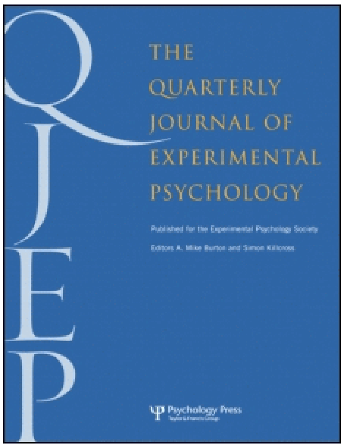

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Distinctive items are salient during encoding: Delayed judgements of learning predict the isolation effect

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Distinctive items are salient during encoding: Delayed judgements of learning predict the isolation effect

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Three experiments examined the role of salience in predicting superior memory for incongruent or odd items (the isolation effect). We tested the hypothesis that encoding salience emerges over the course of the encoding episode and predicts the isolation effect. In Experiment 1 participants studied lists of unrelated items and lists of categorized items containing an isolated item (from a different semantic category) that was presented either early or late in the list. Participants made delayed judgements of learning (JOLs) for studied items and were then given a free recall test. Results showed that participants had superior recall for the isolated items regardless of their list position and that delayed JOLs predicted this effect for both early and late isolation conditions. Experiment 2 replicated this delayed JOL effect using a different isolation paradigm that used only a single study list. Experiment 3 examined the specific mechanism by which isolated items become salient over the course of encoding and demonstrated that isolated items become salient as knowledge of the list structure unfolds. Results from these studies suggest that isolated items become salient over the course of the study episode, and that this salience predicts the isolation effect in memory.

Keywords: Distinctiveness; Memory; Isolation effect; Salience; Judgements of learning.

The isolation effect refers to the finding that people typically show superior memory performance for unusual or incongruent items (see Hunt, 1995, for details of von Restorff's, 1933, dissertation results). 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 better memory for the critical item when it is physically or semantically isolated from its list context at study than when it is not isolated from its list context at study. Although several studies have since demonstrated this effect (e.g., Bruce & Gaines, 1976; Dunlosky, Hunt, & Clark; 2000; Geraci & Rajaram, 2004; Schmidt, 1985), disagreement remains as to the mechanism by which isolation, and distinctiveness in general, influences memory performance (Schmidt, 1991).

According to several prominent theories, the isolated item attracts additional processing at encoding that leads to superior memory performance for that

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item (see McDaniel & Geraci, 2006, for review). These theories rest on the initial assumption that the isolated item appears subjectively salient at the time of encoding (see Dunlosky et al., 2000; Hunt & Lamb, 2001, for further discussion of the purported role of salience in theories of distinctiveness). This salience in turn compels additional processes that produce good memory for isolated items. The exact nature of this additional processing is controversial. According to one view, isolated items are remembered better than common items because they demand more attention than common items (Green, 1956; Jenkins & Postman, 1948). This increased attention may lead to additional rehearsal (Rundus, 1971), elaboration (Waddill & McDaniel, 1998), or simply more overall processing (e.g., Slamecka & Katsaiti, 1987; Watkins, LeCompte, & Kim, 2000; Wollen & Cox, 1981) of the isolated item. Alternately, unusual items may violate expectations regarding the nature of the stimuli that will be encountered and accordingly stimulate more extensive processing of the general context in which the item appears (Hirshman, Whelley, & Palij, 1989). More generally, incongruent items may attract attention and then lead to subsequent controlled memory processes including possibly elaboration, rehearsal, or noting the relationships between the items in the study set (Schmidt, 1991). Similarly, Fabiani and Donchin (1995) have used event-related potential (ERP) data to suggest that people automatically detect incongruent items and then engage in organizational encoding operations immediately thereafter.

Regardless of the exact nature of the additional processing at encoding, the various encoding theories have in common the initial assumption that the isolated item appears salient at the time of encoding and that it is this salience that compels additional processing. A previous study attempted to directly examine the role of salience by having participants make judgements of learning (JOLs) at study (Dunlosky et al., 2000). JOLs were used to measure salience because previous research has shown that people give higher JOLs to extrinsically salient or important information (Koriat, 1997; Sommer, Heinz, Leuthold, Matt, & Schweinberger, 1995). To examine the role of salience on the isolation effect, participants studied a list of 11 homogenous items and a single distinct item isolated either in the second or the seventh position on the list. Participants were asked to provide JOLs for items on the list. Then, the recall and JOL responses were evaluated. The authors hypothesized that if isolated items are perceived as salient, then participants' JOL responses should be significantly higher for the isolated than for the control items regardless of their position in the list. Results showed that the isolation effect occurred when the item was isolated in both the second and seventh positions (the early and late isolation conditions), consistent with prior research (Bellezza & Cheney, 1973; Hunt, 1995; Kelley & Nairne, 2001; Pillsbury & Rausch, 1943; von Restorff, 1933). When the distinct item was isolated in the seventh position, participants gave significantly higher JOLs for that item than for a control item. However, when the isolated item was placed in the second position, the magnitude of the JOLs was no different for the isolated items than for the control items.

The failure of JOLs to predict the isolation effect in both early and late conditions was taken as evidence that salience is not necessary for producing an isolation effect in memory. Dunlosky et al. (2000) interpreted this finding to mean that an isolated item was not perceptually salient at the time of encoding. Results from Experiment 2 of Dunlosky et al. supported this theory and showed that isolated items that were well remembered were not necessarily rehearsed more than other items. People reported rehearsing the late (but not the early) isolates more than the control items, yet they remembered both the early and the late isolates better than the control items. Thus, the rehearsal data, like the JOL data, showed that only late isolates appeared salient at the time of encoding. Yet, there was an isolation effect for both early and late isolates, suggesting that salience alone does not appear necessary for the isolation effect to occur.

We take up this issue and suggest that momentary item salience does not predict superior memory for isolated items, as demonstrated by Dunlosky et al. (2000). Rather, we propose that salience arises over the course of the encoding session, once the study context has been revealed. The important theoretical distinction here is between encoding processes that occur at the moment the odd item is presented and processes that occur over the course of the entire encoding episode, a distinction rarely drawn in current memory theorizing. Our specific hypothesis is that odd items are salient during encoding, but this salience arises over the course of the encoding episode as the list context is revealed.

This view that isolated items become salient over the course of the study episode is consistent with previous theories that suggest that distinctiveness effects result from evaluating and comparing the unusual items to an established norm at study (Geraci & Rajaram, 2002, 2004, 2006; McDaniel & Geraci, 2006). This evaluative process is hypothesized to occur over time as the list context unfolds and establishes the norm. To evaluate an item as odd, then, one must take notice of the context as it is established and compare the item to that standard as the standard becomes known. This comparison process has been described as a conceptual process that occurs over the course of the study episode (Geraci & Rajaram, 2004). By this theory, the isolated item only becomes salient (it stands out) after the study context has been established.

The proposal that the isolate appears salient over the course of the study episode is distinguishable from virtually all existing encoding theories of distinctiveness that posit additional processes that occur at the moment the incongruent item is encountered. We think that it is important to consider the processes that occur over the course of the study episode, even after the isolated item has been encountered. If the isolated item becomes subjectively salient over the course of the study episode, then immediate JOLs would not capture subjective experience for early isolates because the study context is not well established at the time these items are encountered. And, indeed, immediate JOLs do not predict the presence of an isolation effect for early isolates (Dunlosky et al., 2000). However, we propose that isolated items appear salient over the course of encoding as the list context becomes known. To test this hypothesis, Experiments 1 and 2 required participants to make delayed JOLs.

Participants studied multiple (Experiment 1) or single (Experiment 2) lists containing early and late isolates and made two-item delayed JOLs for the studied items. This procedure diverged somewhat from previous studies that have used delayed JOLs (e.g., Nelson & Dunlosky, 1991). In previous studies participants studied a list of paired associates, such as "ocean-tree" and provided an immediate JOL for half of the paired associates and a delayed JOL for the remaining half. The general finding was that delayed JOLs were much more accurate in predicting actual memory performance than were immediate JOLs (see also Dunlosky & Nelson, 1992, 1994, 1997; Kelemen & Weaver, 1997; Thiede & Dunlosky, 1994; Weaver & Kelemen, 1997). In contrast to those paradigms, the current studies required participants to provide a delayed JOL after a set (two-item) delay. Our interest was not in comparing the accuracy of immediate and delayed JOLs, but rather in using delayed JOLs to assess the type of salience that we hypothesize predicts the isolation effect in memory. The prediction is that if participants assess salience over the course of the encoding episode as the list context unfolds then, delayed JOLs should predict the isolation effect in memory for both early and late isolates. Delayed JOLs would be expected to measure salience that arises from the episode because delayed JOLs are based on more episodic information than are immediate JOLs. With an immediate JOL, the participant would primarily base their judgement of an early isolate on the item itself (which is not distinctive at this point since very little of the context has been revealed). In contrast, delayed JOLs for early isolates can be based on more contextual information, because some of the subsequent context has been revealed by the time participants make the delayed JOL.

Experiment 3 was designed to examine the specific processes during encoding that give rise to encoding salience (as measured by delayed JOLs in Experiments 1 and 2). We have suggested that isolated items become salient during the course of encoding once the study context is known. To examine the specific mechanism by which items become salient, Experiment 3 used a category isolation paradigm in which participants studied lists containing isolated items and lists containing unrelated control items. Participants were asked to answer immediate or delayed category verification questions (e.g., *Type of furniture: horse*?), as well as other filler questions. The prediction was that, if isolated items become salient after a delay because the category becomes known, then participants should be faster to indicate that isolated items do not fit within the study list category after a delay, but not upon immediate questioning. If this pattern of data is obtained, then we would have evidence for the process by which isolates become salient over the course of the encoding process. We turn now to Experiment 1, which was designed to examine the initial hypothesis that isolates are perceived as salient over time, as measured by delayed JOLs.

EXPERIMENT 1

In Experiment 1, distinctiveness was achieved by having participants study lists of categorized words that included one item from a different category. Half of the study lists contained an isolate, and half of the study lists contained a control item that was presented in a heterogeneous list context. The isolates and the control items appeared either early or late in the study lists, and participants made two-item delayed JOLs for the studied items. If delayed judgements of learning predict the isolation effect in memory, then we should find that participants give higher JOLs for isolated items than for matched nonisolated items, regardless of whether these items appear early or late in the list.

Method

Participants

A total of 80 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and materials

The experiment was a 2×2 within-subjects design. Item type (isolated vs. control) and list position (early vs. late) served as the independent variables. Free recall performance and JOLs were the dependent variables.

A total of 32 categorized lists of 14 words each were derived from the Battig and Montague (1969) and Shapiro and Palermo (1970) category norms. In addition, we created new categories of words to ensure that no categories would be repeated. Each participant studied 16 lists. In half of these lists the critical item was isolated, and in the other half of the lists (the control lists) the critical item was not isolated. The order of the lists was semirandomized so that at most, no more than two isolation or control lists appeared in a row. In the 8 isolation lists, all of the words in the lists were derived from the same category with the exception of the one critical word that was from a different category. These lists were arranged such that the critical item was isolated because it was the only list item from its semantic category. For example, the word *deer* might be presented among a list of flowers (e.g., *rose*, *daisy*, *lily*, *pansy*, *sunflower*, etc.). The remaining 8 control lists were structured such that the critical item was not distinct. In these control lists, all of the words including the critical item were derived from different semantic categories (e.g., *zipper*, *brick*, *rectangle*, *tin*, *saddle*, etc.). In both types of list, study position was varied for critical isolated and control items. The critical item appeared either early (Positions 1–4) in the study list, or late (Positions 9–12) in the study list. Counterbalancing for list type (isolated vs. control) and list position (early vs. late) produced four study conditions.

Procedure

Participants were told that they would study several lists of words and that they should try to remember these words for a later memory test. Participants were also told that they would be prompted periodically to judge the likelihood that they would recall some words in the list on a scale ranging from 0–100% using the labelled keys on their keyboard. Each JOL was delayed by two items. To ensure that participants would assign a JOL to the appropriate word, the word in question was presented on the screen as part of the question for both the control and the isolated conditions. For example, for the critical word *deer*, participants were asked: "How confident are you that in about 10 minutes you would recall deer?"

Participants gave a total of three judgements of learning per list, and the position of the JOLs varied: early (Positions 1–4), middle (5–8), late (9–14). The critical items only appeared in the early or late positions. For example, if the critical item (isolated or control) appeared in an early position, then participants made two additional JOLs for filler items presented in middle and late list positions. If the critical item (isolated or control) appeared in a late position, then participants made two additional JOLs for filler items presented in early and middle list positions. We included the two additional JOLs per list so as not to draw attention to the critical item. Only JOLs for the critical items were analysed. Before beginning the study session, participants were given an example trial so that they would be comfortable with the procedure. The items appeared in the centre of the screen for 3 s each. Participants were presented with all 16 lists of words and were given short breaks (5 s) between lists. The breaks served to separate the lists so that the structure of each list would be evident to participants. After the study phase, participants performed a perceptual distractor task for 2 min to avoid any recency effects.

Next, participants were given a free recall test. Participants were given a blank, lined sheet of paper and were asked to recall as many words as they could remember studying in any order. Participants were given approximately 6 min for this test. Immediately following the free recall test, participants were asked to about their ability to understand the JOL instructions and to make the delayed JOL. These questionnaires showed that all participants understood the instructions and found the task to be relatively easy and straightforward.

Results

We first examined whether there was an isolation effect in free recall when the isolate was presented early or late in the list. Means are presented in Table 1. A 2 × 2 within-subjects analysis of variance (ANOVA) was conducted to examine the effect of item type (isolated vs. control) and position (early vs. late) on free recall performance. As expected, the results showed a main effect of item type, $F(1, 79) = 14.47$, $MSE = 0.03$, indicating that people remembered more isolated items than control items (i.e., the isolation effect). This result replicates several studies not using JOLs that show superior memory for isolated items (e.g., see Geraci & Rajaram, 2004, for an isolation effect using the same materials as those in the current study). There was no main effect of position, $F(1, 79) < 1$, showing that recall performance was similar for items presented early in the lists and items presented late in the lists. There was also no interaction between the two variables, $F(1, 79) < 1$, showing that item position did not differentially influence recall of isolated and control items. The lack of an interaction between item type and position replicates previous studies showing similar isolation effects in both early and late isolation conditions (Dunlosky et al., 2000; Hunt, 1995).

Turning to the main question of interest: Did participants give higher delayed JOLs to isolates than to control items in both the early and the late isolation conditions? These data are presented in Table 1. A 2 × 2 within-subjects ANOVA was

Table 1. *Average delayed judgement of learning and recall performance for isolated and control items in early and late study list positions in Experiment 1*

		Item type			
		Isolated		*Control*	
	List position	*M*	*SD*	*M*	*SD*
Judgement of learning	Early	.47	.17	.39	.17
	Late	.37	.20	.31	.18
Recall performance	Early	.23	.21	.16	.19
	Late	.22	.19	.14	.16

conducted to examine the influence of item type (isolated vs. control) and position (early vs. late) on JOLs. As predicted, this analysis showed a main effect of item type, $F(1, 79) = 37.19$, $MSE = 1.15$, indicating that people gave higher overall JOLs for isolated than for control items. There was also a main effect of position, $F(1, 79) = 61.01$, $MSE = 0.99$, indicating that people gave higher JOLs to items presented near the beginning of a list than to those near the end of the list. This position effect replicates the finding that JOLs show a primacy effect, with higher JOLs at the beginning of the study list than at the end of the study list (Castel, 2006; Dunlosky & Matvey, 2001). Importantly for present purposes, there was no interaction between item type and position on people's JOLs, $F(1, 79) = 2.22$, $MSE = 0.66$, showing that JOLs for isolated and control items were not differentially affected by list position. In other words, JOLs were higher for isolated items than for control items regardless of whether the items appeared early or late in the list. This pattern of data for the JOLs demonstrates that in contrast to the results using immediate JOLs (Dunlosky et al., 2000), delayed JOLs can accurately predict the isolation effect in free recall.

One concern could be that the JOL task itself artificially augmented perceived salience for the isolated items relative to the control items. One way to determine whether the JOLs changed the encoding processes that people normally engage is to look at the resultant recall data in other experiments that did not require JOLs. Because the paradigm used in Experiment 1 was identical to that used by Geraci and Rajaram (2004; explicit recall condition of Experiment 2), with the exception that JOLs were not included in the 2004 study, we can compare the recall data from that study to the recall data from the current Experiment 1 to determine whether inclusion of JOLs significantly altered the isolation effect. Examination of these two studies shows that the recall results are almost identical. In fact, the size of the isolation effect in the current study (collapsed across early and late conditions) is almost identical to the size of the isolation effect in the Geraci and Rajaram (2004) study (.06 vs. .08, respectively). Thus, it seems very unlikely that the JOL task itself was responsible for the superior recall of isolated items obtained in this experiment.

It is still possible that including the JOL (although it did not influence recall) nonetheless caused isolated items to appear salient that would not have been experienced this way under normal (non-JOL) conditions. However, this possibility seems unlikely given that JOLs were included for both types of items (isolated and control items). Thus, any artificial increase in salience due to the inclusion of JOLs would have occurred for both types of items. Thus, the data from Experiment 1 strongly suggest that isolated items are judged as salient over the course of the encoding episode, as measured by delayed JOLs.

We interpret the current results to mean that isolated items are judged as salient during the course of the study episode and that this type of episodic salience predicts the isolation effect in memory. An alternative interpretation of these results is that participants gave higher JOLs to early isolates in part because they learned to anticipate the structure of the lists. In other words, with the repeated list methodology, participants may have become aware of the presence of the isolates causing them to give higher JOLs to isolates that appeared in the beginning of the lists.

EXPERIMENT 2

Experiment 2 sought to conceptually replicate the findings from Experiment 1 using different materials and only presenting one study list. To do this, we used methodology identical to that used by Dunlosky et al. (2000). Participants studied either a list of items containing 11 homogenous items and a single odd item (the isolation condition) or a list containing 12 heterogeneous items including the same critical item (the control condition). In both conditions the critical item appeared either early or late in the study list. As in Experiment 1, participants made two-item delayed JOLs for the critical items.

Method

Participants

A total of 108 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and materials

The experiment used a 2 × 2 between-subjects design. Item type (isolated vs. control) and list position (early vs. late) served as the independent variables. Free recall performance and JOLs served as the dependent variables of interest.

The materials were based on those used by Hunt (1995) and Dunlosky et al. (2000). Participants studied a single list of words in which the critical item was either isolated or not isolated depending on the list structure. The critical item was presented either early (third position) or late (seventh position) in the study list. Counterbalancing for list type (isolation vs. control), version (List A or List B), and study list position (early vs. late) produced eight study lists. The control lists were composed of the critical item and 11 unrelated symbols, and the isolation lists were composed of the critical item and 11 related items. In List Version A, the number *8* served as the critical item that was presented either in the control list, (III, (), *, *@*, *!*, *K*, + , *%*,#, *{ }*, *&*) or in the isolation list (*BAP*, *TOH*, *LRD*, *XNS*, *DUQ*, *GLK*, *FWJ*, *DAP*, *REZ*, *HOL*, *COS*). In List Version B the trigram, *TQL*, served as the critical item that was presented either in the control list ($, ///, < >, = , ~, . . ., “‘, [ ], ^_?,::, h) or in the isolation list (*15*, *13*, *11*, *17*, *3*, *14*, *5*, *7*, *2*, *19*, *9*).

Procedure

Participants were told that they would study a list of items and that they should try to remember those items for a later memory test. Participants were also told that they would be prompted periodically to judge the likelihood that they would recall some items in the list. They were shown the JOL scale that they would be asked to use during the study session. The scale ranged from 0–100%, and participants were instructed to make their judgements using the labelled keys on their keyboard. As in Experiment 1, participants made JOLs after a two-item delay. Again, to ensure that participants would assign a JOL to the appropriate item, the item in question was presented on the screen as part of the JOL question. As in Experiment 1, we included JOLs for isolated and control items to avoid drawing attention to the isolates. However, participants in this study made a JOL for every item in the list with the exception of the last two items in the list. So, participants made JOLs starting with the first item in the list, which meant that the JOL for this item occurred after the presentation of the third item in the study list.

After the JOL instructions had been given, the study session began. Participants studied and gave JOLs for a single 12-item list. The list was either a control list (Version A or B) or an isolation list (Version A or B) with the critical item presented either early or late in the list. Each item was presented in the centre of the computer screen for 3 s each using the Superlab 4.0 Experiment Program (Cedrus Corporation, 2001) followed by a screen prompting participants to make a JOL for the item that was presented two items earlier in the list.

Immediately following presentation of the study list, participants performed a perceptual distractor task for 10 min in which they had to rank order the size of several obtuse angles. After the filled delay, participants received a free recall test for the study list items. Participants were told to recall the list items in any order, and they were given unlimited time for the test, although most participants were finished with the test within 2 min.

Results

As in Experiment 1, we first examined free recall performance to determine whether the isolation effect was obtained across our conditions (Table 2). A 2 × 2 between-subjects ANOVA examined the effect of item type (isolated vs. control) and list position (early vs. late) on recall performance. Results showed that there was a main effect of item type, $F(1, 104) = 12.09$,

Table 2. *Average delayed judgement of learning and recall performance for isolated and control items in early and late study list positions in Experiment 2*

		Item type			
		Isolated		*Control*	
	List position	*M*	*SD*	*M*	*SD*
Judgement of learning	Early	.65	.30	.53	.27
	Late	.62	.29	.51	.27
Recall performance	Early	.93	.27	.56	.51
	Late	.86	.36	.67	.48

$MSE = 0.17$, indicating that people remembered more isolated items than control items (i.e., the isolation effect) regardless of list position. There was no main effect of position, $F(1, 104) < 1$, and no interaction between the variables, $F(1, 104) = 1.34$, $MSE = 0.17$. Thus, the results demonstrated an isolation effect in free recall in both early and late isolation conditions. The fact that there was no main effect of position contrasts with the results from Experiment 1. There were several differences between the paradigms used in Experiments 1 and 2 that could potentially explain the lack of a serial position effect in Experiment 2. One possibility is that JOLs were higher for early items than for late items in Experiment 1 but not in Experiment 2 because the difference in early and late item positions was larger in Experiment 1 (about a 10-item average position difference between early and late items) than in Experiment 2 (about a 4-item average position difference between early and late items). Regardless, the results from Experiments 1 and 2 demonstrated an isolation effect in free recall in both early and late isolation conditions.

Again, we were primarily interested in whether delayed JOLs predicted the isolation effect in early and late isolation conditions. A 2 (item type) × 2 (list position) between-subjects ANOVA showed that delayed JOLs were higher for isolated items than for control items, regardless of list position. There was a main effect of item type, $F(1, 104) = 4.13$, $MSE = 8.07$, showing that participants gave higher JOLs for isolated items than for control items. There was no main effect of list position, $F(1, 104) < 1$, and no interaction between the item type and list position, $F(1, 104) < 1$. Taken together, these results replicate the findings from Experiment 1 and show that delayed judgements of learning predict the isolation effect in free recall.

Results from Experiments 1 and 2 demonstrate that isolated items are perceived as salient after a delay. Taken together with the results from Dunlosky et al. (2000), it appears that in contrast to late isolates, which appear salient immediately (and after a delay), early isolates become salient over the course of the study episode.

EXPERIMENT 3

In Experiment 3, the main goal was to examine the specific encoding process that caused participants to provide higher JOLs for early isolates, only when the JOL was delayed. We have hypothesized that early isolates are not immediately salient. Rather they become salient over the course of the encoding episode, once the study context has been revealed. This means that the isolated item only becomes subjectively odd when the background context is known. Experiment 3 was designed to gain evidence for this hypothesized mechanism. To do this, we examined the processing of early isolates using the category isolation paradigm used in Experiment 1.

To measure the development of salience over the course of encoding, we gave participants category verification questions either immediately after presentation of the critical item (the isolate or the control) or after a two-item delay. Previous work has shown that people are faster to disconfirm category membership for isolated items when a category verification test is given during a final test (Geraci & Rajaram, 2004). If isolated items become salient after a delay as participants come to appreciate the fact that these items do not fit within the list context, then relative to control items, participants should be faster to indicate that the isolate is not a member of the list category. However, we should only find an advantage in response times for the isolated items over the control items when the category verification question comes after a delay. Here, the isolated item should be easily and rapidly evaluated as coming from a different category because the list construction is known. In contrast, there should be no difference in category verification times when participants are asked to make category membership judgements immediately after the isolated or control item is presented because the list construction would not be obvious at this point during encoding. This overall pattern of results would lend support to the hypothesis that salience arises over the encoding episode as the list construction becomes known.

Method

Participants

A total of 64 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and materials

The experiment used a 2 × 2 within-subjects design. Item type (isolated vs. control) and question position (immediate vs. delayed) served as the independent variables, and response latency served as the dependent variable.

We used the same materials as those from Experiment 1 to allow us to assess category verification times across multiple lists (rather than just one, as in the single-list paradigm used for Experiment 2). The materials were identical to those used in Experiment 1, with the following exceptions. This experiment only included an early isolate condition (and no late isolate condition) in which the critical items appeared in one of the first four positions in the list. In total, participants answered questions about four items in each list, including the critical item. Participants responded to questions about multiple items in the list so that the critical items would not be the only items associated with questions. For the three filler items, participants received various lexical questions (e.g., *Does this word have an "o" in it?: OPAL*), general knowledge questions (e.g., *Is this a mathematical operation?: DIVISION*), rhyming questions (e.g., *Does this word rhyme with cashew?: NEPHEW*), and category verification questions (e.g., *Is this a state?: GRAPE*). The type of question that participants received was matched across isolated and control lists. The critical item in the list (either the isolate or the control) was always followed by a category verification question. The correct answer to the category verification question was always, "no", for both the control and the isolated items. To ensure that participants could respond positively and negatively to the questions in the list an equal number of times, the correct answer for two of the three filler questions was "yes", leaving two questions (the critical item and a filler item) with "no" responses. To ensure that list structure was clearly evident to participants before they answered the category verification question for the critical item, only one question at most appeared before the critical item. Counterbalancing for list type (isolated vs. control) and question position (immediate vs. delayed) produced four study conditions.

Procedure

We attempted to make the instructions and procedure as similar as possible to those in the previous two experiments. As in the previous experiments, participants were told that they would see several lists of words and that they should try to memorize the words for a later memory test. In actuality, we were only interested in their category verification times for the critical items. We did not expect recall performance to reflect standard isolation conditions because our design used several filler questions that appeared after the critical items at varying delays, which would be expected to change the eventual memory representation of the list as a whole. Because it was our intention to examine response time to these critical items, we tried to keep the number of questions occurring before the critical item in the list to a minimum before assessing participants' latency to respond to the critical items. But the remainder of this list was not standard as it included several questions that appeared after the critical items (the early isolate and the early control). As described in the "Design and materials" section, the questions asked about rhyming information, category information, perceptual information, and so on. In doing so, they included several additional unrelated words, which would be expected to disrupt the remainder of the list context. Therefore, we did not expect to necessarily find the same pattern of recall results as those found in the previous two experiments.

Participants were told that they would be periodically asked to answer questions about some of the words on the lists. Before beginning the experiment, participants were given example questions, and they practised speeded responding using the yes/no keys labelled on the keyboard. As in Experiment 1, participants were presented with 16 lists of words. Half (8) of the lists contained an isolate, and the other half contained a control item. For half of these lists (both the control or the isolate lists), the questions either appeared immediately after the item in question or were delayed by two items. In both the immediate and delayed conditions, participants were given a question (presented for 4 s) followed by the critical word for which participants were asked to respond. As in the previous two experiments, the critical word was presented again during the question. For example, if the item *deer* was presented in a list of flowers, then participants would see a screen with the question (either immediately or after a two-item delay), *Is this a type of flower?*, followed by another screen with the word *deer* printed on it. Upon seeing the word, *deer*, participants responded *yes* or *no*, as quickly as possible, and response latency was measured. This same question was provided when the word *deer* was presented among a list of unrelated items. In all conditions the item appeared initially in the list and then again following the question.

Results

Average mean latencies for correct responses for each condition are presented in Table 3. A 2 × 2 within-subjects ANOVA was conducted to examine the effect of item type (isolated vs. control) and question position (immediate vs. delayed) on latency to make a correct category verification response. In all instances, the correct response was to indicate that the critical item was not a member of the given category. The results showed a main effect of item type, $F(1, 63) = 4.54$, $MSE = 123{,}195.61$, indicating that people responded faster to the isolated items than to the control items. There was no main effect of position of question, $F(1, 63) < 1$, showing that reaction times were similar for questions presented immediately after the critical items and questions presented after a two-item delay. Importantly for our purposes, the interaction between the two variables was significant, $F(1, 63) = 4.87$, $MSE = 147{,}058.94$, showing that participants were faster to indicate that isolated items were not members of the category, relative to control items, only when only when the category verification question appeared after a delay. When participants answered the category verification question after a delay, response times to disconfirm category membership were significantly faster for isolated than for control items, $t(63) = 3.63$, $SE = 54.95$. In contrast, when participants answered the category verification question immediately, there was no difference in response times to disconfirm category membership for isolated and control items, $t(63) < 1$. Thus, results suggest that early isolates become odd relative to their list context after a delay, once the context is established in the eyes of the participant.

Table 3. *Average category verification response times for isolated and control items with immediate and two-item delayed questions in Experiment 3*

	Item type			
	Isolated		*Control*	
Question position	*RT (ms)*	*SD*	*RT (ms)*	*SD*
Immediate	1,152.71	597.64	1,140.47	491.01
Delayed	1,047.14	461.25	1,247.14	505.76

Although we did not have any specific predictions for the recall data given the nonstandard presentation of the study lists after the critical items, these data are presented here for completeness. Results showed that there was an early isolation effect; mean recall for isolated items was .14, and mean recall of control items was .08, $F(1, 63) = 9.01$, $MSE = 0.02$. Note that overall memory performance was much lower in the current experiment than in Experiments 1 and 2, probably because the study lists contained several questions occurring after the response latencies were measured that probably muddied participants' eventual memory representation for the list and perhaps disrupted their ability to encode the individual items. There was an effect of question position on recall, $F(1, 63) = 8.12$, $MSE = 0.03$, showing that people had better recall when they received lists containing various immediate questions. There was also an interaction between the two variables, $F(1, 63) = 8.19$, $MSE = 0.02$. In the delayed question condition, in particular, the study context was disrupted, which was probably the reason why there was no early isolation effect in this condition (isolated = .08; control = .08, $t < 1$). When participants received immediate questions (isolated = .19; control = .09), $t(63) = 3.59$, $SE = .03$, they did show better memory for the early isolate than for the early control, despite the fact that the remainder of the list was fairly nonstandard. In both question conditions (using immediate vs. delayed questions), the isolate appeared early, and the list items were identical. However, the inclusion of subsequent questions, particularly delayed questions, probably disrupted participants' ability to encode a central category theme, particularly with the use of various delayed questions. Thus, the recall data from this experiment are not particularly relevant for standard isolation effects and should be interpreted cautiously. Nonetheless, the critical response time data showed that early isolates are processed as different from their context once that context is revealed.

GENERAL DISCUSSION

Three experiments tested the hypothesis that isolated items are salient during the encoding episode and that this type of episodic salience predicts superior memory for isolated items. Experiments 1 and 2 tested this hypothesis using two-item delayed JOLs. Results from Experiment 1 showed an isolation effect for early and late isolation conditions. Importantly, participants gave significantly higher JOLs to isolated items than control items regardless of their position in the list. Experiment 2 used a different isolation paradigm with a single study list and obtained an isolation effect for both early and late isolation conditions, and again, participants gave higher delayed JOLs to isolated items than to control items regardless of list position, suggesting that delayed JOLs at encoding predict the presence of an isolation effect in memory. Experiment 3 provided evidence for the hypothesis that isolated items become salient (or odd) over the course of the study episode, as the list context (the category in this case) becomes known.

These findings are relevant for encoding and retrieval theories of distinctiveness. Existing encoding theories generally propose that the unusual items are remembered well because they receive differential processing at the time they are presented. The most basic and seminal encoding view suggests that distinctive items are remembered better than common items because they receive more attention than common items (Green, 1956; Jenkins & Postman, 1948). Similarly, Schmidt's (1991) incongruity theory contains aspects of these encoding views by proposing that incongruent items automatically attract attention. This increased attention is hypothesized to have several subsequent effects. It can lead to greater overall processing (e.g., Slamecka & Katsaiti, 1987; Watkins et al., 2000; Wollen & Cox, 1981), or other controlled memory processes (Schmidt, 1991). Kishiyama and Yonelinas (2006) have suggested that distinctive items lead to an automatic orienting response (see also Knight, 1996; Knight & Nakada, 1998), and this orienting then leads to further elaborative or controlled processing (see also Karis, Fabiani, & Donchin, 1984). It should be noted that several of these theories also hypothesize a potential role for subsequent retrieval processes, including interactions between test demands and participants' encoding strategies (Schmidt, 1991) or reduced interference for distinctive or novel items (Kishiyama & Yonelinas, 2006). However, in all these theories, the isolated item is hypothesized to initially attract attention, and the assumption is that isolates attract attention because they are, at that moment, perceived as salient. In contrast, the current findings show that the isolated item becomes salient over the course of the study episode and that the processes involved in assessing salience over the course of the study episode predict superior memory for isolates. At a very general level, this finding suggests that it is important to consider the nature of the processing that occurs during the episode, rather than simply the processing that occurs during presentation of the item (see Geraci & McCabe, 2006, for a similar argument applied to understanding recollection of false memories).

The current findings are also relevant to retrieval-based theories of distinctiveness. Currently, there are only a handful of retrieval theories. One idea is that, at the time of the retrieval task, the features of the unusual item guide access to the "distinct" items (Knoedler, Hellwig, & Neath, 1999; Waddill & McDaniel, 1998). Another view is that unusual items make up their own mnemonic category that contains a small set of cues, thereby increasing the relative probability of recalling a distinct item over a common item that contains more cues (Bruce & Gaines, 1976). More recently, other distinctiveness effects, such as the bizarreness effect (superior memory for unusual sentences) have been hypothesized to result from retrieving distinct and common items together during a free recall task (Geraci, McDaniel, & Sappington, 2008; McDaniel, Dornburg, & Guynn, 2005). These retrieval-based theories have in common the fact that they hypothesize that distinctiveness effects are due solely or primarily to processes engaged at the time of retrieval, typically measured using a free recall task. The current results cannot speak directly to whether the isolation effect could be driven in part by processes occurring during retrieval, but they do suggest that that the effect is driven to some extent by processes occurring during the encoding episode.

We have suggested that people give higher delayed JOL ratings to isolated items than control items because isolated items appear salient during the encoding episode once the list context is known. When people make immediate JOLs (Dunlosky et al., 2000), however, they do not give higher JOLs to early isolates in particular because the context is unknown, and the item has yet to become salient. However, an alternative theory could be that isolated items are given higher JOLs than control items using a delayed JOL because people receive retrieval experience with the items that provides feedback to participants regarding the increased memorability of isolated items. However, this interpretation seems unlikely given the method of assessing JOLs in the present experiments, because in both Experiments 1 and 2 the isolate and its control were re-presented to participants in the JOL question. Indeed, the JOL literature demonstrates that re-presenting the stimulus in its entirety during the JOL question does not show a typical delayed JOL effect (Nelson and Dunlosky, 1991)—the finding that a delayed JOL is more predictive of later recall performance than an immediate JOL. The interpretation of this result was that when the entire item was re-presented during the delayed JOL, long-term memory retrieval was not required, and the retrieval context was not instantiated. From a transfer-appropriate processing perspective, the idea is that this retrieval experience may transfer well to a later retrieval experience of the identical form. In the current studies, recall was not required during the JOL, and thus the retrieval context was not instantiated. Therefore, it is unlikely that participants in the current studies engaged in retrieval while making the JOL response, and it is unlikely that their experience making the JOL with the critical item present in the JOL question transferred to their experience of trying to recall the critical item on a later free recall test. Instead, participants judged the isolated items to be salient using a delayed JOL because the isolated item appeared salient during encoding of the list context.

Experiment 3 further provided evidence for the processes that occur during or subsequent to the judgements of learning. The findings from Experiment 3 showing that people are faster to disconfirm category membership (they are faster to notice that the isolate is odd) only after a delay is consistent with the idea that distinctiveness effects result from evaluating and comparing the unusual item to an established norm during the course of encoding (Geraci & Rajaram, 2002, 2004, 2006). The idea is that participants evaluate the incongruent or rare items in the study list as distinctive as the list context unfolds, and the norm is established. To evaluate an item as odd, one must take notice of the context as it is established and compare the item to that standard. The current results are the first to find direct evidence for this process during encoding.

We have suggested that salience develops over the course of the study list. It is reasonable to expect that, if salience develops throughout exposure to the list, there would be a larger isolation effect for late isolates than for early isolates. This result was not obtained in the current studies—JOLs were not greater for late isolates than for early isolates in Experiments 1 and 2. However, this is an interesting point. One might expect that JOLs would steadily increase as more background context becomes available, and the item becomes "more salient". We suspect that this is true to a certain extent—that an isolate would be more salient in a list of five background items than in a list of two background items because in the former case the category would be clearly established. However, we think that once the context is clear (perhaps after the background items unambiguously outnumber the isolate), the item becomes distinctive. At what point this occurs would be a good question to address future research.

In summary, results from the present studies and the research from Dunlosky et al. (2000) together demonstrate that delayed but not immediate JOLs predict the isolation effect in memory. However, immediate and delayed JOLs may show different patterns of results with other types of distinctiveness effects (see Schmidt, 1991, and McDaniel & Geraci, 2006, for a description of various types of distinctiveness effects). Future studies should examine the role of salience in mediating other distinctiveness effects besides the isolation effect. For now, though, it appears that isolated items are salient during the encoding episode and that this salience predicts that presence of the isolation effect in memory.

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