito (1990) instructed first, third and sixth graders to evaluate the meaning of words or their physical attributes. Without deliberately trying to remember the information, the participants in all conditions remembered the words equally well regardless of their ages. Other researchers have found age effects during incidental memory tasks (e.g. Cherney and Ryalls, 1999, 2000). Cherney and Ryalls (1999) investigated 3- to 6-year-old children's object memory using an incidental memory task. Children were asked to play with various sex-stereotyped toys in a room for 2 min. After a filler task, they had to recognize the toys they had previously seen. Their results showed that with age, the participants' performance improved (Cherney and Ryalls, 1999). Similarly, in another study on incidental memory, there were age differences in 3- and 5-year-old children, with older children placing significantly more stimuli into their original spaces than did the younger children (Cherney and Ryalls, 2000). None of the children were told in advance that they would have to remember the position of each stimulus. Thus, similar to Cherney and Ryalls' (1999) other findings, these results suggest that age may play a significant role in the early development of incidental memory, at least when using this paradigm.

The present study was designed to test children's and adults' gender schemata under different modalities of presentation and memory conditions. The same tasks and stimuli were used for all participants, thus allowing for direct comparison between the age groups. Since young and old participants are equally familiar with toys, the same stimuli could be used across the large age range. Even though adults do not play with or use toys, they are aware of the sex-stereotypes of toys (e.g. Campenni, 1999). The rationale for using 5- to 13-year-old children is based on the fact that younger children have difficulties recalling large chunks of information. Although gender schematic processing has been shown in very young children, at the age of five, most children have acquired gender constancy, indicating a secure development of schemata. Gender schema theory provides a useful framework for examining the cognitive processing of gender information primarily once gender schemata are developed. In addition, intentional memory is at least partially dependent on strategies that tend to develop around the age of five.

Hypotheses

Modality hypothesis (*Hypothesis 1*): Since boys play video games more often than girls do (Funk and Buchman, 1996; Greenfield, 1994; Lockheed, 1985) and spend more time doing physical activities (Cherney and London, 2003), it was predicted that males would pay more attention to and therefore remember pictures presented dynamically better than static pictures. In contrast, females were expected to attend to and remember static and dynamic pictures equally well. In other words, an interaction between modality and sex was expected.

Memory and gender schema hypothesis (*Hypothesis 2*): Based on gender schema theory (Martin and Halverson, 1981), Cherney and Ryalls' (1999, 2000) findings, and the stereotype literature (e.g. Devine, 1989) it was hypothesized that gender schematic processing would be more likely to occur under incidental memory than under intentional memory conditions. That is, a three-way interaction between stereotyped pictures, sex and memory conditions was expected.

Memory hypothesis (*Hypothesis 3*): In addition, in line with cognitive theories, a main effect of memory condition was predicted. Objects encoded under intentional memory conditions were hypothesized to be recalled better than objects seen under incidental memory conditions.

Age hypothesis (*Hypothesis 4*): Older participants were predicted to recall more objects than younger participants regardless of the memory condition.

METHOD

Participants

Responses from 160 5- to 13-year-old and adult participants (80 males and 80 females) were collected. In each of four age groups (5–7-year olds: age range 60–95 months, mean age: $M = 76.65$, S.D. $= 11.62$; 8–10-year olds: age range 96–131 months, mean age: $M = 115.90$, S.D. $= 10.28$; 11–13 year olds: age range 135–167 months, mean age: $M = 147.98$, S.D. $= 8.52$; and adults: age range 18–41 years, mean age: $M = 22.20$, S.D. $= 4.63$) and in each of the memory conditions (incidental and intentional memory) there were ten males and ten females. The majority of the children were recruited from local early childcare centres and from a private school. The adult participants were recruited from a Midwestern US university and received extra credit points toward their psychology classes. Eighty-seven per cent of the participants were European American, 7% were Asian American, 3% were African American and 1% were Hispanic, Native American and from a biracial background.

Design and Materials

Toy gender pre-testing: The stimuli consisted of 72 sex-stereotyped toy photographs (masculine, feminine and neutral toys) that were based on previously collected gender ratings of children and adults (Campenni, 1999; Carter and McCloskey, 1984; Cherney and Ryalls, 1999; Miller, 1987) (see Appendix A for a list of the stimuli). As a pretest, a total of 32 men and women (16 men and 16 women) from a Midwestern university rated the gender of the toys on a 7-point Likert scale (1 = very masculine, 4 = gender neutral, 7 = very feminine). The 24 'male' or masculine toys had a mean rating of 2.23 (range = 1.59−2.91), the 24 'female' or feminine toys had a mean rating of 5.61 (range = 4.50−6.75) and the 'neutral' toys had a mean rating of 3.81 (range = 3.09−4.44).

All of the colour photographs were taken with a Hewlett Packard digital camera on a white cloth. Besides the stereotyped ratings, each toy was also classified based on its functions (e.g. Fisher–Thompson, 1990; Robinson and Morris, 1986) by three graduate students. That is, on a continuum, toys were also classified as being moving or static toys, indoor or outdoor toys, large or small toys, manipulative or non-manipulative toys, etc. The gender ratings and function ratings were summed and evenly distributed among the stimulus sets. In order to ensure approximately equal stereotyping and function ratings, and because the study was run at the same location and children may have talked about the study, two versions of 36 stereotyped pictures (12 of each of the three categories representing each gender) were created. Half of all participants were shown one set and the other half of the participants were shown the second set. The order of presentation within each set was random. Gender ratings for set #1 for each gender were as follows: males = 2.34, females = 5.78 and neutral = 3.74 and for set #2: males = 2.18, females = 5.41 and neutral = 3.86. The pictures were displayed on a 15'' laptop computer screen using *PowerPoint* (Microsoft, Office, 2000) software.

Procedure

Each participant was run individually. Half of the participants in each age group were randomly assigned to either the incidental memory (INC) condition or the intentional memory (INT) condition. Within each condition, children and adults participated in both the 'static object memory' (SOM) condition in which the participants were shown static photographs and the 'dynamic object memory' (DOM) condition in which they were presented moving targets. The order of these two tasks was counterbalanced across the participants. Thus, half of the participants saw static pictures first and half were presented with dynamic pictures first.

Incidental memory condition (*INC*). Participants were first asked to label each picture to ensure that they paid equal attention to each picture. 'I am going to show you some toy pictures on this screen. I am interested in knowing whether there are differences in the naming or labelling of these objects. Please tell me what you see on the screen'. If a child did not name the toy presented, the experimenter labelled the toy. During the SOM, each photograph randomly appeared at the centre of the computer laptop screen for 5 s. Five seconds later, the next picture appeared at the same position. A total of 18 stereotyped stimuli were displayed. The order of the pictures was randomized across sessions. Similarly, in the DOM the participants viewed each photograph moving on the screen for the same amount of time (5 s). The photographs randomly appeared at one of the four sides of the screen and 'crawled' across the screen to the opposite side. The participants were also instructed to name each display.

A 3-min filler task (drawing the school) was introduced after the first viewing of the toy pictures. Each participant was asked to tell the experimenter the toys s/he remembered seeing on the screen. The experimenter wrote down each answer. Following the first memory test, the participants were exposed to the other memory condition (either SOM or DOM). To minimize demand characteristics, participants were told before starting the second memory test that the aim of that game was to name each toy 'as quickly as possible'. A built-in microphone was supposedly registering how quickly they were able to name the pictures. Before the second memory task, the participants drew another picture (their family).

Intentional memory condition (*INT*): With the exception that the participants were notified of the true purpose of the study in advance, the procedures for this memory condition were the same as those of the INC condition. That is, the participants were told: 'I am going to show you some toy pictures on this screen. I am interested in knowing whether there are differences in the naming or labelling of these objects. Please tell me what you see on the screen. Later, I will ask you to tell me which toys you remembered seeing'.

RESULTS

The frequencies for each sex-stereotyped toy correctly recalled were assessed. Each participant received a total of six memory scores: male static, female static, neutral static, male dynamic, female dynamic and neutral dynamic memory scores. Two main sets of analyses were performed: (a) analyses using only the first exposure memory scores, and (b) analyses using all memory scores.

First exposure only: Initial analyses on the first exposure memory scores were performed (a) to assess whether the participants guessed the purpose of the study in the INC condition, and (b) to see whether there was any confounding due to the two stimulus sets. To examine whether participants may have scored higher in the second half of the study because they had identifying the study's purpose following the first exposure, a 2 (memory) $\times$ 2 (SOM first vs DOM first) mixed analysis of variance (ANOVA) was performed. Overall, there were no significant interactions between the modality of presentation (SOM or DOM) and memory conditions, $F(1,144) < 1$, *ns* (see Table 1). The analyses confirmed that the participants in the INC condition did not recall more items during the second test than during their first exposure to the stimuli. To ascertain that participants' recall was equal among the two stimulus sets, memory scores were tested using an independent *t*-test with display type as between-subject variable. The findings showed that participant recall was the same among the displays, $t(159) < 1$, *ns*.

Repeated measures: To increase power and because the pattern of results was such that it was reasonable to assume that the participants did not guess the purpose of the second memory test, additional analyses on the total memory scores were performed. The omnibus ANOVA was performed using the six memory scores. They were submitted to a 2 (sex) × 4 (age groups) × 2 (memory condition) × 2 (SOM vs DOM) × 3 (toy gender stereotype) mixed-design ANOVA in which sex of the participant, age and memory condition served as between-subject factors and toy gender stereotype and modality of presentation as within-subjects factors. Tukey's HSD ($p < 0.05$) was used for all *post hoc* tests.

Hypothesis 1: modality predictions: The omnibus analyses revealed that there was a main effect of type of presentation, $F(1, 144) = 11.57$, $p < 0.01$, ($\eta^2 = 0.074$). On average, individuals remembered significantly more stimuli in the SOM condition ($M = 7.11$, S.D. $= 2.83$) than stimuli in the DOM condition ($M = 6.22$, S.D. $= 2.89$). However, inconsistent with the hypothesis, there was no interaction between sex of the participants and type of presentation, $F(1, 144) < 1$, *ns*.

Hypothesis 2: memory conditions and gender schema predictions: Overall, the omnibus analysis revealed no interaction between sex of the participant and toy gender stereotypes, $F(2, 143) = 0.78$, *ns* ($\eta^2 = 0.014$). To test the main hypothesis, the three-way interaction between the sex of the participant, the stereotyped toys and memory conditions, the stereotyped toys from both memory tasks (SOM and DOM) were collapsed. Thus, a 2 (sex) × 2 (memory condition) × 3 (toy stereotype) repeated measures ANOVA on the total number of stereotyped toys recalled (i.e. total male, total female, total neutral) was performed. The results revealed a marginal three-way interaction between stereotyped toys, sex of the participants, and memory condition, $F(2, 144) = 2.72$, $p = 0.063$ ($\eta^2 = 0.034$) and a main effect of toys, $F(2, 144) = 99.90$, $p < 0.001$ ($\eta^2 = 0.563$).

Table 1. Means and standard deviations of recall scores between the first and second memory conditions for both the incidental and intentional memory conditions

Modality condition	Memory condition	*M*	S.D.
Static objects presented first			
SOM	Incidental memory	7.82	2.51
	Intentional memory	8.33	2.32
DOM	Incidental memory	4.69	2.70
	Intentional memory	5.40	2.33
Dynamic objects presented first			
DOM	Incidental memory	6.44	2.40
	Intentional memory	8.30	2.83
SOM	Incidental memory	5.27	2.53
	Intentional memory	7.08	2.98

Simple effect analyses on this interaction revealed that, consistent with the hypothesis that gender-schematic processing may be stronger in the INC condition, there was an interaction between stereotyped toys and sex of participants in the INC condition, $F(2, 144) = 7.92$, $p = 0.028$ ($\eta^2 = 0.049$). There was, however, no interaction between toy stereotype and sex of participant in the INT condition, $F(2, 144) = 0.26$, *ns* ($\eta^2 = 0.004$). Consistent with predictions, the interaction in the INC condition showed that males, on average, recalled significantly more male-stereotyped toys ($M = 5.08$, S.D. $= 2.10$) than female- ($M = 3.93$, S.D. $= 1.90$) and neutral ($M = 2.73$, S.D. $= 1.48$) stereotyped toys. In contrast, females remembered significantly more female- ($M = 4.80$, S.D. $= 2.05$) and male- ($M = 4.70$, S.D. $= 2.13$) stereotyped toys than neutral ($M = 2.85$, S.D. $= 1.70$) toys.

Additional analyses also showed main effects of toy stereotype in both memory conditions, $F(2, 144) = 44.45$, $p < 0.001$ (INC) and $F(2, 144) = 50.37$, $p < 0.001$ (INT). Male-stereotyped toys and female-stereotyped toys were remembered significantly better than neutral stimuli. On average, male-stereotyped toys were recalled more frequently ($M = 5.48$, S.D. $= 2.12$) than female-stereotyped ($M = 4.68$, S.D. $= 2.15$), and more frequently than neutral stimuli ($M = 3.11$, S.D. $= 1.79$) by males and females combined.

Hypothesis 3: memory prediction: Congruent with the hypothesis, there was a significant main effect of memory condition, $F(1, 144) = 9.48$, $p < 0.001$ ($\eta^2 = 0.117$). Individuals in the INT condition recalled on average significantly more stimuli ($M = 7.28$, S.D. $= 2.85$) than participants in the INC condition ($M = 6.05$, S.D. $= 2.75$).

Hypothesis 4: age effects: The omnibus ANOVA also confirmed that with increasing age, individuals are able to accurately remember more stimuli, $F(3, 144) = 48.50$, $p < 0.001$ ($\eta^2 = 0.581$) regardless of the memory condition. On average, 5- to 7-year-old children recalled the fewest number of pictures ($M = 2.94$, S.D. $= 1.55$). The 8- to 10-year-old children ($M = 4.08$, S.D. $= 1.52$) remembered significantly more stimuli than the younger cohort, but less than the 11- to 13-year-old participants ($M = 4.87$, S.D. $= 1.71$). Finally, adults ($M = 5.81$, S.D. $= 1.91$) recalled the most number of toy pictures.

DISCUSSION

The purpose of the present study was to examine how separate encoding conditions (incidental vs intentional) and different modalities of presentations (static vs dynamic) would influence the development of gender-schematic processing in children and adults. Participants were exposed to a set of gender-stereotyped toy pictures that were presented statically or dynamically either under incidental learning conditions or intentional learning conditions. Males were expected to remember more stimuli presented dynamically whereas girls were expected to remember more stimuli presented statically. The findings showed no interaction between modality and sex of the participant (Hypothesis 1). Congruent with gender schema theories (Bem, 1981; Martin and Halverson, 1981), males were predicted to recall more male-stereotyped toy pictures than female- and neutral objects, whereas females were predicted to recall more pictures congruent with their own rather than other sex. This pattern of results was expected under incidental memory conditions (Cherney and Ryalls, 1999). The results showed a weak support of this second hypothesis. The findings further confirmed the third hypothesis that recall under intentional memory condition would be better than under incidental memory condition. Finally, the expected age effects were also supported. Younger children recalled significantly fewer toy pictures than older participants.

The way the stimuli were presented made a significant difference in the participants' recall. On average, males and females recalled more objects presented statically than dynamically. Although the pictures were presented for an equal amount of time, participants were able to remember more of the static toy pictures than the moving toy pictures. The hypothesis that there would be an interaction between sex of the participants and modality was not supported. Males did not recall more dynamic pictures than females. Presumably, it takes additional mental capacity and increased attentional effort to track an item moving across a computer screen compared to having to glance at the centre of a screen to recognize, encode and retrieve an object from long-term memory. Greenfield (1984, 1994) reported evidence that skills of spatial representation are crucial to computer animation. Compared with pictorial representation, a dynamic representation of an object on a computer screen adds time and motion to the iconic imagery. It is therefore not surprising that the objects presented in a dynamic form were less well remembered. Interestingly, objects presented statically were recalled significantly better than objects seen in the DOM by the young adolescents and adults. In contrast, the two younger age groups (5- to 10-year olds) did not differ in their recall of static and dynamic stimuli. It is possible that because the younger cohorts have been exposed to computers at an early age and tend to play computer and video games more frequently (Cherney and London, 2003), they may have developed the necessary spatial skills to track moving objects across a screen. A limitation of this task was the fact that the moving pictures failed to capture what is important about movement in the real world. The presentations of the pictures merely represent a first step in establishing a baseline for future investigations. Future studies should combine a static with a more naturalistic display.

The second hypothesis explored the possibility that gender schematic processing would be stronger under incidental learning than under intentional learning. In general, the support for gender-schematic processing in children and adults was very weak. Children and adults tended to engage in gender-schematic processing only under incidental learning conditions and not under intentional learning conditions. Consistent with gender-schema theory and replicating Cherney and Ryalls' (1999) findings, males recalled significantly more male stereotyped toy pictures than female and neutral pictures, and conversely, females recalled significantly more female- and male-stereotyped toys than neutral toys in the INC condition only. Several researchers have proposed the idea that humans have two separate memory systems with distinct properties (see Schacter, 1987). For example, McClelland *et al.* (1995) contend that two different memory demands dictate functionally incompatible systems. One demand is to record a large sample of experiences over a long period of time. The properties of this 'slow learning' memory system are similar to those of schemata (see Fiske and Taylor, 1991). A second demand is for rapid learning of new information to record novel experiences. Thus, one memory system is responsible for learning general representations of stable information (i.e. schemata) and using them unconsciously to interpret new information, whereas the other memory system is responsible for learning and constructing new representations (i.e. episodic memories) from various contexts. This second system may mediate conscious explicit recall. The current findings partially support this dichotomy.

Gender-schematic processing under incidental memory is also supported by research on stereotypes. These are more likely called to mind under conditions of ambiguity, cognitive overload and during heuristic processing (e.g. Fiske, 1995). Stereotypes supply general expectations about groups or things and serve to simplify the task of perceiving and evaluating individual information. Devine (1989) argued that the activation of stereotypes is governed by automatic processing (Schneider and Shiffrin, 1977; Shiffrin and Schneider, 1977). Automatic processes involve unintentional activation of previously developed associations in memory that have been established through a history of repeated activation. Therefore, these processes can be initiated by the presence of relevant environmental cues without requiring conscious attention (Shiffrin and Dumais, 1981). Since stereotypes typically have been frequently activated, Devine (1989) reasoned that they can be automatically activated. Thus, it is conceivable that stereotypes would be more likely to be activated in an incidental learning condition, where individuals are encoding the information unconsciously, rather than in an intentional learning condition, where individuals are consciously attending to the stimuli.

Consistent with cognitive theories (e.g. Kail, 1990; Siegler, 1996) and the third hypothesis, the participants recalled significantly more toy pictures in the INT than in the INC condition. Presumably, individuals were able to use strategies to encode the stimuli prior to recall in the INT condition. Many studies have demonstrated that strategies are a crucial factor in determining performance on a memory test (see Bjorklund, 2000; Schneider and Pressley, 1997 for a review). Performance was superior on the tasks in which the individuals were able to rehearse, elaborate or use other effortful processes to commit the information to memory (i.e. INT). In addition, consistent with previous studies reporting age differences during intentional (e.g. Bjorklund, 2000) and incidental memory tasks (e.g. Cherney and Ryalls, 1999, 2000), there was also a significant increase in memory in both memory conditions. As predicted, older children and adults recalled on average more objects than younger children.

It was further hypothesized that older children and adults would be able to recall a greater number of gender-stereotyped toy pictures than younger children. Not surprisingly, with increasing age, participants remembered significantly more stereotyped toys in the INC and in the INT conditions. The findings suggest that, consistent with cognitive theories (e.g. Kail, 1990), young children have less capacity to encode and retrieve information from memory than older children. Since recall (especially free recall) requires more in the way of self-initiation and the application of prior knowledge than, for example, recognition does (Bjorklund, 2000), it is not surprising that the younger children had more difficulties encoding and subsequently retrieving the 36 toy pictures than the older children and adults.

Finally, the present results also showed that, across memory conditions, males and females tended to remember male-stereotyped items better than female- and neutral stimuli. Male-stereotyped toys may have been more salient than the female-stereotyped and neutral toys. It is possible that the participants in the current study may have considered the gender classification differently from that of the raters. They may have perceived the toys on a continuum from very desirable to less desirable rather than by gender stereotypes. Research has shown that girls tend to like male-stereotyped toys more than boys like female-stereotyped toys (see Bradbard, 1985; Eisenberg *et al.*, 1982; Etaugh and Liss, 1992; Robinson and Morris, 1986). Since the participants had to name each toy, it was not a lack of familiarity with the objects that could account for the findings.

Future studies should examine whether desirability may be another factor affecting memory recall of toys.

There are several limitations to the present study. First, as mentioned, the modality of the dynamic presentation was perhaps insufficiently realistic to warrant generalizations to other moving targets. However, they do constitute a first step in establishing a baseline for comparison between static and somewhat dynamic stimuli. Second, the fact that there was no significant improvement in the second showing does not unequivocally indicate that participants did not use intentional memory during the second showing of the incidental memory condition, as there was a loss of recall also after the second showing in the intentional memory condition where an increase could be expected. Third, the results only showed a marginal interaction between sex of the participants, gendered toys and memory. It is therefore important to replicate these findings to better understand the relationship among these variables.

Recommendations for Future Research and Education

Future studies should address several questions that were raised in the current study. First, gender schema theory cannot explain the asymmetry in the findings between males and females. Consistent with previous findings, the current data seem to suggest that males and females differ in the extent to which they remember same-gender activities and objects (e.g. Carter and Levy, 1988; Edelbrock and Sugawara, 1978; Levy, 1989, 1995; Liben and Bigler, 2002; O'Brien *et al.*, 1983; Schau *et al.*, 1980; Welch-Ross and Schmidt, 1996). Second, participants recalled on average more pictures that were presented statically than dynamically, suggesting that it may be more difficult to recall moving pictures than static pictures. What cognitive mechanisms account for these differences in memory? What additional cognitive resources are necessary to track a moving target across a computer screen compared to viewing a static picture on a screen? Future research should attempt to address these questions. In addition, many educators supplement their teaching using video and television programmes. Given the present findings, it may be prudent to combine the dynamic presentation with some traditional instructional methods. Children may have more difficulty encoding the fast-pace information.

Third, the findings showed very weak evidence for gender-schematic processing. Females recalled more own-sex stereotyped pictures than other-sex stereotyped pictures only in one of the two memory conditions. In general, although the toy pictures were carefully chosen and controlled for their sex-stereotypes, toys considered masculine tended to be better recalled than feminine or neutral toys by both sexes and across all four age groups. Why did participants recall male-stereotyped toys better than female- or neutral toys? What makes a toy more salient than another? If male-stereotyped toys are better recalled, does this bias influence the type of activities boys and girls choose to engage in? Do these findings have long-term consequences? Future studies should examine the functionality, desirability and classification of toys and the role motivation and appeal play in the recall of toys.

Fourth, researchers should ascertain the participants' interest for each toy. Interest is a predictor of memory performance (e.g. interest hypothesis, McKelvie, 1981) and play complexity (Cherney *et al.*, 2003) and consequently, differential interest, which might not match traditional stereotypes, could influence what participants encode, store and later recall. Engaging children in new activities (sex-incongruent activities) might increase children's overall memory competencies.

The weak evidence for gender schema in the INC condition suggests that schemata may be more accessible when the encoding is done without conscious effort. It is thus important to further investigate how children and adults differentially process stereotyped information under incidental and intentional learning conditions. Why is information encoded incidentally accessed differently from material encoded intentionally? What processes are involved in this dissociation? What roles do strategies play?

In sum, although the support for gender-schematic processing is weak, this line of study deserves further study. The findings suggest that when encoding is voluntary and conscious, sex-stereotypes may be minimized, but that when encoding is involuntary or unconscious, *a priori* biases and familiarity may serve as heuristics to guide the formation of memories. That is, under incidental memory conditions, gender schemata are activated whereas they might be attenuated under intentional memory conditions. Similarly, when demands are placed on perceivers' cognitive resources, stereotype activation can be prevented (Gilbert and Hixon, 1991). When automatic processes are disrupted (e.g. by using controlled processes), activation of schemata and/or stereotypes are decreased.

What are the implications of these results for the preparation and presentation of educational materials? The selective memory bias in favour of masculine items may indicate that children have more exposure to male stereotyped objects or that they find them more appealing and therefore, more memorable. Carefully designing educational games and activities that would increase the exposure and familiarity with feminine objects might be a first step in reducing one bias. However, additional interventions are necessary to reduce children's tendencies to preferentially attend to and remember same-sex information. As the present results suggest, it is mostly during incidental learning conditions, when individuals are merely looking through a book or watching a programme on television that they are going to access gender schemata. Thus, making children explicitly aware of the stereotypes may, over time, help reduce their memory biases.

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APPENDIX. A

Gender-stereotyped toys are listed in Table A1.

Toys	Gender	Toys	Gender
(a) Set 1			
Animals	Neutral	Legos	Neutral
Airplane	Male	Matchbox cars	Male
Backpack	Female	Mickey mouse	Neutral
Barbie	Female	Monster truck	Male
Basketball	Male	Mr. Potato head	Neutral
Bubbles	Female	Nerf ball	Male
Camera	Neutral	Pirate ship	Male
Cash register	Neutral	Pots and pans	Female
Crayons	Neutral	Puppets	Neutral
Doll	Female	Purse	Female
Doll Clothes	Female	Remote control car	Male
Doctor's kit	Neutral	Sit-n-spin	Neutral
Food items	Female	Space shuttle	Male
Football	Male	Soccer ball	Neutral
Foxtail	Neutral	Stroller	Female
Helicopter	Male	Tea set	Female
Jump rope	Female	Tow truck	Male
Kitchen sink	Female	Train	Male
(b) Set 2			
Action figures	Male	Hammer	Male
Audiocassettes	Neutral	High chair	Female
Baby bottles	Female	House	Neutral
Bead Necklace	Female	Jewelry box	Female
Books	Neutral	Magnetic letters	Neutral
Bulldozer	Male	Memory game	Neutral
Cards	Neutral	Mirror	Female
Chalk	Neutral	Oven	Female
Checker board	Neutral	Play doh	Neutral
Crib	Female	Puzzle	Neutral
Dinosaurs	Male	Saw	Male
Doll furniture	Female	Steering wheel	Male
Erector set	Male	Teddy bear	Female
Farm	Male	Telephone	Female
Fireman's hat	Male	Toolbox	Male
Garage	Male	Top	Neutral
Gas station	Male	Watch	Neutral
Globe	Neutral	Watercolors	Female

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