



The distinctiveness effect in the absence of conscious recollection: Evidence from conceptual priming[☆]

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Abstract

We tested whether the distinctiveness effect in memory (superior memory for isolated or unusual items) only occurs with conscious recollection or could emerge with recapitulation of the type of processing that occurred at study even in the absence of recollection at test. Participants studied lists of categorically isolated exemplars. In Experiment 1, participants received either an explicit or an implicit test of category verification. We hypothesized that this task would recapitulate the evaluative processing from study. Results showed better explicit category cued recognition as well as greater priming for isolated items than nonisolated items on a category verification test. The latter outcome suggests that the distinctiveness effect can occur in the absence of conscious recollection. In Experiment 2, we sought converging evidence for our hypothesis that reinstating the evaluative process is critical for obtaining the effect on the implicit test; we used another conceptual implicit memory test (category production) that contained matching test cues but did not require evaluative processing. The absence of a distinctiveness effect on this measure in conjunction with its presence on the implicit category verification measure suggests that evaluative processing mediates the distinctiveness effect.

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The isolation, or von Restorff, effect is perhaps the best-known demonstration of the distinctiveness effect in memory and refers to the finding that people tend to have very good memory for unusual or incongruent items (see Hunt, 1995 for details of von Restorff's findings). In an isolation paradigm, participants study a list of items in which one item is physically or semantically different from the other items in the list. The isolation effect, then, refers to the finding that people have super-

rior memory for an item when it is different from the other items in the list than when it is not. Although this is a robust and intuitive finding, there is some disagreement as to how isolation in particular and distinctiveness in general aid memory (Schmidt, 1991). We examine the role of a central mechanism, namely the role of conscious recollection, in mediating the distinctiveness effect using the isolation paradigm.

The present experiments were designed to distinguish between 2 hypotheses: (1) conscious recollection is a necessary requirement for distinctiveness to affect memory, or (2) distinctiveness can affect performance in the absence of study awareness provided that the appropriate processing is recapitulated at test. To distinguish between these two hypotheses, we manipulated

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awareness by using explicit and implicit tests of memory, and processing match by using two different implicit tests that required different types of conceptual processing.

This line of inquiry has implications for the current theories of distinctiveness. One set of ideas proposes a prominent role of the reinstatement of the encoding context at the time of retrieval (Hunt, 1995; Hunt & McDaniel, 1993; Hunt & Smith, 1996; Waddill & McDaniel, 1998). The second set of ideas emphasizes the specific role of conscious recollection in this process of reinstatement (Smith & Hunt, 2000). Both lines of thinking emphasize the need to reinstate the encoding context and suggest that explicit memory processes are critical for this reinstatement.

The importance of context for distinctiveness

Much research shows that the effect of distinctiveness, or item difference, on memory depends critically on the encoding context (Hunt, 1995; Hunt & McDaniel, 1993; Hunt & Smith, 1996; Smith & Hunt, 2000). Echoing von Restorff's original findings, Hunt (1995) illustrates how the background context, and not simply item difference, produces the distinctiveness effect. The following example from Hunt (1995) illustrates this point.

Imagine that you are presented with a list of 9 numbers and one isolated syllable. The syllable is different from the numbers in the list, both perceptually and conceptually. From this situation, one might say that the syllable is distinct because it is different. However, it is not simply the difference that mediates the distinctiveness effect. For instance, the reader is asked to imagine that one by one all of the numbers except one get replaced with other stimuli (we have created a working example in Fig. 1). In the end, the syllable in the list will remain different from the numbers in the list.

9	K
12	~
3	*
16	&
dap	dap
5	5
14	△
11	
2	apple
7	!

Fig. 1. The importance of the encoding context in producing the distinctiveness effect.

But, it will also be different from the line drawing, the symbols, and the other items that were just added to the list. However, even though the syllable is still different from these items, now that the background context has changed, it ceases to be distinct. As this illustration shows, difference alone is insufficient to explain the distinctiveness effect in memory. Instead, distinctiveness emerges from noting difference in the context of similarity. Thus, the encoding context is critical for obtaining the distinctiveness effect in memory.

Recently, researchers have proposed that the distinctiveness effect depends on the encoding context not only at the time of study but also at the time of test (Hunt, 1995; Hunt & McDaniel, 1993; Hunt & Smith, 1996). A strong version of this retrieval theory proposes that distinctive processes (noting difference in the context of similarity) are only effective if the original encoding context is directly reinstated at the time of test (Hunt & Smith, 1996; Smith & Hunt, 2000). Further, according to this theory of distinctiveness, only memory tests that require direct or explicit reference to the encoding context will show the effects of distinctiveness (Smith & Hunt, 2000). The present experiments were designed to address this issue.

To do this, we used memory tests that differ in the extent to which they require reference to the encoding context. Most tests, such as recall and recognition, require direct reference to the study episode and are thus called explicit memory tests. Implicit tests, on the other hand, do not require the participant to refer back to the study episode to perform the task. Instead, these tests infer the use of memory based on a measure of task facilitation, a benefit in either accuracy or reaction time, called priming (Graf & Schacter, 1985; Tulving, Schacter, & Stark, 1982). The majority of implicit tests benefit from processing the perceptual features of the stimuli (Blaxton, 1989; Roediger & Blaxton, 1987; Rajaram & Roediger, 1993), but implicit tests have been developed that require more conceptual processing of the stimuli (Blaxton, 1989; Hamann, 1990; Srinivas & Roediger, 1990), without intention or awareness of memory. Nonetheless, all implicit memory tests share in common the characteristic that they do not require reference to the encoding context to show the effects of memory. Given this characteristic, the previously mentioned theory of distinctiveness (Smith & Hunt, 2000) predicts that the distinctiveness effect should not be obtained using implicit tests of memory.

The distinctiveness effect and implicit memory

Other researchers have similarly proposed that the distinctiveness effect can only be obtained on explicit, and not implicit, memory tests (Weldon & Coyote,

1996).¹ Weldon and Coyote suggested that explicit memory tests benefit from intentional efforts to distinguish between studied and nonstudied information based on distinctive aspects of the studied information. They proposed this idea to explain the lack of a picture superiority effect (better memory for pictures than words) on a conceptual implicit test. The logic here is that implicit tests typically have more than one possible answer so that people do not access particular episodes to discriminate studied items from other possible answers on these tests. Therefore, performance on these tests does not benefit from distinctive processes or attributes.

Consistent with this view, many effects that have been attributed to distinctiveness are not obtained on implicit memory tests. For example, the orthographic distinctiveness effect (superior memory for words with unusual letter combinations, such as “subpoena”) is not obtained on implicit tests of word fragment completion (Geraci & Rajaram, 2002) in which participants are asked to complete fragmented words (e.g., s _ i l _ _ a t) with the first word that comes to mind, or on perceptual identification (Hunt & Toth, 1990) in which participants are asked to quickly identify intact but briefly presented words. Similarly, the concreteness effect (better memory for concrete items such as “table” than abstract items such as “timid”), which is sometimes categorized as a distinctiveness effect (Schmidt, 1991), is not obtained on implicit tests (Hamilton & Rajaram, 2001). In general, these studies support the hypothesis that distinctiveness affects explicit but not implicit memory (see Geraci & Rajaram, *in press*, for a more extensive review of distinctiveness and implicit memory).

Recently, Smith and Hunt (2000) conducted a direct test of the hypothesis that the distinctiveness effect cannot be obtained on implicit tests, using a variation of the isolation paradigm. Distinctiveness was manipulated at study by having participants judge how a category exemplar (e.g., table) was different from, or similar to, other exemplars (e.g., chair, desk, couch, etc.). At test, participants were given either an explicit test of cued recall or an implicit test of word association or category exemplar production. In the explicit cued recall test, participants saw a category label, such as “furniture,” and were asked to recall all the items from that category presented at study. In the implicit word association test, participants simply wrote 8 words that were associated with the category label (e.g., furniture), and in the implicit category exemplar test, participants listed 8 exemplars in response to the cue. Results demonstrated a distinctiveness effect (i.e., better mem-

ory for exemplars processed for difference than for similarity) only on the explicit test of cued recall and not on the implicit tests of word association or category exemplar production. Thus, these results provide direct evidence that the distinctiveness effect cannot be obtained using implicit tests and further suggest that this is because the effect depends on explicitly reinstating the encoding context. As such, these data provide support for the notion that the distinctiveness of information distinguishes performance between explicit and implicit memory tests.

The suggestion that performance on explicit and implicit tests can be distinguished based on distinctiveness stands in contrast to the transfer appropriate processing view (Roediger, 1990; Roediger, Weldon, & Challis, 1989), which proposes that performance on explicit and implicit tests depends on whether these tests recapitulate the conceptual or perceptual nature of the processing from study. Much research is consistent with the transfer appropriate processing view. Studies show that perceptual manipulations such as changes in modality of presentation (visual versus auditory), influence performance on implicit tests such as fragment completion that rely on the perceptual overlap of the stimulus (Blaxton, 1989; Graf & Mandler, 1984; Jacoby & Dallas, 1981; Rajaram & Roediger, 1993; Srinivas & Roediger, 1990). However, these perceptual changes do not influence performance on implicit tests that rely on the meaning of the stimulus (Blaxton, 1989; Challis & Sidhu, 1993; Srinivas & Roediger, 1990). Conversely, conceptual manipulations, such as studying words for semantic or phonemic properties, influence performance on implicit tests that rely on meaning, but not those that rely on the perceptual match, such as word fragment completion (e.g., Blaxton, 1989; Hamann, 1990; Srinivas & Roediger, 1990). All of these studies support the idea that memory depends on the match in the nature of the processing (conceptual or perceptual) from study to test, and not necessarily the awareness requirements of the test.

Smith and Hunt’s (2000) results provide an exception to this pattern of results and pose a problem for the original version of the transfer appropriate processing view. Their results show an advantage of a conceptual manipulation (processing an item for difference versus similarity) on the conceptual explicit memory test of category cued recall but not the conceptual implicit memory tests of category production or association. Thus, the interpretation is that the conceptual nature of the study task does not predict performance on these explicit and implicit tests of memory. Instead, the distinctiveness of the processing distinguishes performance on these tests.

In the present line of work, we compared the role of conscious awareness and the type of processing to interpret the lack of a distinctiveness effect on certain

¹ See Vaidya and Gabrieli (2000) for conditions under which the picture superiority effect is obtained on certain implicit memory tests.

conceptual implicit tests; to this end, we use the isolation paradigm to examine the exact type of processing that mediates the distinctiveness effect. Our premise is that the lack of a distinctiveness effect on certain conceptual implicit memory tests may be best understood by considering the possibility that not all conceptual implicit tests require the specific type of conceptual processing that mediates the distinctiveness effect. Thus, it is important to delineate both the nature of the type of processing that underlies the distinctiveness effect at encoding, and the type of test that might recapitulate this processing.

We have proposed that the distinctiveness effect results from evaluating and comparing at study the different items to an established norm (Geraci & Rajaram, 2002). With the isolation effect, people may evaluate the isolated item as different from the standard that is provided by the study list. Thus, we described the process that mediates the distinctiveness effect as evaluative in nature and suggested that only tests that allow one to recapitulate this type of processing should show the distinctiveness effect.

By our description, the process that mediates the distinctiveness effect is conceptual in that it requires more elaborative, higher-level consideration of the mismatch between the isolated item and its context. Given the nature of this hypothesized process, one would not expect to find the effects of distinctiveness on tests that do not recapitulate the conceptual evaluation of incongruity. For example, one should not observe the effects of distinctiveness on a data-driven implicit test that does not access this type of evaluative process even if the distinctiveness of the item originates from an evaluation of perceptual features (Geraci & Rajaram, 2002). In this experiment, the orthographic distinctiveness effect (superior memory for words with unusual letter combinations, such as “subpoena,” as compared to words with common letter combinations, such as “sailboat”) was obtained on explicit memory tests across four experiments. However, when participants were given an implicit test that required only perceptual analysis of the words, (and did not permit evaluation of difference), there was no memory benefit for orthographically distinct words. Similarly, one would not expect to find the effects of distinctive processing on conceptual implicit memory tests that do not access this type of evaluative process, as in the case of Smith and Hunt’s (2000) study. Recall that in this experiment participants were given implicit tests that accessed category information (e.g., word association and category exemplar production tests), but did not recapitulate an evaluation of the critical item as different from other exemplars provided at study.

In other words, we argue that although the category production task requires access to category membership, it does not entail an active evaluation of

a possible mismatch between the category and the presented exemplar. For example, performance on the category exemplar production task, in which people are given a category name and are asked to generate members of that category, may be aided by having processed the meaning of an item. But performance on this task may not benefit additionally from having evaluated that the item is different from the other items in its immediate context because category production relies primarily on noting membership and not on noting differences. Instead, we propose that the match in the *specific* conceptual processing predicts performance on conceptual implicit tests (see Cabeza, 1994; Hamilton & Rajaram, 2001; Vaidya et al., 1997; Weldon & Coyote, 1996 for similar views). As such, we propose that the effects of distinctiveness should only be obtained on those implicit tests that allow one to engage in the same sort of comparative or evaluative processes at test as at study.

There is evidence that at least one type of conceptual implicit memory test is sensitive to this type of evaluative processing. This evidence comes from research using the category verification test to examine learning of new conceptual associations in implicit memory (Srinivas, Culp, & Rajaram, 2000). In this experiment, participants studied photographs of common scenes that included a critical incongruent item. For example, participants saw a picture of a restaurant scene containing an incongruent item (e.g., *computer*). While viewing the scenes, participants heard dialogs that associated the incongruent item into the scene without explicitly mentioning it. For example, in the restaurant scene, participants heard a dialog between the students seated at the table with a laptop computer in which one student says that he is writing a paper that is due tomorrow. Later, participants were given the implicit test of category verification to examine whether they had learned to associate *things found in a restaurant* and *computer*. Reaction time to respond correctly to this pairing was examined and results showed that people were significantly slower to correctly reject that *computer* did not belong to the ad hoc category, *things found in a restaurant*, when it was studied compared to when it was not studied. These results were taken as evidence for the rapid development of new conceptual associations in implicit memory. The Srinivas et al. study was not designed to address the nature of the category verification test with respect to evaluative processing, but these results provide preliminary evidence that the category verification test is sensitive to an evaluation of fit within a study context—precisely the processing that we hypothesize mediates the isolation effect. Thus, we propose that the distinctiveness effect can be obtained on this type of conceptual implicit memory test because it requires the type of conceptual processing that mediates the

distinctiveness effect.² In contrast, it cannot be obtained on conceptual implicit memory tests that simply require analysis of meaning, as in the case of the category production task.

We interpret the lack of a distinctiveness effect in Smith and Hunt's (2000) study to be consistent with these ideas. In their study, participants received the implicit tests of category and word association that required them to write the first category exemplar or word that came to mind given the category label. For items previously studied for similarity, providing the category label at test provides a good match for the processing that occurred at study. It is likely that when participants were instructed to provide a similarity judgment at study, they noted that all the items were from the same category. In this case, making the similarity judgment would yield the same cue that is used at test, i.e. the category name. However, in making a difference judgment, participants may have noted any number of ways that the top item differed from the bottom items, and these judgments would not relate to what the items have in common, which is the category. For example, participants might have seen a list of furniture exemplars, with the item, "chair" set above the items, "couch," "table," "dresser," and "bed." In this case, they could have written down any number of ways in which "chair" differed from the other exemplars. Given this, one could argue that providing a category label at test does not access the processing involved in evaluating ways in which an item differs from the category. Therefore, it is not clear whether the lack of a distinctiveness effect obtained in this study is best explained by the lack of awareness of the encoding context or the lack of a match between the processing at study and at the processing at test.

The results from Smith and Hunt's (2000) study and our evaluative-match hypothesis (see also Geraci & Rajaram, 2002) make different predictions about whether the distinctiveness effect can be obtained on implicit memory tests that rely on conceptual processing.

² The category verification does not consistently demonstrate benefits of conceptual processing, such as the levels of processing manipulation (Vaidya et al., 1997). However, our study differs critically from other studies using the category verification test because we specifically examine reaction times for "no" responses, whereas other studies typically focus on reaction times for "yes" responses. It is possible that this distinction is critical and that "yes" and "no" responses to this task may reflect different mechanisms of priming. Nevertheless, the absence of some conceptual effects on category verification in conjunction with the presence of other conceptual effects reported by others (as in the Srinivas et al., 2000; study) is consistent with the distinction we present between evaluative processing required by the category verification test and primarily meaningful-based processing required by other conceptual tests.

According to Hunt and colleagues' hypothesis, the distinctiveness effect should not be obtained on an implicit test, regardless of the processing demands, because these tests do not require explicit reference to the study episode (Hunt & Smith, 1996; Smith & Hunt, 2000). According to our evaluative-match hypothesis, the distinctiveness effect should be obtained on an implicit test, as long as the test recapitulates the distinctive processing (in this case, the evaluative processing) from study. The goal of the following experiments is to test our hypothesis to determine whether conscious awareness is necessary for obtaining the effects of distinctiveness on memory.

Experiment 1

Experiment 1 was designed to separate the contribution of conscious awareness and the match in conceptual processing at study and test by using an implicit test that recapitulates the evaluative process presumed to mediate this distinctiveness effect. In this study, distinctiveness was created using study lists that contained categorically isolated items. At test, participants were given an implicit test of category verification. We used this test to try to mimic the hypothesized evaluative processes that participants carry out at study when they encounter an incongruent item. We used both an explicit and an implicit version of the category verification test. In the explicit version, participants saw a category label and a word and judged whether or not they had studied the word. In the implicit version, participants also saw the category label and the word. However, in this version, participants were simply told to indicate whether or not the word was a member of that category.

In the explicit version of the test, we predicted a distinctiveness effect, i.e., more accurate memory for items that were isolated in a list than items that were not isolated. We predicted the distinctiveness effect in the implicit version as well; we expected participants would be *faster* to disconfirm category membership for the isolated category members than for the nonstudied and nonisolated members. That is, we predicted that when given the test cue "Type of Fish," followed by the item, "table," participants would be faster to disconfirm (to say "no") that "table" is a type of fish if they had studied "table" in a list of fish than if they had either studied it in a nonisolated list or not studied it. We specifically predicted that we would find benefit in reaction time (and not accuracy) because previous research shows that accuracy tends to be at ceiling with this task. We predicted a reaction time advantage because at study participants would have already evaluated the isolated item as incongruent. The category verification test recapitulates this process by requiring participants to again disconfirm category membership

for the critical items. Note that this prediction is different from the results of the Srinivas et al. (2000) study where participants were required to integrate the incongruent item (computer) within the study context (restaurant) by way of the auditory dialogue that justified the presence of the incongruous item and the encoding instructions that required participants to indicate how well the item fit within the category. In the present paradigm, the study conditions are designed to lead the participants to note that the isolated item does not fit within the context without requiring an integration of the incongruous item within the context. Thus, if the process of evaluating mismatch at study is recapitulated at test, participants should be faster to engage in this same evaluation for the isolated items at test compared to the nonstudied and nonisolated items.

Method

Participants

One hundred and thirty-six SUNY Stony Brook students participated for research credit. Fifty-two participants received an explicit category verification test and the remaining 84 participants received the implicit category verification test. Of these 84 participants, 60 were categorized as “unaware” of the connection between study and test based on the data from the post-test questionnaire that is described later. Data from these “unaware” participants were included in the implicit analysis.

Design and materials

The experiment was a $2 \times 2 \times 2$ mixed factorial design. Test type (explicit vs. implicit) was the between subjects variable and Study status (studied and nonstudied) and Item type (common and distinct) served as the within subjects variables.

Twenty-four categorized lists of 8 words each were derived from the Battig and Montague (1969) and Shapiro and Palermo (1970) category norms. All items were chosen from among the top 10 most common exemplars for each category. For each list, one of the eight items served as the critical item. The critical item was either studied as common or as distinct, depending on the structure of its study list. Participants studied 12 lists. Across participants, the order in which the 12 study lists were presented was semi-randomized, with the exception that no more than two common or distinct lists appeared in a row. For each list, the critical item appeared in either the 3rd, 4th, or 5th, study position to avoid primacy and recency list positions.

Six of the 12 study lists were structured such that the critical item was distinct because it was semantically isolated. In these lists, all the words in the list were from the same category except the one critical word that was from a different category. For example, the word,

“table” might be presented in a list of types of fish (e.g., trout, herring, shark, catfish, perch, salmon, and tuna). The other 6 study lists were structured such that the critical item “table” was not distinct. In these lists, all the words, including the critical item, “table” were from different semantic categories (e.g., opium, cookies, sponge, salmon, Iroquois, spokes, and four). Across participants, the same critical item served as either a distinct or a common item by virtue of the study list construction, or as a nonstudied item. Counterbalancing for whether the item was studied as common or distinct and whether it was studied or nonstudied produced 4 study lists sets.

In the test list, there were 24 critical test items, half of which were studied and half of which were nonstudied, and 24 filler items. The purpose of the filler items was to disguise the nature of this task as a memory test, and to include “yes” responses as described later. Of the 12 studied critical items, half had been studied as distinct and the other half had been studied as common. At test, the distinct items were paired with category labels that corresponded to the category membership of the background items in the study list. If the word, “table” had been studied as distinct in a list of fish, then at test participants would see table paired with the category label, “Type of fish”. The common items were paired with other unique category labels that corresponded to one of the background items in the study list. For example, if “table” were studied as a common item in a mixed list of unrelated items including only one type of fish, then the question would again be whether “table” is a type of fish. However, in this case, the word would have been encoded as common instead of distinct. Thus, the category names and the exemplars were held constant and only the encoding of the exemplar as a distinct or common item was varied.

For all studied items, common and distinct, the correct answer to the category verification questions was “no”. This was done for two reasons. First, we wanted to mimic the evaluation process that we assumed to have occurred when people saw the different item in either a list of other similar items (the distinctive processing condition) or in a list of intermixed items (the common processing condition). Second, we wanted to be able to directly compare category verification times for common and distinct items. Previous research using the category verification test has consistently shown that people are faster to confirm category membership than to disconfirm it (Vaidya & Gabrieli, 2000; Vaidya et al., 1997). Therefore, we kept the “no” responses constant across distinct and common items. The 12 category verification questions for nonstudied items also required a “no” response for purposes of comparison across studied and nonstudied conditions. To reduce the bias to respond “no” to the verification questions, we included 24 filler questions to which the correct answer was “yes.” The

order of category verification questions in the test list was randomized with respect to common/distinct encoding, studied/nonstudied status, and yes/no response.

Procedure

At study, each word was presented on the computer screen for 3 s. The study task was incidental and participants were told that the purpose of the experiment was to study reading times for different words. They were instructed to read each word on the screen and to press the space bar as soon as they read the word to record their reading time. Regardless of how long it took them to read the word, they were told to keep their eyes on the word until the screen advanced. The 12 study lists were separated by a distracter task in which participants solved math problems for 30 s after each 8-item list. After the 30 s, the screen advanced and indicated that the next list was going to be presented. At this point, participants were told to get ready for the next list by poising their hand over the space bar. After the study phase, participants in the explicit version were given a perceptual distracter task for 20 min to avoid ceiling effects. Because pilot work showed that priming in the implicit version of the test declined significantly after this time period, the delay was reduced to 5 min for the category verification task (3 min for the distracter task followed by 2 min of instructions for the next task).

At test, participants were given either an explicit category cued recall test or an implicit category verification test. In both tests, participants saw a category label followed by a possible category exemplar. In the explicit version of the test, participants were told to read the category label and the item and to judge, “yes” or “no” whether the item was studied. Participants made their recognition judgments using key presses. Although participants were only required to make their recognition judgments about the target items and not the category labels, they were told to read both because the

category label might help them make their judgment. In the implicit version of the test, participants were also shown category labels followed by possible category exemplars. However, in this version participants were simply told that the purpose of the experiment was to test their knowledge of different categories of items; they were asked to read the label and item and to judge whether or not the item is a member of the accompanying category by pressing a key corresponding to “yes” or “no”. Thus, the procedure for the explicit and implicit versions of the test only differed in the instructions given to the participants.

Immediately following the implicit category verification test, participants were given a post-test questionnaire to assess whether they were aware of the connection between the study and test phase. They were asked to answer 3 questions in the following order. Describe some of the characteristics you noticed about the category labels and/or the words that appeared in this category verification experiment. Describe any factors that you think might have helped you either to verify or disconfirm an item’s category membership. Please state what you think was the purpose of this experiment. If participants mentioned the study episode in response to any of the first two questions or if they said that they thought the purpose of the experiment was to test memory, they were labeled as test aware.

Results and discussion

Data from the explicit and the implicit version of the category verification test were analyzed separately because of procedural and baseline differences. The α level was set at .05 for all analyses. For both tests, we analyzed participants’ mean accuracy and median reaction time (shown in Table 1). For the explicit version of the test, we compared recognition accuracy. As predicted, results from the explicit version of the test showed that

Table 1
Experiment 1 median response times (in Milliseconds) and accuracy for correct category judgments on the explicit and implicit tasks

Item type	Test type					
	Explicit			Implicit		
	<i>M</i>	<i>SD</i>	Difference	<i>M</i>	<i>SD</i>	Priming
<i>Response time</i>						
Isolated	1495	496	296	1486	353	71
Nonisolated	1550	782	241	1545	384	12
Nonstudied	1791	797		1557	369	
<i>Accuracy</i>						
Isolated	.80	.19	.73	.96	.07	.02
Nonisolated	.69	.25	.62	.97	.08	.03
Nonstudied	.07	.09		.94	.07	

Note. Data for the implicit test refer to the response time and accuracy to correctly disconfirm category membership. Also, implicit scores are only from test “unaware” participants.

participants had better recognition for isolated than nonisolated category exemplars, $t(51) = 2.85$, $SE = 0.4$. Consistent with previous literature using the explicit memory test of category verification (Srinivas et al., 2000), there was no difference in reaction time to correctly recognize isolated versus nonisolated exemplars.

For the implicit version of the test, we sorted participants who took the implicit version of the test into test “aware” and “unaware” based on the post-test questionnaire responses. From these responses, 60 of the 84 participants who received the implicit category verification test were deemed unaware of the connection between study and test and their data were analyzed. The counterbalancing was maintained for the unaware participants.

For the implicit version of the test, we again analyzed accuracy and reaction time. We obtained overall priming in the accuracy data and found that participants were better at correctly disconfirming category membership for studied ($M = .97$) versus nonstudied category exemplars ($M = .94$), $t(59) = 2.97$, $SE = .01$. However, they were no more accurate to disconfirm category membership for isolated exemplars than to the nonisolated exemplars. As predicted earlier, this finding may be attributable to the already high level of accuracy for both types of items ($M = .97$ for both types of studied words).

Our main prediction for the implicit category verification test concerned the reaction time data. We compared reaction times to disconfirm category membership for studied versus nonstudied exemplars and found that the pattern of reaction times was in the expected direction, (see Table 1), although the difference was not statistically significant. Importantly, this lack of overall priming appears to be due to the comparable reaction times between the nonstudied and the common or nonisolated items. However, reaction times for the isolated items were significantly faster than reaction times for the nonstudied items, and for nonstudied items, $t(59) = 1.75$, $SE = 40.45$.³ Importantly, priming was significantly greater for the isolated items than the nonisolated items, $t(59) = 2.09$, $SE = 27.96$. Thus, we found greater priming, as measured by speeded reaction times to disconfirm category membership, for category members that had been isolated at study than those that had not been isolated.

The presence of a distinctiveness effect on an implicit test of category verification is inconsistent with Smith and Hunt’s (2000) proposal that the distinctiveness effect

cannot be obtained using implicit memory tests because these tests do not require participants to directly reinstate the encoding context. Rather, our results suggest that the distinctiveness effect can be obtained using an implicit test if the test engages the evaluative processing that took place at study (i.e., evaluating the way in which an item is different from surrounding items). This result is generally consistent with the transfer appropriate processing framework, which states that performance on explicit and implicit tests is based on the match of processing. However, our results demonstrate that it is important to cue the *specific* conceptual processing that occurred at study. As such, the results support the more recent elaborations of multiple conceptual processes that mediate memory (Cabeza, 1994; Hamilton & Rajaram, 2001; Vaidya et al., 1997; Weldon & Coyote, 1996). Ultimately, these findings demonstrate that although awareness is sufficient to mediate the distinctiveness effect and often plays an important role, it is not always necessary.

Experiment 2a

We interpret the results from Experiment 1 to suggest that the distinctiveness effect can be obtained on an implicit memory test if it recapitulates the exact evaluative processing engaged at the time of study. However, it is not clear whether the distinctiveness effect was obtained on this test because the test accessed category information alone, or because it required the same evaluative processing across study and test. In other words, it could be that simply cueing the general category information was sufficient to produce an advantage of the isolated items (and not necessarily the accompanying evaluative process *per se*). To distinguish between these two possibilities, Experiments 2a and 2b used a different conceptual implicit test; this test again accessed general category information, but it did not require an active evaluation of category membership that would recapitulate the evaluative processing that occurred at encoding.

We used explicit and implicit category production tests. In the explicit version, participants saw a category label and were told to write down an example of that category that they had seen earlier. As in Experiment 1, we predicted that people would have better memory for items that were isolated in a list than items that were not isolated (the distinctiveness effect) in the explicit version of the test. In the implicit version, participants also saw the category label and were asked to simply write down as many examples of that category as they could think of in 30 s. Priming would be observed if people were more likely to write down a category exemplar when it had been studied than when it was not studied. While we predicted that we would obtain overall priming, we also

³ Note that the one-tailed effect is for the nonstudied items. This directional comparison is appropriate for the studied versus nonstudied conditions because all theories of memory would generate a directional hypothesis regarding the facilitatory effects on studied over nonstudied items.

predicted that we would not obtain greater priming of isolated than nonisolated category exemplars (a distinctiveness effect on the implicit test). We predicted no distinctiveness effect on this test because, although it provides the correct category cue, it does not reengage the necessary evaluative processing. So, while the implicit test of category production, like the implicit test of category verification, accesses category information, unlike the verification test, it does not require an evaluation of category membership for the given exemplar.

Method

Participants

One hundred and six students from SUNY Stony Brook and 88 students from Washington University in St. Louis (for a total of 194 students) participated for research credit. Seventy-two participants (40 from Stony Brook and 32 from Washington University in St. Louis) received the explicit category cued recall test. The remaining 122 participants (66 from Stony Brook and 56 from Washington University in St. Louis) received the implicit category exemplar production test. One hundred and twenty-two participants were tested in the implicit version to obtain a completely counter-balanced group of 72 participants (43 from Stony Brook and 29 from Washington University in St. Louis) that were categorized as “unaware” of the connection between study and test based on the post-test questionnaire data. Their data were included in the initial analyses.

Design and materials

The experiment was a $2 \times 2 \times 2$ mixed factorial design. Test type (explicit vs. implicit) was the between subjects variable and Study status (studied and non-studied) and Item type (common and distinct) were manipulated as within subject variables. The study materials were identical to those used in Experiment 1. The test materials differed in that participants were now presented with only the category labels in Experiment 2a (e.g., A type of fish), whereas in Experiment 1 they were

presented with category labels and targets (e.g., A type of fish: table). The labels in Experiment 2a corresponded to the critical items-thus, unlike Experiment 1, all of the to-be-recalled targets were consistent with the labels presented. For example, people would be given the label, “Piece of furniture:?” and write down exemplars of this category, regardless of whether they had studied “table” in a list of all types of fish, or in a nonisolated, random list.

Procedure

The study phase and the distracter task were identical to Experiment 1. The test phase differed in that, now, participants were given either an explicit category cued recall test or an implicit category exemplar production test. In both tests, participants saw a category label and were asked to produce exemplars. In the explicit version of the test, participants were to write down an exemplar that they had studied earlier, and if they could not remember, they were told to leave it blank. They were given 30 s for each category to try to remember an item. In the implicit version of the test, participants were also shown category labels but they were asked to produce as many exemplars as they could within the time limit of 30 s. In this version, no mention was made of a memory test; instead, participants were told that the purpose of the experiment was to test their knowledge of different categories of items. As in Experiment 1, participants were given a post-test questionnaire to assess their awareness of the study–test relationship immediately following the implicit category exemplar production test.

Results and discussion

Once again, data from the explicit category cued recall test and the implicit category exemplar production test were analyzed separately because of procedural and baseline differences. For both tests, we analyzed participants’ mean accuracy (shown in Table 2). Results from the explicit category cued recall test replicated earlier work (Smith & Hunt, 2000) and showed that partici-

Table 2

Experiments 2 proportion correct responses (Studied–Nonstudied) on the explicit category cued recall (Experiment 2a) and the implicit category production (Experiments 2a and 2b) tests

Test type	Experiment 2a						Experiment 2b		
	Explicit			Implicit			Implicit		
	<i>M</i>	<i>SD</i>	Difference	<i>M</i>	<i>SD</i>	Priming	<i>M</i>	<i>SD</i>	Priming
Isolated	.35	.22	.29	.57	.21	.09	.20	.18	.05
Nonisolated	.28	.19	.22	.53	.23	.05	.21	.18	.06
Nonstudied	.06	.10		.48	.20		.15	.10	

Note. Implicit scores are only from test “unaware” participants.

pants had better category cued recall for isolated than nonisolated category exemplars, $t(71) = 2.13$, $SE = .03$.

In the implicit category exemplar production test, participants were first sorted into test “aware” and “unaware” groups based on the post-test questionnaire responses. Overall priming for participants classified as unaware showed that these participants produced more studied exemplars than nonstudied exemplars, but this effect did not reach significance using a two-tailed test, $t(71) = 1.86$, $SE = .04$, $p = .07$. This result was attributable to a lack of significant priming for nonisolated items, $t(71) = 1.18$, $SE = .04$. Priming for distinct items was significant, $t(71) = 2.45$, $SE = .04$. Recall that this pattern is similar to the pattern of results from the category verification test in Experiment 1. Priming was observed only for isolated but not for nonisolated items.

We predicted that people would not show a distinctiveness effect when the implicit test did not compel evaluative processing, as is the case with the category exemplar production test. Results from the test unaware participants supported this prediction: people were no more likely to produce exemplars that had been studied as distinct than those that were studied as common, $t(71) = 1.32$, $SE = .03$.

Note that this pattern diverges from the pattern of results in Experiment 1 that showed a priming advantage for isolated over nonisolated items and is consistent with our prediction. Given the theoretical significance of this result, we conducted additional analyses to confirm the lack of a distinctiveness effect in the implicit category production test. First, we conducted a power analysis; the results showed that the effect size for the implicit category production test in Experiment 2a was small ($d = .14$), such that we would need over 1000 participants to have an 80% chance of detecting this effect. Second, we also examined the data from the test aware participants; interestingly, the data from the test aware participants followed the same pattern and showed no difference in category production for isolated and nonisolated items, $t(49) < 1$. This finding suggests that the extent of awareness was not strong enough to motivate participants to engage in intentional strategies.

Two possible reasons support this interpretation. One is that the procedure for this test required speeded responses in that it required rapid production of responses (within 30 s), thereby reducing the opportunity for deliberate retrieval. Two, the responses on the post-test questionnaire indicated that, although many people guessed the purpose of the experiment, they did not report deliberately recalling items to write down in the short time they were given (see Richardson-Klavehn & Gardiner, 1995, 1996; Richardson-Klavehn, Gardiner, & Java, 1996 for a discussion of awareness in the absence of intention). It is also likely that participants

became aware of the purpose of the test only upon answering the questionnaire. Because these two groups did not appear to perform differently, we examined all the implicit participants (both aware and unaware) together to increase power. Even when we increased power by combining these two groups for a total of 122 participants, we found no evidence for a distinctiveness effect: there was no difference in priming for isolated and nonisolated items, $t(121) = 1.45$, $SE = .03$. In sum, results from Experiment 2a suggest that the distinctiveness effect cannot be obtained on the implicit test of category production, and that this outcome is not attributable to a lack of reasonable power.

Although we failed to find a distinctiveness effect on this test of category production, this null result is weakened by the fact that we did not obtain significant priming for the nonisolated items. Experiment 2b was conducted to determine whether the isolation effect would be obtained on a test of category production when significant priming was obtained for both isolated and nonisolated items.

Experiment 2b

We attempted to increase priming in this experiment by using critical items of a lower frequency. In the previous experiment, all critical items were taken from the top 8 exemplars for a given category. We chose to use very good examples of the category in the previous experiment (e.g., the word *table* was the critical furniture item) to make the category manipulation salient so that the isolated items would appear clearly distinctive from the other category. However, in doing so, we might have also increased our nonstudied baseline and reduced overall priming for the category production task. In Experiment 2b, we used less frequent category exemplars for our critical items (e.g., *bookcase* for the critical furniture item). We also used a more elaborate cover story to attempt to further reduce the possibility of explicit contamination. With these changes, we examined whether the distinctiveness effect would be obtained on an implicit test of category production when priming was significant for both the isolated and nonisolated items.

Method

Participants

Ninety-seven students from Washington University in St. Louis were tested in the implicit version to obtain a completely counterbalanced group of 72 participants that were categorized as “unaware” of the connection between study and test based on the post-test questionnaire data. The following data analyses use only the data from these unaware participants.

Design and materials

The experiment was a 2×2 mixed factorial design: Study status (studied and nonstudied) and Item type (common and distinct) were both manipulated within subjects. The materials were identical to those used in Experiments 1 and 2a, with the exception that the critical items were now of lower frequency (average position = 13.58, as compared to 3.96 in Experiment 2a).

Procedure

The procedure was identical to that of Experiment 2a with the following exceptions. We attempted to further reduce the possibility of explicit contamination by using a more elaborate cover story. Again, participants were told that they would be completing three unrelated experiments, beginning with a reading time experiment (the study phase), followed by a perceptual experiment (a distracter task), and a category knowledge test (the implicit test of category production). However, in this experiment, we attempted to convince participants that the reading time experiment was a free-standing experiment, independent of the following tests. To do this, we told participants that before they participated in the “reading time” experiment, their reaction time to name irrelevant symbols and numbers (e.g., \$, #, 7) would be recorded to “obtain a baseline reaction time measure”. Following the reading time experiment (the study phase), participants were then given another computer-based experiment. In the previous experiments, the distracter task was given using paper and pencil and only the study and test phases of the experiment were given on computer, which may have highlighted the connection between the two phases. Therefore, in this experiment, the distracter task was also given on computer and was described in more detail to give more credence to the task. Also, to reduce the connection between the study and test phases, the distracter phase was made more similar to the study phase, by also requiring a speeded response. For this task, participants saw 2 letters on the computer screen that were presented in quick succession, and were told to judge whether the letters were the same or different. The letters could differ from each other either in form (an R vs. a B) and/or in color (presented in red, green, blue, etc.), so the task was relatively challenging. Lastly, as in the previous experiment, participants were given the category production task, disguised as a test of category knowledge.

Results and discussion

Again, participants were first sorted into test “aware” and “unaware” groups based on the post-test questionnaire responses. Examining overall priming for only the participants classified as unaware, a *t* test

showed that these participants produced significantly more studied exemplars ($M = .21$) than nonstudied exemplars ($M = .15$), $t(71) = 2.90$, $SE = .01$. Note that the overall level of performance was lower in this experiment; this reduction was to be expected given that lower frequency category exemplars were used in this experiment. Priming was also significant for both the isolated, $t(71) = 1.99$, $SE = .03$, $p = .05$ (two-tailed), and nonisolated items, $t(71) = 2.50$, $SE = .02$. Importantly, though, we found no difference in priming for words that were isolated or nonisolated at study, $t(71) < 1$. Thus, again, we found no evidence for an advantage for isolated words on the implicit test of category production. Results from Experiments 2a and 2b suggest that the distinctiveness effect cannot be obtained in conceptual priming when the task does not recapitulate the distinctive processing from study.

General discussion

Experiments 1 and 2 reported in this article used an isolation paradigm to test whether the distinctiveness effect depends on conscious reference to the study episode or may be observed even in the absence of conscious recollection by reinstating the specific evaluative processing from study, i.e., our evaluative-match hypothesis. To tease these two hypotheses apart, we used two different tests of conceptual implicit memory across two experiments to vary the specific processing demands. Experiment 1 used an implicit conceptual test of category verification. We reasoned that this task requires the same type of evaluative processing that occurs at the time of study in our paradigm (evaluating whether the isolated item fits within the overall category). To examine the role of conscious awareness, we also included an explicit version of this test. As expected, we obtained the distinctiveness effect on the explicit test; participants were more accurate at recognizing words that had been previously isolated in the study list than those that had appeared in nonisolated lists. Importantly, the implicit test results also showed an advantage of distinctiveness; participants were faster to disconfirm category membership for items that had been isolated than those that had not been isolated, presumably because they had previous experience from study disconfirming category membership for isolated items (the evaluative process).

Experiment 2 was designed to obtain converging evidence regarding the mechanism behind the superior implicit memory for isolated words on the category verification test. Experiment 2 tested whether the distinctiveness effect was obtained in Experiment 1 because the implicit category verification test provided a cue appropriate for accessing general conceptual

information or because it additionally required the same type of evaluative processing for disconfirming the relationship that presumably occurred at study. To this end, Experiment 2 used a different conceptual implicit test (category exemplar production) where category cues at test accessed the general conceptual information but did not require the same evaluative processing as the category verification test. We examined memory on both the implicit test of category production and its explicit counterpart of category cued recall in Experiment 2. Again, the distinctiveness effect was obtained on the explicit test. However, the distinctiveness effect was not obtained on the implicit test of category production. This outcome suggests that the distinctiveness effect depends not simply on accessing the relevant categorical information, but on recapitulating the evaluative process from study at the time of test.

Together, the results from Experiments 1 and 2 have important implications for theories of distinctiveness and theories of implicit memory. First, these results suggest that, contrary to the predictions of the previous theories of distinctiveness (Smith & Hunt, 2000), conscious awareness at test is not always necessary for obtaining the distinctiveness effect in memory. Instead, these results support our evaluative-match hypothesis and suggest that the distinctiveness effect may also occur in the absence of conscious awareness of the study episode if there is a match in processing across study and test. This finding is important because it suggests that distinctive processing can influence behavior without awareness.

Second, the present series of experiments together provide direct evidence for our hypothesis that the distinctiveness effect is mediated by evaluative processing (Geraci & Rajaram, 2002). Using two different conceptual implicit tests, we found that the distinctiveness effect was only obtained on the one that required participants to evaluate category membership, but not on the other that simply required knowledge of the category. These results point to the importance of matching the exact processing (or procedures) from study to test for optimal memory performance (e.g., Jacoby & Craik, 1979; Kolers & Roediger, 1984; Morris, Bransford, & Franks, 1977; Tulving & Thompson, 1973).

Third, our results further support previous work on the specificity of conceptual priming (Cabeza, 1994; Hamilton & Rajaram, 2001; Vaidya et al., 1997; Weldon & Coyote, 1996) and suggest that the conceptual evaluative processing required by the category verification test is distinguishable from the conceptual meaning-based processing required by other “conceptual” tests. Verification and production tasks have also been used to account for dissociations in performance for different populations, such as nondemented older adults and those with Dementia of the Alzheimer’s Type (Gabrieli

et al., 1999; Vaidya, Gabrieli, Monti, Tinklenberg, & Yesavage, 1999). Our findings add to this literature that distinguishes between production and verification tests. However, our emphasis on this distinction appeals to different types of processes to explain the dissociation in performance on these two tasks. We note that while the two tests are similar in that they both draw on category knowledge, they are different in both their cues and the processing that these cues afford. Category production requires one to access knowledge of exemplars that fit with the category cue, while category verification requires one to decide whether each item does or does not fit with the category. As such, the decision processes required by the category verification test provide a good match to the processes engaged at study using an isolation paradigm. Thus, we find the distinctiveness effect on one conceptually driven task (category verification) but not another (category production). This dissociation points to the importance of delineating the nature of the specific processes that drive the reported conceptual effects.

Lastly, although we find that the distinctiveness effect can be obtained in the absence of conscious awareness of the study episode under the specific conditions we outline above (when the test requires one to evaluate category membership), we believe that conscious reference to the study episode plays a large role in producing the distinctiveness effect. Our study specifically shows that without the opportunity to consciously reflect on past information, the distinctiveness effect can be obtained if the test instantiates the processes engaged at study. We demonstrate that when conscious reflection is eliminated, we can isolate the additional processes that lead to superior memory for isolated items. Further investigation using implicit tests with different processing demands could prove valuable in distinguishing the processes underlying the myriad of effects attributed to distinctiveness (the isolation effect reported here, the picture superiority effect, the concreteness effect, the bizarreness effect reported in the literature) and help to uncover some of the critical processes that mediate superior memory for unusual events.

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