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Conscious and Unconscious Processes: The Effects of Motivation

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The process-dissociation procedure has been used in a variety of experimental contexts to assess the contributions of conscious and unconscious processes to task performance. To evaluate whether motivation affects estimates of conscious and unconscious processes, participants were given incentives to follow inclusion and exclusion instructions in a perception task and a memory task. Relative to a control condition in which no performance incentives were given, the results for the perception task indicated that incentives increased the participants' ability to exclude previously presented information, which in turn both increased the estimate of conscious processes and decreased the estimate of unconscious processes. However, the results also indicated that incentives did not influence estimates of conscious or unconscious processes in the memory task. The findings suggest that the process-dissociation procedure is relatively immune to influences of motivation when used with a memory task, but that caution should be exercised when the process-dissociation is used with a perception task.

The process-dissociation procedure has been widely used to estimate the contributions of conscious and unconscious processes to task performance. With the process-dissociation procedure, participants must complete a task following both exclusion and inclusion instructions. When performing a task following exclusion instructions, participants are instructed *not to use* perceived or remembered information in their responses. Here, performance is measured by the number of times a participant *fails to comply* with the instructions. In contrast, when performing a task following inclusion instructions, participants are instructed *to use* perceived or remembered information in their responses. Here, performance is measured by the number of times a participant *complies* with the instructions. Jointly, performance on inclusion and exclusion versions of a task can be used to estimate the separate contributions of conscious and unconscious processes.

The process-dissociation procedure has been used with a number of different tasks in a variety of contexts. Tasks such as stem completion (e.g., Debner & Jacoby, 1994; Jacoby, Toth, & Yonelinas, 1993), yes/no recognition (e.g., LeCompte, 1995; Yonelinas, Regehr, & Jacoby, 1995), and cued recall (e.g., Hay & Jacoby, 1996) have all been adapted for use with process dissociation. These tasks have not only been used to assess conscious and unconscious processes in undergraduate students, but they have also been used with older adults (e.g., Jennings & Jacoby, 1997; Titov & Knight, 1997), patients with dementia (e.g., Spieler, Balota, & Faust, 1996), and patients with organic amnesias (e.g., Kopelman & Stanhope, 1997).

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Across such different tasks and populations of participants, there may be factors that affect how well participants comply with the inclusion and exclusion instructions, which in turn affect estimates of conscious and unconscious processes. One such factor may be the motivational level of participants, which could be affected by task demands or inherent differences across different populations of participants. For example, a group of patients with dementia may be less motivated to follow the inclusion and exclusion instructions than a control group of adults to whom their performance is compared. In turn, the lower motivational level of patients with dementia may lead to performance differences that affect estimates of conscious and unconscious processes. In the present experiments, we investigated the effect of motivational level on the estimates of conscious and unconscious processes provided by the process-dissociation procedure. To this end, we compared the performance of motivated and control groups of participants in a perception task and a memory task.

Both the perception task and the memory task involved stem completion. For the perception task, a five-letter word (e.g., table) was presented and masked on each trial. Each word was followed immediately by its three-letter stem (e.g., tab__). On half of the trials, the participants were asked to complete the stem to make a word other than the one that they had just seen (exclusion instructions). On the other half of the trials, the participants were asked to complete the stem to make the word that they had just seen (inclusion instructions). For the memory task, the participants initially studied a list of words. Memory for these words was then tested by presenting a series of word stems under either inclusion or exclusion instructions. For both tasks, the number of stems completed with the previously studied words under the inclusion and exclusion instructions was used to estimate the conscious and unconscious influences of the words.

The Logic of Process Dissociation

Within the framework of process dissociation, estimates of conscious and unconscious processes are derived from the performance on the inclusion and exclusion tests. Four equations are used to define these dependencies. Inclusion performance is defined as

$$I = C + U - (C \cap U), \tag{1}$$

where I is the number of instances in which a stem is completed correctly with a previously studied word, C is the total magnitude of the conscious influences affecting performance, U is the total magnitude of unconscious influences affecting performance, and $(C \cap U)$ is the joint occurrence of conscious and unconscious influences. The quantity $(C \cap U)$ is subtracted from the total so that conscious and unconscious influences are represented only once in the equation.

Exclusion performance is defined as

$$E = U - (C \cap U), \tag{2}$$

where E is the number of times that a stem is completed incorrectly with a previously studied word, U is the total magnitude of unconscious influences affecting performance, and $(C \cap U)$ is the joint occurrence of conscious and unconscious influences.

In this case, the quantity $(C \cap U)$ is subtracted from the total because only unconscious influences unopposed by conscious influences are assumed to result in a failure to exclude a previously studied word.

Rearranging Eqs. (1) and (2), and solving for C, yields an estimate of conscious influences:

$$C = I - E, \tag{3}$$

Equation (3) shows that the magnitude of conscious influences (C) is calculated by subtracting exclusion performance (E) from inclusion performance (I). From Eqs. (1) and (2), we know that inclusion performance reflects conscious plus unconscious influences, whereas exclusion performance reflects unconscious influences alone. Therefore, the difference between inclusion and exclusion is an estimate of conscious influences alone.

Finally, rearranging Eqs. (1) and (2), and solving for U, yields an estimate of unconscious influences:

$$U = E/(1 - C). \tag{4}$$

Equation (4) shows that unconscious influences (U) are estimated by dividing exclusion performance (E) by a quantity that represents all influences on performance other than the conscious influences $(1 - C)$.[3]

Motivational Effects in Process Dissociation

According to the logic of process dissociation, variations in inclusion and exclusion performance reflect changes in the contributions of conscious and unconscious processes. However, estimates of conscious and unconscious processes would be affected by any factor that has a differential effect on either inclusion or exclusion performance. Some examples of the possible consequences of such differential effects are illustrated in Fig. 1. The left panel in the figure shows what happens when exclusion performance varies and inclusion performance remains constant, and the right panel in the figure shows what happens when inclusion performance varies and exclusion performance remains constant.[4] Examination of the left panel shows that if exclusion performance increases and inclusion performance remains unchanged, then unconscious influences increase and conscious influences decrease with each increase in exclusion performance. In contrast, examination of the right panel shows that if inclusion performance increases and exclusion performance remains unchanged, then conscious influences increase at a faster rate than unconscious influences with each increase in inclusion performance. In both cases illustrated in Fig. 1, the changes in

[3] The exact interpretation of the parameter U depends upon the assumed relation between conscious and unconscious influences (see Buchner, Erdfelder, & Vaterrodt-Plunnecke, 1995; Jacoby, Toth, Yonelinas, & Debner, 1994; Joordens & Merikle, 1993). However, regardless of the assumed relation, the computation of U is invariant. The issue of interpretation of U is not critical for the present experiments. For further discussion of many of the interpretive issues, see Jacoby, Begg, and Toth (1997).

[4] The parameters shown in Fig. 1 were selected because they are within the range of values found in the present experiments.

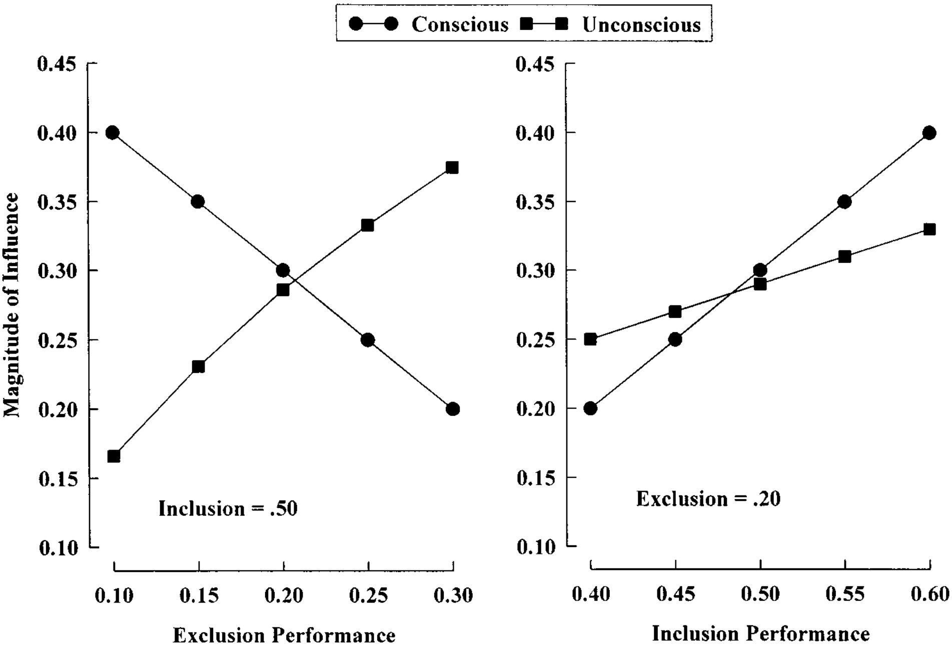

FIG. 1. Variations in estimates of the contributions of conscious and unconscious processes across variations in exclusion and inclusion performance. (Left) Estimates of conscious and unconscious processes across different levels of exclusion performance with inclusion performance fixed at 0.40. (Right) Estimates of conscious and unconscious processes across different levels of inclusion performance with exclusion performance fixed at 0.20.

exclusion or inclusion performance would be interpreted as reflecting concomitant changes in the contributions of conscious and unconscious processes to performance.

These examples show that any factor that has a differential effect on inclusion or exclusion performance will affect estimates of conscious and unconscious processes. The present experiments investigated whether motivational level is such a factor. Our reasoning was as follows. During the course of an experiment, participants may grow bored and allow their attention to wander. By increasing the motivational level of participants, such lapses in attention may occur less frequently, thus increasing the probability of conscious processes. This would improve exclusion performance because successful exclusion depends entirely upon conscious processes. However, the influence of an increase in conscious processes on inclusion performance is less clear. If an increase in conscious processes is accompanied by an increase in total processing (i.e., $C + U$), then inclusion performance should increase. But, if an increase in conscious processes does not lead to a concomitant increase in total processing, then inclusion performance, which reflects both conscious and unconscious processes, may not change when motivational level is increased.

In the present experiments, motivational level was manipulated through monetary rewards. A motivated group was paid according to how well they performed the experimental task, whereas a control group received a flat fee for participating. In

Experiments 1 and 2, we examined motivational influences on performance in a perception task. In Experiments 3A and 3B, we examined motivational influences on performance in a memory task. We found that motivational level influenced performance in the perception task but not in the memory task. Thus, by the logic of process dissociation, motivation influenced conscious and unconscious processes in perception but not in memory.

EXPERIMENT 1

The purpose of Experiment 1 was to examine the effect of motivation on estimates of conscious and unconscious processes in a perception task. The participants viewed five-letter English words that were presented for 0, 50, or 250 ms. Each word was followed immediately by a mask, which in turn was followed by the first three letters of the word. Participants were required to complete each three-letter word stem to form a five-letter English word—either a word other than the one that had just been presented (exclusion instructions) or the word that had just been presented (inclusion instructions). The rationale for the choice of presentation durations was straightforward. The 0-ms condition was used to determine the baseline stem-completion rate for each participant. The 50-ms duration was chosen because it approximated the presentation duration at which Merikle, Joordens, and Stolz (1995) found evidence for a dominance of the unconscious influences of perception relative to the conscious influences of perception. The 250-ms duration was chosen primarily because it provided a manipulation check to assess whether the participants did in fact follow the exclusion instructions.

Method

Participants. Forty-eight undergraduate students were selected from the cognition subject pool at the University of Waterloo. All students were either native speakers of English or had learned the English language by the age of 4, and all reported normal or corrected-to-normal vision. At the time the students were scheduled for the experiment, they were told that they would receive a minimum of $6 for their participation. The students were assigned to either the control group or the motivated group when they arrived for the experiment on the basis of an alternating sequence.

Materials. One hundred eighty English words were used. All words were five-letter nouns ranging in frequency from 1 to 2724 occurrences per million (Kučera & Francis, 1967). These words satisfied two criteria. First, the initial three letters of each word could be completed to make at least two other five-letter English words. Second, at least one of the alternative completions for each word stem had a greater word frequency than the selected word.

The list of 180 words was alphabetized and sorted into three sets of 60 words by assigning every third word in the list to one of the three sets. These sets of words were counterbalanced across the three presentation durations (0, 50, and 250 ms) so that each set was used equally often at each duration.

The presentation of each word was preceded and followed by a string of 10 letters. These letter strings acted as forward and backward masks. There were 51 different letter strings made from all letter pairs found in the set of 180 words. Two different letter strings were selected randomly with replacement on each trial.

All stimuli were presented on a Zenith color monitor (Model ZCM-1492) that was connected to an IBM compatible 486DX266 computer running the Micro Experimental Laboratory software (Schneider, 1990). The stimuli consisted of lowercase, white letters presented against a black background and they were centered both horizontally and vertically. Each letter was approximately 4 mm high by 3 mm wide. The viewing distance was approximately 75 cm, and each five-letter word subtended a visual angle of approximately 0.31° vertical by 1.15° horizontal.

Procedure. The experiment consisted of 180 trials divided into two blocks of 90 trials. Each trial began with the presentation of a fixation cross at the middle of the screen and a message instructing the participant to press the spacebar. After the spacebar was pressed, the following sequence of events occurred: (a) a premask was presented for 500 ms, (b) a randomly selected target word was presented for 0, 50, or 250 ms, (c) a postmask was presented for 500 ms, and (d) the first three letters of the target word were presented, with a message that reminded the participant of the current inclusion or exclusion instruction.

The participants completed each word stem by entering two letters on the keyboard. Any entries that the computer did not recognize, or that were too short, or that were too long, were flagged with an appropriate message (e.g., ‘‘I don’t recognize that word.’’). If an entry was flagged, the word stem was presented again, and the participant was required to make another completion. The word stem was presented repeatedly until a valid completion was made, at which time the computer recorded the response and initiated the next trial.

Within each trial block, the three presentation durations (0, 50, 250 ms) were randomly intermixed with the constraint that there were always 30 trials at each presentation duration. In one block of trials, the participants were instructed to complete each word stem to make the word that had just been presented (inclusion instructions). In the other block of trials, the participants were instructed to complete each word stem to make any word other than the word that had just been presented (exclusion instructions). Half of the participants in each group received inclusion instructions in the first block of trials, followed by the exclusion instructions in the second block of trials. The remaining participants in each group received the inclusion and exclusion instructions in the opposite order.

Prior to the beginning the experiment, the participants were informed of the payment that they would receive for their participation. The participants assigned to the control group were simply reminded that they would receive $6 at the end of the experiment. The participants assigned to the motivated group were told that they would begin each block of 90 trials with $15. They were also told that each time they failed to follow the inclusion or exclusion instructions they would lose $1, down to a minimum of $3 per block. Given that all participants completed two blocks of trials, this payment scheme ensured that everyone received a minimum payment of $6 for their participation.

Results and Discussion

Inclusion and exclusion performance. Table 1 shows the mean inclusion and exclusion performance for the motivated and control groups at each presentation duration. Each mean in the table indicates the proportion of stems completed with target words.

TABLE 1
Mean Proportion of Stems Completed with Target Words and the Associated 95% Confidence Interval for Each Condition in Experiment 1

	Presentation duration		
	0 ms	50 ms	250 ms
Inclusion instructions			
Control group	.20 ± .03	.39 ± .06	.97 ± .02
Motivated group	.25 ± .04	.42 ± .06	.99 ± .01
Exclusion instructions			
Control group	.22 ± .03	.26 ± .04	.08 ± .03
Motivated group	.23 ± .03	.18 ± .04	.02 ± .01

Table 1 also shows the 95% confidence interval (1.96 × standard error of the mean) associated with each mean.

Three aspects of the data shown in Table 1 are important to note. First, baseline performance (i.e., 0-ms presentation duration) was similar in all conditions. Thus, neither the instructions (i.e., inclusion vs exclusion) nor the conditions (i.e., motivated vs control) had a significant impact on baseline performance. The second important aspect of the data in Table 1 concerns inclusion performance. For both the motivated and the control groups, inclusion performance increased systematically across presentation duration. In addition, inclusion performance was similar for both groups, as indicated by the overlapping confidence intervals at each presentation duration. The third important aspect of the data in Table 1 concerns exclusion performance. In contrast to inclusion performance, which was similar for both groups, there was one very important difference in exclusion performance between the motivated and the control groups. For the control group, the proportion of stems completed with previously studied words at the 50-ms presentation duration was *higher* than the baseline level of performance. This result is completely consistent with previous findings (e.g., Debner & Jacoby, 1994; Merikle et al., 1995). However, for the motivated group, the proportion of stems completed with previously studied words at the 50-ms presentation duration was *lower* than the baseline level of performance. Thus, the payment schedule with its financial penalties for not following the exclusion instructions appears to have increased compliance with the instructions. The payment schedule also increased compliance with the exclusion instructions at the 250-ms presentation duration. Here, even though both groups excluded the majority of the target words from their word-stem completions, the motivated group excluded more target words than the control group.

The patterns of inclusion and exclusion performance shown in Table 1 indicate that increased motivation did not simply increase the likelihood that the participants fixated the location of the words in the displays, which in turn increased the likelihood that the words were perceived. If motivation simply increased the accuracy of fixation, then it would be reasonable to expect higher inclusion performance for the motivated group than for the control group. However, inclusion performance was similar for both groups, suggesting that increased motivation did not increase the likelihood

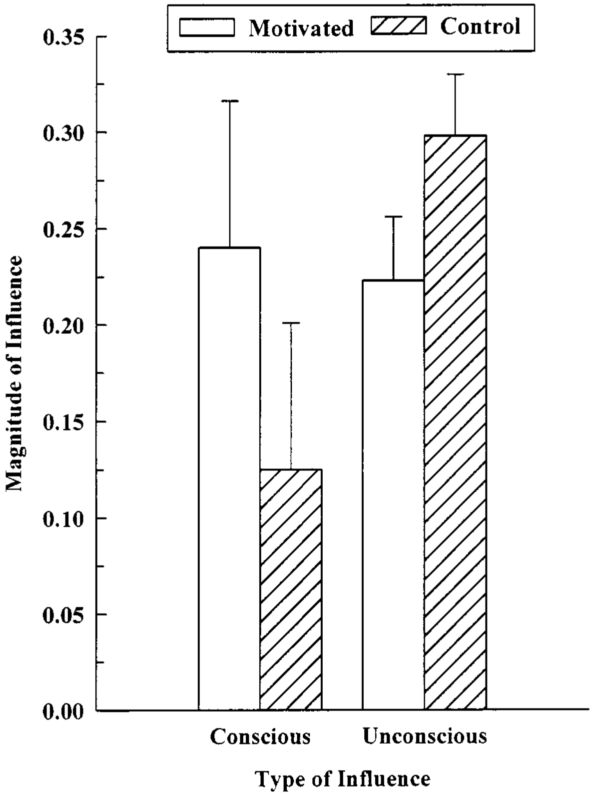

FIG. 2. Conscious and unconscious influences of perception and the associated 95% confidence intervals for the motivated and control groups in Experiment 1.

that the words were perceived. Likewise, if motivation increased the accuracy of fixation, then another reasonable expectation would be that the difference between performance at the 0- and 50-ms presentation durations should be greater for the motivated group than for the control group. However, although direction of the difference between the 0- and the 50-ms presentation durations was different for the motivated and control groups, the magnitude of difference between the 0- and the 50-ms conditions was similar for both groups. The fact that the magnitude of the differences was similar but that the direction of the differences differed suggests that the likelihood of perceiving the words was the same for both groups and that what differed across groups was the effect or consequences of the perceived information (cf., Merikle et al., 1995).

Conscious and unconscious influences. Estimates of conscious and unconscious influences based on the performance of individual participants were calculated only for the 50-ms presentation duration. Similar estimates could not be calculated for the 250-ms presentation duration, because some participants were able to include and exclude 100% of the target words presented at this duration. The mean estimates of conscious and unconscious influences for the motivated and control groups at the 50-ms presentation duration are shown in Fig. 2, which also shows the 95% confidence interval associated with each estimate.

Inspection of Fig. 2 reveals that the estimates of conscious and unconscious influences were considerably different for the motivated and control groups. Conscious influences were greater for the motivated group than for the control group, $t(23) = 2.09$, $p = .042$. In contrast, unconscious influences were greater for the control group than for the motivated group, $t(23) = 3.21$, $p = .002$. These results show that an increase in motivation leads to both a higher estimate of conscious influences and a lower estimate of unconscious influences. Thus, the motivational level of the participants can have a considerable impact on estimates of conscious and unconscious influences.

Despite the fact that some participants were able to include or exclude 100% of the target words presented for 250 ms, estimates of the conscious and unconscious influences of the target words presented for 250 ms were calculated using the group means shown in Table 1. Although interpretation of these results is clouded by possible floor effects (see Jacoby, 1998), the pattern of findings was similar to the pattern found for the 50-ms presentation duration. Namely, whereas conscious influences were greater for the motivated group (.97) than for the control group (.89), unconscious influences were greater for the control group (.73) than for the motivated group (.67).

Taken together, the findings at both the 50- and the 250-ms presentation durations indicate that participants who were motivated by financial rewards to follow the exclusion and inclusion instructions showed higher estimates of conscious influences and lower estimates of unconscious influences than the control group of participants who were not given a financial incentive to follow the inclusion and exclusion instructions. Importantly though, the data in Table 1 suggest that the change in motivational level influenced exclusion performance but not inclusion performance. To confirm this impression, additional statistical analyses were conducted on the inclusion and exclusion data.

The mean exclusion scores for the critical 0- and 50-ms presentation durations were analyzed using a 2 (duration) $\times$ 2 (group) repeated-measures analysis of variance. This analysis revealed no effect of duration, $F(1, 46) = 0.02$, MSe $= .005$, $p > .05$, but a significant effect of group, $F(1, 46) = 4.61$, MSe $= .008$, $p < .04$ and an interaction between duration and group, $F(1, 46) = 11.56$, MSe $= .005$, $p = .001$. An examination of Table 1 reveals that stems were completed with target words more often by the control group than by the motivated group. More important is the fact that for the control group, performance was higher at the 50-ms duration than at the 0-ms duration, whereas for the motivated group, performance was lower at the 50-ms duration than at the 0-ms duration. This difference between the performance of the motivated and control groups confirms that the level of motivation had a considerable impact on exclusion performance.

The mean inclusion scores for the critical 0- and 50-ms presentation durations were also analyzed using a 2 (duration) $\times$ 2 (group) repeated-measures analysis of variance. This analysis revealed a significant effect of duration, $F(1, 46) = 86.30$, MSe $= .009$, $p < .001$, but no effect of group, $F(1, 46) = 1.78$, MSe $= .017$, $p > .05$, and no interaction between duration and group, $F(1, 46) = 0.22$, MSe $= .009$, $p > .05$. An examination of Table 1 shows that the performance of both groups increased when presentation duration was increased from 0 to 50 ms, but that there were no substantial differences between groups in the number of stems completed with target words at either the 0-ms duration or the 50-ms duration. Thus, the analysis revealed no evidence that the level of motivation affected inclusion performance.

In summary, the results of Experiment 1 indicate that the level of motivation influences estimates of conscious and unconscious processes in a perception task. In addition, the results reveal that the level of motivation primarily affects exclusion performance. Given that the effect of motivation seems to be confined to exclusion performance alone, it was important to determine the reliability of this finding.

EXPERIMENT 2

The purpose of Experiment 2 was to replicate the effect of motivation on exclusion performance found in Experiment 1. The general design of Experiment 2 was similar to the design of Experiment 1. On each trial, the participants viewed five-letter English words that were presented for 0, 50, or 250 ms. Following the presentation of each word, the first three letters of the word were presented, and the participants were required to add two letters to form a five-letter English word other than the one that had just been presented. The major difference between Experiment 1 and Experiment 2 was that the participants were tested only with exclusion instructions in Experiment 2.

Method

Participants. Twenty-four undergraduate students were selected from the cognition subject pool used in Experiment 1. None of these participants had taken part in Experiment 1. At the time the students were scheduled for the experiment, they were told that they would receive a minimum of $6 for their participation. The students were assigned to either the control group or the motivated group when they arrived for the experiment on the basis of an alternating sequence.

Materials. Stimuli and equipment were identical to those used in Experiment 1.

Procedure. The procedure was similar to Experiment 1. Each participant received a total 180 trials, with 60 trials at each of the three presentation durations (0, 50, and 250 ms). The sequence of events on each trial was identical to Experiment 1, with the exception that the participants were tested with exclusion instructions on all trials.

Results and Discussion

Table 2 shows the mean exclusion performance for the motivated and control groups at each presentation duration. Each mean in the table indicates the proportion of stems completed with target words. Table 2 also shows the 95% confidence interval associated with each mean.

To determine whether motivation influenced exclusion performance, the data were analyzed using a 2 (duration) $\times$ 2 (group) repeated-measures analysis of variance. The analysis revealed neither a main effect of group, $F(1, 22) = 0.11$, MSe $= 0.002$,

TABLE 2
Mean Proportion of Stems Completed with Target Words and the Associated 95% Confidence Interval for Each Condition in Experiment 2

	Presentation duration		
	0 ms	50 ms	250 ms
Exclusion instructions			
Control group	.20 ± .01	.25 ± .02	.07 ± .02
Motivated group	.23 ± .02	.21 ± .02	.04 ± .01

$p > .05$, nor a main effect of duration, $F(1, 22) = 1.58$, MSe = 0.002, $p > .05$. However, as in Experiment 1, there was a significant interaction between duration and group, $F(1, 22) = 5.83$, MSe = 0.002, $p < .03$. An examination of Table 2 shows that exclusion performance for the control group was greater at the 50-ms duration than at the 0-ms duration. In contrast, exclusion performance for the motivated group was lower at the 50-ms duration than at the 0-ms duration. These findings replicate the results of Experiment 1 and show that incentives to follow the exclusion instructions led to increased compliance with these instructions.

The results of Experiments 1 and 2 are consistent with the idea that the motivational level of the participants affects the amount of attention that they devote to a task. The results suggest that increased motivation led to increased attention, which in turn enabled participants to exclude a greater proportion of the target words from their stem completions. However, neither the results of Experiment 1 nor the results of Experiment 2 are informative as to how increased attention may have influenced task performance. Increased attention may have increased the proportion of trials on which words were consciously perceived at the time of study or increased attention may have led participants to be more careful not to use consciously perceived words when completing the stems at the time of test. These two possible effects of motivation cannot be disentangled with the perception task because each trial involves both study and test. For this reason, we used a memory task in Experiments 3A and 3B in order to separate the effects of motivation at the time of study from the effects of motivation at the time of test.

EXPERIMENTS 3A AND 3B

The purpose of Experiments 3A and 3B was to evaluate the effects of motivation at the time of study and at the time of test on estimates of conscious and unconscious processes. In both experiments, participants first studied a list of words and then completed a stem-completion task with both inclusion and exclusion instructions. In Experiment 3A, the effects of motivation at the time of test were evaluated by giving the participants in the motivated group the motivating instructions *after* they studied the list of words. In contrast, the effects of motivation on study were evaluated in Experiment 3B by giving the participants in the motivated group the motivating instructions *before* they studied the words. In this way, it was possible to assess whether the effects of motivating instructions on performance in the memory task occurred primarily during study or during test.

Experiment 3A

Method

Participants. Sixty-four undergraduate students were selected from the cognition subject pool at the University of Waterloo. All students were either native speakers of English or had learned the English language by the age of 4, and all reported normal or corrected-to-normal vision. At the time the students were scheduled for the experiment, they were told that they would receive a minimum of $6 for their participation. The students were assigned to either the control group or the motivated group when they arrived for the experiment on the basis of an alternating sequence.

Materials. The 180 words that were used in Experiment 1 were alphabetized and divided into two sets of 90 study words by assigning every second word to one of the sets. During the study phase of the experiment, each participant viewed one set of 90 study words that was randomly intermixed with 90 filler words. The filler words were five letters in length, and none of the filler words had a three-letter stem in common with any of the study words. In addition, the distribution of word frequencies for the filler words was similar to the word-frequency distribution for the study words.

To test memory for the studied words, two test lists were constructed in the following manner. First, the stems corresponding to the 90 words in each study set were divided into two subgroups of 45 stems by assigning every second stem in each set to one of the subgroups. Second, one subgroup of stems from each study set was assigned to each test list. Given that each participant saw only one of the two study sets, each test list therefore consisted of 45 stems corresponding to ‘‘old’’ words that had been seen in the experiment and 45 stems corresponding to ‘‘new’’ words that had not been seen in the experiment. For each participant, one test list was used to assess memory with inclusion instructions, and the other test list was used to assess memory with exclusion instructions. Across participants, each test list was used equally often with inclusion and exclusion instructions.

Procedure. In the study phase of the experiment, each participant viewed 90 words from one of the study lists and the 90 filler words. The order in which the words were presented was determined by selecting the words randomly without replacement from the study list and the 90 filler words. Each word was presented in the middle of a monitor screen for 1000 ms, and the participants were instructed simply to remember as many of the words as possible for later tests of memory.

At the end of study phase, there was an unrelated experiment that took approximately 10 min to complete. The reason for including this experiment was to decrease the influence of conscious memory for the studied words. The experiment was basically a replication of an earlier study by Kunst-Wilson and Zajonc (1980). The participants first viewed a series of briefly presented polygons and were then given direct and indirect tests of memory. The participants were informed that this experiment was not related in any way to the list of words that they had studied.

Before beginning the test phase of the experiment, the participants were informed of the payment that they would receive for their participation. The participants assigned to the control group were simply reminded that they would receive $6 at the end of the experiment. The participants assigned to the motivated group were told that they would begin each block of trials with $15. They were also told that each time they failed to follow the inclusion or exclusion instructions that they would lose $1, down to a minimum of $3 per block.

The participants then began the test phase of the experiment. There were two blocks of 90 trials. In each block, stems from one of the test lists were presented in random order. For one block of trials, the participants were instructed to complete each word stem, if possible, to form a word that had been presented in the study phase (inclusion instructions). For the other block of trials, the participants were instructed to complete each word stem to form any word other than a word that had been presented in the study phase (exclusion instructions). Half of the participants were given inclusion instructions in the first block of trials and exclusion instructions in the second block of trials; the order of inclusion and exclusion instructions was reversed for the remaining participants.

Experiment 3B

Method

Participants. Sixty-four undergraduate students were selected from the cognition subject pool at the University of Waterloo. All students were either native speakers of English or had learned the English language by the age of 4, and all reported normal or corrected-to-normal vision. The students were told at the time they were scheduled for the experiment that they would receive a minimum of $6 for their participation. When they arrived for the experiment, they were assigned to either the control group or the motivated group in the same manner as in Experiment 3A.

Materials. The stimuli used in this experiment were identical to the stimuli that were used in Experiment 3A.

Procedure. With one exception, the procedure was identical to the procedure followed in Experiment 3A. The one exception involved when the participants were told about the pay they would receive at the end of the experiment. Rather than waiting until the beginning of the test phase, as was done in Experiment 3A, the participants were informed about the pay that they would receive before they began the study phase of the experiment. In all other respects, the procedures followed in Experiments 3A and 3B were identical.

Results and Discussion

Inclusion and exclusion performance. Table 3 shows the mean exclusion and inclusion performance for the motivated and control groups in Experiments 3A and 3B. Each mean in the table indicates the proportion of stems completed with target words. Table 1 also shows the 95% confidence interval associated with each mean.

Inspection of Table 3 shows that the results of Experiments 3A and 3B were very similar. On the inclusion tests, the motivated and control groups performed in a virtually identical manner across experiments, and in both experiments, the motivated group's performance was indistinguishable from the control group's performance. Exclusion performance was also very similar both across experiments and between

TABLE 3
Mean Proportion of Stems Completed with Target Words and the Associated 95% Confidence Interval for Each Condition in Experiments 3A and 3B

	Instructions			
	Inclusion		Exclusion	
	New	Old	New	Old
Experiment 3A				
Control group	.23 ± .02	.30 ± .02	.21 ± .02	.23 ± .03
Motivated group	.23 ± .02	.31 ± .03	.18 ± .03	.21 ± .03
Experiment 3B				
Control group	.23 ± .02	.31 ± .02	.18 ± .02	.22 ± .03
Motivated group	.25 ± .02	.30 ± .03	.23 ± .02	.24 ± .01

the motivated and control groups within experiments. Even though there were some small variations between experiments in the way that the control and motivated groups completed old and new items on the exclusion tests, the general impression from an inspection of Table 3 is that the overall patterns of findings were similar.

The small observed differences in exclusion and inclusion performance across experiments were evaluated by separate analyses of variance that assessed Experiment (3A vs 3B), group (motivated vs control), and word type (old vs new). The analysis of inclusion performance revealed a significant overall difference between old and new items, $F(1, 124) = 55.92$, MSe = 0.005, $p < .001$, which did not interact with any other factors, all Fs < 1.19. Likewise, the analysis of exclusion performance revealed a small but significant overall difference between old and new items, $F(1, 124) = 8.06$, MSe = 0.004, $p < .005$, which also did not interact with any factors, all Fs < 1.17. These results confirm that the patterns of inclusion and exclusion performance were similar across the two experiments. Thus, it appears that the time at which the motivating instructions were presented to the participants had little or no effect on either inclusion or exclusion performance.

Conscious and unconscious influences. Given that the analyses of the inclusion and exclusion performance revealed no differences in performance across Experiments 3A and 3B, the data were collapsed across the two experiments for purposes of calculating estimates of the conscious and unconscious influences of memory. The resulting estimates for the motivated and control groups are shown in Fig. 3. It is clear from an examination of Fig. 3 that the estimates of conscious and unconscious processes were basically the same for the two groups. Thus, the motivation of the participants does not appear to affect estimates of the conscious and unconscious influences of memory for previously studied words.

GENERAL DISCUSSION

Estimates of conscious and unconscious processes derived on the basis of the process-dissociation procedure are sensitive to any factor that has a differential effect

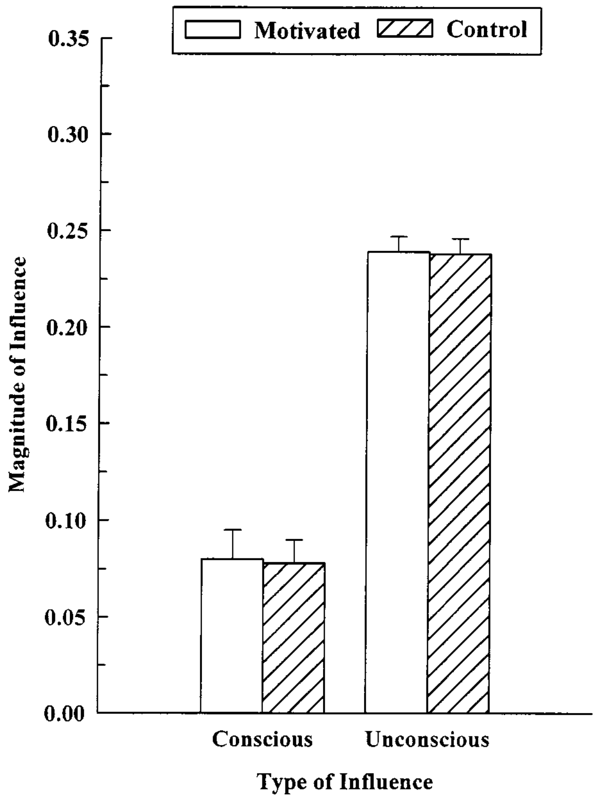

FIG. 3. Conscious and unconscious influences of memory and the associated 95% confidence intervals for the motivated and control groups in Experiments 3A and 3B.

on exclusion or inclusion performance. We hypothesized that one such factor was the motivational level of participants. The results of Experiment 1, which involved a perception task, are consistent with this hypothesis. In Experiment 1, the motivated group of participants complied better with the exclusion instructions than did the control group. However, inclusion performance did not differ across the motivated and control groups. This differential effect of motivation on exclusion and inclusion performance led to different estimates of conscious and unconscious processes for the motivated and control groups; the estimate of conscious influences was higher for the motivated group, whereas the estimate of unconscious influences was higher for the control group.

In contrast to the results of Experiment 1, the results of Experiments 3A and 3B, which involved a memory task, showed no evidence of any effects due to motivational level. Exclusion performance and inclusion performance for the control and motivated groups were virtually indistinguishable. This outcome is similar to previous findings reported by Nilsson (1987), who found no effect of monetary incentives on either recall or recognition performance. Given that exclusion performance and inclusion performance were unaffected by motivational level in Experiments 3A and 3B, similar estimates of conscious and unconscious processes were found for the motivated and control groups.

The obvious issue that needs to be addressed concerns why the results of Experiment 1 are so different from the results of Experiments 3A and 3B. The results of Experiment 1 are consistent with the idea that an increase in motivational level increases attention to a task, which in turn both increases the level of conscious processing and decreases the level of unconscious processing. The factor mediating increased attention to the perception task in Experiment 1 may have been the opportunity that the participants had on each trial to assess the relation between their attention to the word at the time it was presented and their subsequent ability to consciously recognize the word. On each trial, a word and its stem were presented in close temporal contiguity. This contiguity between words and stems should have made it relatively easy for the participants to monitor their performance and to adjust the way in which they allocated their attention to the words.

If temporal contiguity between words and stems accounts for the effect of motivation in the perception task, then the absence of temporal contiguity between words and stems in the memory task may account for why motivation did not affect estimates of conscious and unconscious processes in Experiments 3A and 3B. With the memory task used in Experiments 3A and 3B, the participants were presented with all study words prior to testing. Thus, there was no opportunity for the participants, independent of how motivated they were to do well on the experimental task, to receive feedback regarding the relation between their allocation of attention during study and their performance on the inclusion and exclusion tests. It is quite possible that the lack of such feedback accounts for the complete absence of any effect of motivation on the memory task.

Previously, Debner and Jacoby (1994) examined the influence of attention on estimates of conscious and unconscious processes in a perception task. Consistent with the results of Experiment 1, they found that a higher level of attention led a higher estimate of conscious processes. However, in contrast to the results of Experiment 1 in which increased attention led to a decrease in the estimate of unconscious processes, Debner and Jacoby found that variations in attention had virtually no effect on estimates of unconscious processes. If the effects of motivation in a perceptual task are mediated by changes in the allocation of attention, then a question that arises concerns why the results of Experiment 1 are so different from the results reported by Debner and Jacoby. One possible answer to this question is that it is incorrect to interpret the effects of motivation on estimates of conscious and unconscious processes in terms of variations in attention. A second possible answer to this question is that the effects of motivation are due to variations in attention but that methodological differences between Experiment 1 and the experiments conducted by Debner and Jacoby account for the different results.

One methodological difference between Experiment 1 and in the experiments conducted by Debner and Jacoby (1994) is that different regions of the function that defines the relation between attention and performance were sampled. The experimental conditions for the control group in Experiment 1 and the focused-attention conditions in the Debner and Jacoby experiments were similar and most likely reflect a common point on the attention/performance function. Relative to this common point, the incentives for the motivated group in Experiment 1 are assumed to have *increased* attention, whereas the divided-attention conditions in the Debner and Jacoby experiments are assumed to have *decreased* attention. Thus, Experiment 1 and the experiments conducted by Debner and Jacoby likely assessed different regions of the attention/performance function. If this is the case and one makes the plausible assumption that the relation between attention and performance is not linear across all degrees of attention, then the results of Experiment 1 and the findings reported by Debner and Jacoby are not necessarily contradictory.

Another methodological difference between Experiment 1 and the experiments conducted by Debner and Jacoby (1994) is that different demands were placed on visual attention. In Experiment 1, the visual displays and the information that the participants were required to extract from the visual displays were the same for the motivated and control groups. In contrast, in the experiments conducted by Debner and Jacoby, the demands on visual attention varied between their focused- and divided-attention conditions. In their focused-attention condition, the participants were simply required to perceive the target words. However, in their divided-attention condition, the participants were not only required to the perceive the target words but they were also required to perceive a pair of digits that flanked each target word. Thus, the participants in Debner and Jacoby's experiments were required to extract different types of information from the visual displays in the focused and divided attention conditions, whereas in Experiment 1, the participants in the motivated and control groups were required to extract the same information from the visual displays. Given previous findings demonstrating modality-specific limits to attention (e.g., Treisman & Davies, 1973), it is possible that dividing attention within the visual modality places unique demands on participants. For this reason, the results of studies based on a division of attention within the visual modality may not be representative of the results obtained using other methods for varying attention. One way to assess this suggestion would be to compare the effects of dividing attention within the visual modality (e.g., Debner & Jacoby) with the effects of dividing attention between the visual and the auditory modalities (e.g., Jacoby, 1991, 1996; Jacoby et al., 1993).

This discussion of the methodological differences between Experiment 1 and the experiments conducted by Debner and Jacoby (1994) suggests that it may be premature to conclude that all variations in attention lead to same pattern of findings when the process-dissociation procedure is used in conjunction with perception tasks. It is entirely possible that different methods for varying attention lead to different patterns of findings. It is also possible that the patterns of conscious and unconscious influences differ when different regions of the attention/performance function are sampled. Both of these possibilities need to be evaluated before strong conclusions are made regarding how attention influences estimates of conscious and unconscious processes in a perception task.

A final issue that needs to be addressed concerns whether the conclusions based on the results of the present experiments generalize to all variants of inclusion and exclusion instructions. Jacoby (1998) has noted that inclusion and exclusion instructions can emphasize either a direct retrieval strategy or a generate–recognize strategy. Instructions that emphasize a direct retrieval strategy explicitly encourage participants to use the stems to recall the previously studied words and to either use these words (i.e., inclusion instructions) or avoid using these words (i.e., exclusion instructions) when completing the stems. In contrast, instructions that emphasize a generate–recognize strategy simply encourage participants to use each stem to form a word and then to decide whether they recognize the word that they generated. Our exclusion instructions were closer to generate–recognize instructions than to direct retrieval instructions. We modeled our instructions for the perception task in Experiment 1 on the instructions used by Debner and Jacoby (1994) to dissociate the conscious and unconscious influences of perception. Their exclusion instructions both asked participants to ‘‘generate a five-letter word that would be a completion for that stem’’ and ‘‘emphasized that the word stem should not be completed with a word from the sequence flashed immediately preceding the stem’’ (p. 308). Given that our instructions for the perception task in Experiment 1 were of the generate–recognize variety, we used similar instructions for the memory task in Experiments 3A and 3B so as not to confound instructions with type of task. We doubt that our exclusion instructions that emphasized a generate–recognize strategy can account for the observed effects of motivation. Even though different instructional sets can lead to different estimates of conscious and unconscious processes (e.g., Jacoby, 1998), it is difficult to see how exclusion instructions emphasizing a direct retrieval strategy would either eliminate all effects of motivation in the perception task or introduce effects of motivation in the memory task.

The results of the present experiments show that the motivational level of participants can have a critically important influence on estimates of conscious and unconscious processes in perception tasks but that it has no influence on estimates of conscious and unconscious processes in memory tasks. These results suggest that caution should be exercised whenever an exclusion task is used in perception experiments either by itself to estimate the relative magnitude of conscious or unconscious influences (e.g., Merikle et al., 1995) or in conjunction with an inclusion task to estimate the separate contributions of conscious and unconscious processes (e.g., Debner & Jacoby, 1994). This conclusion is important because factors such as presentation duration are often varied in perception experiments, and these factors may influence the participants’ level of motivation, which in turn may influence estimates of conscious and unconscious processes. However, in contrast to the cautions indicated for perception experiments, the present results also suggest that the process-dissociation procedure is relatively immune to the influences of motivation when it is used in memory experiments and that it can be used without fear of confounding experimental manipulations and the motivational level of participants. This conclusion is particularly relevant to experiments that have compared the conscious and unconscious influences of memory across different clinical populations (e.g., Spieler, Balota, & Faust, 1996) or across different age groups (e.g., Jennings & Jacoby, 1997) because these different populations are likely to have intrinsically different levels of motivation. The results of the present experiments suggest that such motivational differences across different populations should not affect estimates of the conscious and unconscious influences of memory.

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