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Providing Support for Distinctive Processing: The Isolation Effect in Young and Older Adults

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Abstract

The isolation paradigm is the classic method for studying the effects of distinctiveness on memory (Hunt, 1995). Previous studies using the isolation paradigm with older adults (Bireta et al., 2008; Cimbalo & Brink, 1982; Geraci et al., 2009; Vitali et al., 2006) placed the isolated items late in the study list. The current experiments, which are the first to investigate the isolation effect in young and older adults when the isolated item occurs early in the list, were motivated by a new framework for understanding age-related differences in the beneficial effects of distinctive processing. The framework, which is motivated by Hunt's (2006) discussion of distinctiveness and Craik's (1986) environmental support view, proposes that when contextual support is provided for the processing of both the difference and similarity components, older adults are more likely to show beneficial effects of distinctiveness. In Experiment 1, young adults showed both early and late isolation effects, while older adults showed only a late isolation effect. In the first experiment the isolated item was the word "table" in a list of fish names. In Experiment 2, the contrast between the isolated item and background items was increased by isolating numbers in a list of words. In the second experiment older adults, as well as young adults, showed an early isolation effect.

Keywords

memory; aging; adult age differences; von Restorff; isolation effect; distinctiveness; similarity

Age-related declines in memory for past events have been well documented in the literature (for reviews see Craik & Jennings, 1992; Light, 1996; Smith, 1996; Zacks, Hasher, & Li, 2000), and one possible explanation for age-related differences in episodic memory points to age-related differences in distinctive processing (e.g. Smith, 2006). The current experiments use the isolation paradigm, considered the gold-standard for investigating distinctiveness, to investigate possible age-related differences in distinctive processing and to test whether support can be provided to allow the beneficial effects of distinctive processing to emerge for older adults. The experiments are motivated by a new framework for understanding age-related differences in distinctive processing. The framework will be introduced following a discussion of the concepts relevant to the discussion of distinctiveness and memory.

Distinctiveness and Memory

One approach to thinking about distinctiveness and memory begins with the idea that if an event is distinct in some way more attention will be paid to that event and therefore the event will be better remembered relative to non-distinct events. For example, on my way to work one day I saw two adult black-bellied whistling ducks escorting a large number of very

young ducklings across a neighbor's lawn. I remember that particular trip to work clearly. In contrast, there are many other trips to work for which I have no particular memory. The intuitive explanation is that I remember the distinctive event because its salience attracted additional processing.

However, as explained by Hunt (1995, 2006), this intuitive explanation is not consistent with important data from the isolation paradigm. In the isolation paradigm participants are presented with a list of items to remember. Some participants are given a control list, while others receive an isolation list. In the case of a control list the items are either all alike (a homogeneous control list, e.g. a list of furniture names) or all different (a heterogeneous control list, e.g. a list of words, each from a different taxonomic category). In the isolation list one or two items are isolated from the other list items on some dimension (e.g. the word "table" in a list composed of fish names). The isolation effect has occurred when memory for the isolated word "table" in the isolation list surpasses memory for the same word appearing in the control list. As noted by Hunt (1995), most studies that use the isolation paradigm place the isolated item late in the isolation list (e.g. the 7th item in a 12 item list, Bireta, Suprenant, & Neath, 2008). However, von Restorff (1933) conducted experiments in which she purposely placed the isolated items early in the list (e.g. serial positions 2 and 3). Von Restorff placed the items early in the list where no list context had been established and therefore the isolated items would not be surprising or salient; nonetheless, early isolates were better remembered. Thus, perceived salience is not necessary for the isolation effect, undermining a key assumption of the intuitive theory of distinctiveness.

Dunlosky, Hunt, and Clark (2000) further investigated the issue of salience by asking participants in an isolation paradigm to make judgments of learning (JOLs). JOLs are a metacognitive index of a participant's belief that a given item will be remembered on a later recall test, and evidence exists suggesting that salience can elevate JOLs (e.g. Koriat, 1997). Dunlosky et al. reported that JOLs for an item isolated early in the list did not differ from the JOLs for matched items in a control list, but JOLs for items isolated late in the list were elevated relative to their controls. Despite the apparent lack of salience for early isolates, isolating the item early in the list produced an isolation effect equivalent to that of late isolates.

Hunt's (1995, 2006) explanation for the isolation effect does not depend upon salience and differential attention, but instead focuses on the combined processing of similarity and difference, rather than the processing of either alone. Difference among items is not sufficient for improved memory (Hunt, 2006): The same isolated item presented in a list in which the background items are all different (e.g. a list consisting of a number, a word, a color splotch, a geometric shape, a nonsense syllable, an asterisk, etc.) will not be better remembered. Nor will similarity alone improve memory for the isolated item: the same item is not particularly well remembered if processed in a list of similar items (e.g., a list of two digit numbers). Only if the non-isolated item is presented in a list in which the background items are all similar to each other, but different from the isolate, will the isolation effect be demonstrated. The combined processing of difference in the context of similarity establishes the encoding and retrieval of features shared by all of the items of an event, plus the different features that delineate one item from another within the shared features. The processing of difference in the context of similarity is highly diagnostic of a particular item.

A New Framework

As described above, distinctiveness has been defined as the processing of difference in the context of similarity (Hunt, 2006). Older adults have been shown to benefit from combination of these processes (e.g. Fisher & McDowd, 1993; Luszcz, Roberts, & Mattiske,

1990). However, the benefit of distinctive processing is sometimes reduced (Mäntylä & Bäckman, 1992) and in some cases absent (Smith, Lozito, & Bayen, 2005) for older adults. Based upon these types of findings Smith (2006) predicted that older adults will be less likely to benefit from manipulations of distinctiveness unless additional support is provided that can aid distinctive processing. A specific framework for understanding age-related differences in the effects of distinctive processing on retrospective memory is presented here. This framework was motivated by Hunt's (1995, 2005) view of distinctiveness and Craik's (1986) proposal that memory deficits associated with older adults' reduced cognitive resource availability can be overcome through environmental support. The new framework will be described following a discussion of evidence regarding distinctiveness and resource availability.

Distinctiveness and Resource Availability

As noted by Hunt (2006), distinctiveness is not an inherent characteristic of materials, but instead, distinctiveness is a process of perceiving and comprehending similarity and difference. Important variables influencing this process are the nature of materials and the intent of the perceiver/comprehender. Smith (2006) suggested that the processing of similarity and/or the processing of difference also may require cognitive resources. If these processing requirements exceed the availability of resources, distinctive processing and its associated memory advantage will not occur. To illustrate this point, consider the modality effect in false memories, which describes Smith and Hunt's (1998) discovery that presenting study list items visually reduced written false recall relative to the levels of false recall when the study list is presented auditorally. This effect has been explained in terms of distinctive processing (e.g. Smith & Hunt, 1998; Smith, Hunt, & Gallagher, 2008). The modality effect on false recall, however, is eliminated when attention is divided at study (Smith & Engle, in press), suggesting that the use of modality information to reduce false recall requires resources and, to the extent that distinctive processing explains the modality effect, indirectly indicates that distinctive processing requires resources. Similarly, older adults, who have reduced cognitive capacity relative to young adults (Verhaegán, Marcoen, & Goossens, 1993), do not show the modality effect in false recall (Smith et al., 2005), nor do young adults with lower working memory span scores (Smith & Engle, in press). These findings are consistent with the proposal that the benefits of distinctiveness can rely on controlled cognitive processing (see also Garaci & Rajaram, 2002).

On the other hand, additional research in the area of false memories indicates that older adults can benefit from distinctive processing when processing of difference requires fewer resources. As noted in Smith et al. (2005), presenting study lists in the form of pictures can reduce false memories for both young and older adults (Schacter, Israel, & Racine, 1999). Smith et al. discussed evidence suggesting that pictures encourage the processing of differences among items that when combined with the spontaneous processing of similarity allows reduction in false memory. In accord with Craik's (1986) view, presenting list items in the form of pictures provides the environmental support necessary for older adults to also benefit from distinctiveness in this case.

Retrospective Memory, Aging, Difference, and Similarity

The research reported here is motivated by the proposition that older adults' retrospective memory will benefit from manipulations of distinctive processing when the task structure and/or materials are selected to facilitate both the processing of similarity and the processing of difference in order to compensate for age-related differences in resource availability. The idea that reduced resource availability on the part of older adults could impact distinctiveness has been suggested previously (e.g. Mäntylä & Bäckman, 1992); however, the current Contextual Support for Similarity and Difference (CSSD) framework goes

further by specifying that the benefits of distinctiveness can be facilitated by providing contextual support of the component processes of processing similarity and difference.

Consider the role of similarity processing. If materials or tasks do not encourage spontaneous relational processing, the context of similarity may not be fully established and, according to Hunt's (1995, 2006) view of distinctiveness, there will be no background against which a "different" event can be contrasted. For instance, Hunt and Seta (1984) demonstrated that when categories are made up of fewer than four items, participants are less likely to spontaneously engage in relational processing of the similarity among the items. Subsequent research has shown this is also true for older adults (Guttentag, 1998; Fisher & McDowd, 1993; Luszcz et al., 1990). Furthermore, based upon a review of the literature on the effects of adult age on clustering scores, which are thought to reflect relational processing, Smith (2006) concluded that age-related differences in clustering were more likely to emerge when categories were smaller, but age-related differences in clustering were often eliminated with larger categories. Thus, the CSSD framework proposes that older adults may need additional support, for instance in the form of larger categories or orienting tasks that direct attention to similarities among items, in order to fully engage in the processing of similarity required for benefits of distinctiveness to emerge. The first experiment in this study investigates whether providing support for similarity processing can support older adults' distinctive processing.

The CSSD framework also proposes that additional support may be provided for processing the features that make the distinctive item different from the context of similarity. For instance, selecting items that differ on a perceptual basis (red item in a list of black items) should facilitate the spontaneous processing of difference to a greater extent than items that require additional semantic processing to delineate the difference among items. In the former case the dimension of difference occurs on a more superficial level, while the latter case requires deeper processing of the items. The second experiment investigates whether providing support for the processing of difference can facilitate older adults' distinctive processing.

Experiment 1

The CSSD framework leads to specific predictions regarding when older adults will, and will not, show an isolation effect. When the isolated item occurs late in the list, a sufficient number of similar background items have occurred to encourage spontaneous relational processing of the information shared among those items, which in turn establishes the list context before the late isolate appears. The comparison of the isolated item with the previously established list context occurs at the point at which the late isolate is presented, which should facilitate detecting the difference between the isolated item and the background items. In other words, the nature of the list structure supports processing the difference between the late isolate and the already established list context, leading to more detailed processing of the isolated item, which in turn improves memory for that item. Therefore, both young and older adults are likely to show the late isolation effect.

Four previously published studies have investigated the isolation effect in older adults (Bireta et al., 2008; Cimbalo & Brink, 1982; Geraci et al., 2009; Vitali et al., 2006). Three of these studies found a significant isolation effect for both young and older adults. In these studies the isolate occurred sufficiently late in the list to allow spontaneous relational processing of the category membership (see Table 1). In the fourth study, in which older adults did not show a late isolation effect, the isolated item did occur in the 5th serial position (Cimbalo & Brink, 1982); however, in this experiment participants had to recall the items in order. Tests requiring recall of order information can also reduce the isolation effect

in young adults (Kelley & Nairne, 2001) and it may have been the request for serial recall that eliminated the isolation effect for older adults in the Cimbalò and Brink (1982) study. Overall, the results from these previous studies are consistent with the proposal made by the CSSD framework that older adults can benefit from distinctiveness when support is provided for the processing of difference in the context of similarity.

In contrast to the late isolation paradigm, when an item is isolated early in the list, for example in the second serial position, only one item from the list context category precedes the isolated item. As discussed above, spontaneous relational processing of shared category information is unlikely with categories of fewer than four items and cannot occur when only one item precedes the isolate. Furthermore, age-related differences in relational processing are more likely to emerge with small category size. Therefore, the similarity provided by the context of the background items is not yet available when the isolate appears early in the list; thus, the processing of difference in a context of similarity cannot occur at the point at which the early isolate is presented. Of course, additional items from the list's dominant category are presented following the isolated item, and Geraci and Manzano (2010) provide evidence that, at least for young adults, the list context emerges while encoding those additional list items. However, even if the older adults also eventually detect the categorical nature of the list context, processing the isolated item as different from the shared context of the background items involves comparison of the isolated item to the list context. Thus, the distinctive processing in this case would require either that the isolated item be maintained in short-term memory or retrieved from long-term memory (either later during encoding or during retrieval) in order to process the difference between the isolated item and the list context once the list context has emerged, which may pose a greater challenge for older adults. Therefore, older adults may be less likely to show an early isolation effect.

In the first experiment, young and older adults were presented with a single list of words that included the word "table" in either the second (early) or fifth (late) serial position. Half of the participants in each age group received a heterogeneous control list of unrelated words, each word from a different taxonomic category, while the other half received an isolation list in which the word "table" appeared in a list of fish names. When the isolated item appears early in the list, the context of "fish" has not yet been established and the difference between the first word "trout" and second word "table" may be more difficult to detect until additional items are processed. Older adults may not show an early isolation effect in this case. In contrast, when the isolated item appears late in the list, the list context has been established, and the difference between the isolated item and the background items is more obvious and this may encourage more detailed processing of the isolated item. Older adults do show a late isolation effect (Bireta et al., 2008; Geraci et al., 2009; Vitali et al., 2006). In short, both young and older adults should show a late isolation effect, while only the young adults will show an early isolation effect in the first experiment.

Method

Participants and design—Individuals who reported having health problems that could affect memory performance or who reported that they were in poor health were excluded. Participants, all native English speakers, were recruited through flyers and newspaper advertisements or through a secure online sign-up system and came to the laboratory to complete the experiment. Older participants received monetary compensation. Young adults received either monetary compensation or credit towards a course requirement. The 136 young adults ranged in age from 17 to 30 years, $M = 20$ years, $SEM = .17$, while the 120 older adults ranged in age from 60 to 89, $M = 70$ years, $SEM = .64$. Participants in each age group were randomly assigned to one of four conditions created by the orthogonal combination of isolate position (early v late) and list type (isolate v control).

An alpha level of .05 was used for all tests of statistical significance and effect sizes are reported in terms of partial eta squared (η_p^2). Older adults, $M = 15.30$, $SEM = .18$, had completed more years of formal education relative to young adults, $M = 13.33$, $SEM = .08$, $F(1,254) = 108.51$, $MSE = 2.30$, $p < .001$, $\eta_p^2 = .30$, and older adults had higher vocabulary scores, $M = 19.78$, $SEM = .53$, relative to the young adults, $M = 11.51$, $SEM = .30$, $F(1,254) = 191.93$, $MSE = 22.70$, $p < .001$, $\eta_p^2 = .43$. Vocabulary scores are reported in raw number correct on the 30-point Gardner-Monge (1977) vocabulary test.

Materials and procedure—Participants were instructed that they would see a list of words and they should try to remember those words for a later memory test. Each word was shown for 3 s with a 250 ms inter-stimulus-interval. The heterogeneous control lists consisted of eight words, each from a different taxonomic category (e.g., opium, table, cookies, sponge...). The isolation lists consisted of the isolated word “table” in a background of fish names (e.g., trout, table, herring, shark...). The word “table” appeared in either the second (early) or fifth (late) position for both the isolation list and its matched control list. Presentation of the study list was followed by a five minute delay in which participants completed a health and demographics questionnaire. After the delay participants were given a sheet of paper and were asked to recall the items from the study list.

Results and Discussion

Isolated item—Recall of the isolated item is shown in Figure 1. An analysis of variance was conducted with the between subject variables of age group, isolate position (early versus late), and list condition (isolation versus control). Both age group, $F(1, 248) = 6.05$, $MSE = .23$, $p = .02$, $\eta_p^2 = .02$, and list type, $F(1, 248) = 13.32$, $MSE = .23$, $p < .001$, $\eta_p^2 = .05$, significantly affected performance, however there was a trend towards an interaction of isolate position and list type, $F(1, 248) = 2.89$, $MSE = .23$, $p = .09$, $\eta_p^2 = .01$, and, more importantly, the three-way interaction of age group, list type, and isolate position approached significance, $F(1, 248) = 3.80$, $MSE = .23$, $p = .05$, $\eta_p^2 = .02$. Follow-up analyses were conducted separately for each age group.

For young adults, only the main effect of list type reached significance, $F(1, 132) = 9.82$, $MSE = .22$, $p = .002$, $\eta_p^2 = .07$. Neither the main effect of isolate position nor the interaction were significant, $F_s < 1$, $p_s > .58$. In other words, young adults showed a significant isolation effect regardless of whether the isolate occurred early in the list, $F(1, 66) = 5.38$, $MSE = .22$, $p = .02$, $\eta_p^2 = .08$, or late in the list, $F(1, 66) = 4.46$, $MSE = .21$, $p = .04$, $\eta_p^2 = .06$.

In the case of the older adult data, the main effect of list type, $F(1, 116) = 4.31$, $MSE = .23$, $p = .04$, $\eta_p^2 = .04$, was qualified by a significant interaction of list type and isolate position, $F(1, 116) = 6.01$, $MSE = .23$, $p = .02$, $\eta_p^2 = .05$. The interaction was investigated with separate analyses for each isolate position. Consistent with previous studies using a late isolate paradigm and non-serial recall tests (Bireta et al., 2008; Geraci et al., 2009; Vitali et al., 2006), older adults did show an isolation effect when the isolated item occurred late in the list, $F(1, 58) = 11.29$, $MSE = .21$, $p = .001$, $\eta_p^2 = .16$. In contrast, the effect of list type was not significant for older adults when the isolate occurred early in the list, $F < 1$, $p > .79$.

Background items—In the early isolation conditions, the background items included items in serial positions 1 and 3 through 8. In the late isolation condition, the background items included items in serial positions 1 through 4 and 6 through 8. The proportion of these items recalled, shown in Table 2, was significantly affected by age group, $F(1, 248) = 30.22$, $MSE = .04$, $p < .001$, $\eta_p^2 = .11$, isolate position, $F(1, 248) = 8.89$, $MSE = .04$, $p = .003$, $\eta_p^2 = .04$, and list type, $F(1, 248) = 97.11$, $MSE = .04$, $p < .001$, $\eta_p^2 = .28$, with a

significant interaction between age group and isolate position, $F(1, 248) = 5.12$, $MSE = .04$, $p = .02$, $\eta_p^2 = .02$. No other interactions reached significance, $F_s < 1$, $p_s > .32$.

For young adults, there was a main effect of list type, with better background item recall in the isolate condition, $M = .68$, $SEM = .02$, relative to the control condition, $M = .45$, $SEM = .02$, $F(1, 132) = 50.35$, $MSE = .04$, $p < .001$, $\eta_p^2 = .28$. This pattern was expected given that the background items in the isolation condition all come from the same category, whereas the background items in the control condition are all unrelated. For young adults, the effect of isolate position was not significant, $F < 1$, $p > .56$, and the two variables did not interact, $F(1, 132) = 1.18$, $MSE = .04$, $p > .27$.

In the case of older adults, both the main effect of list type, $F(1, 116) = 46.47$, $MSE = .05$, $p < .001$, $\eta_p^2 = .29$, and the main effect of isolate position, $F(1, 116) = 10.86$, $MSE = .05$, $p = .001$, $\eta_p^2 = .09$, reached significance, but the variables did not interact, $F < 1$, $p > .82$. As expected and consistent with the young adults, older adults' recall of the semantically related background items in the isolation conditions, $M = .56$, $SEM = .03$, was higher than older adults' recall of the unrelated background items in the control condition, $M = .28$, $SEM = .03$. It is unclear why older adults recalled more background items in the late isolate conditions, $M = .49$, $SEM = .03$, than in the early isolate conditions, $M = .35$, $SEM = .04$. One concern might be that older participants in the early isolate conditions had lower recall abilities overall and this may have prevented the early isolation effect from emerging. However, this concern is unwarranted given the lack of an interaction between isolate position and list type. In addition the lack of an interaction also argues against a differential attention argument (i.e., background items following the isolated item received additional processing) as the effect of list position on background item recall appeared in both the isolation and control conditions.¹

Experiment 2

No early isolation effect was found for older adults in Experiment 1; however, the CSSD framework predicts that it should be possible to provide support for the distinctive processing required for the early isolation effect to occur for older adults. A second experiment was conducted to investigate the early isolation effect in young and older adults using different materials that were selected to support distinctive processing of the early isolate. Specifically, materials for the second experiment were selected to make the dimension of difference between the isolated item and background items more accessible when the early isolate is initially presented. In the first experiment participants saw a list of words and the categorical distinction between the first and second word was unlikely to emerge until after the presentation of additional list words revealed the semantic context of the list. In the second experiment the isolated items were numbers while the background items were words. The categorical difference between numbers and words is more immediately apparent than the semantic difference between words. Participants can distinguish between words and numbers expressed in numerals, even if the words are in a language the participant does not speak, but the participants would not be able to distinguish semantic categories of words unless they can process the meaning of the words. Foreign language words were not used in this experiment, but the example illustrates the distinction between isolation on the dimension of number versus word relative to isolating on basis of word meaning.

¹The suggestion that isolation leads to differential attention to background items is not supported by previous research. See Wallace (1965) for review and discussion.

In contrast to the CSSD framework's proposal that support for processing of difference may allow the early isolate to emerge for older adults, it is possible that older adults will only show the isolation effect when the relationship among the background items is fully established prior to the appearance of the isolated item (i.e., when the isolate occurs late in the list). In this case, older adults would not show the early isolation effect, regardless of the particular dimension of distinctiveness. The current experiment will test these possibilities.

Method

Participants and design—As in Experiment 1, individuals who reported having health problems that could affect memory performance or who reported that they were in poor health were excluded and all participants were community dwelling native English speakers who came to the laboratory to complete the experiment. All participants were recruited through flyers or newspaper advertisements and all received monetary compensation for their time. The 32 young adult participants ranged in age from 18 to 30 years, $M = 24$ years, $SEM = .76$. The 38 older adult participants ranged in age from 60 to 89, $M = 69$ years, $SEM = 1.02$. Young adults, $M = 14.90$, $SEM = .33$, and older adults, $M = 14.58$, $SEM = .44$, did not differ in the number of years of formal education, $F < 1$, $p > .57$. Vocabulary scores for older adults, $M = 18.58$, $SEM = .96$, did not differ significantly from those for young adults, $M = 17.47$, $SEM = .79$, $F < 1$, $p > .38$. Half of the participants in each age group were randomly assigned to one of two groups defined by list type (isolation versus control)

Materials and procedure—Participants in the homogenous control group studied a list consisting of 12 numbers. Participants in the isolation group studied a 12-item isolation list in which the items in the second and third serial position were numbers while the remaining items consisted of vehicle names. In a study involving young adults, Hunt (2009) found significant early and late isolation effects using isolation lists in which numbers were isolated in a background of vehicle words. Two items were isolated in order to increase the number of observations per participants. Multiple isolated items within a single isolation list have been used successfully in previous research (e.g., Hunt & Mitchell, 1982). The same numbers appeared in the second and third position in both the control and isolation lists. Because the focus is on whether older adults will demonstrate an early isolation effect using these alternative materials, this experiment included only an early isolation list and its appropriate control list. Otherwise, procedures matched those in Experiment 1.

Results and Discussion

Recall of the isolated items—The likelihood of recalling the isolated items is shown in Figure 2. The main effects of age group, $F(1,66) = 9.28$, $MSE = .11$, $p = .003$, $\eta_p^2 = .12$, and list type (isolate versus control), $F(1,66) = 33.37$, $MSE = .11$, $p < .001$, $\eta_p^2 = .37$, both reached significance. The two variables did not interact, $F(1,66) = 1.98$, $MSE = .11$, $p = .16$. Thus, young adults recalled more isolated items than did older adults, but an early isolation effect was demonstrated in both age groups in this experiment in which the materials were specifically selected to support the processing of the dimension of difference at the time the isolated items are presented.

Recall of background items—In this experiment background items occurred in serial positions 1 and 4 through 12. Background item recall (Table 2) was significantly affected by both age group, $F(1,66) = 9.07$, $MSE = .02$, $p = .004$, $\eta_p^2 = .12$, and list type, $F(1,66) = 39.85$, $MSE = .02$, $p < .001$, $\eta_p^2 = .38$, but the variables did not interact, $F(1,66) = 2.25$, $MSE = .02$, $p > .13$. Young adults, $M = .59$, $SEM = .03$, recalled more background items than did older adults, $M = .48$, $SEM = .03$. More background items were recalled in the isolation condition, $M = .65$, $SEM = .02$, than in the control condition, $M = .42$, $SEM = .03$.

General Discussion

The classic isolation paradigm was used to investigate two proposals made by the CSSD framework, which is a new framework for understanding age-related differences in distinctive processing that combines ideas from Hunt's (1995, 2006) view of distinctive processing and Craik's (1986) proposal that environmental support can compensate for resource differences between older and younger adults. The first experiment investigated whether providing support for the processing of similarity would facilitate distinctive processing on the part of older adults by contrasting early and late isolation lists. Experiment 1 replicated previous demonstrations of a late isolation effect in both young and older adults (Bireta et al., 2008; Geraci et al., 2009; Vitali et al., 2006). In contrast, young, but not older adults, showed the early isolation effect in Experiment 1. In Experiment 2 the early isolation list was constructed to provide additional support for the processing of difference and in this experiment both young and older adults showed the early isolation effect. The results of these experiments, the first to investigate the early isolation effect in older adults were consistent with the proposed CSSD framework: while older adults can benefit from distinctive processing, manipulations designed to influence distinctive processing may not always produce the same effects in young and older adults unless additional support is provided for the processing of difference and similarity.

These experiments demonstrate that providing support for the processing of similarity or the processing of difference can facilitate older adults' distinctive processing of the isolated items. In the first experiment this facilitation came through an increase in the relational processing of the list context encouraged by placing the isolate late in the list, which supports the processing of similarity. In the second experiment the facilitation was provided by differentiating the isolated items and list context on a categorical basis that would be apparent even before additional semantic processing of the list items occurred. Experiment 2 demonstrates that it is possible to facilitate distinctive processing through variations in what defines the difference between categories of items and Experiment 1 demonstrates that distinctive processing can be facilitated through increasing the processing of similarity, all of which fits nicely with Hunt's conceptualization of distinctive processing as the processing of difference in the context of similarity (Hunt, 1995, 2006).

At first glance, one might view the finding that older adults showed an early isolation effect in the second experiment as inconsistent with Geraci and Rajaram's (2002) proposal that distinctiveness effects involve a comparison process that "requires conceptual processing that involves knowledge of a standard and evaluation of difference" (p. 288) and this comparison process is not automatic. In fact, the current findings are completely consistent with Geraci and Rajaram's hypothesis. Although the identification of the categories of number versus word may occur in a more automatic fashion, this does not mean that the comparative process is automatic. As Geraci and Rajaram suggest, the conceptual comparison processes are likely to require resources even if automatic perceptual processes contribute to the distinctiveness effect. While older adults have reduced cognitive capacity (Verhaegán et al., 1993), their capacity for non-automatic controlled processing, such non-automatic comparison processing, is not eliminated and the fact that older adults can show an early isolation effect does not suggest that the isolation effect occurs entirely through automatic processing.

In addition to providing the first investigation of the early isolation effect in older adults, these experiments are the first to use a single list procedure to investigate possible age-related differences in the isolation effect, in contrast to the previous studies with older adults that all used multiple isolations lists (see Table 1). The use of multiple lists may be less than ideal for studying age differences due to the potential for differential effects of interference.

Hasher and Zacks (e.g. Hasher and Zacks, 1988; Zacks et al., 2000) proposed that older adults have more difficulty inhibiting irrelevant information and that this can have a detrimental effect on memory. It is possible that information from earlier lists can interfere with memory for the current list when multiple lists are used in the isolation paradigm and this interference is likely to be greater for older adults than younger adults. Alternatively, the use of multiple lists may lead participants to anticipate the isolated item and therefore adopt different strategies during encoding and/or retrieval. Comparison of the current Experiment 1 with previous experiments using multiple lists to investigate the late isolation list can speak to concerns over possible negative effects of the use of multiple isolation lists.

The late isolation condition in Experiment 1 is quite similar to the experiment reported by Geraci et al. (2009), aside from the use of a single list in the current Experiment 1 versus multiple lists in the Geraci et al. experiment. On the one hand, both studies found late isolation effects for young and older adults, indicating that the demonstration of a late isolation effect in the Geraci et al. experiment was not due to the use of multiple lists. On the other hand, the magnitude of the late isolation effect is considerably larger in the current experiment than in the three previous studies. Given the parallel in materials between the current Experiment 1 and Geraci et al.'s experiment on other dimensions, this suggests that the use of a single list in the current study versus multiple lists in the Geraci et al. may play key role in the size of the late isolation effects, especially for older adults. The use of a single list may have reduced negative interference effects and thereby facilitated a larger late isolation effect in Experiment 1 of the current study relative to the Geraci et al. experiment. However, it is also the case that Geraci et al. presented all twelve lists followed by a five minute delay prior to the single cued recall test; thus, the overall delay for at least some of the isolated items would be longer than that in the current experiment. Future research should examine the possible effects of multiple lists and variations in the length and nature of the delay preceding recall on the expression of the early and late isolation effects and on the relative size of these effects in young and older adults.

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Figure1.
Recall of the isolated item as a function of isolate position, age group, and list type in Experiment 1. Error bars represent standard error of the mean.

Figure 2. Recall of the isolated items as a function of age group and list type in Experiment 2. Error bars represent standard error of the mean.

Table 1

Description of lists used in previous studies showing an isolation effect for older adults.

Study	List Length	<u>Number of Lists</u>		Location and Nature of Isolate
		Isolate	Control	
Geraci et al. (2009)	8	6	6	5th word isolated by semantic category
Bireta et al. (2008)	12	10	10	7th word shown in red on white, all others in black on white
Vitali et al. (2006)	10	20	5	4 th , 5 th , 6 th , or 7 th word shown in 120 pt font, all other words in 60 pt font

Note: List type (isolate v control) was manipulated within-subjects in these studies. List Length = number of words in each isolate and control list.

Table 2

Proportion of background items recalled.

Experiment	Age Group	Isolate Position	List Type			
			Isolate		Control	
			M	SEM	M	SEM
1	Young	Early	.66	.04	.46	.03
		Late	.71	.03	.44	.04
	Older	Early	.49	.05	.21	.03
		Late	.64	.04	.34	.04
2	Young	Early	.68	.02	.51	.06
	Older	Early	.63	.03	.34	.03