

Outstanding Memories: The Positive and Negative Effects of Nudes on Memory

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A picture of a nude isolated in a series of pictures of clothed models was quite memorable, but when compared with a clothed picture, the nude impaired memory for background picture details as well as pictures immediately following the nude (anterograde amnesia). Recall of details given picture-gist recall, as well as recognition of person details, were equivalent in the clothed and nude conditions. A clothed picture isolated in a series of nudes did not hurt memory for background information, nor did it produce anterograde amnesia. Apparently, distinctiveness supports good memory for the gist of the nude or clothed pictures. However, distinctiveness is not responsible for the anterograde amnesia and poor memory for background details found with nudes.

The information processing capacity of man varies from moment to moment depending upon the nature of the information being processed. The presence of a single “outstanding” event in a message may result in memory loss for other parts of the message. (Ellis, Detterman, Runcie, McCarver, & Craig, 1971, p. 361)

Detterman, Ellis, and their colleagues (Detterman & Ellis, 1972; Ellis et al., 1971) investigated memory for “outstanding” events in a series of relatively simple experiments. A picture containing male and female nudes from a sunbathing magazine was isolated in a series of black-and-white line drawings of common objects. Not surprisingly, memory for the nudes was much better than memory for a control item—approaching 100% correct. However, the presence of the nudes caused amnesia, in that memory for items immediately preceding and following the nudes was poor relative to the control condition. These researchers carefully determined the conditions under which both retrograde and anterograde amnesia would be observed in this type of experimental design. Retrograde amnesia was found only on immediate memory tests, whereas anterograde amnesia was found with various retention intervals. Longer exposures of the nude picture increased retrograde amnesia, whereas faster rates of presentation increased anterograde amnesia. In this manner, Detterman, Ellis, and their colleagues (Detterman & Ellis, 1972; Ellis et al., 1971) provided one of the few systematic investigations of when good retention of one stimulus is at the direct cost of memory for the immediately surrounding stimuli. As such, this research continues to have implications for explanations of the impact of distinctiveness on memory (e.g., Hunt & McDaniel, 1993; Schmidt, 1991) and for theories that include attention-narrowing mechanisms in memory (e.g., Christianson, 1992b; Easterbrook, 1959; Loftus, 1979; Safer,

Christianson, Aury, & Osterlund, 1998; Steblay, 1992). However, the results are open to numerous interpretations.

Detterman and Ellis (1972) cast their results in terms of explanations of the von Restorff effect, or what we today call the effects of distinctiveness (Hunt, 1995; Schmidt, 1991). Schmidt (1991) distinguished between several different types of distinctiveness that may apply to the nudes in the Detterman and Ellis experiments. With primary or contextual distinctiveness, the target material is incongruent with the immediate context (the contents of primary memory). With secondary or absolute distinctiveness, the target material is unique relative to the totality of previous experiences (the contents of long-term or secondary memory). A nude presented in a series of line drawings would fit both definitions of distinctiveness in that it is unlike the rest of the pictures and infrequent in the experience of the typical research participant. Distinctive material is often well remembered, and good memory for distinctive material sometimes occurs at the mnemonic expense of other material on the list (see, e.g., Schmidt, 1985). However, distinctive material does not typically produce anterograde amnesia (see Schmidt, 1991, for a review). For example, Rabinowitz and Andrews (1973) isolated a word printed in red in a list of words printed in black. Good recall of the isolated item was observed with no evidence of a negative impact on recall of the other list items. Perhaps anterograde amnesia is found only with material that is extremely distinctive, or outstanding.

A number of factors may have made the nudes outstanding in the Detterman and Ellis experiments. First, the nude pictures were photographs, whereas the surrounding pictures and the picture in the control condition were line drawings. Second, the nude pictures contained people, whereas the other pictures were of common objects. Schmidt (1996) provided evidence that memory for a picture of a (clothed) person is distinctive when isolated in a list of pictures of objects. Third, perhaps the participants rarely viewed nude pictures and thus the nudes were outstanding because of their low absolute frequency. Fourth, some combination of these factors may be required for an event to be truly “outstanding.”

There is yet another explanation for the Ellis et al. (1971) and the Detterman and Ellis (1972) results. Perhaps the nude pictures elicited an emotional response and the putative effects of distinc-

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tiveness were in fact the result of the impact of emotion on memory. Researchers have clearly determined that nudes are emotional stimuli that elicit increased heart rate, skin conductance, and arousal ratings (Bradley, Greenwald, Petry, & Lang, 1992; Greenwald, Cook, & Lang, 1989) relative to control pictures. In addition, several researchers have demonstrated that emotional stimuli sometimes produce anterograde amnesia (e.g., Christianson & Nilsson, 1984; Loftus & Burns, 1982) and poor memory for background information (Burke, Heuer, & Reisberg, 1992). However, some researchers have argued that good memory for emotional material should be attributed to the distinctiveness of that material, or to a von Restorff effect (Christianson & Loftus, 1987; Loftus & Burns, 1982; McCloskey, Wible, & Cohen, 1988). Determining the potent variable in the Ellis et al. (1971) and Detterman and Ellis (1972) studies may help us decide whether the impact of emotional material on memory should be attributed to the distinctiveness of that material.

Uncertainty concerning the nature of the contrast in the Detterman and Ellis studies is compounded by a lack of information regarding the exact character of participants' memory for the nudes. If lenient scoring criteria were adopted, participants may have been given credit for recall of the target pictures on the basis of their recall of the presence of nudes or people in the picture. If so, we would know that memory for the gist of the nude picture was greater than memory for the drawings, but we would not know the impact of nude pictures on memory for picture details. This scoring issue bears directly on the theoretical conclusions reached by Detterman and Ellis (1972). They argued that the nude pictures were maintained in primary memory thus preventing new material from being encoded. This hypothesis is similar to the attention-narrowing hypothesis developed by other researchers (e.g., Christianson, 1992b; Easterbrook, 1959; Loftus, 1979). Such increased attention to, or rehearsal of, the nude pictures should lead to better memory for picture details relative to the control pictures.

The experiments reported here are excerpts from a series of careful replications and extensions of the Ellis et al. (1971) and the Detterman and Ellis (1972) nude studies. Instead of using a mixture of pictures and line drawings, we used full color photographs for all the stimuli. In addition, all the pictures in the experiments reported here contained exactly one person. The first experiment provided an in-depth analysis of the impact of presenting a nude in a picture on memory for picture gist and detail. Experiment 2 provided a test of an encoding interpretation of the memory effects reported in Experiment 1. Experiment 3 determined the effects of isolating a clothed picture in a list of nude pictures on memory for picture gist and detail. Together, these studies help determine what makes a picture outstanding, what features are remembered from outstanding events, and when outstanding events produce anterograde amnesia.

Experiment 1

Direct replications of the Ellis et al. (1971) study demonstrated good memory for a nude picture isolated in a series of pictures of objects (Schmidt, 1996) and for a nude picture isolated in a series of pictures of people (Schmidt, 1997). Both investigations replicated the anterograde amnesia effects reported in the Ellis et al. (1971) and Detterman and Ellis (1972) experiments.¹ However, the Schmidt experiments failed to provide definitive evidence

concerning memory for picture details. To provide a sensitive measure of memory for person details, the recall tests in the experiments reported here included mixtures of forced-choice items (for hair color, complexion, etc.) and rating scales (for hair length and build). The recall protocols from the experiments were scored on the basis of the responses of a separate group of participants who provided normative data for perceived values of the person details.

Further evidence concerning memory for person details was acquired from a forced-choice recognition test for the target pictures. The recognition test was designed to include person details that were clearly in view in all target pictures (clothed and nude) and would be included in the participants' focus of attention. We selected two such details, hair color and skin tone. The attention-narrowing hypothesis predicted better recall and recognition of person details from the nude-target pictures than from the clothed-target pictures.

Method

Participants and design. A total of 102 students (46 men and 56 women) participated in Experiment 1 in partial fulfillment of a research requirement for an introductory psychology course. The four conditions tested differed only in the content of a target picture presented in Position 8 of a 15-item list. The target pictures contained either a male nude model (viewed by 10 men and 10 women), a male clothed model (viewed by 12 men and 14 women), a female nude model (viewed by 10 men and 16 women), or a female clothed model (viewed by 15 men and 15 women). The participants were told twice (when they volunteered and when they completed the informed-consent sheet) that the research materials were intended for adults and that some of the pictures "would be offensive to some people."

Materials and apparatus. Seven male and seven female pictures were selected to form a common list of background pictures. The color background photographs contained attractive models from various clothing catalogs and fashion magazines engaged in some easily labeled activity. The pictures were scanned in 16-bit color, edited in Adobe Photo Shop to remove text, and sized to fill the standard 480 × 640-pixel monitor. Four target pictures were created as follows. First, pictures of a male and female nude were selected and scanned. The models were similarly posed (partially reclining, leaning on the right arm) and showed full frontal nudity. These pictures were carefully cropped around the edges of the person, and the cropped nudes were pasted into separate copies of a common background. The background was a picture of a living room staged to accommodate the pictures of the models. The background contained a dark wood floor with windows at the back and five easily identifiable objects: a guitar, a plant, a music book, a telephone, and a pillow. The model was both visually and thematically central to the picture. The model was not interacting with any of the objects; thus, the objects were both visually and thematically peripheral to the scene. The clothed versions of the targets were digitally created by cutting and pasting clothes from similar models in similar poses.

Four lists were created by placing the 14 background pictures plus one of the four targets (male clothed model, male nude model, female clothed model, female nude model) into a Microsoft Power Point presentation. Our final list contained pictures that were homogeneous with respect to race (Caucasian), age (20s-mid-30s), height, and weight. The pictures, in order of presentation, can be described as follows: (a) woman pumping gas, (b) woman sitting and drinking a cup of coffee, (c) man climbing a mountain,

¹ Retrograde amnesia was neither expected nor found because we used a delayed memory test (see Ellis et al., 1971).

(d) man sitting at a computer, (e) man carrying a mountain bike, (f) woman standing at a window reading a newspaper, (g) woman exercising on a weight machine, (h) the target picture, (i) man resting on a hammock, (j) man stacking wood, (k) woman fishing, (l) woman picking apples, (m) man sitting on a bench, (n) woman playing a cello, and (o) man opening a present. The PowerPoint slideshows were recorded using a VCR connected to the video output of a computer.

The target pictures were edited to create 4 four-alternative-forced-choice recognition tests. The three altered versions of each target were made by digitally altering skin tone and hair color. The target male model had black hair, therefore his hair was changed to a dark brown. The target female model had light brown hair, and her hair was altered to dark brown. Equivalent changes were made to the pubic hair in the nude pictures. Both the males' and females' skin tones were changed to a darker, suntanned color. The forced-choice test contained all four versions of a target picture, each version filling one quarter of the screen. The four versions were as follows: the original, one with darkened skin (suntanned), one with changed hair color, and one with darkened skin and changed hair color. Electronic copies of the stimuli and test pictures are available from Stephen R. Schmidt via e-mail.

Procedure. The participants were seated in a small classroom 2.85–6.33 m from a 1.75×1.70 m video screen. They were told that they would see a series of pictures and then would be asked to remember those pictures. The room was partially darkened, and the videotapes were played through a video projector. Each picture was projected for 3 s without a detectable slide transition. Following a 5-min distractor task, the participants were directed to the recall sheets and were asked to complete one sheet for each picture they remembered. At the top of the sheet was a space to write a brief description of the picture. Participants were then asked to (a) generate an approximate age, height, and weight for each pictured model; (b) rate build and hair length on 7-point scales; (c) circle one of five races; (d) choose one of eight hair colors; (e) describe the model's clothing; and (f) record any background objects and other details from the picture. Participants were given 10 min to complete the recall test. They were then directed back to the presentation screen and shown the four-alternative recognition test. They were given 30 s to choose the alternative they thought they had seen during the list presentation.

Normative procedure. Normative data concerning perceived age, weight, hair length, and so forth were collected. Participants were asked to complete the recall sheet while viewing the slides. The participants were given 2 min to view each picture while completing the recall sheet. The raters viewed all 15 slides in memory set, presented in the same order used for participants in the memory portion of the experiment. The four conditions (i.e., clothed vs. nude and male vs. female) were independently tested, with between 10 and 19 participants in each condition ($N = 59$).

Results

Recall. Pictures were judged as recalled if information on the sheet could be used to uniquely define one of the pictures. This information could be included in the initial description of the picture (as was the case most of the time) or in the description of the background or objects in the picture. For example, if a participant described a woman standing and smiling, this description by itself would not be scored as a recalled picture because the list included several women standing and smiling. However, if the participant also noted that the woman was holding a fishing net or rod, then the participant would be given credit for recalling the appropriate picture. In this manner, recall of the gist of the picture required correct recall of the gender of the model and either a description of what the model was doing or at least one object from the picture. All recall protocols were scored by two independent raters. There were 38 disagreements in 1,530 judgments, yielding

97.5% scoring reliability, and many of these disagreements were simple scoring errors. All disagreements were resolved by mutual assent of the raters.

The serial position curves for pictures recalled appear in Panel A of Figure 1. A main effect of serial position was observed, $F(14, 1316) = 16.12$, $MSE = .1980$, $p < .01$. The only other significant effect was the interaction between serial position and condition, $F(14, 1316) = 2.89$, $MSE = .1980$, $p < .01$. Recall of nude targets ($M = .92$ probability correct) was greater than recall of clothed targets ($M = .55$), $t(90) = 4.03$, $p < .01$. Recall of the three pictures following the nude target ($M = .10$) was worse than recall of the pictures following the clothed target ($M = .30$), $F(1, 94) = 24.45$, $MSE = .1254$, $p < .01$.

Person details were recorded directly from the recall sheet and scored as correct or incorrect on the basis of the normative ratings. For the quantitative variables (age, height, weight, build, and hair length), a range of one standard deviation was used to determine correct recall. Nearly unanimous agreement was observed among our raters on race, therefore a single value (Caucasian) was used as the correct response. Hair color proved a little more problematic because our normative raters selected several different hair colors for both the target pictures. Three values for the female picture (blond–brown, brown, and red–brown) accounted for 92% of the ratings, and three values for the male picture (brown, brown–

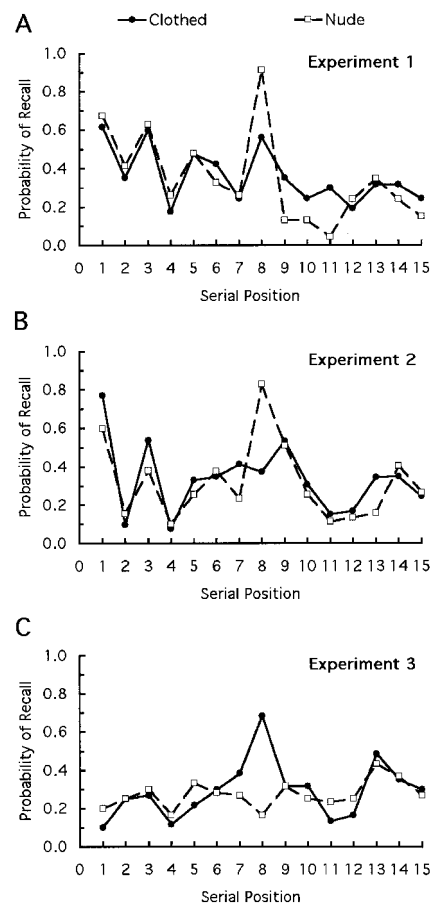


Figure 1. Recall as a function of presentation order for Experiments 1–3. The target pictures appeared in Position 8.

black, and black) accounted for 97% of the ratings. These values were counted as correct responses on the memory tests for the female and male pictures, respectively. The seven person details (age, height, weight, build, race, hair color, and hair length) were then summed to provide an overall score for person memory. A summary of memory for person and background details can be found in Table 1.

Recall of person details from nude models ($M = 4.20$ features) greatly exceeded recall of these details from clothed models ($M = 2.35$), $F(1, 94) = 17.77$, $MSE = 4.73$, $p < .05$. However, as noted earlier, many more nude pictures were scored as recalled than were clothed pictures. The attention-narrowing hypothesis clearly predicted that details of a remembered event would be better recalled if the event was the focus of attention than if it was not. A proper test of this hypothesis requires comparisons of memory for details between conditions equated on memory for gist. When recall of person details was conditionalized on the picture-gist recall, the difference between the nude ($M = 4.59$) and the clothed ($M = 4.15$) conditions was not significant, $F(1, 66) = 1.39$. Analyses of each detail independently also failed to show any significant differences between the nude and the clothed conditions. Apparently, good recall for details of the nude models can be attributed to access to the gist of the nude pictures, not to a more vivid or complete memory representation of the nude pictures.

Memory for background objects recalled from target pictures demonstrated good recall of objects from clothed pictures ($M = .72$ objects) compared with nude pictures ($M = .23$), $F(1, 94) = 9.05$, $MSE = 0.6694$, $p < .01$. The results became more lopsided in favor of the clothed pictures when object recall was conditionalized on correct recall of the target (see Table 1). One might expect that men and women would respond differently to male versus female nudes. Indeed, men remembered a greater number of objects from pictures of women ($M = .83$) than from pictures of men ($M = .30$). In contrast, women remembered a greater number of objects from pictures of men ($M = .49$) than from pictures of women ($M = .27$). However, the cost of the presence of a nude on memory for background information was nearly identical for same-sex nudes (mean loss = .47 objects) as for different-sex nudes (mean loss = .52), yielding $F(1, 94) = .03$, $MSE = 0.6694$, for the interaction between condition, model gender, and participant gender. Across all the measures of memory, the impact of

nudes on memory was never influenced by interactions between model gender and participant gender in this series of experiments.

Recognition. Overall recognition performance ($M = .43$ probability correct) was significantly above chance (25%), $t(98) = 3.68$, $p < .01$. A trend toward better recognition in the clothed condition ($M = .50$) than in the nude condition ($M = .36$) was observed, but the effect was not significant, $F(1, 90) = 1.73$, $MSE = .2589$. Furthermore, chi-square tests failed to reveal any difference in the distribution of multiple-choice selections across condition, $\chi^2(3) = 2.72$, $p = .44$. Given that recall of the nude targets was better than recall of the clothed target, the recognition data may have been biased toward better performance in the nude condition. Even with this bias, there was still no evidence for better recognition of person details from the emotional pictures than from the neutral pictures.

These results provide direct evidence for a trade-off in which good recall of the gist of the nude pictures occurred at the expense of the recall of other pictures. In addition, memory for background details contained in the nude targets was worse than memory for background details in the control condition. On the surface, the results provide support for the idea that attention was focused on the models in the nude pictures to the exclusion of background details and to the detriment of recall for several subsequent pictures. However, once the results were conditionalized on memory for the gist of the picture, no evidence for enhanced recall of the features of the nude models was obtained. These features should be included in the narrow attention participants focused on the nude stimuli. Further, the recognition test failed to reveal enhanced recognition of the target pictures in the nude conditions. To use a camera metaphor, central details from the nude pictures were not brought into sharp focus. Rather, peripheral details were "cropped" from memory.

My students and I have replicated the main results of this study in three additional experiments (e.g., Schmidt, 1996, 1997). In each case, the gist of the nude pictures was recalled at nearly 100%. Further, recall of the three pictures following the nudes and recall of the background objects was impaired. We never found any evidence for enhanced memory for details of the nudes themselves. These findings were replicated with a slower presentation time (5 s per picture), with incidental learning instructions, with several orders of picture presentation, and with several kinds of recall tests.

Table 1
Recall of Target Pictures and Details in Experiments 1–3 as a Function of Type of Picture

Experiment and conditions	Pictures recalled ^a	Details recalled		Details/picture recall	
		Person ^b	Background ^c	Person ^b	Background ^c
Experiment 1					
Clothed model	.55	2.35	0.72	4.15	1.35
Nude model	.92	4.20	0.23	4.59	0.24
Experiment 2					
Clothed model	.37	1.75	0.19	4.71	0.55
Nude model	.83	4.11	0.04	4.88	0.05
Experiment 3					
Clothed model	.69	2.76	0.53	4.01	0.75
Nude model	.17	0.78	0.23	4.96	1.46

^a Probability correct. ^b Number correct out of a possible 7. ^c Number correct out of a possible 5.

Experiment 2

Detterman and Ellis (1972) found that the anterograde amnesia for pictures following nudes decreased as rate of presentation was slowed. One interpretation of this finding is that anterograde amnesia is the result of a disruption of the encoding processes for the pictures following the nudes. At slower rates of presentation, participants may have time to “recover” from viewing the nude stimulus and then to encode the next picture normally. However, as noted earlier, a number of variables were confounded with the comparison between nude and control stimuli in the Detterman and Ellis study. The major purpose of the present experiment was to determine whether changing the interval between picture presentations would eliminate the anterograde amnesia reported above. Participants performed a rating task for 10 s between the presentation of each slide. We predicted that if anterograde amnesia is an encoding phenomenon, then this manipulation would remove the effect. However, one should still expect poor memory for background details in the nude condition. A second purpose of the experiment was to provide emotional ratings of our stimulus set.

Method

Participants and design. The basic design was a 2 (condition: clothed or nude) \times 2 (picture gender: male or female) \times 2 (participant gender) factorial. Twenty-six participants were tested in each of the four picture conditions. A total of 56 women and 48 men participated, with the proportion of women to men held constant across the four conditions.

Materials. The set of pictures used in Experiment 1 was used again. The background pictures were put into a new random order, but the target pictures still appeared in Position 8.

Procedure. Except for the rating task, the procedure was very similar to that of Experiment 1. Intentional learning instructions were given, and each picture was presented for 3 s. Following each picture, participants were given 10 s to rate the picture on two dimensions. The rating scale used the self-assessment manikin (Bradley et al., 1992; Lang, 1980). Participants were asked to put an x through a picture of one of the little men that expresses a range of emotions. One scale assessed the arousal level of participants and ranged from *excited* (1) to *calm* (5). A second set of manikins assessed pleasantness and ranged from *happy* (1) to *sad* (5). After viewing and rating the 15 pictures, participants performed 5 min of arithmetic and then filled out the recall sheets used in Experiment 1.

Results

Arousal and pleasantness ratings. Experimental condition did not significantly affect either ratings of arousal, $F(1, 96) = 2.01$, $MSE = 1.38$, or ratings of pleasantness, $F(1, 96) = 1.15$, $MSE = 1.27$, for the target pictures. The average arousal ratings were 3.93 and 3.60 (lower ratings indicate more arousal) for the clothed and nude conditions, respectively. The average pleasantness ratings were 2.76 and 2.99 (lower ratings indicate more pleasantness) for the clothed and nude conditions, respectively. However, the interactions between picture gender and participant gender were reliable with both the arousal ratings, $F(1, 96) = 27.14$, $MSE = 1.38$, $p < .01$, and the pleasantness ratings, $F(1, 96) = 41.14$, $MSE = 1.27$, $p < .01$. The major source of these interactions was that when participant and model gender matched, the pictures were rated as less arousing ($M = 4.37$) and pleasant ($M = 3.59$) than when the participant and model gender were different ($M_s = 3.16$ and 2.16, for arousal and pleasantness, respectively).

Recall. The serial position curve for the recall of picture gist is presented in Panel B of Figure 1. Recall of target details is summarized in Table 1. There was a main effect of position, $F(14, 1344) = 17.52$, $MSE = .1866$, $p < .01$, and an interaction between experimental condition and serial position, $F(14, 1344) = 3.39$, $MSE = .1866$, $p < .01$. Recall of the nude target pictures ($M = .83$ probability correct) was significantly greater than recall of the clothed targets ($M = .37$), $t(102) = 5.38$, $p < .01$. Unlike Experiment 1, recall of the three pictures following the nude ($M = .29$ probability correct) was not significantly different than recall of the three pictures following the clothed picture ($M = .33$), $F(1, 96) = .62$, $MSE = .1779$. Experiments 1 and 2 should have had similar power to detect anterograde amnesia. Exactly two more participants were tested in Experiment 2 than in Experiment 1, and the two experiments had similar error terms. To further contrast the effects reported in Experiments 1 and 2, we combined the data from the experiments to test for an interaction between experiment and condition (clothed vs. nude). The interaction was significant, $F(1, 199) = 6.40$, $MSE = .1518$, $p < .05$.

The normative values collected in Experiment 1 were used to determine correct recall of person details. The nude condition produced greater recall of the person details ($M = 4.11$ details) than did the clothed condition ($M = 1.75$), $F(1, 96) = 27.53$, $MSE = 5.23$, $p < .01$. Unlike the ratings data, none of the interactions involving model or participant gender approached significance ($F_s < 1.0$). As noted above, many more participants recalled the nude than the clothed picture, so it was not surprising that they also were more likely to remember some of the details of the recalled person. When recall of person details was conditionalized on recall of the picture, memory for details of the clothed model ($M = 4.71$) was equivalent to memory of the nude model ($M = 4.88$), $F(1, 55) = .25$, $MSE = 1.43$.

Experimental condition had a very different effect on the recall of background details, with the clothed condition ($M = .19$ details recalled) leading to greater recall than the nude condition ($M = .04$), $F(1, 96) = 4.24$, $MSE = .1296$, $p = .06$. As in the above results, neither participant gender, $F(1, 96) = 2.16$, $MSE = .1296$, $p < .15$, nor participant gender and model gender, $F(1, 96) = .14$, $MSE = .1296$, interacted with experimental condition. The analysis of background-item recall was repeated with the data conditionalized on picture recall. Again, the clothed condition ($M = .55$) led to greater recall than the nude condition ($M = .05$), $F(1, 54) = 22.81$, $MSE = .1222$, $p < .01$.

Several important conclusions can be reached from this experiment. First, anterograde amnesia was eliminated by the 10-s rating task inserted between each picture. This finding supports the conclusion of Detterman and Ellis (1972) that the amnesic effect of nude stimuli is the result of a disruption of encoding processes. Second, good recall of the gist of the nude target pictures was at the expense of recall of background details. Third, the loss of memory for details was not accompanied by any improvement in memory for the putative focus of attention (i.e., the nude model).

An interesting disconnect was observed between the ratings data and the memory data. The pleasantness and arousal ratings were greatest when model gender and participant gender were different. In contrast, the memory data demonstrated clear effects of nudity that were not compromised by interactions with model gender and participant gender. A similar pattern of results was reported by Bradley et al. (1992). They asked students to rate a large variety of

pictures on arousal and pleasantness and followed the rating task with an incidental free-recall test. In general, recall was greater for pictures rated as highly arousing than for low-arousal pictures. One notable exception to this rule was that students rated same-gender nudes relatively low on the arousal scale. Nonetheless, recall of the nude-model pictures exceeded 90% for nude-model pictures of both genders and participants of both genders. Greenwald et al. (1989) investigated the relation between arousal ratings and physiological indices of arousal. With one exception, skin conductance was highly correlated with rated arousal. Same-gender nudes were given one of the lowest average ratings of arousal but produced one of the highest skin conductance responses. One interpretation of these dissociations between ratings, memory, and physiology is that the ratings data are mediated by higher cognitive processes that take into account social expectations and task demands. The skin conductance and memory data may result from more primitive or automatic responses to the stimulus material.

Experiment 3

The major purpose of Experiment 3 was to determine whether the effects reported above should be attributed to the distinctiveness of the nude pictures. Several pilot attempts were made to contrast the impacts of nudity and distinctiveness on memory prior to Experiment 3. Clothed target pictures of people were made distinctive by presenting them (a) in the context of pictures of objects, (b) in black and white in a series of color pictures, or (c) as line drawings in a series of photographs. The effects of these contextual manipulations in the pilot studies fell far short of the impact of nudity observed in the experiments reported here. In another pilot study, the clothed target was presented as a photographic positive or negative in a series of normal photographs. The photographic negative was more poorly recalled than the photographic positive. Thus, one cannot make a picture outstanding by simply making it different or unusual. However, these manipulations may not have been comparable with the contrast between a clothed and a nude picture. Perhaps a nude picture is simply very distinctive in the context of clothed pictures. Experiment 3 provided an analogous contrast by presenting the clothed target embedded in a series of nude pictures. The nude target provided the appropriate comparison.

One interpretation of Experiments 1 and 2 is that the results reflect the absolute, or secondary, distinctiveness of the nude pictures. This interpretation led us to predict that the results of Experiment 3 would be an inversion of the results of Experiment 1. Memory for the clothed picture should be lost in the context of a series of extremely memorable nudes, creating a "trough" in the serial position curve. In contrast, we predicted that if the results were due to contextual distinctiveness, then the results of Experiment 3 would mirror the results of Experiment 1. That is, the clothed target would be better remembered than the nude target. The three pictures following the clothed target should be more poorly recalled than the same pictures following the nude target. In addition, we predicted that background details from the clothed target would be more poorly recalled than details from the nude target. An alternative set of predictions can be generated from the hypothesis that two factors combined to produce the results of Experiments 1 and 2. Perhaps the contextual distinctiveness of the nude-model pictures supported good recall of the gist of these

pictures, but their emotional content produced the negative effects of the nudes on memory for background details and the pictures following the nude. According to this two-factor view, gist recall of the isolated clothed picture should be quite good, but the clothed model picture should not produce anterograde amnesia or loss of background details.

Method

Participants and design. Research participants were drawn from the same pool as was used in Experiments 1 and 2. There were 120 participants in the 2 (type of target picture: clothed versus nude) \times 2 (list order) \times 2 (participant gender) design. The proportion of men ($n = 48$) to women ($n = 72$) was held constant across type of target picture.

Materials and apparatus. The pool of stimulus pictures was expanded to create a homogeneous set of nudes. The set contained pictures of nudes that were of similar age and race, engaged in easily identifiable activities, or placed in easily labeled scenes. Because we could not find a sufficient number of pictures of male nudes that fit our requirements, the final picture set consisted of 14 female nudes. The gists of the pictures can be described as a nude woman doing the following: (a) reclining in a chair drinking from a clear bottle, (b) laying on a raft in a swimming pool, (c) riding a horse, (d) sitting on a bed reading a newspaper, (e) laying on a string hammock, (f) standing over a bicycle with a basket of flowers, (g) washing a car, (h) taking a shower, (i) leaning over the open hood of a car adjusting the carburetor, (j) sitting in the back seat of a limousine holding a glass of champagne, (k) playing pool, (l) standing on the ladder of a large boat, (m) playing a cello, and (n) sitting at an exercise machine doing sitting presses. The digital pictures were sized and cropped so that each picture filled the screen height and so that the women's faces were approximately the same size. The two primary conditions were created by placing one of the female target pictures (clothed vs. nude) from Experiments 1 and 2 in Position 8 in the series. In this manner, a set of pictures was created that was as homogeneous as possible except for the clothed target in the appropriate condition. The nontarget pictures were randomly placed in the 14 remaining positions. A second presentation order was also created to partially control for specific differences in pictures. In this second order, the pictures in Positions 1 and 12 were exchanged. These positions were selected to test for a habituation effect over the series of pictures. In addition, these two pictures were matched in that each woman partially wore one piece of clothing, held one item in her hand, and was shown against a background containing three identifiable objects. The remaining pictures (except the target picture, in Position 8) were randomly scrambled from their positions in the first order. The presentations were videotaped as described in the previous experiments.

Procedure. The procedure was identical to that used in Experiment 1 except that no recognition test was administered. The participants were led to expect a memory test and viewed each picture for 3 s. After performing a 5-min distractor task, the participants were directed to the recall sheets and were asked to complete one sheet for each picture they remembered.

Results and Discussion

Recall of picture gist and detail were scored as in the above experiments. The serial position curve for picture-gist recall is plotted in the bottom portion of Figure 1. In the analysis of picture-gist recall, a main effect of serial position, $F(14, 1568) = 4.91$, $MSE = .1881$, $p < .01$, an interaction between serial position and condition, $F(14, 1568) = 3.53$, $MSE = .1881$, $p < .01$, and an interaction between position and list order, $F(14, 1568) = 4.86$, $MSE = .1881$, $p < .01$, were observed. No other effects were reliable in the serial position analysis of variance (ANOVA). As one would predict from the perspective that a

clothed picture is distinctive in the context of a series of nudes, recall of the clothed target ($M = 0.69$) exceeded recall of the nude target ($M = 0.17$), $t(118) = 6.50$, $p < .01$. However, there was no evidence of anterograde amnesia, with recall of the three pictures following the clothed target ($M = 0.26$) equivalent to recall of the three pictures following the nude target ($M = 0.28$), $F(1, 112) = 0.25$, $MSE = .1505$. In a combined analysis with Experiment 1, the interaction between experiment and condition was reliable, $F(1, 214) = 14.59$, $MSE = 0.1416$, $p < .01$. Apparently, anterograde amnesia occurs only when the target model is nude and the models following the target are clothed.

A summary of memory for picture details can be found in Table 1, along with comparable results from Experiments 1 and 2. Recall of person details from clothed targets ($M = 2.76$ details recalled) exceeded recall of details from nude targets ($M = 0.78$), $F(1, 112) = 26.87$, $MSE = 4.100$, $p < .01$. This result mirrors those obtained when the nude was isolated in a list of clothed models.

Recall of background objects in the clothed condition ($M = 0.53$ objects) exceeded memory for objects in the nude condition ($M = 0.23$), $F(1, 112) = 6.12$, $MSE = 0.4153$. This result is in stark contrast to recall of background items from a nude picture isolated in a list of pictures of clothed models. Thus, the cropping effects reported in Experiments 1 and 2 cannot be attributed to an isolation effect or contextual distinctiveness.

When recall of person details was conditionalized on recall of the picture, memory for nude targets was better ($M = 4.95$ details) than memory for clothed targets ($M = 4.01$), $F(1, 43) = 4.26$, $MSE = 1.352$, $p < .05$. Similarly, when the recall of background objects was conditionalized on correct recall of the target, background objects from the nude target ($M = 1.46$ objects) were better retained than background objects from the clothed target ($M = 0.75$), $F(1, 43) = 6.09$, $MSE = 0.5249$, $p < .05$. These results suggest that distinctiveness may impair processing of picture details. However, there is a simpler explanation of the conditional recall results. As noted above, correct recall of the target required that participants mention something distinguishing from that picture. The response "nude woman lying down" does not uniquely identify the target because several pictures fit this description. In fact, at least one background object was mentioned for every correctly recalled nude target in Experiment 3. In contrast, the response "woman laying down wearing blue jeans" unambiguously identified the clothed target without mentioning any person details or background objects. This creates a bias, both in the participant's mind when trying to remember a particular picture and in the experimenter's mind when scoring the recall protocols. The good conditional recall of picture details from the nude target may have resulted from these unavoidable biases.

Our experimental design provided a partial test for habituation to the nude pictures. Pictures 1 and 12 were switched in the two presentation orders; memory for the gist and details of these two pictures was scored. Picture-gist recall was lower when the pictures appeared in the 1st position ($M = 0.16$ probability correct) than when they appeared in the 12th position ($M = 0.21$), but this difference was not significant, $F(1, 112) = 0.86$, $MSE = 0.1490$. Similarly, the number of details recalled was numerically, but not significantly, lower in the 1st ($M = 0.29$ details) than in the 12th position ($M = 0.48$), $F(1, 112) = 2.32$, $MSE = 0.8661$, $p < .14$. However, the conditional recall of background details given pic-

ture recall was significantly lower in the 1st position ($M = 1.94$ details) than in the 12th position ($M = 2.48$), $t(40) = 2.08$, $p < .05$.² Apparently, nude stimuli disrupt processing of picture details, but this disruption habituates with repeated presentation of nude pictures.

In summary, these results provided a clear test of a distinctiveness interpretation of the influence of nudes on memory reported in Experiments 1 and 2. A prediction based on secondary distinctiveness, or absolute frequency, incorrectly predicted that memory for the nude pictures would be better than memory for the clothed pictures. The results were also inconsistent with the idea that contextual distinctiveness was solely responsible for the results of Experiments 1 and 2. The distinctive clothed picture did not produce anterograde amnesia, and memory for background details from the distinctive picture was better than memory for background details from the nude picture. Thus, the anterograde amnesia and peripheral cropping reported in Experiments 1 and 2 cannot be attributed to the distinctiveness of the nude pictures.

General Discussion

When pictorial stimuli included full frontal nudes, memory for the gist of those stimuli was very good. In five experiments conducted in our laboratories (see also Schmidt, 1996, 1997) recall of a nude isolated in a series of nonnudes ranged between 83 and 100% correct. Recall of the nude target invariably included correct recall of the gender and race of the nude. However, there was no evidence that details of the nude pictures were better remembered than details of remembered clothed pictures. When recall was conditionalized on correct recall of the target, person details were equally well retained from nude and clothed pictures. Correct recognition of the target was the same in the nude and clothed conditions. Further, when clothed targets were recalled better than the nude targets (the clothed condition in Experiment 3), person details were recalled better from the clothed target.

There was also clear evidence that the nude stimuli impaired memory. The presence of a nude in a picture impaired memory for background information in the picture. With relatively fast presentations (e.g., 3 s a slide), memory for the three pictures following the nude picture was impaired relative to memory for pictures following a clothed picture. When a 10-s rating task was inserted between the slides, the anterograde amnesia disappeared. These results lend themselves to an encoding interpretation. The presentation of a nude momentarily impairs encoding of material spatially and temporally surrounding the nude. These results were consistent with those reported by Detterman, Ellis, and their colleagues (Detterman & Ellis, 1972; Ellis et al., 1971). However, these earlier investigations failed to determine the impact of the stimuli on memory for details. In addition, Detterman and Ellis did not control for appropriate stimulus attributes.

The results reported here challenge the idea that the impact of nudes on memory can be attributed to the fact that the nudes were distinctive. Whereas distinctive events may impair memory for

² Only 2 research participants recalled both of the pictures in this analysis, precluding both a conventional within-subjects ANOVA and a paired t test with the conditional recall of pictures recalled as the dependent measure. To provide a conservative statistical test, we calculated an independent t test.

other material on a list (Schmidt, 1985), their negative impact is not focused on the immediately following items (see Schmidt, 1985, 1991), does not occur on recognition tests (Schmidt, 1985), and does not impair memory for details of the distinctive event itself (McDaniel & Einstein, 1986; Schmidt, 1991). The experiments reported above directly contrasted memory for distinctive pictures with memory for nude pictures. Secondary or absolute distinctiveness did not support good recall of the pictures. A contextually distinctive picture, when compared with the nude pictures, led to better recall of background details and better recall of the pictures that followed.

The research reported above provided mixed support for the idea that the nude pictures were maintained in working memory to the exclusion of other stimuli. This is essentially a variation of the attention-narrowing hypothesis developed to explain the impact of emotion on memory (e.g., Christianson, 1992a, 1992b; Easterbrook, 1959; Loftus, 1979). Consistent with this hypothesis, good memory for the nude pictures occurred at the expense of background details and pictures that followed. The attention-narrowing hypothesis also implies that memory for the focus of attention should be good relative to memory for a control picture. In support of this hypothesis, several recent studies have reported enhanced recall of details from emotional pictures (Burke et al., 1992; Heuer & Reisberg, 1990; Libkuman, Nichols-Whitehead, Griffith, Thomas, 1999). Some additional support was reported here, in that the nude pictures led to greater recall of person details than did clothed pictures in Experiments 1 and 2. However, as argued above, this comparison is inappropriate—one cannot recall details from a picture that was not recalled. When memory for the gist of the pictures was statistically equated, memory for person details was unaffected by the emotional content of the nude pictures, and recognition of the person was unaffected by nudity. Thus, the results are better explained in terms of peripheral cropping than in terms of attention narrowing.

Perhaps the best explanation of the results is that two mechanisms were operative. First, in Experiments 1 and 2 the nude pictures were distinctive. Distinctive stimuli are well remembered because of such factors as increased attention and/or rehearsal and retrieval processes that favor access to the stimuli (Hunt & McDaniel, 1993; Schmidt, 1991). Under many conditions, emotional stimuli are distinctive (Reisberg, Heuer, & Laney, 2000), and good memory for the gist of these stimuli may result from these same memory processes. However, a separate mechanism is needed to explain why the distinctive clothed pictures did not lead to the peripheral cropping observed with the nude pictures. Perhaps the nude pictures led to an emotional response and this response required emotional regulation by the cognitive system. Richards and Gross (2000) have demonstrated that emotional regulation has a mnemonic cost. In this case, the cost may be decreased processing of background information and information contained in subsequent pictures. This interruption in processing distinguishes the impact of distinctiveness from the impact of emotion on memory. Although both distinctive and emotional events are well recalled, the impacts of distinctiveness and emotionality on memory may be quite different (see Christianson, 1992b; Schmidt, 1991). Truly outstanding events may be those that are both distinctive and lead to an emotional response.

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