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Noncriterial Recollection: Familiarity as Automatic, Irrelevant Recollection

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Recollection is sometimes automatic in that details of a prior encounter with an item come to mind although those details are irrelevant to a current task. For example, when asked about the size of the type in which an item was earlier presented, one might automatically recollect the location in which it was presented. We used the process dissociation procedure to show that such noncriterial recollection can function as familiarity—its effects were independent of intended recollection.

Jacoby (1991) introduced the process dissociation procedure as a means of separating the contributions of recollection and familiarity to judgements of recognition memory. By that procedure, recollection is defined in terms of subjects' ability to respond selectively on the basis of memory for some criterial feature such as the list in which an item was presented. However, even when subjects are unable to recollect the criterial feature, they may be able to recollect noncriterial details of the prior presentation of an item. After further describing the process dissociation procedure we consider the possibility that noncriterial recollection invalidates an assumption underlying the procedure. Finally, we report an experiment designed to investigate the nature of noncriterial recollection and to examine its effects on the process dissociation procedure.

THE PROCESS DISSOCIATION PROCEDURE

The procedure, developed by Jacoby, provides estimates of recollection and familiarity by contrasting performance in an inclusion condition, where the two processes act in concert, to performance in an exclusion condition, where the two processes act in opposition. Consider the procedure as used in a list discrimination paradigm (e.g., Yonelinas & Jacoby, 1994). Subjects studied two different lists of words followed by a recognition-memory test containing words from both lists mixed with new words. In one test condition, subjects were instructed to respond *yes* if the word

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was in the first list and to respond *no* if it was new or from the nontarget list. Further, subjects were instructed to respond *yes* if they could not recollect which list the word was in but they thought the word was studied (i.e., the word was familiar in the absence of recollection). In a second condition, the test instructions were reversed—subjects were instructed to response *yes* if the word was from the second list.

Inclusion performance is measured as the probability of accepting an item from the target list (i.e., accepting a list 1 word under ''list 1?'' instructions or accepting a list 2 word under ''list 2?'' instructions). The inclusion items may be accepted either if list membership is recollected or if recollection fails but the item is sufficiently familiar. If the two processes are independent then

$$P(\text{``yes''/old})_{\text{inc}} = R + (1 - R)F.$$

In contrast, exclusion performance is measured as the probability of accepting an item from the nontarget list (i.e., accepting a list 1 word under ''list 2?'' instructions or accepting a list 2 word under ''list 1?'' instructions). The exclusion items will only be accepted if they were familiar in the absence of recollection. If the two processes are independent then

$$P(\text{``yes''/old})_{\text{exc}} = (1 - R)F.$$

Recollection is estimated as the difference between the inclusion and exclusion scores ($R + (1 - R)F - (1 - R)F = R$). Having solved for R, either of the two equations could be used to solve for familiarity (e.g., exclusion/$(1 - R) = F$).

The above equations rest on the assumption that recollection and familiarity independently contribute to performance (for a discussion of the independence assumption see Jacoby, Toth, & Yonelinas, 1993; Jacoby, Toth, Yonelinas, & Debner, 1994; Jacoby, Yonelinas, & Jennings, in press; Joordens & Merikle, 1993). We have gained evidence consistent with that independence assumption by showing that manipulation of variables traditionally identified with automaticity produce process dissociations. That is, if the two processes are independent then it should be possible to find manipulations that influence one component but leave the other unaffected. For example, forcing subjects to response very rapidly at test, (i.e., response deadline) has been found to decrease recollection but to leave estimates of familiarity relatively unaffected (Yonelinas & Jacoby, 1994; Toth, in press), showing that familiarity is a relatively fast process that is functionally independent of recollection. That familiarity was not influenced by response deadline shows that it had run to completion prior to the required response deadline. In contrast, recollection was reduced by the deadline because it took longer to complete.

The procedure measures recollection as the ability to recollect some specified aspect of the study event (list membership in the example just described) and to use that recollected detail as a basis for discriminative responding. Familiarity, on the other hand, does not support such discriminative responding and leads to the same response in both inclusion and exclusion conditions.

Note that the definition of recollection that underlies the process dissociation procedure is nonexhaustive in the sense that only information that supports the required discrimination (i.e., list membership) is counted as recollection. Recollection of non-

criterial information (i.e., remembering that one coughed during the presentation of the study item) would not support the required discrimination and thus would not be measured as recollection.

NONCRITERIAL RECOLLECTION AND THE INDEPENDENCE ASSUMPTION

The issue that we examine in the current paper is whether the existence of noncriterial recollection leads to a violation of the independence assumption that underlies the process dissociation procedure. The issue is critical because a violation of that assumption could lead the procedure to produce distorted estimates of recollection and familiarity. To illustrate the potential problem, imagine that we varied the difficulty of recollection by making the basis for discrimination easy in one condition but difficult in the other condition. For example, in the easy discrimination condition, suppose subjects are required to recollect an aspect of the study event that was attended to at the time of study (e.g., subjects were told to try to remember whether words were presented on the left or right side of the screen, and they were later tested for location information). In contrast, in the difficult discrimination condition, suppose they were required to recollect an aspect of the study event that was much less memorable (e.g., subjects were told to remember location, but at test they were asked whether the words were studied in a large or small font size). The more difficult discrimination would result in a lower estimate of recollection, but what would be the effect on the estimate of familiarity?

One possibility is that the items that were recollected under easy discrimination conditions would still be recollected under hard conditions, but they would be treated as familiar and would inflate the estimate of familiarity. For example in the difficult discrimination condition, subjects might recollect location information, but this would not support the required size discrimination and thus would not be measured as recollection. Because subjects are instructed to respond *yes* to items that they think were studied but for which they cannot recollect the critical information, noncriterial recollection should increase both the inclusion and exclusion scores and, so, should be measured as familiarity. What this means is that only criterial recollection will be measured as recollection and that familiarity may include not only recognition judgements based on undifferentiated feelings of familiarity, but also the retrieval of information that is noncriterial for the task at hand. Thus, what was measured as recollection in one condition would be measured as familiarity in another. This could be problematic for the process dissociation procedure because it suggests that recollection and familiarity are not independent. Because the inclusion and exclusion equations are based on the assumption that recollection and familiarity are independent, a violation of the assumption could lead to distorted estimates of the two processes.

EXAMINING THE INFLUENCE OF NONCRITERIAL RECOLLECTION

Because of the above possibility, previous studies using the process dissociation procedure have minimized the likelihood of noncriterial recollection by making the two classes of items as distinctive as possible (e.g., Jacoby, 1991) or by using a repeated study–test procedure in which subjects were well practiced at encoding and retrieving criterial information (e.g., Yonelinas, 1994; Yonelinas & Jacoby, 1994).

Findings of invariances in those studies provides support for the claim that recollection and familiarity were operating independently.

However, what would happen if noncriterial recollection occurred very frequently? The current experiment was designed to examine how noncriterial recollection influences estimates of familiarity and determine if it leads to a violation of the independence assumption. We examined estimates of recollection and familiarity under easy and hard discrimination conditions, and under speeded and nonspeeded response conditions.

Under hard discrimination conditions we expected noncriterial recollection to be more frequent than under easy discrimination conditions. Thus, if noncriterial recollection were occurring and subjects were using it as a basis for memory judgements, then we expected the estimates of familiarity to be greater in the hard discrimination conditions than in the easy conditions.

The response speed manipulation was introduced to determine whether noncriterial recollection was operating independently of criterial recollection. As previously discussed, forcing subjects to make speeded responses under standard inclusion/exclusion conditions (easy discriminations) leads to a dramatic decrease in recollection but leaves familiarity unaffected (Yonelinas & Jacoby, 1994; Toth, in press), as would be expected if familiarity were a relatively fast process that was independent of recollection. However, what is the effect of response deadline on estimates of familiarity under difficult discrimination conditions? If noncriterial recollection is behaving like criterial recollection then our estimates of familiarity, which should be inflated by noncriterial recollection, should decrease when responses are speeded. On the other hand, if noncriterial recollection is a fast process that is independent of criterial recollection then we may expect our estimates of familiarity under the difficult discrimination conditions to remain invariant across response deadline. That noncriterial recollection is a fast process is suggested by introspection. For example, when noncriterial recollection occurs it seems to come to mind relatively quickly and with little, if any, conscious effort. This, of course, is in contrast to criterial recollection which seems to involve a slow search process. Thus, noncriterial recollection may behave like familiarity in that it comes to mind automatically. If this is true, then its occurrence would not lead to a violation of the independence assumption.

In summary, we examined the effect of noncriterial recollection on estimates of recollection and familiarity. We compared estimates of these processes under easy discrimination conditions, in which noncriterial recollection should be relatively rare, to estimates under difficult discrimination conditions, in which we expected noncriterial recollection to be much more frequent. If subjects do recollect noncriterial information and it is treated as familiarity then we expect estimates of familiarity to be greater in the hard than the easy discrimination conditions. On the basis of prior studies we expect the response deadline manipulation to dissociate estimates of recollection and familiarity under the easy discrimination conditions. However, the effect of deadline under difficult discrimination conditions should show if noncriterial recollection is operating independently of criterial recollection. If noncriterial recollection is a fast processes that is operating independently of criterial recollection than we expect the effect of deadline on familiarity to be the same under easy and hard discrimination conditions. On the other hand, if both types of recollection are operating

in a similar way then we expect estimates of familiarity to be influenced by response deadline, in the same way as criterial recollection.

METHOD

Subjects and Materials

Sixty-four subjects received a class experimental credit in an introductory psychology class for participated in the experiment. Two-hundred and sixty-four words were randomly selected from the Toronto word pool for each subject.

Design and Procedure

Speeded and nonspeeded inclusion and exclusion performance was measured in a recognition task under easy and difficult discrimination conditions. Response speed and discrimination difficulty were crossed and were varied between subjects. Inclusion and exclusion scores were collected for each subject and were used to derive estimates of recollection and familiarity.

Materials were presented and responses collected on a PC compatible computer. Each subject participated in one session that took approximately 40 min. Subjects were told that they would be presented with a list of words and that they were to try to remember them for a later recognition memory test. They were informed that half of the words would be presented on the left side of the screen and half would be presented on the right, and that they were to try to remember not only which words were presented but which side of the screen they were presented on. To help subjects remember side information they were given associative encoding instructions: associate the words on the right side with a distinctive person or place, and associate the words on the left with a different person or place. Subjects were told that we would present words in a random order and that we would vary how difficult it was to read the words by presenting words in different sizes.

In the study list, 204 words were presented one at a time on the screen. The first 12 words were buffer items that were used for practice items later in the test phase. Each word was on the screen for 3 s. Half of the words were presented on the far left side of the screen and the others were presented on the far right. Half of the words were presented in large font (character size was approximately 10×15 mm) and half were presented in small font (2×3 mm). Word size and word location were crossed, and the presentation order was randomized for each subject.

There were four different test conditions with 16 subjects in each condition. Half the subjects were asked to determine which side the words had been studied on (easy discriminations). The other subjects were required to judge whether words had been presented in large or small font at study (hard discriminations). Half of the subjects in each of these conditions were allowed to take as long as they needed to make each judgement (slow conditions). The other subjects were told to make each response within approximately a second after the target word was presented (fast conditions). In the slow conditions, the computer would not accept responses until the word had been presented on the screen for 1.2 s. For the fast conditions, a buzzer was sounded if a response was not made within 1.2 s after the word onset. However,

each word remained on the screen until a response was made, and all responses were recorded. Subjects made *yes/no* responses by pressing designated keys on the computer keyboard.

In the easy discrimination conditions subjects were asked ''was the word on the left?'' or ''was the word on the right?'' Subjects were instructed to respond *yes* if they remembered the word was on the appropriate side and to respond *no* if it was new. If the word had been presented on the inappropriate side, they were to respond *no*. Finally, if they thought the word was presented, but they could not remember which side it was on, they were to response *yes.*

In the hard discrimination condition, the test phase was the same, except that subjects were asked ''was the word in large font?'' or ''was the word in small font?''

The recognition test was divided into two sections. In the first section subjects were required to make one type of discrimination (e.g., was the word on the left?) and in the second they were required to make the opposite discrimination (e.g., was the word on the right?). Test order was counterbalanced across subjects.

Each of the two test lists contained 12 buffer items followed by a random mixture of 48 items from the left side (half had been in large font), 48 items from the right side (half had been in large font), and 24 new items. All items were presented one at a time in a medium font size (5×7 mm). The first 12 words in each section were practice words. The experimenter worked through the first few words with each subject to make sure they understood the instructions. For example, when a word appeared, the experimenter asked the subject if they remembered the word and what their response should be. Responses to the buffer words were not scored.

The design yielded an inclusion and exclusion score as well as a false alarm rate (the probability of accepting new items) for each subject. For the easy discrimination conditions the inclusion score was equal to the probability of accepting a word from the left side under ''left?'' instructions or accepting a word from the right side under ''right?'' instructions. The exclusion score was equal to the probability of accepting a word from left under ''right?'' instructions or accepting a word from the right under ''left?'' instructions. For the hard discrimination conditions the inclusion score was equal to the probability of accepting a word that had been presented in large font under ''large?'' instructions or accepting a word that had been presented in small font under ''small?'' instructions. The exclusion score was equal to the probability of accepting a word that had been presented in large font under ''small?'' instructions or accepting a word that was presented in small font under ''large?'' instructions. The significance level for all statistical tests was $p < .05$.

RESULTS AND DISCUSSION

Table 1 presents the average inclusion and exclusion scores as well as the average estimates for recollection and familiarity under easy and difficult discrimination conditions for fast and slow response speed conditions. Before examining the estimates of recollection and familiarity, we present a brief analysis of the inclusion, exclusion, and new scores. As can be seen in Table 1, inclusion performance was better in the slow than in the fast conditions, $F(1, 60) = 11.90$, $MSe = .011$, showing that fast responding decreased the probability that old items were recognized. Inclusion scores

TABLE 1
Proportion of Old and New Items Accepted as Old, and Estimates for Recollection and Familiarity for Easy and Hard Discriminations under Fast and Slow Response Speed Conditions

	Discrimination difficulty			
	Easy		Hard	
Response speed:	Slow	Fast	Slow	Fast
Condition				
Inclusion	.78	.68	.74	.66
Exclusion	.28	.44	.55	.62
New	.29	.34	.30	.31
Parameter				
R	.50	.24	.18	.04
F	.56	.57	.67	.64

were slightly higher in the easy than difficult discrimination conditions; however, the effect was not significant, $F(1, 60) = 1.89$, $MSe = .003$, nor was there a significant speed by condition interaction ($F < 1$).

Exclusion performance was influenced by discrimination difficulty and response speed, More items were accepted under hard than easy conditions, $F(1, 60) = 33.47$, $MSe = .023$, and more items were accepted under fast than slow response speed conditions, $F(1, 60) = 8.84$, $MSe = .023$. Discrimination difficulty did not interact with response speed. $F(1, 60) = 1.71$, $MSe = .023$.

To determine if there were differences in response bias between the experimental conditions we examined the false alarm rates. Such a comparison is important because differences in response bias can lead to distortions in the estimates derived using the process dissociation procedure (for a further discussion of response bias and the process dissociation procedure see Yonelinas, Regehr, & Jacoby, 1995). Note that in the easy discrimination conditions, the false alarm rate was .05 higher in the fast than the slow conditions, suggesting that subjects may have been slightly more lenient with their response criterion in the fast condition. However, an analysis of the false alarm rates showed that the scores did not differ significantly across conditions (*F*s < 1).

Of most importance are the estimates of recollection and familiarity. Recollection was estimated as the difference between the inclusion and exclusion scores. Familiarity was estimated as the probability of accepting an item under exclusion conditions divided by the probability that it was not recollected ($1 - R$). Separate analyses were conducted on estimates of recollection and familiarity.

As expected, recollection was greater under easy discrimination conditions (.37) than under hard discrimination conditions (.11), $F(1, 60) = 33.47$, $MSe = .030$. Recollection was also greater under slow (.34) than fast retrieval conditions (.14), $F(1, 60) = 21.41$, $MSe = .030$. There was no significant difficulty by speed interaction, $F(1, 60) = 2.12$, $MSe = .030$.

In contrast to recollection, familiarity was greater under hard discrimination conditions (.66) than under easy discrimination conditions (.56), $F(1, 60) = 9.40$, $MSe =$

.014. Furthermore, familiarity did not differ significantly between slow (.62) and fast (.60) response speed conditions, $F < 1$, nor was there a significant discrimination difficulty by speed interaction, $F < 1$.

The finding that response speed influenced recollection but did not influence familiarity replicates previous studies using the process dissociation procedure (Yonelinas & Jacoby, 1994; Toth, in press) and is in agreement with the notion that familiarity is a relatively fast, automatic process. The two important new findings are that the estimates of familiarity increased when the recollective discrimination was made more difficult and that the invariance in familiarity across response deadline was still seen under the difficult discrimination conditions. The increase in familiarity under the difficult discrimination conditions suggests that noncriterial recollection does influence the estimates of familiarity. That is, some of the items that would have been recollected in the easy discrimination conditions were treated as familiar in the difficult discrimination conditions.

Did noncriterial recollection lead to a violation of the independence assumption that underlies the process dissociation procedure? That it did not is evidenced by the invariance in familiarity across response speed. If noncriterial recollection were not automatic, requiring fast responding would have disallowed noncriterial as well as criterial recollection and, thereby, decreased estimates of both familiarity and recollection. Further, this decrease in estimated familiarity should have been larger for the difficult discrimination—the condition for which noncriterial recollection was most likely. However, for both the easy and the difficult discrimination conditions, requiring fast responding reduced recollection but left familiarity unaffected.

These results show that even when noncriterial recollection was quite likely, estimates of recollection were still dissociated from those of familiarity, as would be expected if recollection and familiarity are independent. This finding is important for the process dissociation procedure because it shows that noncriterial recollection did not lead to a violation of the procedure's underlying assumption that the two processes are independent.

CONCLUSION

A question that arises for any dual process theory of memory is: ''What should count as recollection?'' By our process dissociation procedure, recollection is situation specific, defined in terms of the demands of the task. For example, in the current experiment, recollection was measured as memory for location in one condition and memory for size in the other. Treating recollection as situation specific may seem problematic (cf. Graf & Komatsu, 1994; Roediger & McDermott, 1994), but we see no way to avoid doing so. Recollection is, after all, always measured in relation to some criterion. For a standard recognition-memory test, as an example, recollection is defined in relation to an earlier-studied list. A subject may recall having recently read a word when it is presented for test; however, if this recall does not differentiate words that were studied within the experimental context from those that were not, it is not treated as recollection.

Our approach contrasts with attempts to define recollection in terms of phenomenology. For the ''remember/know'' procedure, introduced by Tulving (1985), sub-

jects are asked to introspect during recognition judgments and to report when they experience recollection. Such an approach seems to treat recollection as being stable across situations and does not allow for the distinction between criterial and noncriterial recollection. However, as a commonplace example, suppose that one encounters a person and recollects some trivial detail about him or her. Would this be experienced as recollection? Perhaps it would not if one were trying to recollect the person's name. Despite this possibility, previous studies have shown that estimates of recollection gained using inclusion/exclusion instructions often parallel subjective reports of recollection (see Yonelinas & Jacoby, 1995). However, the two methods do define recollection in very different ways, and, so, one should not always expect parallel results, particularly not when noncriterial recollection is very likely. Importantly, experiments that have produced parallel results with the two procedures have made criterial that information that is most likely to be recollected and, thereby, avoided or minimized the possibility of noncriterial recollection.

Our approach to measuring recollection is closer to that of measuring source memory (cf. Johnson, Hashtroudi, & Lindsay, 1993) than it is to the remember/know procedure. For a source-memory task, one might be asked to judge whether a word was earlier spoken by a male or a female, whereas we might ask participants to include words spoken by a male and exclude those spoken by a female. Measured recollection or memory for source, of course, is specific to the question that is asked. In contrast, the recollection gained by the remember/know procedure is less well specified—almost anything that is recollected counts when one is using the remember/know procedure.

An advantage of strictly defining recollection is that it makes obvious the distinction between criterial and noncriterial recollection. That these two types of recollection were found to differ shows that the distinction is a useful one.

Given that noncriterial recollection differed from criterial recollection, one may be tempted to introduce terms into the process dissociation equations in such a way that we could derive quantitative estimates for noncriterial recollection. However, we have not done so for the following reason. Although we found noncriterial recollection to differ from criterial recollection, we have not found evidence to suggest that its effects are functionally separable from those of familiarity. Perhaps noncriterial recollection is most appropriately treated as being familiarity. For example, recollection of having coughed during the presentation of an item when one is trying to recollect the location of the item may have a status that is functionally equivalent to that of the item looking familiar.

A similar, although slightly more extreme, position has been taken by Lindsay, Gruppuso, and Kelley (1995). They, too, found trade-offs between effects on estimates of recollection and those of familiarity. Similar to our results, they showed that increasing the difficulty of the question that is criterial for the definition of recollection produced a decrease in estimated recollection along with an increase in estimated familiarity. They argued that their results are compatible with the notion that recollection and familiarity are entirely determined by the demands of the task. That is, recollection is the retrieval of information that supports a required discrimination whereas familiarity reflects anything else that is retrieved. In support of their claim, our results show that, at least with respect to the effects of response deadline, noncri-

terial recollection behaves like familiarity. In line with the claim that familiarity is a nonanalytic basis for judgments (Jacoby & Brooks, 1984), perhaps it is appropriate to treat familiarity as an amalgamation rather than attempting to reduce it to separate components. At present, there seems no reason to add a term to our equations to represent noncriterial recollection whose effects are to be treated as separate from those of familiarity.

It is likely that there are important boundary conditions for the independence of criterial and noncriterial recollection. In the difficult discrimination conditions, criterial and noncriterial recollection were measured as memory for size and location, respectively. The observed independence may be due to the fact that the size and location dimensions were varied orthogonally in our experiment. If values on the two dimensions were correlated for studied items then we might not expect the recollection of one aspect of the study event to be independent of the other. Future studies will examine the effects of introducing feature correlations on the estimates of recollection and familiarity.

Although we are only beginning to understand the complex nature of recollection the results of the current experiment are promising in that they show that the process dissociation procedure provides a useful tool for examining questions about noncriterial recollection.

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