Massed Versus Distributed Exposure and Imaging of Faces: Changing the Test View

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This research examined the effects of massed versus distributed exposure and imaging of faces, and the effects of changing the study-to-test view on subsequent recognition performance. The massed procedure consisted of individual faces exposed once for 6 s, followed by a 30 s off period. The distributed procedure consisted of faces exposed three times for 2 s, followed by a 10 s off period after each exposure. During the off periods, groups of participants either imaged the previous face, imaged another face, or performed an irrelevant letter-search task. Results showed that distributed exposure and post-exposure imaging of target faces facilitated recognition, but these effects primarily occurred when the same facial view was given at both study and test. Recognition diminished when the target was presented in a different view at test, but when combined with distributed presentation and target imaging, performance was enhanced. Implications for suspect identification and recognition of other kinds of complex visual stimuli are discussed.

Law enforcement personnel are typically shown pictures of suspects with the expectation that they will be able to recognize (and apprehend) the depicted persons at a later time. Likewise, crime victims often participate in identification procedures using their memory of the crime scene. In both instances, the suspect or assailant may look different when viewed at a later time. The present research examines several factors that might influence face recognition, specifically, the effects of massed versus distributed training, post-exposure imaging, and same versus different view from study to test.

A fairly consistent finding in the learning literature is that multiple presentations or practice with a stimulus results in better performance compared to continuous massed presentation or practice, controlling for time and fatigue (for a review, see Rea & Modigliani, 1988). While the massed versus distributed effect has not always been found (Perruchet, 1989; Underwood, Kapelak, & Malmi, 1976; Woodhead, Baddeley,

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& Simmonds, 1979), it has generally been found to apply to most memory tasks (Rea & Modigliani, 1988), and has been considered by some to be an established principle of learning (e.g., Landauer & Ross, 1977; Rea & Modigliani, 1988; Woodworth, 1938).

Research on massed versus distributed learning has mainly focused on verbal memory and motor skills. No research has used more complex, pictorial stimuli, such as faces. This fact prompted one purpose of the current study: Does face recognition benefit from distributed presentations compared to massed presentations? If so, this finding might be useful in the forensic situations cited earlier.

A second purpose of the study was to determine whether covert facial imaging (or rehearsal) between presentations facilitates later recognition of the faces. Previous research suggests that such visual rehearsal is beneficial (Graefe & Watkins, 1980; Sporer, 1988). However, the evidence is not conclusive, because some research has failed to find a positive effect of post-exposure imaging of faces (e.g., Schooler & Engstler-Schooler, 1990). Indeed, even in research showing a positive effect of imaging faces, only a small effect has been found (e.g., Graefe & Watkins, 1980). The present study re-examines the effectiveness of post-exposure imaging of faces.

One difficulty in measuring the effect of imaging concerns the selection of the appropriate control condition. In this study, target imaging is compared to two non-target control tasks: (a) imaging an earlier-presented face, and (b) performing an irrelevant perceptual speed (letter-search) task. These two control tasks represent a "within domain" (facial imaging) and an "out of domain" (no facial imaging) task. Thus, a subsidiary question is addressed: Does a control task with greater similarity to the primary target-study activity (non-target imaging) produce more interference compared to a control task with less similarity (letter-search activity)? According to some research (e.g., Allport, Antonis, & Reynolds, 1972; Friedman & Polson, 1981), we might expect two tasks that require similar processing resources to produce greater interference than two tasks that require different processing resources. Thus, the performance of participants imaging the non-target face was expected to be worse than participants performing the letter-search task.

A third purpose of the present study involves examination of the effect of study versus test view. In most face memory research, the same pictures are used in both study and test conditions. However, a large body of research shows that when the stimulus face is changed at test, recognition performance is severely degraded (Bruce, 1988). For example, inversion and lateral reversal of the face pictures (McKelvie, 1983) and change of expression and pose (Kottoor, 1989; Wogalter & Laughery, 1987) dramatically lowers recognition performance. However, these kinds of alterations differ considerably from events that a witness is likely to encounter. It is not unusual for a witness to be involved in a task of trying to recognize the assailant who has undergone multiple changes in appearance (e.g., aging & hair style) since the face was first viewed (Bruce, 1988). In the current research, some of the target faces were shown in the same view at study and test, while others were changed at test. The change involved using another picture taken of the same person separated by approximately 1 year. While we would expect recognition to be better for the same view compared to the different view, a more interesting question was asked: Does the effect depend on the other two independent variables? For example, does the influence of distributed practice depend on the identicality of the stimuli from study to test and the kind of post-exposure task employed?

METHOD

Participants

Ninety-six University of Richmond students participated for credit in an introductory psychology course.

Design

Three independent variables were orthogonally manipulated:

1. presentation method (massed vs. distributed),
2. post-exposure task (imaged target vs. imaged initial non-target face versus letter-search), and
3. same vs. different view of targets at test.

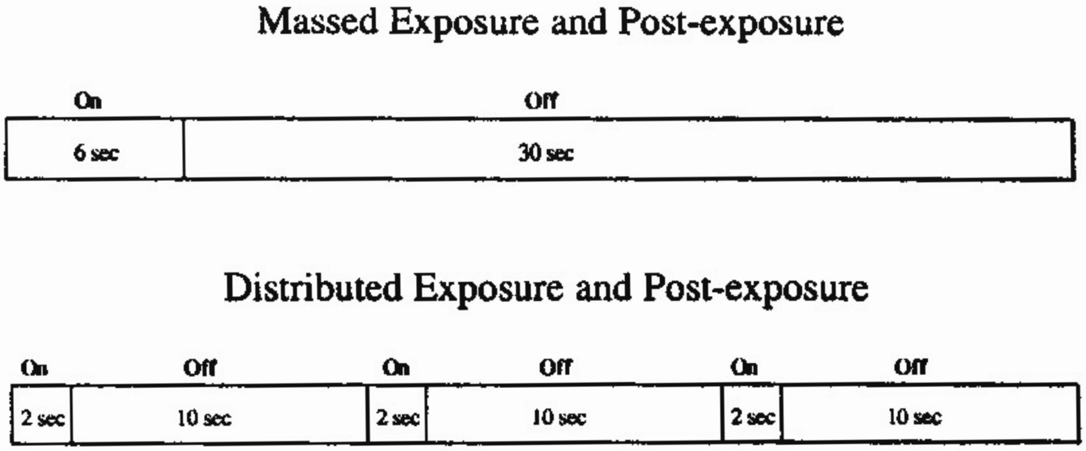
The first two variables were between-subjects variables and the latter was a repeated-measures variable. The six groups formed by the presentation method and post-exposure variables were:

1. massed, imaged targets,
2. massed, imaged, initial non-target face,
3. massed, letter-search task,
4. distributed, imaged targets,
5. distributed, imaged, initial non-target face, and
6. distributed, letter-search task.

Materials

Six target faces were chosen randomly from a large pool of photographs taken from University of Richmond yearbooks. The pictures were of male students who had graduated 6 to 7 years earlier. For each target, two pictures taken 1 year apart were used as the different views, resulting in 12 target pictures (two views of six faces). One picture from each target pair was used at study. Stimuli also included 73 non-target faces taken from the same face pool, which were used as foils in the recognition test. In addition, one of two views of another, initially-viewed, face was presented at the outset of the procedure for all participants, and was also included in the subsequent recognition test. All photographs were presented as slides. Timing was controlled by a computer connected to a Sharp Educator Synch tape deck (Model RD-670AV) that drove a carousel slide projector.

FIGURE 1
Representation of Massed and Distributed Exposure (On) and Post-exposure (Off) Timing for One of Six Targets Presented at Study



Procedure

Participants were randomly assigned to one of the six groups. All participants first viewed one of two depictions of an initial, non-target face for 2 s, given the prior instruction that their memory of this face would be tested later.

A sequence of six faces was shown at study. Participants in the massed presentation conditions were shown a sequence of six target faces for 6 s each, with 30 s off time between exposures (the post-exposure periods). Participants in the distributed presentation conditions were shown each target three times for 2 s, with a 10 s off time between exposures. Thus, the total on time and off time in the massed and distributed presentation conditions was identical. The duration of the entire presentation/post-exposure phase was held constant at 216 s; the total time was 36 s (6 s for each target) and the total off time was 180 s (30 s for each target). Figure 1 shows a graphic representation of the massed and distributed exposure and post-exposure times for one of six targets presented at study.

Participants in the image-target conditions were told to try to image the most recently seen face during the post-exposure periods. Participants in the image initial non-target conditions were told to image the initially presented face during the post-exposure periods. Participants in the letter-search conditions performed an unrelated letter-search task during the post-exposure periods in which they quickly looked for and circled specific letters on sheets containing a large array of letters.

Following the target-presentation/post-exposure phase, participants were given a recognition test. The test consisted of a sequence of 80 faces that contained the target faces embedded in a set of foil faces. Targets were placed in random positions in the latter half of the recognition test sequence. Half of the targets were in the same view at test as seen at study and half were in a different view. The recognition test also included one of the two photographs (same vs. different view) of the initial non-target face. For each face of the sequence, participants marked a "Y" (Yes, the face was shown earlier) or "N" (No, the face was not shown earlier) in the corresponding numbered blank on a response sheet. Participants also indicated their confidence in their answers by placing a "1" (guessed the answer), "2" (fairly sure of the answer), or "3" (very sure of the answer) next to their "Y" or "N" response.

Presentation of the two views of the targets was balanced in the experiment. Across participants, the two depictions of each target were presented an equal number of times at study and at test in both the same and different view conditions.

RESULTS

Recognition scores were produced by combining the yes-no responses with the confidence ratings to form a six-point recognition scale (i.e., "N3" assigned a "1," "N2" assigned a "2," "N3" assigned a "3," "Y1" assigned a "4," "Y2" assigned a "5," and "Y3" assigned a "6"). Thus, this scale ranged from 1 (very sure the face was not seen before) to 6 (very sure the face was seen before). Two scores from each participant were entered into the analysis of target recognition. One was a mean of the targets seen in the same view from study to test. The other was a mean of the targets seen in a different view. Target recognition means for all conditions are shown in Table 1.

A 2 (presentation method) × 3 (post-exposure task) × 2 (test view) mixed-model analysis of variance (ANOVA) showed a significant main effect of post-exposure task, $F(2,90) = 9.47, p < .001$. A Newman-Keuls comparison test indicated that target imaging ($M = 4.75$) produced significantly greater target recognition than the letter-search activity ($M = 3.78$). Non-target imaging ($M = 4.27$) was intermediate, but it did not differ from the other two conditions. A main effect for test view was also shown, $F(1,90) = 114.86, p < .001$. Targets presented in the same view at test ($M = 4.99$) were recognized better than targets in a different view ($M = 3.54$). Presentation method did not produce a significant main effect.

In addition, test-view interacted with presentation method, $F(1,90) = 5.47, p < .03$. Examination showed that the difference between the same and different views was greater for distributed ($M = 5.17$ vs. $M = 3.40$) than for massed ($M = 4.81$ vs. $M = 3.68$) presentation. Test view also interacted with post-exposure task, $F(2, 90) = 7.52, p < .01$. Simple effects analysis and a Newman-Keuls test showed that target imaging ($M = 5.68$) produced greater recognition than non-target imaging ($M = 5.16$) which was, in turn, greater than the letter-search activity ($M = 4.14$), but only for the same-view targets ($ps < .05$) and not for different-view targets ($Ms = 3.82$, 3.38, and 3.43, for target imaging, non-target imaging, and letter search, respectively, $ps > .05$). The ANOVA also yielded a significant three-factor interaction, $F(2, 90) = 3.20, p < .05$. A specific contrast showed that under distributed presentation, different-view targets were recognized somewhat better when they were imaged compared to the other two post-exposure tasks ($p = .05$).

An ANOVA examining performance on the foil faces showed no effect of conditions on false alarm scores ($ps > .05$). In addition, two discrimination (sensitivity) mea-

TABLE 1
Mean Recognition as a Function of Presentation Method, Test-view, and Post-exposure Task

	Massed		Distributed	
Post-exposure task	Same view	Different view	Same view	Different view
Image targets	5.71	3.73	5.65	3.92
Image initial face	5.00	3.59	5.31	3.17
Letter-search	3.73	3.73	4.54	3.13

sures were also computed based on hit and false-alarm scores. The discrimination results were similar to the hit results and are not reported here.

Recognition of the non-target, initial face was also analyzed. Only a significant main effect of picture view was shown, $F(1, 84) = 32.72, p < .001$. Recognition of the initial face was higher when presented in the same view ($M = 5.10$) than in a different view at test ($M = 3.08$).

DISCUSSION

This experiment showed that distributed exposure and post-exposure target imaging facilitated subsequent recognition, but these effects primarily occurred when the same facial view as given at both study and test. Recognition was generally quite poor when the target was presented in a different view from study to test. However, the data suggest that when a different view is combined with distributed presentation and target imaging, performance is enhanced relative to the other two post-exposure tasks.

Imaging the target faces facilitated recognition compared to the irrelevant, letter-search activity, and thus supports research showing that imaging a face following exposure benefits recognition (Graefe & Watkins, 1980; Sporer, 1988). The other control task, non-target imaging, showed intermediate performance that did not differ from the other two tasks. The failure to find lower performance than the other two tasks fails to support the findings of earlier research suggesting that similar tasks will interfere more than different tasks (Allport, Antonis, & Reynolds, 1972; Friedman & Polson, 1981). Perhaps, participants in the non-target imaging tasks were able to time-share processing resources to some extent. Alternatively, it is possible that participants in this condition only spent a small fraction of time imaging the non-target face, and used the remaining time to image the target faces. Some support for this last notion is given by other results. There were no differences between the post-exposure conditions on recognition of the initial non-target face, although it was expected that participants in the non-target imaging task would perform better than participants in the other post-exposure conditions.

The present research has implications for face identification in forensic settings. The passage of time from initial exposure to apprehension and viewing of a suspect is likely to result in a different appearance. Police officers might therefore benefit from distributed exposure and imaging of suspect pictures. In addition, persons who are at risk of being involved in a crime situation (e.g., a convenience store clerk or bank teller) might benefit from trying to view the assailant's face in a distributed manner and to image the face during the intervening views.

The results may also have implications for learning other kinds of complex visual stimuli. For example, distributed exposure and imaging could benefit military training tasks such as aircraft, tank and vehicle identification – situations where positive identification of friend or foe is critical. Other potential uses include the training of experts in visual interpolation of medical diagnosis techniques (e.g., CAT scans, X-ray films), areas in which errors are frequent, and can be serious (Herman & Hessel, 1975).

NOTES

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