ATTENTION, INTERFERENCE AND INFORMATION PROCESSING

Our world simultaneously presents us with many different types of stimuli that our brain must effectively filter in order to survive (Everaerd, 1995). Attention has been defined as "the process of focusing selectively on some part of the environment while ignoring other aspects" (Ellis & Hunt, 1989). Because of limitations of working memory, we must filter from our surrounding environment that which we consider less important, or less interesting, and attend to that which we consider most important, or most interesting (Everaerd, 1995). Much of our initial decision-making has been found to take place unconsciously, and is influenced by a variety of factors (Kihlstrom, 1987). Some of these factors include the physical environment, the context of a current situation, and mood states. For example, mood states such as depression and anxiety have been shown to influence mental processes (Fox, 1993; Segal, 1995).

Many models and theories have been proposed to explain cognitive biases found in human attention and information processing. The Information Processing Model is based on the idea that there are multiple information processing systems in the brain. The model asserts that there are at least two different processes the brain uses to encode information (Posner & Snyder, 1975; Schneider & Shiffrin, 1977). One of these processes is referred to as a controlled process (explicit); and the other, an automatic (implicit) process. Automatic processes are thought of as fast and unconscious, therefore consuming little or none of our limited working memory. Controlled/conscious processes are slower, more directed, and goal-oriented; therefore, consuming most or all of our limited working memory (Posner & Snyder, 1975; Schneider & Shiffrin, 1977). Many studies have shown sexual stimuli to be processed in more of an automatic (implicit) fashion than a controlled (explicit) fashion (Janssen, Everaerd, Spiering & Janssen, 2000; Geer, Lapour, and Jackson, 1993; Bush & Geer, 2001). The Information

Processing Model further explains that as we encounter multiple stimuli simultaneously, these two different processes are placed into competition with each other, for the limited amount of working memory we possess (Everaerd, 1995). Our constant daily decisions to attend to certain information and not others may then be affected by the interaction of these two competing processes.

COGNITIVE BIAS

The tendency to focus attention on the most emotional or motivationally salient stimuli (or stimulus features) in the environment and the resulting interference between the controlled and automatic information processing systems that ensues has generally been referred to as “cognitive bias.”

Cognitive bias has been studied in a number of different ways. One classic measure of cognitive bias was discovered by James McKeen Cattell who originally (1886) reported that objects (and colors) took longer to name aloud than reading actual words themselves. Saying "red" to a patch of color was found to be slower than saying "red" to the word "red." Cattell found this effect while he was writing his dissertation under the mentorship of Wilhem Wunt, and it was not until 1935 when J. Riddley Stroop coined the effect as the "Stroop" effect. This “Stroop” effect is explained as the result of interference between the automatic and controlled information processing systems that occurs when participants are instructed to name the ink color of color words, which were printed in either a congruent color (saying "red" to the word red written in red ink) or an incongruent color (saying "red" to the word blue written in red ink). Response times to incongruent conditions are significantly longer than to the congruent condition, leading many researchers, including Posner & Snyder (1975) as well as Schneider &

Shiffrin (1977), to continue to explain this effect in the same fashion as Cattell did 120 years ago. Cattell explained the observed effect in the following words:

> This is because, in the case of words and letters, the association between the idea and name has taken place so often that the process has become automatic, whereas in the case of colors and pictures we must, by a voluntary effort, choose the name (p. 65).

MODIFICATIONS OF THE STROOP PARADIGM

Modifications of the Stroop paradigm have given researchers the ability to study the interference between information processing systems during attention. Often this interference during attention is referred to as attentional bias, a form of cognitive bias. One specific modification of the Stroop paradigm is an auditory analogue which has been used by Hammers. Hammers (1973) had participants either say "low" to the word "low" presented in a low sound pitch, or say "low" to the word "low" presented in a high pitch sound. She recorded response times to trials like these and compared the response times to trials where participants were required to say "high" to the word "high" presented in a high sound pitch, or say "high" to the word "high" presented in low sound pitch. She reported significant interference in cases where the two elements were incongruent.

THE PICTURE-WORD STROOP INTERFERENCE TASK

Interference during information processing has been studied thoroughly within various Stroop-like paradigms. Smith & Magee (1980) used a Picture-Word Stroop task to test the idea of differential processing of pictures and words. Words were superimposed upon line-drawings

of pictures. In a categorization task, they found that the categorization of words was significantly affected by the presence of an incongruent picture; however, the categorization of pictures was not significantly affected by the presence of an incongruent word. These findings indicate that the distracting qualities of pictures are greater than the distracting qualities of words. Thus, it was concluded that incongruent pictures create more interference in word-categorization than incongruent words in picture-categorization. One explanation of these findings is that pictures tend to be processed more automatically than words. Information processed in an automatic fashion, versus a controlled fashion, is thought to have the ability to access the limited amount of working memory we possess faster, thus preventing other material from being processed as quickly, if at all (Janssen, Everaerd, Spiering, & Janssen, 2000).

Smith & Magee (1980) further hypothesized from their findings that the recognition of word versus picture distracter information would differ. An unannounced recognition task, given immediately after the categorization task, assessed memory for distracter items. Results showed that memory for word distracters in the picture-categorization group, as well as memory for the picture distracters in the word-categorization group were very poor, and did not reach values greater than chance. These findings indicate that even though distracting incongruent pictorial information may have caused interference (longer reaction times) in the categorization of words, the stimuli do not appear to have been processed at any deeper cognitive level than the words.

INFLUENCE OF MOOD AND MOTIVATIONAL STATES ON DECISION MAKING

Mood and motivational factors have been found to influence the information attended to in a given environment (Cowan, 1995). This is often thought of as supporting evidence for attentional bias.

Attentional biases have been found in clinically anxious populations (MacLeod & McLaughlin, 1995; MacLeod, Matthews, & Tata, 1986). When trials presented anxious participants with threat-related probes that replaced a threat word, reaction times to locate the probe were faster than to neutral probes (MacLeod et al., 1986).

Attentional bias has also been found in participants with social phobia (Spector, Pecknold, & Libman, 2003). Participants with social phobia produced slower reaction times to name the color of words related to negative evaluation and anxiety symptoms versus neutral words (Spector et al., 2003).

Similar forms of attentional bias have been found toward emotional stimuli (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002), aggression stimuli (van Honk, Tuiten, van den Hout, Putman, Haan & Stam, 2001), food-related stimuli (Dobson & Dozois, 2004; Mogg, Bradley, Hyare & Lee, 1998), and pain-related stimuli (Keogh, Thompson, & Hannent, 2003) in relevant clinical populations.

THE ROLE OF SEXUAL INTEREST & AROUSAL ON COGNITIVE PROCESSES

In 1984, Singer proposed his Trichotomy of Sexual Arousal Theory. He claimed that: (1) If a stimulus or an aspect of the environment initiates a sexual response, then one will attempt to maintain contact with that stimulus, and (2) while attempting to maintain contact with the stimulus, the individual will be distracted, (3) and will experience decreased performance on other tasks requiring attention and concentration.

Rosen and Beck (1988) operationally defined sexual arousal as " . . . a complex triad involving physiological, psychological (cognitive and affective), and behavioral components." Sexual interest causes sexual arousal which is considered to be a mood, or motivational state in

itself (Wright & Adams, 1994). In a 1994 pilot study, Wright & Adams found sexual arousal to affect mood states. Based on Singer's Trichotomy of Sexual Arousal Theory, and because certain mood states had been shown to influence mental processing, Wright and Adams (1999) hypothesized that if sexual arousal had the ability to affect mood states, then sexual interest may have the ability to influence cognitive processes.

COGNITIVE BIAS FOR SEXUAL STIMULI

The phenomenon of Sexual Content Induced Delay (SCID)[1], consistently found in primed and unprimed lexical decision tasks, is identified as a hesitancy in decision making related to the presence of sexual/erotic material (Geer & Melton, 1997). The SCID was discovered in 1996 via studies involving lexical decision tasks; however, the effect was only found to be significant with female participants.

Supporting evidence for the SCID was found, in women, by Geer and Bellard (1996) in an *unprimed* lexical decision task. Male and female participants in the experimental group were presented letter strings and instructed to decide, as rapidly as possible, if the letter string formed a word or not. Words of sexual and neutral nature were used in the task. Participants in the control group were presented letter strings of words that were scrambled into non-words. The results showed slower decision making, by female participants, for words of sexual nature. Slower reactions times on these tasks are thought to reflect a bias toward sexual words versus neutral words.

Geer and Melton (1997) continued research on the processing of sexual material by using a *primed* lexical decision task. Male and female participants were shown priming sentences

[1] The acronym SCID, standing for Sexual Content Induced Delay in Cognitive-Emotional research is not to be confused with the same acronym, SCID, standing for Structured Clinical Interview for DSM-IV in schizophrenia research.

ending in a "double entendre word" (e.g., screw, pussy). Participants were then presented with a target word, which was neutral or sexual in nature, and asked to categorize the word as neutral or sexual. For instance, one of the trial sentences reads, "Before sex, he enjoys getting a blow." The associated target words for this trial were "Suck" (sexual), and "Bubbles" (neutral). A neutral trial read, "He loves to sit and feel the wind blow." Followed by the same associated target words (Suck & Bubbles). Decision times, for female participants, were found to be *faster* when the context of the priming sentence and the meaning of the target word were both congruent and neutral (e.g., neutral priming sentence, neutral target word). In conditions where the target word, the priming sentence context, or the combination was sexual in nature, response times were *slower* than for the neutral prime + neutral target condition. No significant difference was found between any of the other three groups (Geer & Melton, 1997). Male participants showed no significant differences in response time for any of the conditions. These two studies indicate longer response latencies when sexual content is involved, providing further support for the SCID effect in females.

In dot-probe studies using picture stimuli Wright & Adams (1999) recorded participant reaction times to the location of a white dot superimposed in different locations on pictorial stimuli: nude men and women, clothed men and women and neutral scenes. Their participants were 20 heterosexual males, 20 heterosexual females, 20 gay men, and 20 lesbian women. They found longer reaction times to the location of the superimposed dot when the pictorial stimuli were congruent with the participants' sexual orientation. Participants were thought to have experienced greater sexual interest to slides that were more provocative (nude vs. clothed stimulus), and as a result produced longer response latencies. Wright and Adams (1999) concluded from their findings that the preferred-gender nude stimuli elicited sexual interest,

which interfered with cognitive processing by directing attention to the more salient background image of the stimulus competing for attention.

Wright and Adams further hypothesized from their findings that if it was indeed the sexual interest to the preferred nude stimuli that caused the interference (longer-reaction times), greater recognition accuracy of the preferred nude slides would be evident in an incidental learning-memory task (1999). They found supporting evidence for their hypothesis when all four groups of participant in their study demonstrated the greatest memory for nude preferred-gender stimuli. This data indicated that sexual interest caused distraction during performance on the cognitive task, and facilitated memory for the stimulus causing the distraction (1999).

In contrast, faster responses to sexual stimuli were found by MacLeod, Matthews, & Tata (1986) who used a dot-probe task to assess gender differences in the processing of romantic, sexual and neutral words. They found that male participants detected a dot-probe quicker when it replaced a sexual word but not a romantic or neutral word; whereas, female participants were quicker when the dot probe replaced a romantic word but not a sexual or neutral word. Researchers believed that the inconsistency of gender was due to a difference in the way males and females process sexual material (Geer, 1991; Geer & Lapour, 1990; Geer & McGlone, 1990; Kirsch-Rosenkrants & Geer, 1991).

Memory studies have indicated that males have better memory for explicit sexual material, whereas females' memory is better for romantic material (Geer, Lapour, 1990; Geer & McGlone, 1990). However, more recent research has argued that males and females do not differ in memory processing of sexual/explicit words (Hedreen, submitted for publication). Hedreen, et al. presented neutral/neutral and neutral/sexual word pairs in a modified Paired-Word Associates Task. Participants were instructed to memorize the word pairs because they

would be asked to recall them later. Participant performance was best for sex word pairs; moreover, females performed better than males for all word categories, including explicitly sexual word pairs (Hedreen, submitted for publication).

HYPOTHESES & INTENT

The purpose of the first task in the present study was to test whether or not evidence of the SCID effect would be found in a Picture-Word Stroop paradigm, when using male subjects. However, the Stroop and SCID literature tend to predict more divergent than convergent results. Past Picture-Word Stroop literature has produced results indicating that, during categorization tasks, incongruent picture distracters hamper the categorization times of word targets, but that incongruent word distracters do not affect the categorization times of picture targets. Furthermore, when word targets are paired with congruent picture distracters, categorization times are facilitated; this is not the case when a target picture is paired with a congruent word distracter.

The SCID literature simply states that there is "… a hesitancy in decision making related to erotic material" and in a broader sense to the particular aspects of processing sexual information (Spiering, Everaerd, & Elzinga, 2002). SCID literature has shown that participants decision times to indicate "yes" or "no" if a word was sexual or neutral in nature, were significantly slower when the word was sexual. Other SCID literature has found the same effect with female participants. Recent research has begun to find support for the phenomenon in males when visual stimuli are used instead of word stimuli. Researchers have tried to explain the SCID through the "Information Processing Model of Sexual Arousal" (Janssen, Everaerd, Spiering, and Janssen, 2000) which views the phenomenon as a result of interference between

automatic and controlled cognitive processes. The Stroop task has classically been a very robust measure of this type of interaction between cognitive processes. Therefore, the present study was interested in the possibility of understanding the SCID in male participants through a modified Stroop paradigm.

Since previous memory studies have indicated that a male participant's memory increases for explicit sexual material, whereas a female participant's memory increases for romantic material (Geer, Lapour, 1990; Geer & McGlone, 1990), and that males are more aroused by visual material than women (Geer, 1993) the following predictions were made: Between instruction groups, there would be a significant difference in overall reaction time to categorize target stimuli. (1) The Word-Categorization Instruction Group was predicted to produce a slower overall reaction time to categorize target words in the presence of distracter pictures, than the Picture-Categorization Instruction Group would to categorize pictures in the presence of distracting words. (2) Within the Picture-Categorization Instruction Group, it is predicted that the word distracters would not cause any difference in reaction time; however, (3) the Sexual Picture (Target) + Sexual Word (Distracter) compound stimulus and the Sexual Picture (Target) + Non-Sexual Word (Distracter) compound stimulus will produce significantly slower reaction times than the Non-sexual Picture (Target) + Non-Sexual Word (Distracter), and Non-Sexual Picture (Target) + Sexual Word (Distracter) compound stimuli, due to the target sexual *pictures* versus the target non-sexual pictures. (4) Within the Word-Categorization Instruction Group, it was predicted that the Sexual Picture (Distracter) + Sexual Word (Target) compound stimulus would produce the slowest reaction times of all four stimuli presented. (5) It was also predicted that, within the Word-Categorization Instruction Group, the Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) would produce the fastest reaction times of all four stimuli.

(6) Lastly, it was predicted that, within the Word-Categorization Instruction Group, the Sexual Picture (Distracter) + Non-Sexual Word (Target) would produce slower reaction times than the Non-Sexual Picture (Distracter) + Sexual Word (Target).

METHOD

TASK 1: CATEGORIZATION TASK
DV: Reaction Time to Categorize Compound Stimuli

Participants

Sixty-four heterosexual males between the ages of 18 and 23 were recruited from a southeastern university student population. All subjects were introductory psychology students participating for class credit. The mean age of the subjects was 19 (SE = .126) years old (Picture-categorization Instruction group, M = 18.6875, SE = .114; Word-categorization Instruction group, M = 19.2941, SE = .209). Forty-six of the subjects were freshman, fifteen were sophomores, and three were juniors. The predominant ethnicity was Caucasian due to their large concentration at the university. Participants signed up for the study, which was titled "Categorization of different types of stimuli." Experimental sessions were generally held in the late afternoon. Once in the laboratory, the experimenter (always male) asked each participant to sit in front of a different computer monitor and he then distributed an informed consent document (Appendix A). The experimenter read aloud the informed consent for the participants while they were instructed to follow along. The form explained, in general, what we were interested in studying in the laboratory. Part of it read:

> We are interested in studying the information processing of various types of stimuli. Previous literature has shown that the brain may process certain types of information in different ways. In the present study we intend to experimentally address this theory.

The document also informed the participants that they may be exposed to some material that might be of an emotional nature.

Participants were informed that if at any time during the study they wished to discontinue their participation they may do so without giving a reason and he would not be asked for one. After completely reading through the informed consent document with the participants the experimenter asked them to consent by signing or turn their form in blank and leave. All participants completed the study. Each participant had two copies of the document to sign, one for them to take with them and one for the experimenter to keep on file. The form included the telephone number and email address of the Chairman of the University of North Carolina Wilmington Institutional Review Board in the event that the participant may have questions after the study about his rights as a research participant. Each participant was given a subject code to ensure that all data were recorded and kept in complete confidence, and in no way would their identity be traced back to the data provided. This was done to engender a sense of confidence in the participant's mind that their data would, in fact, be kept confidential. The informed consent document was the only material gathered containing the participant's given name, and was kept in a locked file cabinet separate from all data received during the course of the study. From the informed consent, each participant's name was recorded in a database to ensure that they only participated in the study once.

Before participants arrived to the lab for the study, they were randomly assigned to one of two instruction groups. One group was referred to as the word-categorization instruction group, and the other as the picture-categorization instruction group. At the culmination of the study each group had an equal number of participants (thirty-two each). The computer monitor in front of each participant had specific instructions on it (Appendix B). They were asked to read over the instructions and familiarize themselves with them. The experimenter then read the instructions aloud making sure there were no questions about what they were to do.

Materials

The study required a number of hardware and software components. The hardware included Dell computers with flat-screen monitors and keyboards. Software components included a computerized version of the International Affective Picture System (I-APS) (Lang, Ohman & Vaitl, 1988) from which stimulus pictures used in the study were carefully selected based on high validated measures of valence and arousal; SuperLab Pro (Cedrus Corporation, 1989), which was programmed to run the computer task; Microsoft Excel, which recorded the data into a database; and Stat View to complete the final analysis of the data.

The I-APS (pronounced Eye-Aps) is a collection of pictorial stimuli which have been internationally rated on valence and arousal via the Self Assessment Manikin (SAM) (Lang, Bradley, Cuthbert, 2001)). Each picture in the I-APS was given an identification number by its creators and the numbers of the pictures used may be viewed in Appendix C. The SAM is based on a 9 point rating scale, where 1 represents low valence or arousal, and 9 represents high valence or arousal. Each picture used in the present study received mean ratings between 6 and 8 on valence and arousal. Forty words, gathered from a previous study in our laboratory (Hedreen,

submitted for publication), were selected for use in this study based on their mean ratings of imagery, emotionality and frequency of encounter. Ratings were collected in a similar fashion as the ratings of the pictures in the I-APS. These ratings were gathered based on a 1-7 rating scale. A rating of one was considered low, and seven high. The words were then divided based on their matched mean rating of imagery, emotionality and frequency of encounter into four categories Sex-High, Sex-Low, Neutral-High and Neutral-Low. The words used in the present study were from the Sex-High and Neutral-High categories. This was done so that pictures and words were both chosen based on their high ratings.

A Dell computer monitor was used for stimulus presentation. The computer used Microsoft Excel to collect data from participants' answers to stimuli presented by SuperLab Pro (Cedrus Corporation, 1989) . All pictures were presented at the same size, 540 pixels across by 303 pixels high, 96 dpi, in the center of the computer monitor on a white background. The words were presented, superimposed, on top of the picture, in bright green New Times Roman, size 50 font. The color green was used because it was easily seen when superimposed on top of all pictures. SuperLab Pro (Cedrus Corporation, 1989) was programmed to record the decision times on all stimulus trials, accuracy of categorization, and stimulus condition. Data were later exported from SuperLab Pro to Microsoft Excel.

Procedure

Four different conditions of compound picture-word stimuli were presented: Non-Sexual picture + Non-Sexual word (congruent), sexual picture + sexual word (congruent), Non-Sexual picture + sexual word (non-congruent), sexual picture + Non-Sexual word (non-congruent). The picture stimuli, sexual in nature, depict intimate/erotic acts, most involving nude female models or heterosexual couples engaged in oral or genital sexual activity (Figure 1).

Once participants were seated in front of the computer monitor, and after participants consented to participate, they were asked to read and familiarize themselves with the instructions presented on the computer monitor in front of them. Then the experimenter read the instructions aloud for them and made sure there were no questions about what they were to do.

Both instruction groups were presented the same 40 trials, in a randomized order, controlled by the SuperLab Pro (Cedrus Corporation, 1989) software program. Slides contained compound stimuli: a word superimposed on a picture. The word-categorization group was instructed to categorize only the word presented in the compound stimulus as either Non-Sexual or sexual in nature. Participants were asked to respond as quickly and as accurately as possible using the alphanumeric key pad on the computer keyboard. Instructions were to use the #1 key for categorizing Non-Sexual words, and the #3 key was used to categorize sexual words. The picture-categorization group was given the same instructions, except they were instructed to categorize only the picture, not the word, using the alphanumeric keypad using the #1 key for categorizing Non-Sexual pictures and the #3 key for categorizing sexual pictures.

Non-Sexual Picture + Non-Sexual Word



Non-Sexual Picture + Sexual Word



Sexual Picture + Non-Sexual Word



Sexual Picture + Sexual Word



FIGURE 1: Examples of the four stimuli complexes presented in the picture-word-categorization task.

The experimenter then asked the participants to press the #1 key on the alphanumeric keypad to advance the program to the first example slide. The first example slide was intended to familiarize participants with the stimuli they would be presented during the course of the experiment. The experimenter reminded the participants to categorize only the word or picture, depending on the specific instructions given to them, as quickly and accurately as possible. Each trial was preceded by a white screen containing a green asterisk in the center of the computer monitor. The first example slide contained only Non-Sexual material (both word and picture were Non-Sexual). Participants were asked to categorize the example as they would if it were presented to them during the course of the task. Their response brought a green asterisk to the center of the computer monitor, which preceded the second example slide. The second example was presented for the same reason as the first; however, this example contained explicit sexual material. Participants were again asked to respond on the keypad, based on their specific instructions, as they would during the task. Participants were informed that after responding to the second example trial the task would begin, and their response times would be recorded.

The two example trials were not included in the final data analysis. The presentation of the stimulus ended at the time of the participant's response, and the green asterisk again appeared in the center of the computer monitor, signaling the beginning of the next trial. Decision times to categorize each trial, accuracy of the answer for each trial, and each trial stimulus condition were recorded by SuperLab Pro (Cedrus Corporation, 1989) in a Microsoft Excel file.

Study Design

A between-subjects 2 X 4 factorial design, with repeated measures on the second variable (stimulus condition) was implemented. The two levels of the first independent variable were the two different instruction type groups. Subjects were randomly assigned to either the word-categorization instruction group or the picture-categorization instruction group. The four levels of the second independent variable were the four stimulus conditions: Non-Sexual picture + Non-Sexual word (congruent), sexual picture + sexual word (congruent), Non-Sexual picture + sexual word (non-congruent), sexual picture + Non-Sexual word (non-congruent). The dependent variable was the reaction time to categorize the target stimulus. A mixed-design ANOVA was used to analyze the reaction time to categorize the complex stimuli from the first experiment in this study.

RESULTS

Data were analyzed for 64 subjects. The overall mean reaction time for the picture-categorization instruction group (N = 128) was M = 1122.062 ms (SE = 46.672), and the overall mean reaction time for the word-categorization instruction group was (N = 128) M = 1205.233 ms (SE = 43.988). An ANOVA showed that these reaction times were not significantly different between instruction groups [$F(1, 254) = 1.682$, $\underline{p} = .1959$] (Figure 2).

A repeated measures, 2 (instruction type) X 4 (compound stimulus type) mixed design ANOVA was conducted assessing the effect of instruction type on the reaction time data for each compound stimulus type. There was no overall effect of instruction type [$F(1, 62) = .480$, $\underline{p} = .4911$] on RT ; however, an effect was found for compound

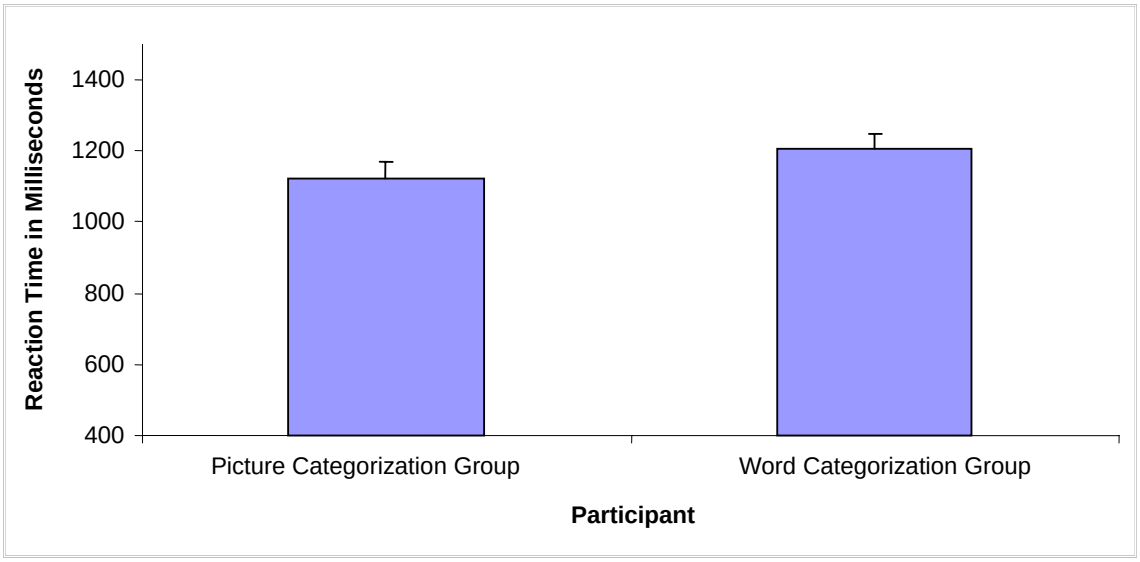


FIGURE 2: Overall Reaction Time To Categorize: Between Instruction Groups The figure above shows that total reaction time for the picture-categorization instruction group (N = 128, M = 1122.062 ms, SE = 46.672) and the word-categorization instruction group (N = 128, M = 1205.233 ms, SE = 43.988) were not significantly different [$F(1, 254) = 1.682$, $\underline{p} = .1959$]

Error Bars: ± 1 Standard Error

stimulus type [F(3, 186) = 3.970, p = .0090] such that there was a significant difference in reaction times to categorize across compound stimulus type (Figure 3), and an interaction was found between compound stimulus type and instruction type [F(1, 3) = 4.452, p = .0048] (Figure 4).

Unpaired t-tests indicated no significant difference between instruction type and reaction time to categorize each compound stimulus type. There was an indication toward a trend for those participants in the Word-Categorization group who (N = 32; M = 1349.322, SE = 109.549) categorized the Sexual Picture (Distracter) + Non-Sexual Word (Target) compound stimulus slightly slower than the picture-categorization group (N = 32; M = 1125.966, SE = 97.851; t = -1.521, p = .1334) (Figure 4).

One-way ANOVAs, were conducted to assess differences in reaction times to each compound stimulus type within each of the two instruction groups. The results show that there was no significant difference in reaction times to categorize the compound stimuli within the picture-categorization instruction group [F(3, 31) = .188, p = .9043] (Figure 5). However, there was a significant difference in reaction times to categorize the compound stimuli within the word-categorization instruction group [F(3, 31) = 5.996, p = .0009].

Paired t-tests showed that when participants were instructed to categorize only the word element of each compound stimulus, the compound stimulus consisting of a Sexual Picture (Distracter) + Non-Sexual Word (Target) produced significantly slower categorization times (M = 1349.322 ms, SE = 109.549) than any of the other three compound stimulus types: Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) (M = 1224.106, SE = 89.659; t = 2.003, p = .0540); Sexual Picture (Distracter) + Sexual Word (Target) (M = 1148.622, SE = 85.032; t = -

4.515, $p < .0001$); and the Non-Sexual Picture (Distracter) + Sexual Word (Target) (M = 1098.881, SE = 57.350; t = 3.014, $p = .0051$).

The compound stimulus consisting of a Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) (M = 1224.106 ms, SE = 89.659) was found to produce significantly slower reaction times than the compound stimulus consisting of a Non-Sexual Picture (Distracter) + Sexual Word (Target) (M = 1098.881 ms, SE = 57.350; t = 2.084, $p = .0455$), but not from the compound stimulus consisting of a Sexual Picture + Sexual Word (M = 1148.622, SE = 85.032; t = -1.203, $p = .2382$) (Figure 6).

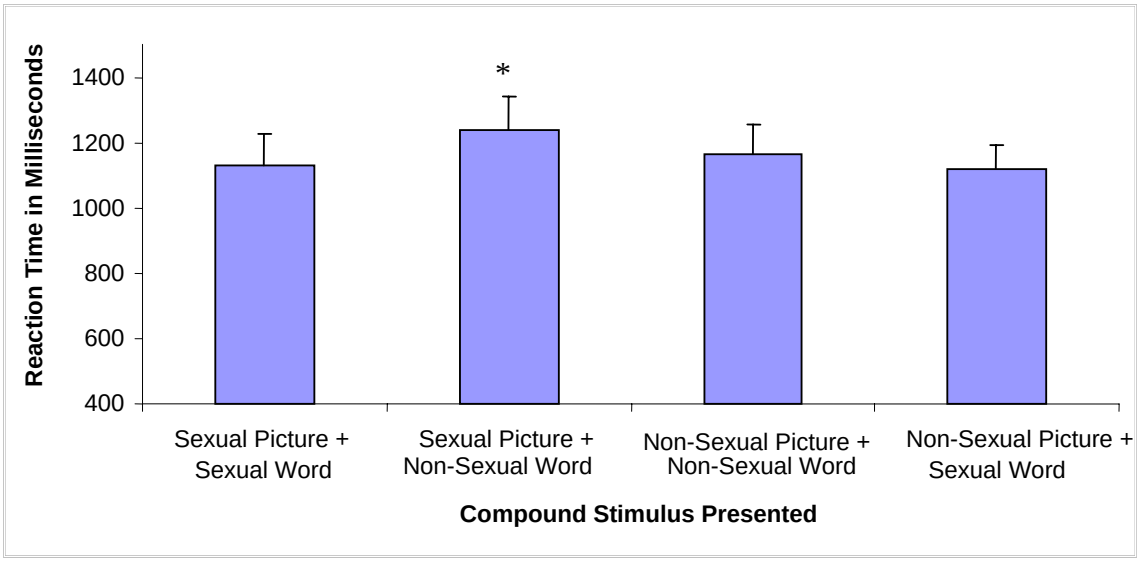


FIGURE 3: The figure above shows ANOVA results indicating a significant effect for compound stimulus type [$F(3, 186) = 3.970$, $\underline{p} = .0090$].

Error Bars: ± 1 Standard Error

*$p < .01$

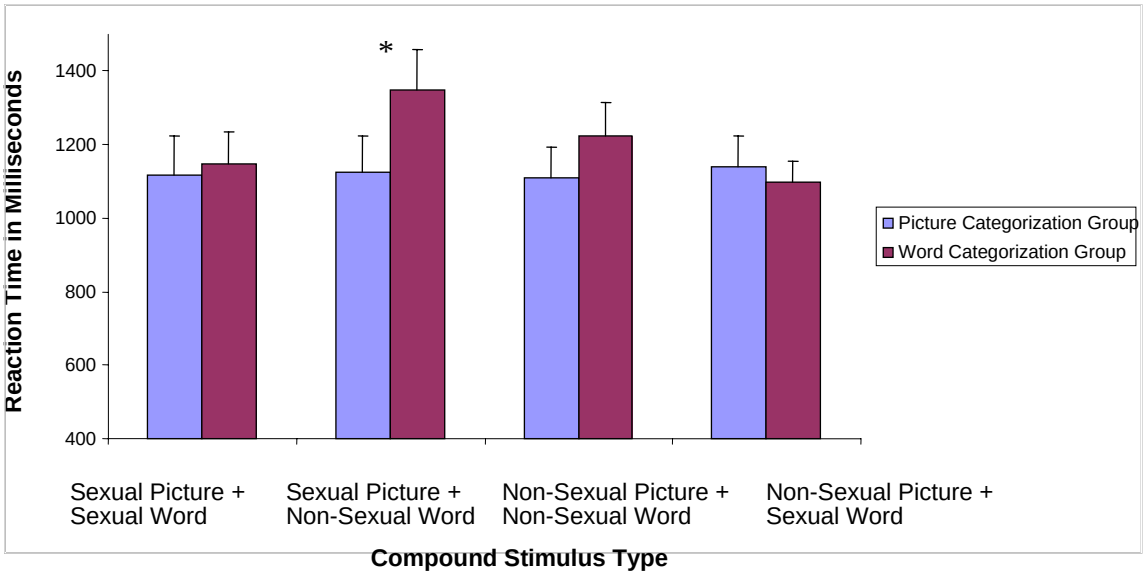


FIGURE 4: The figure above shows ANOVA results that indicate an interaction found between compound stimulus type and instruction type [$F(1, 3) = 4.452$, $\underline{p} = .0048$]. Unpaired t-tests showed no significant difference between instruction type and reaction time to categorize each compound stimulus; however a trend did occur suggesting that the Word-Categorization Instruction Group (N = 32; M = 1349.322, SE = 109.549) took longer to categorize the Sexual Picture (Distracter) + Non-Sexual Word (Target) compound stimulus than the Picture-Categorization Instruction Group (N = 32; M = 1125.966, SE = 97.851; t = -1.521, $\underline{p} = .1334$.

Error Bars: ± 1 Standard Error

*$p < .01$

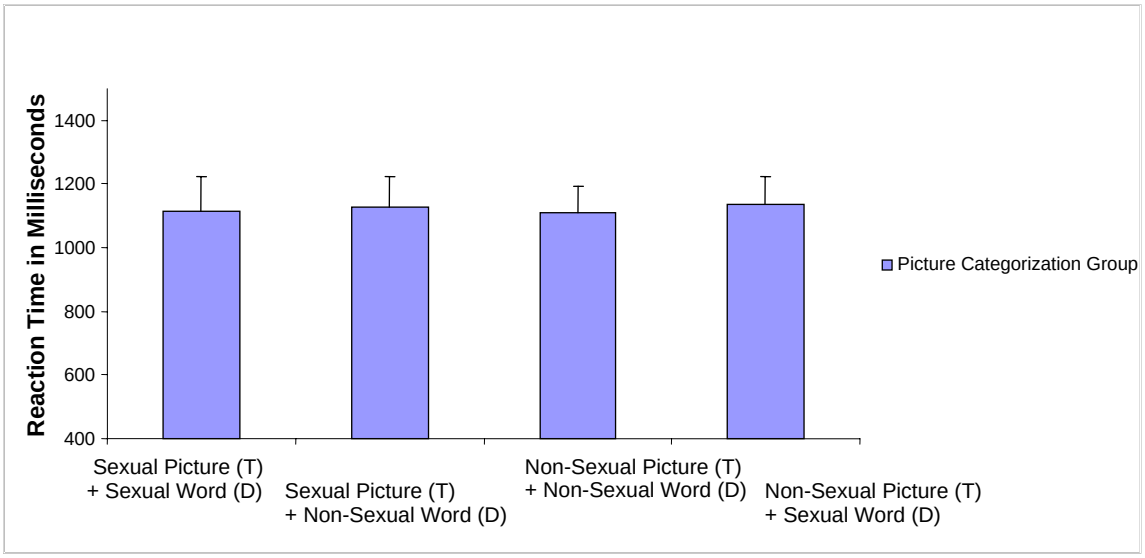


FIGURE 5: The results show that when participants were instructed to categorize only the picture element of each compound stimulus there were no significant differences in reaction times [$F(3,31) = .188$, $\underline{p} = .9043$].

Error Bars: ± 1 Standard Error

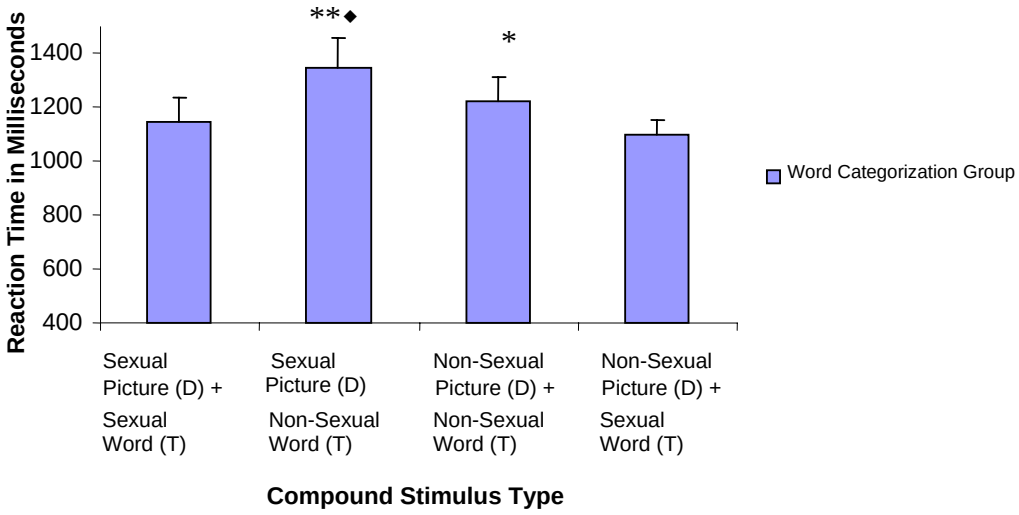


FIGURE 6: The results above show that there was an effect of compound stimulus type within the word-categorization instruction group [$F(3, 31) = 5.996$, $\underline{p} = .0009$]. Participants responded with significantly slower reaction times to the Sexual Picture (D) + Non-Sexual Word (T) compound stimulus (M = 1349.322 ms, SE = 109.549) than any of the other three compound stimulus types: Non-Sexual Picture (D) + Non-Sexual Word (T) (M = 1224.106, SE = 89.659; $t = 2.003$, $\underline{p} = .0540$); Sexual Picture (D) + Sexual Word (T) (M = 1148.622, SE = 85.032; $t = -4.515$, $\underline{p} < .0001$); and the Non-Sexual Picture (D) + Sexual Word (T) (M = 1098.881, SE = 57.350; $t = 3.014$, $\underline{p} = .0051$) . The compound stimulus consisting of a Non-Sexual Picture (D) + Non-Sexual Word (T) (M = 1224.106 ms, SE = 89.659) was found to produce significantly slower reaction times than the compound stimulus consisting of a Non-Sexual Picture (D) + Sexual Word (T) (M = 1098.881 ms, SE = 57.350; $t = 2.084$, $\underline{p} = .0455$), but not from the compound stimulus consisting of a Sexual Picture + Sexual Word (M = 1148.622, SE = 85.032; $t = -1.203$, $\underline{p} = .2382$).

"T": used to indicate the participant's target. "D": used to indicate the participant's distracter.

**$\underline{p}$ = < .01 = significantly different from Sexual Picture (D) + Sexual Word & Non-Sexual Picture + Sexual Word

◆$\underline{p}$ = < .05 = significantly different from Non-Sexual Picture + Non-Sexual Word

Error Bars: ± 1 Standard Error

METHOD

TASK 2: INCIDENTAL RECOGNITION TASK (IRT)

DV: Recognition Accuracy for Target and Distracter Items From the Categorization Task

Procedure

The picture-word Stroop task, was followed by an incidental recognition task (to assess incidental, automatic learning) was given to all participants, regardless of instruction group. All participants were randomly presented the same trials, which consisted of single pictures on some trials and single words on others. Participants were instructed (Appendix D) to press the #1 key on the alphanumeric key pad if they believed that they had seen the stimulus in the previous categorization task, and the #3 key if they believed that they had not seen the stimulus in the previous categorization task.

The recognition task consisted of 80 randomly presented trials. Four different types of stimuli were presented to each participant. Ten of the trials were of sexual words that had been shown in the categorization task, and ten of the trials were of sexual words that had not been shown. Ten of the trials were of sexual pictures that had been shown in the categorization task and ten of the trials were of sexual pictures that had not been shown. Ten of the trials were of Non-Sexual words that had been shown in the categorization task, and ten of the trials were of Non-Sexual words that had not been shown. Ten of the trials were of Non-Sexual pictures that had been shown in the categorization task, and ten of the trials were of Non-Sexual pictures that had not been shown in the categorization task. All novel stimuli presented, words and pictures, were matched on the same ratings used in the categorization task. Participants indicated, on the keypad whether they had or had not seen the stimuli before. Participants were informed that, unlike the categorization task, this task was not timed.

HYPOTHESES

An incidental recognition test was administered as a follow up measure to assess the extent of cognitive processing for Non-Sexual versus sexual material, as both targets and distracters. The incidental recognition task was not only used to determine if sexual material is processed more deeply than Non-Sexual material, but to directly measure the unconscious, automatic processes theoretically associated with the distracter information.

The present study predicted that between those who were in the Picture-Categorization Instruction Group and those who were in the Word-Categorization Instruction Group recognition accuracy for certain stimuli would differ. (1) Those that were in the Picture-Categorization Instruction Group were predicted to recognize Non-Sexual pictures better than those who were in the Word-Categorization Group. In addition, (2) those who were in the Word-Categorization Instruction Group were predicted to recognize Non-Sexual words better than those who were in the Picture-Categorization Group.

Within instruction groups predictions were as follows: (3) It was predicted that those participants previously in the Word-Categorization Instruction Group would recognize target sexual words significantly better than target Non-Sexual words, and that (4) sexual picture distracters would be recognized significantly better than Non-Sexual picture distracters. (5) It was also predicted that sexual picture distracters would be recognized with significantly better accuracy than Non-Sexual word targets.

It was predicted that those participants previously in the (6) Picture-Categorization Instruction Group would recognize sexual pictures and Non-Sexual pictures better than sexual words and Non-Sexual words, and (7) sexual pictures would be recognized with greater accuracy than Non-Sexual pictures.

RESULTS

A repeated measures, 2 (instruction type) X 4 (stimulus type) mixed design ANOVA was conducted assessing the effect of instruction type on the recognition accuracy for each stimulus type. There was no overall effect of instruction [$F(1, 62) = .361$, $p = .5500$]; however, there was an effect for the type of stimulus recognized [$F(3, 186) = 36.031$, $p < .0001$], and an interaction between the type of stimulus recognized and the instruction group from the categorization task [$F(1, 3) = 21.003$, $p < .0001$] (Figure 7). The overall recognition accuracy did not differ between the two instruction groups. However, there was evidence that stimuli were recognized with significantly different accuracy. Within the two Categorization-Instruction Groups there were significant differences in recognition of certain stimuli.

Taking into account that participants were given different sets of instructions in the categorization task, recognition data were further analyzed with unpaired t-tests. Performance on this task was based on a 50% chance rate.

Between instruction groups, differences in stimulus recognition were found. Participants who were in the Picture-Categorization Instruction Group recognized Non-Sexual pictures (targets) significantly better ($M = 84.5\%$, $SE = .028$) than participants who were in the Word-Categorization Instruction Group ($M = 68\%$, $SE = .024$), who had been presented Non-Sexual pictures as distracters ($t = 4.471$, $p < .0001$) (Figure 8).

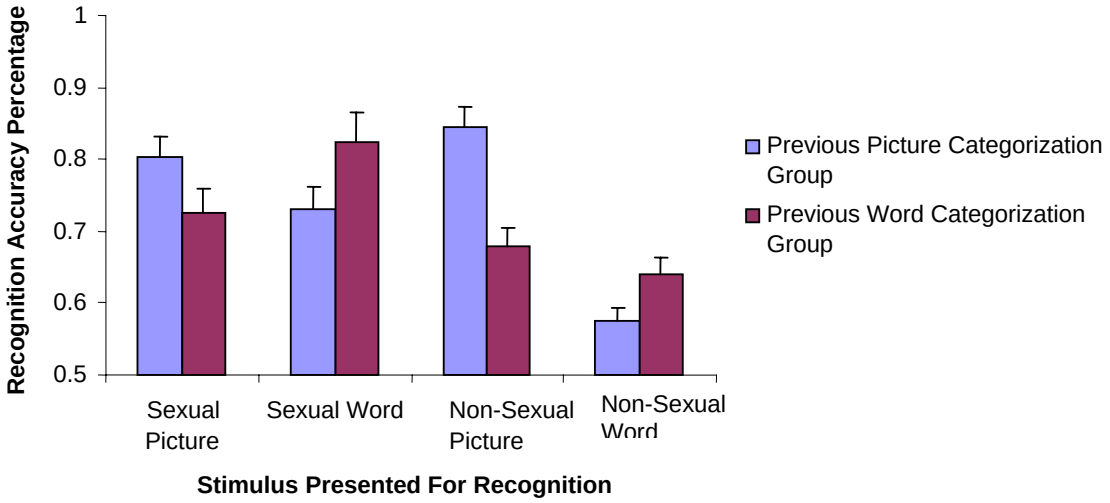


FIGURE 7: The figure above shows that there was no overall effect of instruction [$F(1, 62) = .361$, $\underline{p} = .5500$]; however, there was an effect for the type of stimulus recognized [$F(3, 186) = 36.031$, $\underline{p} < .0001$], and an interaction between the type of stimulus recognized and the instruction group from the categorization task [$F(1, 3) = 21.003$, $\underline{p} < .0001$].

Error Bars: ± 1 Standard Error

*$\underline{p} < .01$

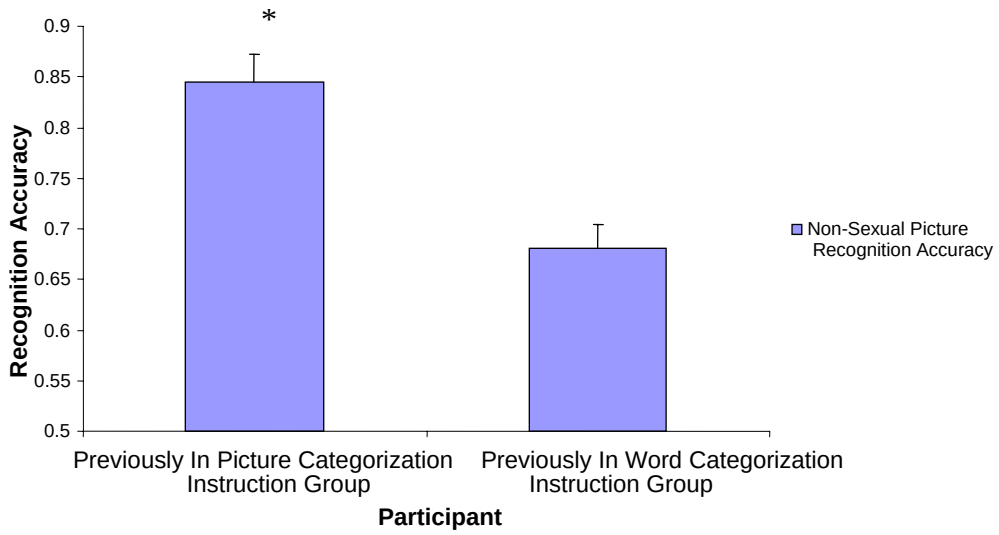


FIGURE 8: Unpaired t-test. The results above show that when the participant had previously been instructed to categorize pictures as targets in the first task, Non-Sexual pictures are recognized significantly better (M = 84.5%, SE = .028) than Non-Sexual pictures previously been presented as distracters (M = 68%, SE = .024), as in the word categorization instruction group ($t = 4.471$, $p < .0001$).

Error Bars: ± 1 Standard Error
*$p < .01$

Participants who were in the Word-Categorization Instruction Group recognized Non-Sexual words significantly better (M = 64.1%, SE = .022) than participants who were in the Picture-Categorization Instruction Group (M = 57.5%, SE = .017), where Non-Sexual words were presented as distracters (t = -2.391, p = .0198) (Figure 9).

The instruction condition did not significantly affect recognition of sex words. Participants who were in the Word-Categorization Instruction Group did not recognize sexual words significantly better (M = 82.5%, SE = .040) than participants who were in the Picture-Categorization Group, who had previously been presented sexual words as distracters (M = 73%, SE = .031), (t = -1.893, p = .0630) (Figure 10). Likewise, participants who were in the Picture-Categorization Instruction Group did not recognize sexual pictures significantly better (M = 80.2%, SE = .030) than participants who had previously been presented sexual pictures as distracters (M = 72.5%, SE = .034) (t = 1.689, p = .0962) (Figure 11). These findings suggest that sexual information is processed just as deeply, whether presented as targets or distracters.

Paired t-tests also showed that participants who were previously instructed to categorize pictures, recognized target Non-Sexual pictures better (M = 84.5%, SE = .028) than target sexual pictures (M = 80.2, SE = .030) (t = -2.092, $\underline{p}$ = .0447). They also recognized target Non-Sexual pictures (M = 84.5%, SE = .028) significantly better than distracting Non-Sexual words (M = 57.5%, SE = .017) (t = 10.732, $\underline{p}$ <.0001). Target Non-Sexual pictures were recognized significantly better (M = 84.5%, SE = .028) than distracting sexual words (M = 73%, SE = .031) (t = -4.442, $\underline{p}$ = .0001) and target sexual pictures were recognized (M = 80.2%, SE = .030) significantly better than distracting sexual words (M = 73%, SE = .031) (t = 2.597, $\underline{p}$ = .0142).

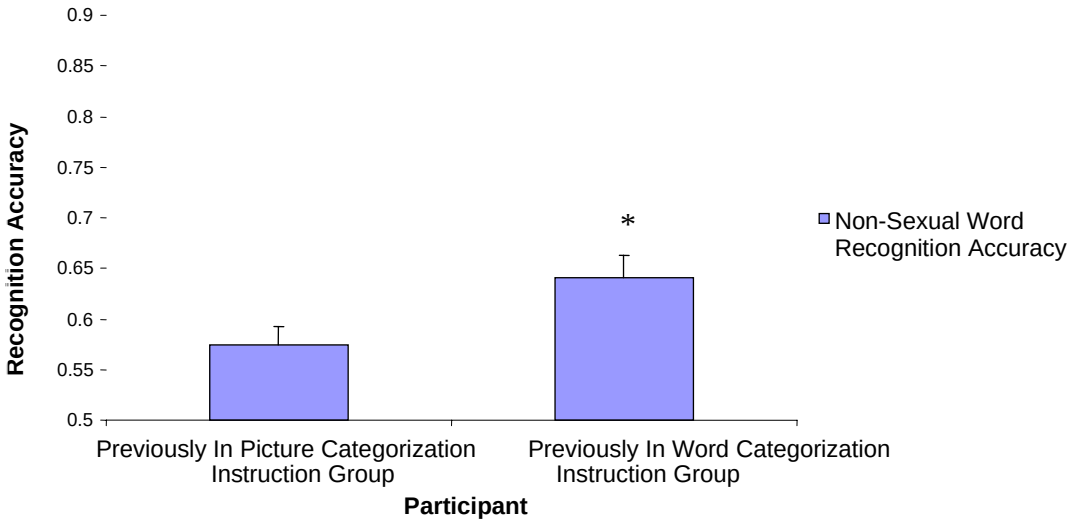


FIGURE 9: Unpaired t-test. The results above show that when participants had previously been instructed to categorize words as targets in the first task, Non-Sexual words were recalled significantly better (M = 64.1%, SE = .022) than Non-Sexual words which had previously been presented as distracters (M = 57.5%, SE = .017), as in the picture categorization instruction group (t = -2.391, $\underline{p}$ = .0198)

Error Bars: ± 1 Standard Error
*$\underline{p}$ < .05

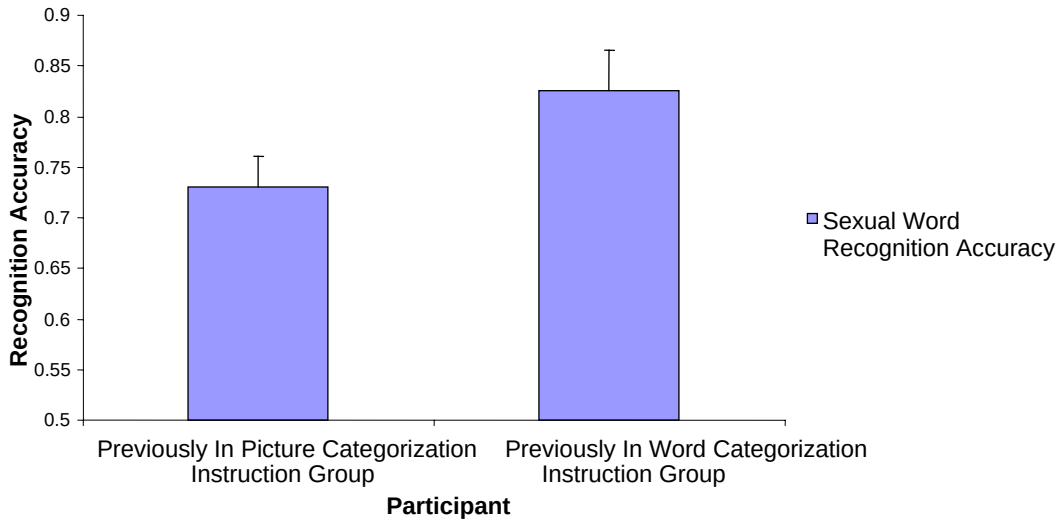


FIGURE 10: Unpaired t-test. The results above show that when participants had previously been instructed to categorize words as targets in the first task, sexual words were not recognized significantly better (M = 82.5%, SE = .040) than sexual words which had previously been presented as distracters (M = 73%, SE = .031), as in the picture categorization instruction group ($t = -1.893$, $\underline{p} = .0630$).

Error Bars: ± 1 Standard Error

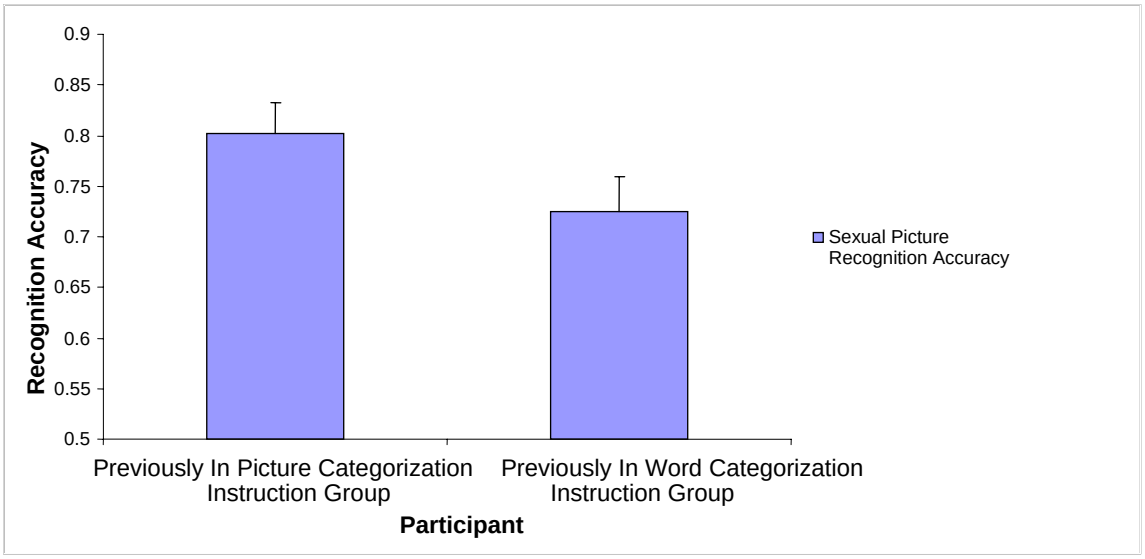


FIGURE 11: Unpaired t-test. The results above show that when participants had previously been instructed to categorize pictures as targets in the first task, sexual pictures were not recognized significantly better (M = 80.2%, SE = .030) than sexual pictures which had previously been presented as distracters (M = 72.5%, SE = .034), as in the word categorization instruction group.

Error Bars: ± 1 Standard Error

Participants also recognized target sexual pictures (M = 80.2%, SE = .030) significantly better than distracting Non-Sexual words (M = 57.5%, SE = .017) (t = -2.092, p <.0001). Distracting sexual words (M = 73%, SE = .031) were recalled significantly better than distracting Non-Sexual words (M = 57.5%, SE = .017) (t = 5.528, p <.0001) (Figure 12).

On the other hand, those participants who were in the Word-Categorization Instruction Group recognized target sexual words significantly better (M = 82.5%, SE = .040) than target Non-Sexual words (M = 64.1%, SE = .022) (t = 6.424, p <.0001). They also recognized target sexual words significantly better (M = 82.5%, SE = .040) than distracting sexual pictures (M = 72.5%, SE = .034) (t = -4.100, p = .0003). Target sexual words were recognized significantly better (M = 82.5%, SE = .040) than distracting Non-Sexual pictures (M = 68%, SE = .024) (t = 4.442, p = .0001). Target Non-Sexual words were recognized significantly worse (M = 64.1, SE = .022) than distracting sexual pictures (M = 72.5%, SE = .034) (t = 2.913, p = .0066). However, the recognition accuracy of distracting sexual pictures (M = 72.5%, SE = .034) and distracting Non-Sexual pictures (M = 68%, SE = .024) did not differ (t = 1.832, p = .0766) (Figure 13). Moreover, the recognition accuracy of target Non-Sexual words (M = 64.1%, SE = .022) and distracting Non-Sexual pictures (M = 68%, SE = .024) did not differ (t = 1.631, p = .1129) (Figure 13).

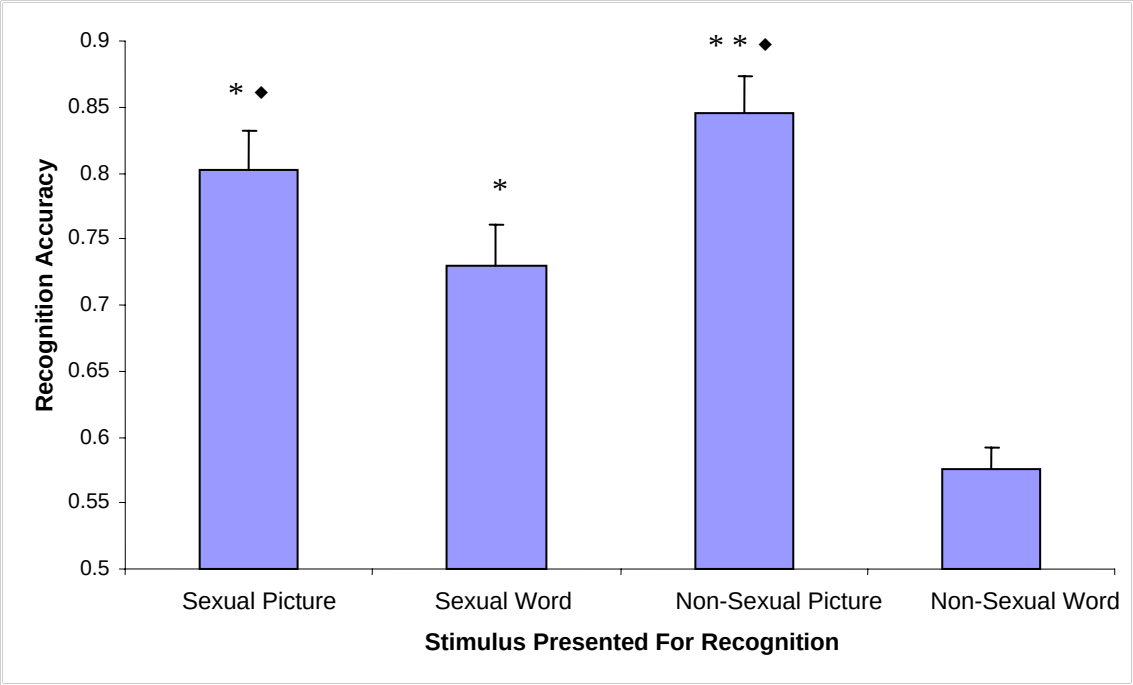


FIGURE 12: Paired t-tests of Recognition Data: Picture-Categorization Instruction Group. Non-Sexual picture recognition accuracy was superior to all of the other three stimuli. Sexual picture recognition accuracy was superior to that of Non-Sexual Word recognition, and Sexual Word recognition. Sexual Word recognition was superior to Non-Sexual Word recognition accuracy. Non-Sexual Word recognition accuracy was significantly worse than the other three stimuli.

*p = < .01
◆p = < .05

Error Bars: ± 1 Standard Error

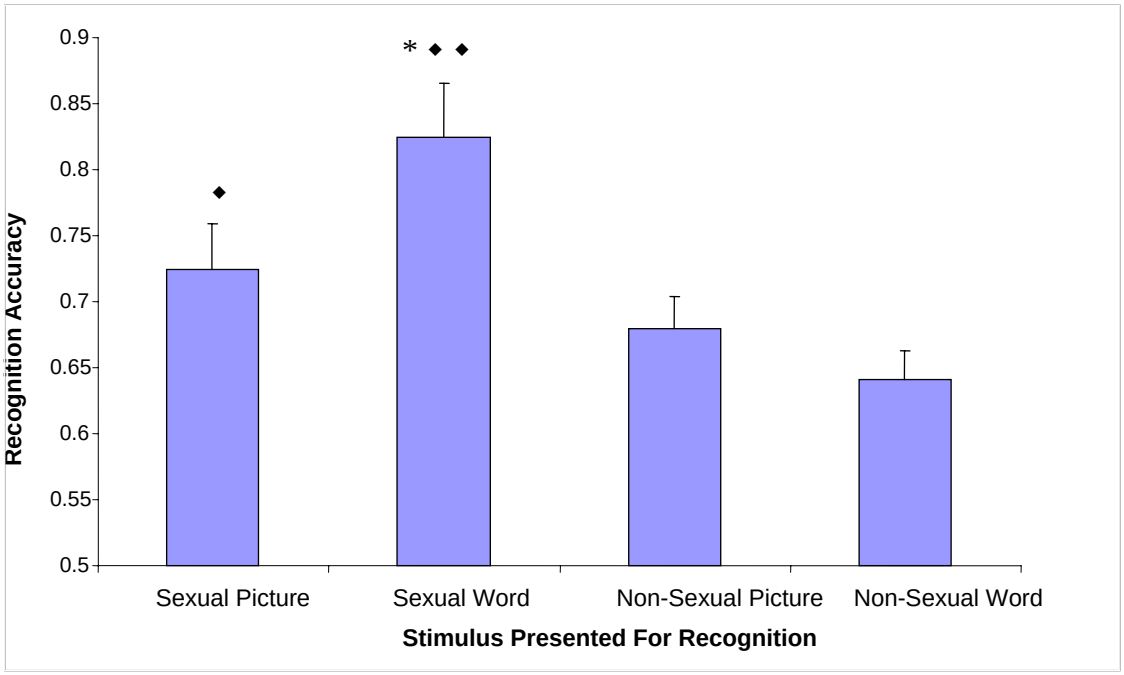


FIGURE 13: Paired t-tests or Recognition Data: Word-Categorization Instruction Group. Sexual word recognition accuracy was superior to the other three stimuli. Sexual picture recognition accuracy was superior to Non-Sexual Word recognition accuracy, but not Non-Sexual Picture, or Sexual Word recognition accuracy. Non-Sexual Picture and Non-Sexual Word recognition accuracy were not significantly different.

*$\underline{p}$ = < .01
◆$\underline{p}$ = < .05

Error Bars: ± 1 Standard Error

DISCUSSION

Harold Pashler (1994) stated that "overloading a system is often one of the best ways to figure out what the parts of the system are, and how these parts function together." Along this line of thinking, cognitive tests addressing attention and the role that interference plays in the attentional process have been formed. In other words, many cognitive tests systematically overload the human brain in attempts to understand how attentional processes work. This has been done in laboratory settings by controlling the types of stimuli presented to participants and measuring which type(s) of stimuli are attended to most often and which are attended to less often.

Kohler (1976) found that participants will attend longer to material that is motivating and interesting. The present study, based on earlier literature, has assumed that sexual material is motivating and interesting material for normal male populations, 18 years of age or older (Wright & Adams, 1999).

Sexual Content Induced Delay (SCID) (Geer & Melton, 1997) is defined as "a hesitancy in decision making due to the presence of sexual/erotic material." Female participants have consistently shown the SCID effect in studies which have used words as stimuli. Male subjects have not produced this effect with word stimuli, only a trend toward the same performance as females was found. Not until recently have studies found the SCID effect in male subjects. This may be due to a variety of reasons. One of these reasons is that male subjects tend to be more aroused by visual stimuli versus word or letter stimuli (Geer, 1993). Males also show better memory for explicit sexual material versus romantic or non-sexual material, whereas females show better memory for romantic material versus explicit sexual or non-sexual material (Geer & Lapour, 1990; Geer & McGlone, 1990). Researchers have explained that males and females

process sexual information differently (Geer, 1991; Geer & McGlone, 1990; Geer & Lapour, 1990). Now that visual stimuli are being used, evidence for the SCID effect has been found in male subjects (Speiring, 2002).

This study addressed the differential processing of pictures and words, and sexual material and non-sexual material in male subjects. The purpose of the study was to address two main questions. The first was an attempt to explain what attentional biases mean. Do they indicate more or less cognitive processing of stimuli? The other question addressed the issue of whether sexual material is processed at a deeper cognitive level than non-sexual material.

A Picture-Word Stroop task was used, in which pictures were presented with words superimposed on them. Non-sexual and explicit sexual pictures, as well as non-sexual and explicit sexual words were used, creating four different complex stimuli: Sexual Picture + Sexual Word, Sexual Picture + Non-Sexual Word, Non-Sexual Picture + Non-Sexual Word, and Non-Sexual Picture + Sexual Word. Participants were randomly assigned to one of two categorization instruction groups: the Word-Categorization Instruction Group, or the Picture-Categorization Instruction Group.

Based on past literature which has found incongruent picture distracters to cause longer reaction times to categorize word targets (Smith & Magee, 1980), and no interference of incongruent word distracters causing longer reaction times to categorize targets picture, (1) the first hypothesis predicted that there would be a significant overall difference in mean reaction time to categorize target stimuli between the two instruction groups. It was expected that the Word-Categorization Instruction Group would produce longer overall mean reaction times to categorize target words in the presence of distracting pictures than the Picture-Categorization Instruction Group would to categorize target pictures in the presence of distracting words. On

the contrary, it was found that overall mean reaction time for the Picture-Categorization Instruction Group and the Word-Categorization Instruction Group were not significantly different.

The predictions made within the instruction groups are as follows:
Based on Stroop literature, within the Picture-Categorization Instruction Group, distracting words were predicted to not interfere with the categorization of target pictures, (2) it was predicted that neither distracting sexual words, nor distracting Non-Sexual Words will interfere with the categorization of target sexual pictures or target Non-Sexual Pictures. However, it was thought that if the target picture was sexually explicit, it would take subjects significantly longer to categorize it than to categorize a target Non-Sexual Picture. This prediction is in accordance with the Stroop literature indicating that distracting words do not interfere with the categorization times of target pictures, and in accordance with the SCID literature, which indicates that the presence of erotic material causes a hesitancy in decision making. However, it does contradict the SCID literature which would predict that the presence of a sexually explicit distracter word would cause a hesitancy in decision making. (3) Thus, the prediction was that the reaction times to categorize the Sexual Picture (Target) + Sexual Word (Distracter) would not be significantly different than from the Sexual Picture (Target) + Non-Sexual Word (Distracter). However, the Sexual Picture (Target) + Sexual Word (Distracter), and the Sexual Picture (Target) + Non-Sexual Word (Distracter) were both predicted to take longer to categorize than the Non-Sexual Picture (Target) + Non-Sexual Word (Distracter) and the Non-Sexual Picture (Target) + Sexual Word (Distracter).

It was found that there was no difference in reaction times to categorize the compound stimuli within the picture-categorization instruction group. Distracting sexual and Non-Sexual

Words did not interfere with the reaction time to categorize sexual and Non-Sexual target pictures. Target sexual pictures did not differ in reaction time from Non-Sexual target pictures.

Within the Word-Categorization Instruction Group (4) it was predicted that reaction times to categorize Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) compound stimuli would be significantly faster than all other three compound stimuli which contain it sexual material. This prediction is one that both Stroop literature and SCID literature would predict. According to Stroop literature, reaction times to categorize words would be faster due to the congruency between the picture and word; however, SCID predicts faster reaction times due to the lack of sexual material compared to the other three compound stimuli.

Results indicate that the Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) did not produce the fastest reaction times. This finding contradicts both Stroop and SCID literature. Furthermore, the fastest reaction times were produced by the Non-Sexual Picture (Distracter) + Sexual Word (Target). This finding contradicts the congruency effect normally found in Stroop tasks, as well as the fundamental basis of the SCID effect. There is no evidence of "a hesitancy in decision making related to the presence of sexual/erotic material," compared to the other three compound stimuli which contain it.

(5) The Sexual Picture (Distracter) + Sexual Word (Target) compound stimulus is predicted by Stroop literature to be categorized just as fast as the Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) compound stimulus due to the congruency between the picture and word. Given that Picture-Word Stroop literature has not reported on sexual material in this specific type of situation it is hard to make a prediction based on literature. SCID literature would predict that there would be a hesitancy in decision making due to the presence of erotic

material. The reaction time to categorize sexual words in the simultaneous presentation of sexual pictures has, to my knowledge, not been researched.

Results showed that the Sexual Picture (Distracter) + Sexual Word (Target) did not produce the slowest reaction times. In fact, it tied for the fastest reaction times with the Non-Sexual Picture (Distracter) + Sexual Word (Target). When participants were instructed to categorize target words, the Sexual Picture (Distracter) + Non-Sexual Word (Target) compound stimulus produced the slowest categorization times of any of the other stimuli.

Lastly, (6) it was predicted that those participants instructed to categorize word targets would produce slower reaction times categorizing a Sexual Picture (Distracter) + Non-Sexual Word (Target) than a Non-Sexual Picture (Distracter) + Sexual Word (Target). This prediction was made based on past literature finding that visual stimuli are more arousing for men than other types of stimuli, and that the distracting sexual picture will cause more interference between information processing systems than the distracting Non-Sexual Picture, which would result in slower reaction times.

Supporting evidence for this prediction was found. The Sexual Picture (Distracter) + Non-Sexual Word (Target) was found to not only produce slower reaction times than the Non-Sexual Picture (Distracter) + Sexual Word (Target), but slower reaction times than all other compound stimuli.

It was hypothesized that if it was the distracting sexual picture causing the longer reaction times to categorize the target Non-Sexual Word, the distracting Sexual Picture would be recognized with better accuracy than a distracting Non-Sexual Picture. Within the picture categorization instruction group, no differences in reaction time were found, therefore it was predicted that there would be no differences in the recognition accuracy between Non-Sexual

and Sexual target Pictures, as well as no difference in the recognition accuracy of Non-Sexual and Sexual distracter Words; however, the recognition accuracy for target stimuli would be better than that of distracting stimuli.

The present study addressed this issue by using an unannounced incidental recognition task. (1) The first prediction was that the recognition accuracy for certain target and distracter stimuli would differ between the two instruction groups.

Although the overall mean recognition accuracy did not differ between the two instruction groups, within the instruction groups there were significant differences in recognition accuracy of certain stimuli.

(2) It was predicted that those participants instructed to categorize target pictures would recognize Non-Sexual Pictures better than those who were instructed to categorize target words. The results indicated that participants who were instructed to categorize target pictures, recognized Non-Sexual Pictures better than those who had been instructed to categorize words.

(3) Participants who were instructed to categorize target words were predicted to recognize Non-Sexual Words better than those who were instructed to categorize target pictures. The results showed that participants who were instructed to categorize target words recognized Non-Sexual Words better than those who had been instructed to categorize pictures.

Within instruction groups predictions were that (4) those participants who were instructed to categorize target words would recognize target Sexual Words better than target Non-Sexual Words. Evidence was found to support this. However, (5) distracting Sexual Pictures were predicted to be recognized better than Non-Sexual Picture distracters, but Sexual Pictures were recognized just as well when they were distracters as when they were targets. (6) Distracting

Sexual Pictures were recognized better than target Non-Sexual Words, confirming the last hypothesis within the Word-Categorization Instruction Group.

When participants were instructed to categorize target pictures, (7) it was predicted that target Sexual Pictures and target Non-Sexual Pictures would be recognized better than distracting Sexual and Non-Sexual Words. It was found that those who had been instructed to categorize target pictures, recognized target Non-Sexual Pictures better than distracting Non-Sexual Words, distracting Sexual Words and target Sexual Pictures. Target Sexual Pictures were recognized better than distracting Sexual Words and distracting Non-Sexual Words, and distracting Sexual Words were recognized better than distracting Non-Sexual Words. However, although (8) Sexual Pictures were predicted to be recognized better than Non-Sexual Pictures, this was not the case. Non-Sexual target Pictures were recognized better than target Sexual Pictures.

In Smith and Magee's (1980) study where line-drawings of objects were used as "pictures" both the word-categorization group and the picture-categorization failed to score higher than chance on an unannounced recognition task. Recognition for distracter words was 36.5%, and memory for distracter picture recognition was 41.1% (Smith & Magee, 1980). However, the results of the present study found participant memory for most stimuli better than chance. This may be due to many differences in the intensity of the stimuli. Smith and Magee used line drawings, whereas the present study used colored images. They also did not address sexual information.

The results of the present study suggest that when participants are instructed to categorize pictures with words superimposed on them the words do not interfere with reaction times to categorize pictures. This was found to be evident across all four compound stimulus types. Distracting Sexual Words did not appear to play a role in the categorization process of pictures.

However, when participants were instructed to categorize words superimposed on pictures, the distracting quality of the pictures appears to create significant interferences in reaction times to categorize words. This is especially true in the Sexual Picture (Distracter) + Non-Sexual Word (Target) complex stimulus, and in the Non-Sexual Picture (Distracter) + Non-Sexual Word (Target) complex stimulus. This finding implies that both distracting Sexual Pictures and distracting Non-Sexual Pictures are more distracting when the target is a Non-Sexual Word; however, when the target is a Sexual Word, Sexual Picture distracters and Non-Sexual Picture distracters do not differ in their distracting effects.

Evidence for the SCID effect in male subjects was found in the Word-Categorization Instruction Group when a target Non-Sexual Word was presented with a distracting Sexual Picture. Reaction times were slowest to this particular compound stimulus; however, the Stroop effect could also account for the slowed response times due to the incongruency between the stimuli.

The findings of the recognition task indicate that when participants were previously in the Picture-Categorization Instruction Group, they recognized Non-Sexual Pictures better than any other stimulus. Sexual Pictures were also recognized with significantly better accuracy than the previous distracters, Sexual Words and Non-Sexual Words. Interestingly, although words were found not to interfere with the categorization times of pictures, previously distracting Sexual Words were recalled better than previously distracting Non-Sexual Words.

On the other hand, participants previously in the Word-Categorization Instruction Group recognized Sexual Words significantly better than any other stimulus. Sexual Pictures, previously distracters, were recalled with significantly better accuracy than Non-Sexual Pictures.

Sexual Pictures, although they were previously distracters, were recalled with significantly better accuracy than Non-Sexual Words, which were previously targets.

Attentional biases to sexual stimuli are of significant interest in the field of cognitive psychology. Many researchers believe sexual interest to be a conduit for motivation, which in turn, leads to sexual arousal. Sexual arousal has been shown to affect mood (Wright, 1999). A number of cognitive tests, such as the Stroop Color-Naming Task, a complex task of attention involving compound stimuli, have proven to be instrumental in assisting researchers with demonstrating the interference certain mood states may render on cognitive abilities (MacLeod, 1991). Anxiety and depression tend to interfere with the ability to process information efficiently (Fox, 1993; Segal, 1995). From this evidence it can be hypothesized that sexual interest, due to its motivational properties, would produce the same kind of interference in cognitive performance (Wright, 1999). In fact, Wright and Adams (1999) demonstrated this interference effect with the measurement of reaction time on a discrimination task. The study involved the presentation of slides of nude adults to participants who were instructed to, as rapidly as possible, locate the position of a dot on nude men and women, clothed men and women, and Non-Sexual images. The results reflected what they had hypothesized. Sexual interest was shown to influence cognitive processes, causing longer response times to preferred-gender stimuli (Wright & Adams, 1999). The results were seen as supporting evidence for the relationship between motivational characteristics of sexual interest and cognitive processes. The Sexual Content-Induced Delay (SCID) indicates that there is a "hesitancy in decision making related to erotic material." Previous studies have reflected SCID effects in categorization tasks where sexual and Non-Sexual Pictures were used. A delay to the recognition of sexual primes was found, but only when the sexual system of the participant had already been activated, or

primed. This can be accomplished by presenting conscious sexual primes to the participant preceding the recognition task.

Spiering, et al. (2002) tested the SCID effect using a similar categorization task. They chose to make only two manipulations to the task that Geer, et al. used in 1996. The two manipulations were implemented, with intentions of better understanding the underlying processing mechanisms of the SCID. One of the manipulations was varying the instructions, and the other tested the specificity of the SCID effect by adding primes of sexual and Non-Sexual nature.

The results for Spiering's validation study found that the SCID effect only emerged under specific conditions. Participants in one condition were instructed to attend to sexual primes, and the other was instructed to ignore the primes. The SCID effect was only present when sexual primes were ignored. In contrast to what Geer, Bellard and Melton have indicated, Spiering's results show that participants actually had shorter reaction times when they were primed sexually (Spiering, Everaerd & Elzinga, 2002). The researchers concluded that the SCID can be interpreted as: "The activation of regulatory modules by emotional stimuli in the stage of elicitation of emotional response; however, when the sexual system is already activated, it appears that decisions regarding sexual information are facilitated" (Spiering, Everaerd & Elzinga, 2002).

There were limitations to this study. One limitation may be that participants were randomly assigned instruction types within testing sessions. This may have caused participant bias, such that some of the participants may have been wondering why they were categorizing one part of the stimulus while others were categorizing another. Future studies of this nature should test only one instruction type during testing sessions. Another limitation may, in fact, be

the content of the information being studied. The SCID, specifically, has only been studied for nearly a decade. Male participants have only recently been found to exhibit the phenomenon that has consistently been found in female participants; however, visual stimuli instead of words have been used. The differing predictions of the bodies of literature created an interesting but very involved analysis.

There may also be an issue of priming in the categorization task conducted in the present study. Priming may be an issue due to the fact that sexual material and visual material have been shown to access the limited amount of working memory, we as humans possess, faster than other information. Although it is not presented before the target stimulus, it may be automatically processed and therefore interfere with the task to categorize the target word.

There may have been an issue with the instructions to categorize Sexual or Non-Sexual stimuli working as a prime. This effect has been referred to as priming the sexual system, an idea that the instructions could have aroused participants, or initiated a bias for the sexual material presented. Or as Speiring et al. (2002) described, the SCID could result from the "activation of regulatory modules by emotional stimuli in the stage of elicitation of emotional response." The emotion generated by the instructions could have primed participants.

Future research may want to investigate the SCID effect when participants are under the influence of alcohol. The alcohol myopia theory states that “alcohol limits one's perceiving and thinking so as to leave one still able to respond to salient, immediate cues, but less able (than if one were sober) to respond to more peripheral cues and embedded meanings.” (Steele & Josephs, 1990). The Stroop paradigm used in the present study may be helpful in addressing the question of how distracting sexual material really is under the influence of alcohol, versus results with matched sober participants.

REFERENCES

Bradley, M.M., & Lang, P.J. (1994). Measuring emotion—the self-assessment manikin and the semantic differential. *Journal of Behavioral Therapy and Experimenta Psychiatry*, 25(1), 49-59.

Bush, S.I., & Geer, J.H. (2001). Implicit and Explicit Memory of Neutral, Negative Emotional and Sexual Information. *Archives of Sexual Behavior*, vol. 30(6), 615-631.

Catell, J.M. (1886). The time it takes to see and name objects. *Mind*, 1886, 11, 63-65.

Cedrus Corporation (1989 – 2005). *SuperLab Pro: General purpose psychology testing package.*

Cowan, N. (1995). Attention and memory: An integrated framework. New York, NY: Oxford University Press.

Dobson, K. & Dozios, D. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. *Clinical Psychology Review*, 23, 1001-1022.

Ellis, H.C., & Hunt, R.R. (1989). Fundamentals of human memory and cognition. Dubuque, IA: Wm. C. Brown Publishers.

Everaerd, W. (1995). Information processing approach and the sexual response in human studies. In J. Bancroft (Ed.). *The Pharmacology of Sexual Function and Dysfunction.* Amsterdam: Elsevier.

Fox, E. (1993). Attentional bias in anxiety: Selective or not? *Behavior Research & Therapy*, 31, 487-493.

Franken, I., Rosso, M., & van Honk, J. (2003). Selective memory for alcohol cues in alcoholics and its relation to craving. *Cognitive Theory and Research*. August vol. 27(4), 481-488.

Geer, J.H., & Fuhr, R. (1976). Cognitive Factors in sexual arousal. The role of distraction. *Journal of Consulting and Clinical Psychology*. Apr. vol. 44(2), 238-243.

Geer, J.H. (1991). Geer, J. H. (1991, July). The information processing approach in helping understand sexuality and its disorders. Paper presented at the International Congress on Stress, Anxiety, and Emotional Disorders, Braga, Portugal.

Geer, J. H., Lapour, K. (1990, June). The sexes differ in their processing of erotic, romantic, and neutral sentences. Paper presented at the American Psychological Society Annual Convention, Dallas, TX.

Geer, J. H. & McGlone, M.S. (1990). Sex differences in memory for erotica. *Cognition. Emotion*. 4: 71-78.

Geer, J.H., & Bellard, H.S. (1996). Sexual content induced delays in unprimed lexical decisions: Gender and content effects. *Archives of Sexual Behavior*, 25, 379-395.

Geer, J.H., & Melton, J.S. (1997). Sexual content induced delay with double entendre words. *Archives of Sexual Behavior*, 26, 295-316.

Geer, J. H., Lapour, K. J., & Jackson, S. R. (1993). The information processing approach to human sexuality. In N. Birbaumer & A. Ohman (Eds.), *The structure of emotion: Psychophysiological, cognitive, and clinical aspects* (pp. 139-155). Toronto: Hogrefe-Huber.

Hammers, J., & Labmber, W. (1972). Bilingual interdependencies in auditory perception. *Journal of Verbal Learning and Verbal Behavior,* 11, 303 – 310.

Hedreen, S. (submitted for publication). *Cognitive bias for sex recall*. Manuscript submitted for publication.

Janssen, E., Everaerd, W., Spiering, M., & Janssen, J. (2000). Automatic cognitive processes and the appraisal of sexual stimuli: Towards an information processing model of sexual arousal. *Journal of Sex Research*, 37, 8-23.

Keogh, E., Thompson, T. & Hannent, I. (2003). Selective attentional bias, conscious awareness and the fear of pain. *Pain*, 104, 85-91.

Kihlstrom, J.F. (1987). The cognitive unconscious. *Science*. 237. 1445-1452.

Kirsch-Rosenkrants, J., & Geer, J. H. (1991). Gender differences in memory for a sexual story. *Archives of Sexual Behavior*, 20, 295-305.

Kohler, I. (1976). Buswell's discoveries. In R.A. Monty & V.W. Senders (Eds.), *Eye movement and psychological processes* (pp. 371-395). Hillsdale, NJ: Erlbaum.

Lang, P.J., & Ohman, A., & Vaitl, D. (1988). *The International Affective Picture System [Photographic Slides]*. Gainesville: Center for Research in Psychophysiology, University of Florida.

Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (2001). International affective picture system (I-APS): *Instruction manual and affective ratings.* Technical Report A-5, The Center for Research in Psychophysiology, University of Florida.

MacLeod, C.M. (1991). Half a Century of Research on the Stroop Effect: An Integrative Review. *Psychological Bulletin*, vol.109(2), 163-203.

MacLeod, C., Matthews, A. & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, 95(1), 15-20.

MacLeod, C. & McLaughlinn, K. (1995). Implicit and explicit memory bias in anxiety: A conceptual replication. *Behaviour Research & Therapy*, 33(1), 1-14.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G. & Halker, L. (2002). Selective attention and emotional vulnerability: Assessing the casual basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology*, 111(1), 107-123.

Mogg, K., Bradley, B., Hyare, H. & Lee, S. (1998). Selective attention to food-related stimuli in hunger: Are attentional biases specific to emotional and psychopathological states, or are they also found in normal drive states? Behavioral Research & Therapy, 36, 227-237.

Pashler, H. (1994). Dual-task interference in simple tasks: Data and theory. *Psychological Bulletin*, 116, 220-244.

Posner, M.I., & Snyder, C.R.R. (1975). Attention and cognitive control. In R.L. Solso (Ed.), *Information processing and cognition: The Loyola symposium* (pp.55-85). Hillsdale: Erlbaum.

Rosen, R.C., & Beck, J.G. (1988). Patterns of sexual arousal. New York: Guilford Press.

Rosinski, R.R., Golinkoff, R.M., & Kukish, K.S. (1975). Automatic semantic processing in a picture-word interference task. *Child Development*, 46, 247-253.

Schneider, W., & Shiffrin, R.M. (1977). Controlled and automatic human information processing: Detection, search, and attention. *Psychological Review*, 84, 1-66.

Segal, Z. (1995). A priming methodology for studying self representation in major disorder. *Journal of Abnormal Psychology*, 104, 205-213.

Spector, I.P., Pecknold, J.C. & Libman, E. (2003). Selective attentional bias related to the noticiablity aspect of anxiety symptoms in generalized social phobia. *Anxiety Disorders*, 17, 517-531.

Singer, B. (1984). Conceptualizing sexual arousal and attraction. *The Journal of Sex Research*, 20, 230-240.

Smith, M.C., & Magee, L.E. (1980). Tracing the time course of Picture-Word Processing. *Journal of Experimental Psychology: General*. vol. 109(4), 373-392.

Spiering, M., Everaerd, W., & Lann, E. (2000). *Conscious processing of sexual information: Mechanisms of primary appraisal*. Manuscript submitted for publication.

Spiering, M., Everaerd, W., & Elzinga, B. (2002). Conscious processing of sexual information: Interference caused by sexual primes. *Archives of Sexual Behavior*, April v31, i2, p. 159(6).

Spiering, M., Everaerd, W. & Janssen, E. (2003). Priming the sexual system: implicit versus explicit activation. *Journal of Sex Research*, May.

Steele, C., Josephs, R. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist.* August Vol. 45(8) 921-933.

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643-662.

van Honk, J., Tuiten, A., van den Hout, M., Putman, P., de haan, E., & Stam, H. (2001). Selective attention to unmasked and masked threatening words: Relationships to trait anger and anxiety. *Personality & Individual Differences*, 30, 711-720.

Wright, L.W., Jr., & Adams, H.E. (1994). Assessment of sexual preference using a choice reaction time task. *Journal of Psychopathology and Behavioral Assessment*, 3, 221-231.

Wright, L.W., & Adams, H.E. (1999). The effects of stimuli that vary in erotic content on cognitive processes. *Journal of Sex Research*, 36, 145-151.

APPENDIX A

Informed Consent Document

You have signed up to participate in the present study we are conducting in this laboratory. Thank you for your interest and participation. We are interested in studying the information processing of various types of stimuli. Previous literature has shown that the brain may process certain types of information in different ways. In the present study we intend to address this theory by way of two different experiments. The duration of the experiment should be no longer than one hour. However, over the course of the experiments you will be presented some material that will be of a sexual or erotic nature. If you do not wish to be exposed to such material, you are free to leave without giving a reason. If you consent to participate, and during either experiment choose to terminate the session, you are free to do so by letting the experimenter know. You may, at any time, choose to terminate the session without giving a reason, and we will not ask you for one. All data gathered in the two experiments will be kept confidential. We ask that you do not provide us with your full given name at any time during the experiments, except on this consent form because you must sign it. Experimenters will only use your first name, and your data will be recorded under a participant number. Any data received during the course of the experiment will be kept confidential and separate from your informed consent document, which will be kept in a locked file cabinet until the end of the study.

Consent

In signing this form I consent to participate in the present study. I know that, at certain times in the experiments, I will be presented some material that will be of a sexual or erotic nature. I understand that all of my data will be kept completely confidential and that this informed consent form will be kept separately in a locked file cabinet until the end of the study. I also understand that I will receive class credit for my participation in the current study.

_____	_____	___/___/_____
Participant Name	Participant Signature	Date

_____	___/___/_____
Experimenter Signature	Date

APPENDIX B

Instructions presented to the Word-Categorization Group

"In a few moments an asterisk will appear in the center of the computer screen. Please focus your attention on this asterisk. The asterisk will appear in the center of the computer screen between trials, each time signaling the beginning of a new trial. The asterisk will disappear and a slide containing a word and a picture will appear. The word will be superimposed on the picture. Please attend to only the *word*.

Categorize the *word* as either sexual or neutral by pressing the key labeled "N" for words neutral in nature, and the key labeled "S" for words sexual in nature. Please do this as quickly and as accurately as possible.
Remember to attend to, and categorize the *word* only.

You will begin in a few moments."

Instructions Presented to the Picture-Categorization Group

"In a few moments an asterisk will appear in the center of the computer screen. Please focus your attention on this asterisk. The asterisk will appear in the center of the computer screen between trials, each time signaling the beginning of a new trial. The asterisk will disappear and a slide containing a word and a picture will appear. The word will be superimposed on the picture. Please attend to only the *picture*.

Categorize the *picture* as either sexual or neutral by pressing the key labeled "N" for pictures neutral in nature, and the key labeled "S" for pictures sexual in nature. Please do this as quickly and as accurately as possible.
Remember to attend to, and categorize the *picture* only.

You will begin in a few moments."

APPENDIX C

Pictorial Information Used from International Affective Picture System (IAPS)

Picture Numbers Used From IAPS:

NN: 1670, 1101, 5395, 7495, 7233, 7490, 7080, 1616, 7100, 5455 ---- "5Valence"
NS: 8160, 5390, 7036, 5740, 7190, 7640, 5875, 7095, 7236, 7503 ---- "5Valence"
SN: 4001, 4002, 4141, 4142, 4810, 4235, 4800, 4220, 4232, 4240 ---- "7Valence"
SS: 4651, 4690, 4611, 4664, 4652, 4659, 4670, 4310, 4680, 4658 ---- "7Valence"

APPENDIX D

Instructions Presented to All Participants Before the Recognition Task

"In a few moments you will be presented slides, this time containing only one stimulus. The stimulus will either be a sexual or neutral picture or a sexual or neutral word. Stimuli will only be presented for a few seconds. Please indicate on the response box whether you remember seeing the stimulus at any time during the first task. There are two keys, one labeled "Y," for yes, and the other labeled "N," for no.

You will begin in a few moments.