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An Investigation of the Role of Distinctiveness on the Production Effect

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Abstract

The current study examined the role of distinctive processing on the production effect (i.e., enhanced memory for words read aloud versus silently). Participants read a mixed list of thirty-six words presented one at a time for three-seconds each. Half of the items were read aloud and half were read silently; these word lists were comprised of items belonging to either natural categories or ad hoc categories. Immediately following study, participants completed a free recall test then a recognition test two days later. Results from recall and recognition tests support a distinctiveness account of the production effect. The current results support MacLeod et. al's (2010) suggestion that distinctiveness underlies the production effect. Specifically, reading words aloud increases item-specific processing, a crucial component of distinctive processing.

An Investigation of the Role of Distinctiveness on the Production Effect

The production effect is the phenomenon which occurs when memory is improved by repeating a word aloud as opposed to reading it silently. Several researchers have proposed that distinctiveness (produced words gain a discriminative quality thereby enhancing memory for them) underlies the production effect, but this has not been well tested in the literature (Dobbins, Kroll, Yonelinas & Liu, 1998; Hunt & Einstein, 1981; Hunt & Lamb, 2001; Hunt & McDaniel, 1993; MacLeod, et. al; 2010; Ozubko & MacLeod, 2010; Rawson & Van Overschelde, 2007). Because the causes of production are not well understood, the current study aims to directly test the role of distinctiveness on the production effect and how this may influence explicit memory.

Recently, the literature has given wide attention to production, suggesting it to be an easy memory improvement tool. In a series of eight experiments, MacLeod, Ozubko, Gopie, Hourihan and Neary (2010), tested the production effect, a phenomenon which asserts that verbalizing words aloud enhances memory more than reading silently. Using the model of MacDonald and MacLeod (1998) to test the true influence of production on explicit memory, MacLeod et. al., (2010) investigated within vs. between subjects designs to determine whether design influences the presence of production. In within-subject designs, each participant completes every aspect of an experiment. For example, in research on the production effect, all participants read some words aloud and others silently. Conversely, between-subject designs expose participants to different conditions of the same study (e.g., reading all words aloud or all silently). Interestingly, MacLeod and colleagues (2010) found that production is influenced by design type because it is only obtained in only obtained in a within-subject design.

The results of MacLeod et al. (2010) demonstrated the value of a within-subjects design in attaining the production effect; between-subject conditions lacked any significant evidence of the production effect. In fact, production was consistently present in a within-subjects design, and accuracy at test was significantly greater for words read aloud over silent items. Additional experiments indicate that more than a vocal response is responsible for the benefit of memory, such that some particular aspect of a word benefits memory among other words in the same context. Importantly, MacLeod et al. (2010) found the production effect to be item-specific and that recognition is not essential to remember items. The authors also found production to benefit both weak encoding (e.g., reading) as well as strong encoding (e.g., generating) and that production does not weaken memory for un-produced items. In sum, the results of this series of experiments indicate that non meaningful, non-vocal, generated, and semantic items all benefit memory from the production effect.

Although the term “production effect” was recently coined in the literature (MacLeod et al., 2010), several past studies have previously demonstrated the effect as a possibility of increased memory (Conway & Gathercole, 1987; Ekstrand, Wallace and Underwood, 1966; Gathercole & Conway, 1988; Hopkins and Edwards, 1972). However, only recently has significant evidence been gathered determining its true significance in benefiting explicit memory. The first demonstration of the production effect by Ekstrand, Wallace and Underwood (1966) showed that recognition was better for said-aloud words than those read silently; they suggested that verbalization extends the item’s frequency. Some years later, Hopkins and Edwards (1972) examined the production effect within mixed and pure word lists and found that items read aloud were better recognized in mixed lists. In addition, Conway & Gathercole (1987) and Gathercole & Conway (1988) found a 15% - 25% advantage for aloud items compared to silent items, arguing production occurred at encoding and was the result of "enhanced distinctiveness."

Similar to Conway and Gathercole's (1987, 1988) proposal, MacLeod et al. (2010) suggested that the robust effect of production is due to distinctive processing. They suggested that distinctive processing underlies the production effect in the following way: when some words are said aloud and others are read silently, they can be relationally organized as "silent or aloud." Those items read aloud involve additional item-specific processing due to different sound codes for those words. As such, a production effect should only be obtained in a within-subjects design. Hunt and Lamb (2001) assert that distinctiveness is a psychological resultant, not a property of actual objects and events. In other words, according to this view, distinctiveness is an important psychological function that allows discrimination among events that otherwise would appear similar. According to this idea, if all words were read aloud, as in a between-subjects design, a production effect would not be present because the discriminatory value of having both aloud and silent items would be absent. Consistent with the suggestion that distinctiveness benefits production, Lin and MacLeod (2012) found older adults to benefit less from production than younger adults and other research indicates older adults are impaired with distinctive processing (Butler, McDaniel, McCabe, & Dornburg, 2010; Ferguson, Hashtroudi, & Johnson 1992; Geraci, McDaniel, Manzano, & Roediger, 2009; Rankin & Firnhaber, 1986; Smith, Lozito, & Bayen, 2005).

Ozubko and MacLeod (2010) directly tested the hypothesis that distinctive processing (production adds a unique quality to those items which distinguishes them among other items) underlies the production effect. They examined the production effect with a "list discrimination paradigm." Participants were presented with two separate lists (a critical mixed list and a pure distractor list) to study. Words were presented again and participants identified to which list each item belonged. The authors suggest that aloud words in a mixed list were distinct when no other aloud words were present (e.g., the pure list was read silently). However, when other words were said aloud at time of study (the all-aloud distractor list), memory is not indicative of list status, and so the production effect disappears. Therefore, Ozubko and MacLeod (2010) assert that for the production effect to be present, recollection that a word was said aloud must be diagnostic of list status. Overall, this means that memory (distinctiveness) can be improved by production.

Despite evidence consistent with a distinctive processing view of the production effect, Bodner and Taikh (2012) argued that the results from Ozubko and MacLeod (2010) may be explained by attribution (referring to the phenomenon in which familiarity to a stimulus may be attributed to a source of detail in an experiment) instead of distinctiveness. In a study investigating the attributional account of production, Bodner and Taikh (2012) found negative production effects to be present. Bodner and Taikh (2012) asserted that recognition influences list judgments and knowledge about list composition, thereby causing a bias to attribute non-recognized items to the earlier list. Therefore, Bodner and Taikh (2012) suggested that the production effect is dependent upon the intentional evaluation of item memory strength, not distinctive processing.

While the current literature is unclear as to whether or not distinctive processing underlies the production effect, it is worth considering how distinctive processing is typically regarded in the literature. Classic studies of distinctive processing indicate two fundamental processes: relational processing and item specific processing (Hunt & Einstein, 1981). Relational processing refers to the processing of similarities among items. This happens naturally when given obviously related items (e.g., fruits: peach, strawberry, kiwi). This also occurs when given a set of category labels for seemingly unrelated items (e.g., things that make noise: stereo, telephone, baby; Hunt & Einstein, 1981). Relational processing facilitates memory because creating such groupings improves memory at retrieval. The second type of processing fundamental to distinctiveness is item-specific processing, which requires more semantic effort. Item-specific processing is directed at encoding and recognizing the differences among items, not similarities. Therefore, words that seem unrelated at first glance are classified according to item-specific characteristics. Importantly, both relational and item-specific processing must be present to yield distinctiveness.

The combination of relational and item-specific processing facilitates memory by navigating relevant information to find target, pertinent information. In this way distinctiveness leads to better memory. Classic studies (e.g., Dobbins, et al., 1998; Hunt & Einstein, 1981; Hunt & Lamb, 2001; Hunt & McDaniel, 1993; Rawson & Van Overschelde, 2007) have used ad hoc and natural categories to examine distinctive processing. Researchers have found that memory is improved for these different types of lists under certain conditions. It is only when people engage in both relational and item-specific processing that memory is improved. As such, when directed to make item-specific judgments (such as pleasantness ratings) of items in natural categories, memory is improved. On the other hand, a task to promote relational processing (categorization), improves ad hoc category memory (Hunt & Einstein, 1981).

The current study aims to adapt the production effect to the typical paradigm for the study of distinctive processing. Participants will read lists of words belonging to either natural (e.g., purple, black, green) or ad hoc categories (e.g., tree, money, traffic light), with half the words read silently and half read aloud as part of a within-subject design. Participants will only be instructed to study the words for a later memory test. As such, participants will naturally engage in different kinds of processing depending on which type of word lists they study. Participants should automatically engage in relational processing with the natural categories, but not with the ad hoc categories as only item-specific processing can be used with the ad hoc lists. After studying word lists, participants will take recall and recognition tests of memory.

Predictions based on findings in the distinctiveness literature indicate that there should be different results for the recall and recognition tests. Hunt and Einstein (1981) found that relational and item-specific processing yields better performance for recall, whereas item-specific processing drives performance on recognition tests. As such, items read aloud from natural categories should yield best performance on the recall test, whereas there should be no difference between list types for aloud items on the recognition test, therefore, an interaction is predicted. Considering only the recall test, when the combination of relational processing and item-specific processing (reading aloud) with natural categories is implemented, performance will be at its peak. It is predicted that an interaction will occur in which a production effect will be present for both ad hoc and natural categories, but that the production effect will be much larger for the natural categories because those participants are simultaneously engaging in truly relational and item-specific processing. However, somewhat different predictions are made for the recognition test. Specifically, there should still be a production effect overall, however there should be no additional benefit present for relationally processed, item-specific (read aloud) natural category items compared to those from ad hoc categories.

Method

Participants: Forty-nine John Carroll University undergraduate students between the ages of eighteen and twenty-four participated in this study. All participants received course credit.

Materials and Procedure: Materials included two list types, either natural or ad hoc. Thirty-six total items were used for study with six items from six different categories. Items were familiar nouns for both related and unrelated categories. Each participant saw six items from every category, the other six item items in the second set were counterbalanced fillers for the recognition test. The current study exactly replicates that of Hunt and Einstein (1981) in how items were presented. One item from each category was presented before any repetitions in items occurred. Items from the same category were never presented consecutively.

Participants completed the study individually at a computer. The screen displayed words which appeared three-seconds each. Words belonging to either natural or ad hoc categories were presented in either blue or red font. Participants were instructed to read blue words aloud and red words silently, or vice versa. Following the study, there was a free-recall test in which participants were instructed to type as many words they could remember from the list they had just studied. Participants returned two days later and completed a recognition test which included all studied words, along with thirty-six filler words belonging to the same categories.

Results

Performance on the free recall test is shown in Figure 1. Results of a 2 (Production: aloud, silent) x 2 (List: natural, ad hoc) Analysis of Variance (ANOVA) yielded a significant main effect of production, $F(1, 40) = 71.10$, $p < .001$, $\eta_p^2 = 0.64$. Aloud words were better recalled than silent words, on average. The main effect of list type approached significance, $F(1, 40) = 2.40$, $p = 0.125$, $\eta_p^2 = .06$, indicating that, for recall, natural categories tended to be better remembered than ad hoc categories. Although no interaction between production and list type was found as predicted, $F(1,40) = .822$, $p = .37$, the production effect was numerically larger for natural (25.1%) than ad hoc (19.7%) categories as predicted. Consistent with predictions and the findings of Hunt and Einstein (1981), items read aloud from natural categories (*M* = 0.44, *SD =0.14)* were recalled better than those read aloud from ad hoc categories (*M* = 0.37, *SD* = 0.12), *t* (41) = 1.78, *p* = .08.

Performance on the recognition test is shown in Figure 2. Results of a 2 (Production: aloud, silent) x 2(List: natural, ad hoc) ANOVA yielded a significant main effect for production in which aloud items were better recognized than silent items, $F(1, 41) = 80.80$, $p < .001$, $\eta_p^2 = 0.66$. As predicted, there was no significant main effect of list type, $F(1, 41) = 873.80$, $p = 0.67$. Consistent with predictions, there was no benefit present for aloud natural (*M* =.70, *SD* = .18) over aloud ad hoc categories (*M* = .75, *SD* = .17), $t(41) = -.94$, $p = .36$.

Of particular interest is the analysis between items read aloud from natural and ad hoc categories on each of the tests, with performance shown in Figure 3. Results of a 2 (Test: recall v. recognition) x 2 (List: natural v. ad hoc) ANOVA for aloud-only items yielded a significant interaction, $F(1, 41) = 5.93$, $p = .02$, $\eta_p^2 = 0.13$, demonstrating a differential effect of production, replicating the results of Hunt and Einstein (1981). On average, recognition was better than recall, F (1, 41) = 168.9, p <.001, η_p^2 =.805, but no significant main effect was present for list type, $F(1, 41) = .07$, $p = 0.79$. The interaction indicates no effect of list type on recognition, as it primarily taps item-specific processing (natural: 70%; ad hoc: 74%, $t(41) = -.94$, $p = 0.36$). However, a significant effect of list type with recall (natural: 44%; ad hoc: 37%, $t(41) = 1.78$, $p = 0.04$, one-tailed). The results explicitly demonstrate that recall benefits from both relational and item specific processing, which only occurred with natural lists.

General Discussion

The results of this study suggest that production may increase item-specific processing, consistent with MacLeod et al.'s (2010) hypothesis and findings from Lin and MacLeod (2012). Although Bodner and Taikh (2012) demonstrated that Ozubko and MacLeod's (2010) findings may not have been due to distinctive processing, the current results support distinctive processing as underlying the production effect. Differences for aloud items based on test type (recall), which benefits from relational and item specific processing (Hunt & Einstein, 1981), showed better performance for natural aloud items than ad hoc ones. However, performance for items read aloud from both categories was equally high on the recognition test, which taps item-specific processing and has been shown not be benefit from extra, relational processing (Hunt & Einstein, 1981).

Current results provide further convergent evidence for the role of distinctive processing in the production effect. By manipulating list structure (natural vs. ad hoc categories), results supported distinctive processing. This is consistent with MacLeod et al.'s (2010) findings that the production effect only occurs in within-subject design. List structure manipulations supporting distinctive processing are also consistent with Lin and MacLeod (2012) finding that older adults do not benefit as much from distinctiveness.

An important "next step" in this line of research is to more strongly test the distinctive processing hypothesis utilizing a between-subjects design. Although MacLeod et al. (2010) asserted that experimental designs for the production effect should be completely within-subjects because exposing participants to mixed lists allows for relational processing, strong predictions of a distinctive processing account suggest a between-subjects production effect should be found in some conditions. Thus far, all studies on the production effect have used unrelated words which only afford item-specific processing; the within-subjects manipulation is necessary to afford some relational processing. However, findings from The current study as well as others (e.g., Hunt & McDaniel, 1993; Hunt & Smith, 1996; Hunt & Lamb, 2001; Rawson & Van Overschelde, 2007) demonstrate when using natural categories, relational processing automatically occurs. As such, a between-subjects production effect should be found if relational processing is afforded by list structure.

Furthermore, although production studies have used within-subjects designs, classic distinctive processing studies have used between-subjects designs. If production truly enhances item-specific processing, the production effect should be observed when materials lend themselves to relational processing (e.g., natural categories) and not need to be a within-subjects manipulation. The current results support MacLeod et al.'s (2010) suggestion that distinctiveness underlies the production effect. Specifically, reading words aloud increases item-specific processing, a crucial component of distinctive processing. The current study is a strong step in directly testing and finding evidence for production increasing item-specific processing due to distinctiveness. Further research is underway to investigate the role a between-subjects design may play on distinctiveness and the production effect.

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Recall

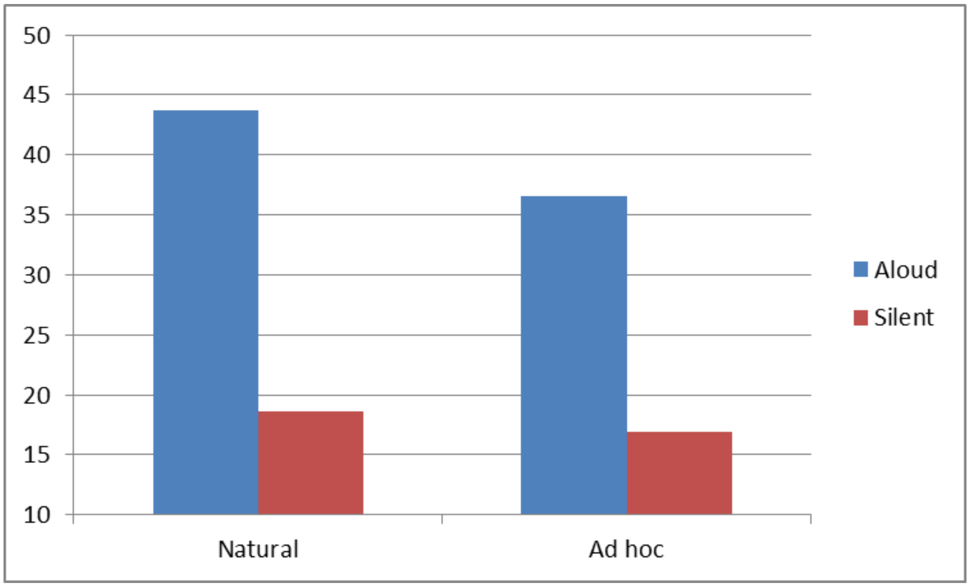

Figure 1. ANOVA p-values for list type on recall.

Recognition

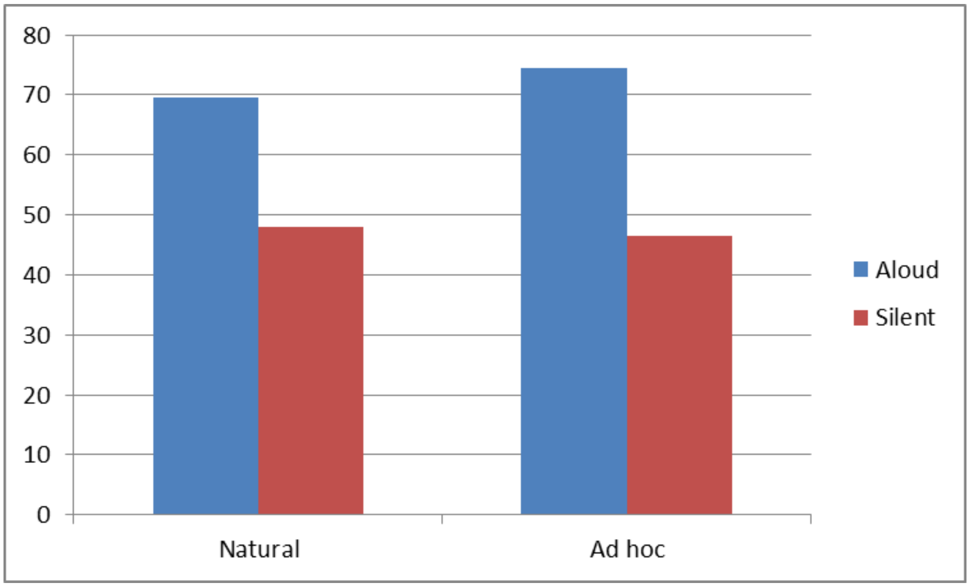

Figure 2: ANOVA p-values for list type on recognition.

Aloud Only

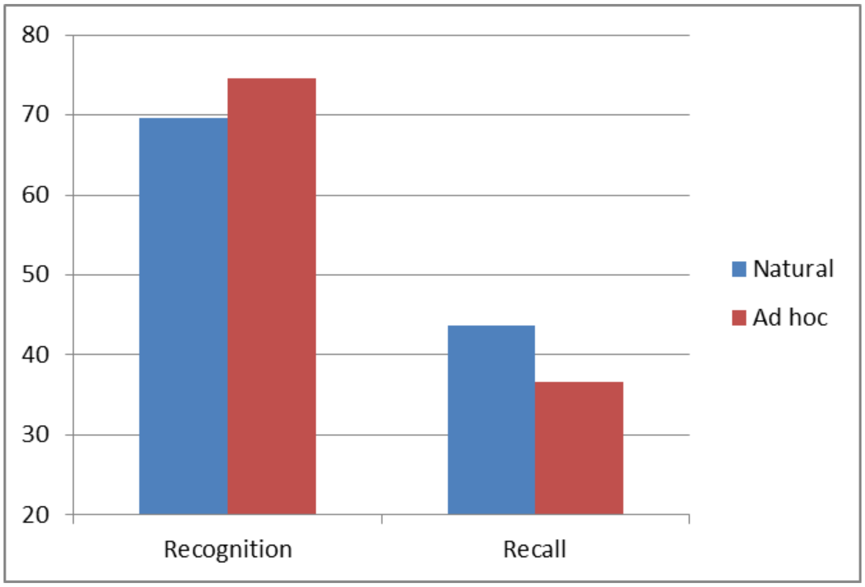

Figure 3: ANOVA p-values for “aloud only” conditions on recognition and recall.