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The Mnemonic Effect of Choice

Michelle E. Coverdale
Purdue University

THE MNEMONIC EFFECT OF CHOICE

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Michelle E. Coverdale

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STATEMENT OF COMMITTEE APPROVAL

Dr. James S. Nairne, Chair
Department of Psychological Sciences
Dr. Jeffrey D. Karpicke
Department of Psychological Sciences
Dr. Darryl S. Schneider
Department of Psychological Sciences

Approved by:
Dr. David Rollock
Head of the Graduate Program

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TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

Author: Coverdale, Michelle, E. MS
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Making choices during encoding leads to better memory than having the same choices made for you. Beyond a mnemonic benefit for choosing, our laboratory has shown a benefit for items that have been chosen over those that are not chosen. Though many experiments in the fields of memory and education involve a choice component, little consideration has been paid to how an item's status as chosen or unchosen affects memory. Prior research comparing memory for chosen and unchosen items has confounded choice and congruity, making the source of the recall benefit unclear. We conducted three experiments to dissociate choice and congruity effects. The first two experiments manipulated both choice and congruity and showed mnemonic benefits for chosen words over unchosen words and for congruent words over incongruent words, but these effects did not interact. In the third experiment, in which participants did not overtly interact with the word that they were selecting, we replicated the choice and congruity effects found in the first two experiments. We also compared recall for word-pairs that were given a "yes" response to those given a "no" response and found both a benefit for congruent words as well as for word-pairs that were given a "yes" response.

INTRODUCTION

Our daily lives are filled with choices. During a typical day, we decide what to buy, what route to take while traveling and what foods to consume. Students choose which topics to study, how long to spend working on an assignment, and what way to prepare for an upcoming exam. Choice plays a central role in our lives. It is important to consider how these decisions affect memory. The effects of choice on memory have implications for not only general memory theory but also for fields like education and consumer behavior.

When participants choose which words to study for a test they perform better than a control group who is assigned those same words to study (Hirano & Ukita, 2003; Monty & Perlmuter, 1975; Perlmuter, Monty, & Kimble, 1971; Takahashi, 1992, 2002; Toyota, 2015; Watanabe, 2001; Watanabe & Soraci, 2004). Monty and Perlmuter (1975) demonstrated that participants performed better in a delayed paired-associate learning task if they chose a stimulus (or response) from a list of alternatives, after reading each of the alternatives aloud, compared to when they read the alternatives aloud and studied the word chosen by the previous participant. This effect, which has been labeled the *self-choice effect*, has also been demonstrated using both recognition (Watanabe, 2001; Watanabe & Soraci, 2004) and free recall (Hirano & Ukita, 2003; Takahashi, 1992, 2002; Toyota, 2015).

One flaw in this yoked-control methodology is that the participant may select words that he or she finds more meaningful, familiar, or easier to remember. Because those words may not be as significant to the yoked partner there are item-selection concerns. Watanabe and Soraci (2004) addressed this problem by using a “constrained” choice encoding paradigm. Subjects saw a prompt (e.g. cloth made from sheep) with three response alternatives (e.g. cotton, wool, silk) and either had to choose and write the correct response (i.e., wool) or write down an experimenter circled correct choice. Even with the constrained choice procedure they found that, in a free recall task, more words from the “constrained” choice condition were recalled than words from the forced choice condition.

A choice benefit has also been found in a paradigm in which the stimuli were initially hidden and not revealed until after a choice had been made. In an experiment by Murty, DuBrow, and Davachi (2015), participants were presented with hiragana characters (Japanese writing symbols) that occluded the images of two objects. Below the left character was the letter “L” and below the right was the letter “R”. On half of the trials (choice trials) participants made a button press choosing which occluding character to reveal on the other half of the trials (fixed trials), the choice was made by the experimenter (the “L” or “R” was highlighted in red font). Pressing the button removed the occluding mask and revealed the object that the participant needed to remember. Though participants believed they were viewing only one of the two objects based on their (or the experimenter’s) selection, in reality, objects were presented in a randomly predetermined order that was not affected by which button (left or right) was pressed. Murty et al. found that participants had better recognition memory for objects that had been studied in the choice condition than those studied in the fixed condition. Even though the participants could not use any characteristics of the to-be-remembered items to decide, because the objects were occluded, they showed a mnemonic benefit for those they believed they had chosen.

The above-mentioned choice effects are similar to *self-directed learning* effects, in which participants exhibit better memory for information learned while controlling aspects of the learning episode such as presentation order or duration (Markant, DuBrow, Davachi, & Gureckis, 2014). Voss, Gonsalves, Federmeier, Tranel, and Cohen (2011) demonstrated a mnemonic benefit for self-directed study in a spatial exploration task. In an intentional memory task, participants viewed pictures of objects on a grid through a transparent "window" in a semi-transparent mask. During half the blocks participants controlled when and where the window moved (self-directed). During the other blocks, the window was moved by the experimental program based on the decisions of the prior participant (yoked). Participants showed better item recognition and spatial recall for objects encountered during the self-directed blocks than those during yoked blocks. Thus, controlling a study episode may improve recognition and recall for studied items. However, it was unclear whether the benefits arose from participants controlling aspects of the study event or other uncontrolled factors such as the amount of attention devoted to the objects.

In a replication and extension of Voss et al. (2011), Markant et al. (2014) performed a series of experiments with the goal of incrementally equating the self-directed and yoked groups to identify the source of the self-directed advantage. First, they equated attentional coordination by implementing a 600-millisecond delay before each window movement and by adding a black outline around the window's next position to act as an attentional cue. Next, they programmed the window to move in a snaking pattern so that participants in the self-directed group were no longer able to choose the order in which to view the objects; instead, they only controlled stimulus onset and presentation time. Finally, presentation time of each item was also fixed such that during the self-directed blocks participants were only able to control when each stimulus would be presented. In each of these experiments Markant and colleagues (2014) found that participants who were able to control some aspect of the study episode had better memory for the stimuli than their yoked partners. In short, they found that merely allowing participants to choose the onset timing of stimuli improved recognition memory.

These examples demonstrate that there is a mnemonic benefit associated with making a choice, even if that choice is merely when a stimulus will be presented. However, frequently when a choice is made it involves the selection of one alternative over another. What are the mnemonic effects of choice on the chosen and unchosen items? Many self-choice experiments have participants choose to-be-remembered items from a set of alternatives, yet memory for the chosen item is rarely compared to that of the unchosen alternatives. One reason is that these experiments typically employ intentional memory tasks. If participants are instructed to choose the to-be-remembered items and do not believe that they will need to remember the alternatives, then the comparison between chosen and not chosen items is confounded with factors such as motivation and expectation. These confounds can be eliminated by using an incidental memory task.

Recently, we observed a recall benefit for words chosen in an incidental memory task over those that were not chosen (Nairne, Coverdale, Cogdill, & Pandeirada, 2018). Participants in one condition were asked to imagine that they were moving to a new home in a foreign land and would need to locate and purchase a new house and transport their belongings. In another condition, participants were asked to imagine that they were stranded in the grasslands of a foreign land and would need to find food and water and protect themselves from predators in order to survive. Participants were then presented with pairs of objects (e.g., a drum and a pencil). For each pair, they were asked to select which one of the two objects would be more useful in the given scenario (survival or moving). After a 2-minute distractor task, participants were given a surprise free recall task. We found a survival processing benefit (cf. Nairne, Thompson, & Pandeirada, 2007)—that is, words that were processed for their usefulness to survival were better remembered than words that were processed for their usefulness to moving. We also found a benefit for chosen items; words that were chosen as more useful were better remembered than the words that were not chosen. The chosen-item benefit did not depend on whether the choice was made relative to the survival or the moving scenario. In other words, there were main effects of both condition (survival versus moving) and choice (chosen versus not chosen), but there was no interaction. These results indicate that items are more memorable if they are chosen rather than unchosen. The positive effect of choosing an item on memory is a potentially important effect that has not been systematically examined in previous work.

Ownership is another area of research that may be related to the effect of choice on memory. Participants better remember things that they own, even when ownership has been assigned to them by an experimenter (Cunningham, Turk, Macdonald, & Macrae, 2008; Englert & Wentura, 2016; Turk, van Bussel, Waiter, & Macrae, 2011; van den Bos, Cunningham, Conway, & Turk, 2010). For example, in work by Cunningham, Turk, Macdonald, and Macrae (2008), participants were told to imagine that they had won a basket of grocery items and took turns sorting, or watching a confederate partner sort, items into their basket or their partner’s basket based on a sticker that indicated who had won the item. There was no actual choice involved—the “stickers” simply identified the relevant basket—but one set of items was subjectively “owned” by the participant. In a surprise recognition test, people remembered more of the items that had been assigned to them as “property” than items that had been assigned to their partner. This finding is referred to as the *mere ownership effect*.

However, when choice is added to the typical mere ownership experiment, items that are chosen tend to be remembered better than items that are merely owned. In Cunningham, Brady-van den Bos and Turk (2011), participants were given pairs of grocery items and were required to choose one item for their own basket (owned) and to place the other into their partner’s basket (not owned). Participants took turns choosing which object of a pair would be placed in their basket and which would be assigned to their partner. Cunningham et al. (2011) found that in an old/new recognition task, participants had better recognition memory for objects that had been self-chosen to be owned rather than merely owned (i.e., when assigned as “owned” by the other participant); moreover, the “merely owned” items were not recognized significantly better than items in any of the other conditions.

A similar pattern of results was found by Cunningham et al. (2011) using an “illusory” choice paradigm, wherein two participants were each given a 50-number grid and asked to choose 25 of the numbers that they were told would correspond to the objects that they could keep; the other 25 corresponded to objects that would be given to the other participants. Thus, people were not asked to choose actual items; rather, they merely chose numbers that they believed corresponded to items. In reality, the items were assigned randomly and were not determined by the numbers that were selected by the participants. Following the number selection task, participants performed two computerized sorting tasks, one that they were told was based on their own decision and the other one based on their partner's decisions. They again found that participants recognized more of the objects that they believed they had selected to own compared to those that were owned or chosen by the other participant. Considering that the self-chosen items are not only owned, but also chosen during a choice condition (as opposed to the other-unchosen items that are essentially assigned to the participant), it is not surprising that they are the most memorable. These results suggest that choice is a powerful mnemonic variable.

What accounts for the mnemonic benefits associated with choice? One explanation for the benefit of chosen versus assigned words is that the perception of control improves cognitive processing generally, including memory (Findley & Cooper, 1983; Henry & Sniezek, 1993; Leotti, Iyengar, & Ochsner, 2010). This explanation can account for the mnemonic benefits found by Murty et. al (2015) and Markant et al. (2014) which are otherwise very difficult to explain. In both cases the only difference between the forced and choice conditions is one minor aspect of control. For Murty et al. subjects only controlled which occluding mask to remove and in Martkant et al.'s fourth experiment they only controlled when stimulus presentation would begin. Though this explanation can account for the benefits of self-choice and self-directed learning it cannot account for the mnemonic benefit of chosen over unchosen items because for both words the participant is able to make a selection. In other words, they have control over both which item to choose and which item not to choose.

From a general memory perspective, congruity may account for the benefit of chosen words over unchosen words. Craik and Tulving (1975) suggested that when stimuli form an integrated unit with the encoding context or question (congruent), they are better recalled than those that do not (incongruent). For example, Craik and Tulving found that when participants were asked to judge whether a word (e.g. “friend”) fit into a sentence (e.g. “The boy met a ____ on the street”), participants later remembered more of the words that they had given a “yes” response than words that they had given a “no” response. This effect, originally demonstrated by Schulman (1974), is referred to as *the congruity principle*. Though it was originally considered to be an effect of response type (i.e. a benefit for “yes” responses versus “no” responses), it has since been demonstrated that it is not the type of response that it crucial, but rather the compatibility of the item with the context (Marks, McFalls, & Hopkinson, 1992; Staresina, Gray, & Davachi, 2009). Staresina et al. (2009) presented participants with names of items (e.g. cheese) on color backgrounds and instructed them to imagine each item being the color presented. Prior to the presentation of each word-color pair, participants were prompted with either the question “plausible?” or “unusual?”. They then answered “yes” or “no” regarding the plausibility or unusualness or the word-color combination (e.g. cheese green). Combinations that were judged as being plausible (“yes”) and usual (“no” to the question “unusual?”) were considered congruent whereas word-color combinations that were implausible (“no”) and unusual (“yes”) were incongruent. An effect of congruency was found such that congruent combinations were better recalled than incongruent combinations, but there was no effect of response. Put differently, compatibility between the item and the context (color) improved recall regardless of whether the response was “yes” or “no”. Marks et al. (1992) found a similar effect using pictures of scenes and objects. They found that an image of an object that was consistent with a scene (e.g. scissors and a barber shop) was more memorable than an inconsistent object (e.g. a dress) during a cued recall task, regardless of the participant’s response to a prompt about whether the object fit (or did not fit) in the scene.

Congruity between the object and the scenario is one explanation of the benefit for chosen words over unchosen words; participants choose the word that is more congruent with the scenario and that congruity leads to better memory for those words. A similar interpretation of the self-choice effect was proposed by Toyota and Kobayashi (2009), who named this the integration hypothesis. They claimed that the key component in the self-choice effect was a clear “criterion” for choosing. If participants have a well-structured dimension along which to choose, their choices will be better integrated into existing cognitive structures and therefore more memorable (Toyota, 2015). When participants make choices along a dimension (e.g. usefulness to survival) a recall benefit for the chosen items may potentially be confounded by the congruity of the items.

The purpose of the present research was to better understand the chosen-item benefit. For example, it is important to separate choice from congruity to see if congruity explains some or all of the observed advantage for chosen items. Three experiments are reported that are designed to separate choice from congruity. The goal was to determine if the effect of choice is independent from or interacts with congruity by having participants choose in one instance the less congruent of two items and in the other the more congruent. If they are indeed separate effects, then it is important to know whether choosing improves memory for the chosen item or hinders memory for the unchosen item.

EXPERIMENT 1

Our first experiment was designed to disentangle congruity from choice. We used the “two-object” choice paradigm developed by Nairne et al. (2018) in which participants choose which of two objects is more useful within a given scenario. In previous experiments using this paradigm, the chosen words were remembered better but they were also more useful and presumably more congruent with the situation. Therefore, the mnemonic benefit from choosing a word may have been due merely to congruity. The goal of Experiment 1 was to determine whether choice, the item’s congruity with the scenario, or a combination of both lead to improved memory for an item. In order to disentangle these two factors (choice and congruity), the “two-object” choice task was modified such that in one condition participants choose which of two objects would be *more useful* in a survival situation (congruent) and in another condition, they choose which would be *less useful* (incongruent). With this design, we were able to look at the effect of choice (chosen versus not chosen) on memory at two levels of congruity (congruent versus incongruent).

If congruity is the controlling factor then we would expect the chosen items in the “more useful” condition and the not-chosen items in the “less useful” condition to be remembered well—both are more congruent with the scenario. On the other hand, if choice is important then we would expect chosen items to be remembered well regardless of condition—e.g., the chosen items in the “less useful” condition should be remembered better than the not-chosen items in the “more useful” condition. A main effect of congruity but not choice would suggest that the observed mnemonic benefit of choosing a word was due to a word’s fit with the situation, and not the act of choosing. A main effect of choice and no main effect of congruity would suggest that the act of choosing was responsible for the obtained memory benefit. Main effects of both congruity and choice with no interaction between the two would suggest that the observed choice effects were caused both by the act of choosing *and* the word's congruity independently of each other.

Method

Participants

Forty-eight Purdue University undergraduates (25 females, 23 males) were recruited from an introductory psychology class and participated in exchange for partial course credit. Only native English speakers were included in the analyses and participants were run in groups of one to four.

Materials

The experiment was completed on individual computers using the keyboard and mouse to respond. Each session lasted fewer than 30 minutes. Twenty-four two-object pairs (e.g. pencil and drum) were used. All forty-eight words were manipulable objects with familiarity, concreteness and imageability values above 450 based on normative data from the Medical Research Council (MRC) Psycholinguistic Database (Wilson, 1988). All participants saw the same pairs of words, which are shown in Appendix A.

Word-pairs were divided into four blocks of six pairs. Block order was held constant across all participants, such that each person saw the same set of six pairs in the first block regardless of the decision type (more useful or less useful). However, within each block presentation order of the pairs was randomized.

For half of the pairs participants chose the word that they thought would be more useful (M) in a survival situation and the other half the word that they thought would be less useful in a survival situation (L). Decision type alternated between blocks and was counterbalanced such that half of the participants made a "more useful" judgement first and the other half made a "less useful" judgement first (i.e. half did MLML and half did LMLM). The choice task was followed by a 2-minute even/odd parity task. After the 2-minute distractor task, participants were given a 5-minute surprise free recall task. Except for the counterbalancing of the decision type across the block and ordering of the pairs within each block, all other variables were held constant across participants.

Procedure

At the start of the experiment, participants were told that they would be performing a series of tasks on the computer. Before each block of choices and before each task, instructions were presented. For both types of decisions (more/less useful), participants made their choices about the same survival situation. The survival situation, and instructions for the two types of decisions, were as follows:

> *Survival Situation* "We would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators."
>
> *More Useful* "We are going to show you pairs of words, representing objects, and we would like you to decide which of the two objects would be MORE useful to you in the survival situation."
>
> *Less Useful* "We are going to show you pairs of words, representing objects, and we would like you to decide which of the two objects would be LESS useful to you in the survival situation."

Before the first block of both decision tasks (more/less useful), participants performed two practice trials. These trials were excluded from all analyses. Each pair of objects was accompanied by the prompt “Which is MORE (or LESS) useful in the survival situation?”. Participants had 5 seconds per pair of objects to decide. Participants made their choices by clicking, with the mouse, on the word that they wished to select. In total, participants made 24 decisions, 12 for each type (more/less useful).

The encoding task was followed by a 2-minute distractor task. During this task participants saw a single digit number on the screen for 2 seconds and made a parity judgment by clicking on either the word “even” or “odd” presented below the number. Following the distractor task, participants were given a 5-minute surprise free recall task. Participants were asked to recall the names of all the objects that were encountered during the experiment, regardless of whether the item had been chosen or not. The recall instructions were as follows:

> *Recall Instructions* “During this experiment, you were asked to make choices about pairs of objects.
>
> Now, we would like to see if you can remember all of the objects that you made decisions about throughout this experiment. Try to remember all of the objects regardless of the choices you made.
>
> Type the objects that you saw in any order you like. You do not have to remember them in pairs or based on the type of decision you made about them. We just want you to remember as many individual objects as you can.”

Participants typed the names of the objects that they recalled into a text-box which was visible on the screen for the entire duration of the recall task.

Results and Discussion

For all analyses, we set alpha = .05 (two-tailed), unless otherwise noted. For the purpose of these comparisons we considered words that were chosen in the "more useful" condition and not chosen in the "less useful" condition to be "congruent". Words that were not chosen in the "more useful" condition or chosen in the "less useful" condition were considered to be "incongruent". Therefore, we had four categories of words: chosen, congruent; not chosen, congruent; chosen, incongruent; not chosen, incongruent.

The results of main interest are shown in Figure 1. Consistent with previous experiments, participants recalled a greater proportion of chosen objects (*M* = .46, *SD* = .12) than not chosen objects (*M* = .39, *SD* = .13). Using a repeated measure analysis of variance (ANOVA) we found both a main effect of choice ($F(1, 47) = 10.35$, $p < .01$, $MSE = .02$, $\eta^2 = .18$) and a main effect of congruity ($F(1, 47) = 25.41$, $p < .001$, $MSE = .03$, $\eta^2 = .35$) but no interaction between choice and congruity, $F(1, 47) = .65$, $p = .43$, $MSE = .02$, $\eta^2 = .01$. In other words, objects that were chosen were more memorable than objects that were not chosen, and objects that were congruent with the survival situation were more memorable than incongruent objects. The effect of choice on recall was the same for both congruent and incongruent words.

As a manipulation check we compared the proportion of times a word was chosen in the "more useful" condition to the proportion of times that same word was not chosen in the "less useful" condition and found that the two were highly correlated ($r = .92$ $p < .001$). Put simply, if participants chose an object in the "more useful" condition, then that

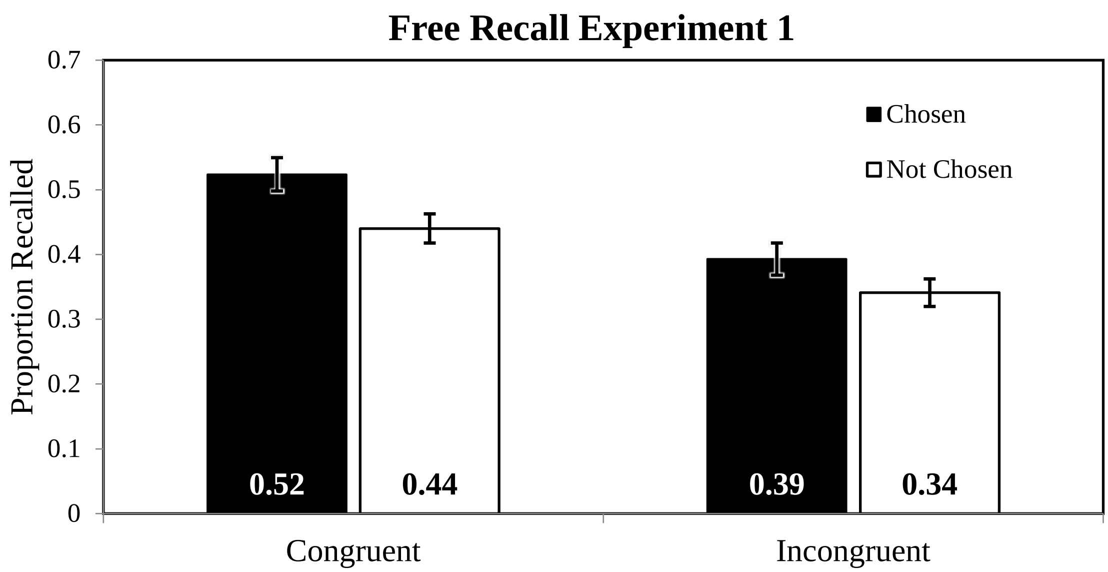

Figure 1. Free recall performance by choice and congruity. Congruent-Chosen is the proportion recall for words chosen in the "more useful" condition. Congruent-Not Chosen is the proportion of recall for words not chosen in the "less useful" condition. Incongruent-Chosen is the proportion recall for words chosen in the "less useful" condition. Incongruent-Not Chosen is the proportion of recall for words not chosen in the "more useful" condition. Error bars represent the standard error of the mean.

same object was very likely not to be chosen in the “less useful” condition. This suggests that participants were analyzing the items in the same way across the two instruction conditions—e.g., they were making a relative usefulness judgment and then deciding which item to choose based on the instructions. In other words, the “congruent” words comprised one set of words and the “incongruent” another.

Response times, the time in seconds from the stimulus onset to the first mouse click, for the “more” and the “less” task were also compared. Participants were significantly faster to make a choice in the “more” task (M = 2.73 s, SD = .37) than in the “less” task (M = 2.94 s, SD = .43), $t(47) = 3.70$, $p < .001$. Response time can be used as an indicator of task difficulty – that is, participants will take longer to respond when they are doing a more difficult task. This suggests that it may have been more difficult for participants to do the “less” task than to do the “more” task. However, we found no recall differences between the “more” task (M = .43, SD = .12) and the “less” task (M = .42, SD = .12), $t(47) = .75$, $p > .1$, suggesting that the response time differences cannot account for the observed pattern of results.

In sum, we found that congruity and choice both benefit recall but do not interact. This suggests that the choice effect found in previous experiments, was due only partially to congruity effects. In other words, something beyond congruity increases chosen items’ memorability.

EXPERIMENT 2

As noted above there was a strong correlation ($r = .92$, $p < .001$) between the words chosen in the “more useful” condition and those not chosen in the “less useful” condition. This pattern indicates that the main effect of choice was not an artifact of item selection, because the same words were being compared for both the chosen and not chosen conditions. However, a main effect of congruity could potentially be the result of item-selection – the set of words that were deemed as more useful was a more memorable set of words than the less useful words but not necessarily because of their congruity. In order to rule out item-selection as an explanation of the main effect of congruity in Experiment 2 we manipulated the congruity for each word.

This experiment was designed to fix the item-selection problem and replicate the choice effect from Experiment 1. As before, participants saw pairs of words and selected one of the words based on a provided prompt. However, rather than seeing a prompt regarding the usefulness of each object to survival, each pair of words was accompanied by a category description that applied to only one of the two words. For example, a participant might see the words “golf” and “boot” accompanied by the category “a sport” and they would need to choose the word that is either *more* representative of the category (golf) or *less* representative of the category (boot). Crucially, we manipulated the category prompt between subjects such that half of the participants saw prompts that were congruent with one set of words while the other half of participants saw prompts that were congruent with the other set of words; in this way, each word participated as both a congruent and an incongruent item across participants.

Method

Participants

We performed a statistical power analysis to estimate sample size for this experiment based on the choice effect found in Experiment 1, f(U) = .0.47. Using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) the estimated sample size for 2 groups (congruent and incongruent) with 2 measurements (chosen and not chosen) with alpha = .05 and power = .95 is *N* = 64[1].

Sixty-four Purdue University undergraduates (26 males, 38 females) participated in exchange for partial course credit. As described in Experiment 1, participants were run in groups of one to four in sessions lasting fewer than 30 minutes, and only native-English speaking participants were included in the analyses.

Materials

Forty word and category stimuli were selected from the Van Overschelde, Rawson, and Dunlosky category norms (2004; see Appendix B). The 40 words were paired together into 20 word-pairs that were presented in blocks of five. Decision criteria (more representative or less representative) alternated between blocks and was counterbalanced between subjects such that half of the participants selected the more representative word (M) first and the other half selected the less representative word (L) first (MLML and LMLM respectively). Each word-pair had two category descriptions, one congruent and one incongruent, for each word (see Appendix B). Half of the descriptions were presented in one version (A) and the other half were presented in the other version (B), such that each word was congruent in one version while it was incongruent in the other. Version (A or B) was also counterbalanced between subjects, resulting in four counterbalance conditions that each had 16 subjects. The length of the category description (measured in number of characters) was matched between the two versions. The set of words that were congruent in version A did not differ significantly from those in version B in their average word length, familiarity, concreteness, or imageability (Wilson, 1988). Importantly, the words in the two versions were also matched for their category representativeness, as measured for each word by the average number of subjects in Van Overschelde et al. (2004) who responded with that word when given the category as a cue. As in Experiment 1, the set of word-pairs in each block was held constant across participants but presentation order within blocks was randomized. All other materials were as described in Experiment 1.

Procedure

On arrival participants were seated at individual computers and verbally instructed that they would be performing a series of tasks on the computer. Instructions were presented on the computer screen before each task, and before each of the four blocks of the choice task. The instructions for the two types of choice task were as follows:

> *More Representative*: “In this task, we are going to show you pairs of words along with a description of a category. For each pair of words, we would like you to choose the word that is MORE representative of the category. You will make your choice by using the mouse to click on the word you choose to select.”
>
> *Less Representative*: “In this task, we are going to show you pairs of words along with a description of a category. For each pair of words,

> we would like you to choose the word that is LESS representative of the category. You will make your choice by using the mouse to click on the word you choose to select."

Participants performed two practice trials before the first block of each of the two decision tasks (more/less) for a total of 4 practice trials overall. These trials were excluded from all analyses. For each pair of words, the prompt "Which is MORE (or LESS) representative of the category?" appeared at the top of the screen, and below the prompt was the category. Under the category label were the two target words. Participants made choices by using the mouse to click the word that they wished to select. In total, participants made 20 decisions, 10 for each decision type (more/less representative).

The distractor task was identical to the one described in Experiment 1. For the recall test, participants were asked to recall the names of all the objects that they made decisions about during the experiment, regardless of whether the item had been chosen or not. They were also instructed that they did not need to remember the category that the words were presented with, only the individual words. Each participant was given 5 minutes to recall as many words as possible.

Results and Discussion

The goal of this experiment was to replicate Experiment 1 while also fixing the item-selection problem. We predicted that we would find the same pattern of results as in the prior experiment such that congruent words would be more memorable than incongruent words and chosen words would be more memorable than not chosen words.

We also anticipated that these two effects (choice and congruity) would not interact with one another.

The main results of interest are shown in Figure 2. We used a repeated measure analysis of variance (ANOVA) to compare the four categories of words: chosen, congruent; not chosen, congruent; chosen, incongruent; not chosen, incongruent. We replicated the effects found in Experiment 1. There was both a main effect of choice ($F(1, 63) = 8.34$, $p < .01$, $MSE = .01$, $\eta^2 = .12$) and a main effect of congruity ($F(1, 63) = 83.51$, $p < .001$, $MSE = .01$, $\eta^2 = .57$) but no interaction between choice and congruity ($F(1,63) = .26$, $p = .61$, $MSE = .03$, $\eta^2 = .004$). Words that were chosen were more memorable than those that were not chosen, and words that were congruent with the presented category were more memorable than words that were incongruent with the presented category. The effect of congruity on recall did not vary based on whether the word had been chosen or not.

As in Experiment 1, participants were faster to respond in the "more" task ($M = 2.14$ s, $SD = .44$) than in the "less" task ($M = 2.26$ s, $SD = .52$), $t(63) = 2.58$, $p < .05$. The response time differences between the two tasks did not lead to recall differences between the words processed in the "more" task ($M = .19$, $SD = .11$) and "less" task ($M = .20$, *S*D = .12), $t(63) = .51$, $p > .1$.

One might notice that the recall levels are much lower for this experiment than they were for Experiment 1 despite the fact that fewer words were presented. There are several reasons why this may be the case. Experiment 1 used survival processing for the encoding task. Survival processing is a powerful encoding technique which is known to lead to better memory than most other deep processing tasks (Nairne, Pandierada, &

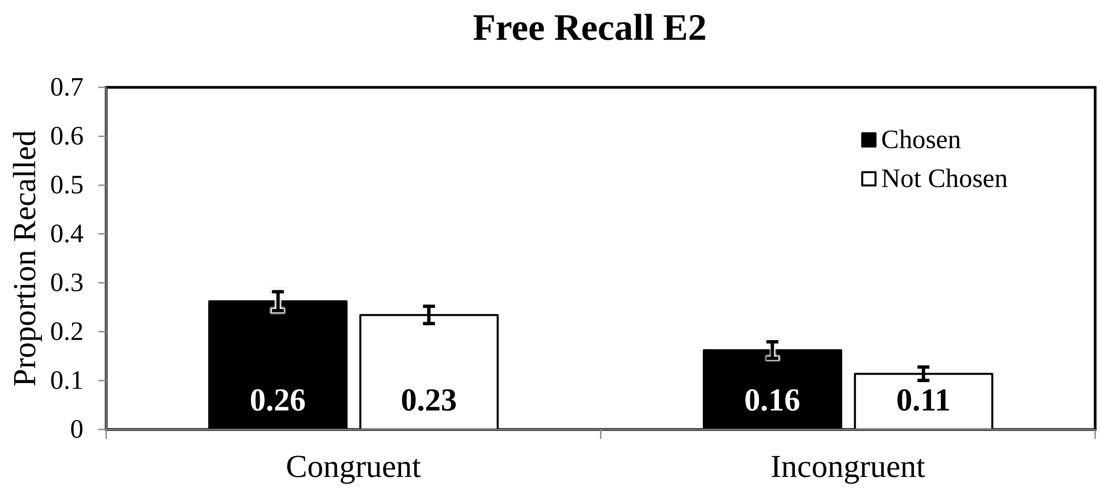

Figure 2. Free recall performance by choice and congruity. Congruent-Chosen is the proportion recall for words chosen in the “more representative” condition. Congruent-Not Chosen is the proportion of recall for words not chosen in the “less representative” condition. Incongruent-Chosen is the proportion recall for words chosen in the “less representative” condition. Incongruent-Not Chosen is the proportion of recall for words not chosen in the “more representative” condition. Error bars represent the standard error of the mean.

Thompson, 2008). The lower recall in this experiment may also be due in part to the stimuli used in this experiment. In Experiment 1 all stimuli were the names of concrete objects that had familiarity (*M* = 557.40), concreteness (*M* = 594.48) and imageability (*M* = 589.46) values above 450. In the present experiment, though many of the stimuli were objects, some were abstract concepts (e.g. week) and they had lower average familiarity (*M* = 538.95), concreteness (*M* = 571.38) and imageability (*M* = 564.88) values than the words used in Experiment 1. An additional factor that may have contributed to the low recall levels observed in this experiment is that unlike in Experiment 1, in which participants encoded all words relative to a common dimension (their usefulness to survival), participants had no sematic dimension along which to relate all the words. Not having a common dimension along which to encode the words may have made it more difficult to recall the words because the encoding dimension could not be used as a cue for recall. However, despite the low recall levels in this experiment, we still found the same pattern of effect that we observed in Experiment 1.

A programming error, which resulted in the correct answer appearing 12 times on one side of the screen and only 8 times on the other, was found after the data for this experiment were collected. This meant that half of the participants saw more correct words on the left side of the computer screen and the other half of participants saw more correct words on the right side of the computer screen. Collapsing across participants, the correct answer appeared the same number of times on both sides of the screen. Although we have no theoretical reason to anticipate that this confound should affect either the main effect of choice or the main effect of congruity, we performed an additional repeated measures ANOVA and included which side had more correct answers ("side") as a between-subjects factor.

We found no significant effect of side on recall ($F(1, 62) = 2.83$, $p = .10$, $MSE = .028$, $\eta^2 = .04$) such that participants recalled an equal number of words when they saw more correct answers on the right side of the screen than on the left side of the screen. There was also no interaction between the effect of choice and side ($F(1, 62) = .28$, $p > .10$, $MSE = .01$, $\eta^2 = .004$), or the effect of congruity and side ($F(1, 62) = 3.17$, $p > .05$, $MSE = .009$, $\eta^2 = .05$) such that the effects of choice and congruity were the same for participants who saw more correct answers on the right and those who saw more correct answers on the left. There was also no 3-way interaction between choice, congruity and side ($F(1, 62) = .45$, $p > .10$, $MSE = .03$, $\eta^2 = .007$). With side included as factor in the ANOVA there was still a main effect of choice ($F(1, 62) = 8.24$, $p < .01$, MSE $= .01$, $\eta^2 = .12$) and a main effect of congruity ($F(1, 62) = 86.38$, $p < .001$, $MSE = .009$, $\eta^2 = .58$) with no interaction between choice and congruity ($F(1, 62) = .26$, $p > .10$, $MSE = .03$, $\eta^2 = .004$). These results indicate that having more correct answers appear on one side of the screen did not change the effects of choice or congruity or their interaction. As such, the factor of side does not change our interpretation of the results.

An important feature of this experiment is that we manipulated both the congruity and level of choice (chosen/not chosen) for each word by making one word of each pair objectively the correct answer. Participants were highly accurate when making their choice. The correct response was made 99% of the time ($SD = .03$). This means that when we compare conditions, we are comparing recall of virtually the same words under four different conditions. This experiment eliminates any item-selection concerns.

Overall, this experiment provides additional evidence that the choice effects found in Nairne et al. (2018) and Experiment 1 were not exclusively due to congruity effects. This is also evidence that there is something other than congruity that improves memory for chosen items.

EXPERIMENT 3

If chosen items are indeed more memorable than unchosen items, as Experiments 1 and 2 suggest, what accounts for this advantage? One possibility is that when words are selected memory for those words is improved. Alternatively, it may be that not choosing (i.e., rejecting) inhibits recall for unchosen words. An alternative explanation is that what appears to be a choice effect is really an artifact of the way participants perform the choice task – that is, when a participant uses the mouse to select a word they spend more time looking at that word (because they are coordinating their mouse movement in that direction) which leads to the observed mnemonic benefit.

For our third experiment, we wanted to explore these possible explanations for the chosen-item benefit. This experiment had two goals. One goal was to see if a choice effect would still be obtained without having participants click directly on the word. The other was to examine whether being chosen increases an item's memorability, and/or if being unchosen decreases its memorability relative to a baseline condition.

To accomplish these goals, we made two changes to Experiment 2. First, we altered the choice task such that participants no longer clicked on the word that they wished to select, instead they clicked on either the word "left" or "right" to make their selection. Second, we included a new yes/no task to act as a baseline comparison. This new task involved the participant responding by clicking either "yes" or "no" to answer a question (e.g. "Is *golf* MORE representative of the category than *boot*") about which of the two words is more (or less) representative of the category (e.g. a sport). This task was adopted because we needed a baseline condition that required participants to make the same type of judgement about the object as in the two-object choice condition without selecting one of the words over the other. By making this comparison we hoped to identify the source of the choice effect. That is, we wanted to see whether it was an enhancement for the chosen words or a detriment for the not chosen words that led to the differences in the two conditions.

Method

Participants

We performed a statistical power analysis to estimate sample size for this experiment based on the choice effect found in Experiment 2, f(U) = .0.37. The estimated sample size for 4 groups (chosen, not chosen, yes and no) and 2 measurements (congruent and incongruent) with alpha = .05 and power = .95 is N = 104.

One-hundred and four (43 males, 61 females) Purdue University undergraduate students, who were native English-speakers, participated in exchange for partial course credit in an introductory psychology class. As in the prior two experiments, groups of one to four people were run in sessions lasting fewer than 30 minutes.

Materials

The stimuli used in this experiment were the same as those were used in Experiment 2. Task type (yes/no and left/right) was manipulated between subjects such that half of the participants did the two-object choice task and the other half made yes/no judgements. The choice task was the same as it had been in Experiment 2 except that participants were asked to click on the word "left" or "right," which appeared below the target words, to make their choices.

The yes/no task was very similar to the choice task except that instead of seeing the more/less prompt, the category, and a word pair, participants saw the category and a question asking if one word was more/less representative of the category than the other (e.g. “Is golf MORE representative of the category than boot”). Participants responded by clicking either the word “yes” or “no” to make their decision. All other aspects of the materials were the same as those reported in Experiment 2.

Procedure

Participants received instructions at the start of the experiment, and before each block and task. The instructions for the four tasks (yes/no-more; yes/no-less; left/right-more; left/right-less) are as follows:

> *Left/right-More*: “In this task, we are going to show you pairs of words in bold along with a description of a category. For each pair of bolded words, we would like you to choose the word that is MORE representative of the category. You will make your choice by using the mouse to click on either the word “Left” or “Right” to indicate which word you wish to select.”
>
> *Left/right-Less*: “In this task, we are going to show you pairs of words in bold along with a description of a category. For each pair of bolded words, we would like you to choose the word that is LESS representative of the category. You will make your choice by using the mouse to click on either the word “Left” or “Right” to indicate which word you wish to select.”
>
> *Yes/No-More*: “In this task, we are going to show a series of categories and questions with two words in bold. Each question will ask if one of the bolded words is MORE representative of the category than the

other. We would like you to choose the correct answer to the question, either "yes" or "no". You will make your choice by using the mouse to click on the answer you wish to select.

Yes/No-Less: “In this task, we are going to show a series of categories and questions with two words in bold. Each question will ask if one of the bolded words is LESS representative of the category than the other. We would like you to choose the correct answer to the question, either "yes" or "no". You will make your choice by using the mouse to click on the answer you wish to select.”

As with the prior two experiments, after the encoding task participants completed 2 minutes of an even/odd distractor task and spent 5 minutes recalling as many words as possible.

Results and Discussion

This experiment had two goals: First, to rule out the action of clicking on the word as an explanation for the chosen item effect and second, to compare chosen and not chosen items against a yes/no baseline. With respect to this first goal, we altered the choice task such that participants clicked on the words “left” and “right” as opposed to clicking directly on the word that they were choosing. We found that the choice effect remained even when participants did not click on the word that they were choosing to make their selections.

The recall data for the choice conditions are shown in Figure 3. For the two-object choice task, we replicated the findings of Experiment 2 such that participants remembered more words that they had chosen than words that they had not chosen (*F*(1,

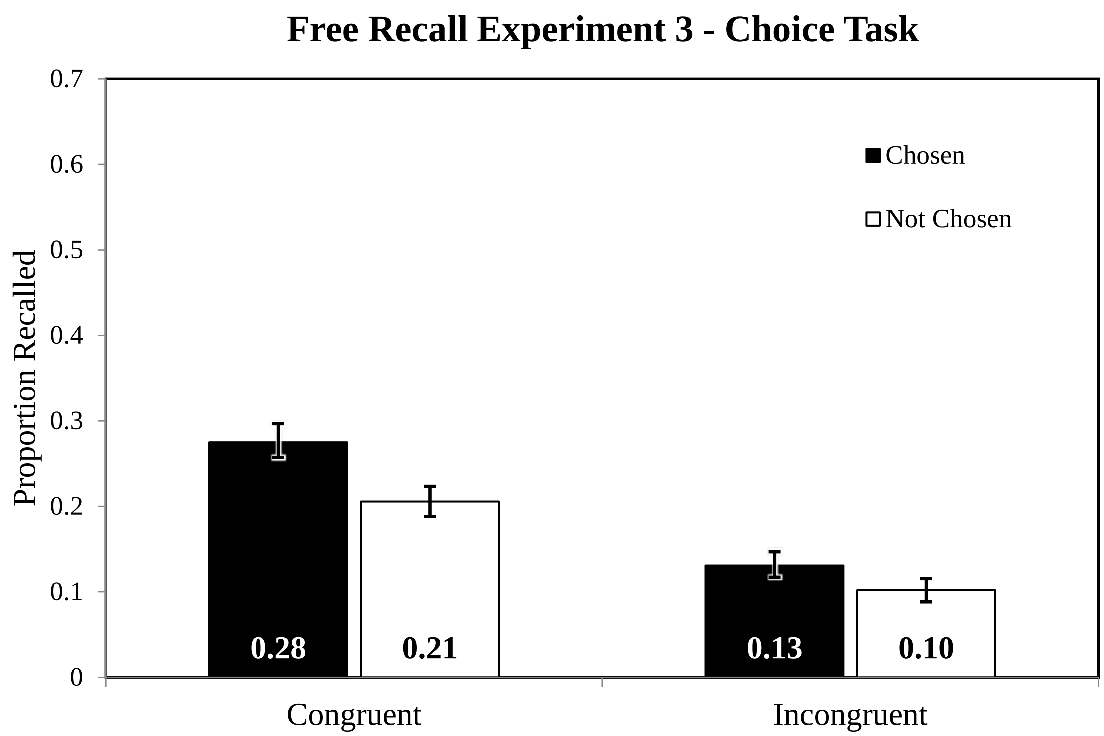

Figure 3. Free recall performance by choice and congruity. Congruent-Chosen is the proportion recall for words chosen in the “more representative” condition. Congruent-Not Chosen is the proportion of recall for words not chosen in the “less representative” condition. Incongruent-Chosen is the proportion recall for words chosen in the “less representative” condition. Incongruent-Not Chosen is the proportion of recall for words not chosen in the “more representative” condition. Error bars represent the standard error of the mean.

51) = 15.24, $p < .001$, *MSE* = .01, $\eta^2 = .23$), and they remembered more category-congruent words than category-incongruent words ($F(1, 51) = 89.81$, $p < .001$, *MSE* = .01, $\eta^2 = .64$), but these two effects did not interact ($F(1, 51) = .91$, $p > .10$, *MSE* = .03, $\eta^2 = .02$). As in Experiments 1 and 2, participants took significantly longer to make their decisions in the "less" task (*M* = 2.34 s, *SD* = .50) than they did in the "more" task(*M* = 2.13 s, *SD* = .47), $t(51) = 3.76$, $p < .001$, but there were no recall differences between the "more" (*M* = .19, *SD* = .11) and "less" (*M* = .17, *SD* = .11) conditions $t(51) = .92$, $p > .10$. This experiment provides evidence that neither the congruity effect nor the choice effect is dependent on participants clicking on the target words to make their choices. This suggests that the choice effect is not merely an artifact of participants physically clicking on the word that they are selecting.

As in Experiment 2, half of the participants saw more correct answers on the left side of the screen (and thus clicked on the word "left" more often) and the other half saw more correct answers on the right side of the screen (and thus clicked on the word "right" more often). Despite the confound, however, the observed pattern of effects remained the same when side was included in the ANOVA as a between-subjects factor – that is, there were main effects of choice ($F(1, 50) = 15.00$, $p < .001$, *MS*E = .01, $\eta^2 = .23$) and congruity ($F(1, 50) = 91.23$, $p < .001$, *MSE* = .01, $\eta^2 = .65$) but no interaction between choice and congruity ($F(1, 50) = .89$, $p > .01$, *MSE* = .03, $\eta^2 = .02$). There was also no main effect of side ($F(1, 50) = .04$, $p > .10$, *MSE* = .02, $\eta^2 = .001$), such that participants who clicked "left" more often did not recall more words than those who clicked "right" more often. Side did not interact with either the main effect of choice ($F(1, 50) = .20$, $p > .10$, *MSE* = .01, $\eta^2 = .004$) or the main effect of congruity ($F(1, 50) = 1.80$, $p > .10$, *MSE*

= .01, η^2 = .04), nor did it form a 3-way interaction with choice and congruity ($F(1, 50)$ = .18, $p > .10$, MSE = .03, η^2 = .002). In other words, there was no effect of having more correct answers appear on one side of the screen on the pattern of results.

The second goal of this experiment was to compare recall of chosen and not chosen items to recall of items that were neither chosen nor unchosen. To do this we had half of the participants perform a yes/no judgment task in which they responded “yes” or “no” to questions about which of two words was more or less representative of a category. Though congruity effects were originally conceptualized as a mnemonic benefit for yes responses over no responses, both Staresina et al. (2009) and Marks et al. (1992) found an effect of contextual congruity and no effect of response (yes/no) in paradigms designed to manipulate both response and congruity. In other words, they found mnemonic benefits for congruent items over incongruent items but no difference between “yes” and “no” responses.

Based on those findings we did not predict a recall difference between response types. That is, we did not anticipate that pairs of words would be recalled better if the question asked about them was given a “yes” response. However, we found a marginally significant mnemonic benefit for word-pairs (i.e. both the congruent and incongruent words) that received a “yes” response (M = .21, SD= .12), over those that received a “no” response (M = .17, SD = .10). Items that were part of “true” questions (“Is golf is more representative of the category [a sport] than boot”) were recalled better than items that were part of “false” questions (“Is golf less representative of the category [a sport] than boot”). Furthermore, when we compared the effects of response and congruity using a repeated measures ANOVA we found a main effect of congruity ($F(1, 51)$ = 64.12, p <

.001, *MSE* = .02, η^2 = .56), such that words that were members of the presented category were more memorable than words that were not members of the presented category, and a marginal effect of response type ($F(1, 51) = 4.00$, $p = .05$, *MSE* = .02, η^2 = .07), such that words that were given a yes response were more memorable than those that were given a no response. We found no interaction between response and congruity ($F(1, 51) = .61$, $p > .10$, *MSE* = .02, η^2 = .01) such that the effect of response on recall did not change between the two levels of congruity (congruent/incongruent). This pattern of results is similar to what was found in the choice task with the primary difference being that in the choice task, one word of the pair benefits from being selected, whereas in the yes/no task, both words in a pair benefit from receiving a yes response. Put differently, the effect of choice benefits an item whereas the effect of response benefits a pair of items.

An additional similarity between the yes/no task performance and the choice task is that response times were shorter for the “more” task (*M* = 3.21 s, *SD* = .60) than for the “less” task (*M* = 3.62 s, *SD* = .76), $t(51) = 5.35$, $p < .001$. As in the choice task, this response time difference did not yield recall differences between the “more” (*M* = .19, *SD* = .11) and the “less” (*M* = .18, *SD* = .09) tasks, $t(51) = .33$, $p > .10$. It is also worth noting that response times were significantly slower for the yes/no task (*M* = 3.4 s, *SD* = .62) than they were for the choice task (*M* = 2.23 s, *SD* = .44), ($t(102) = 11.17$, $p < .001$) suggesting that the choice task may have been an easier task than the yes/no task. However, once again this difference did not lead to recall differences between the yes/no task (*M* = .18, *SD* = .08) and the choice task (*M* = .18, *SD* = .07), $t(102) = .36$, $p > .10$.

The observed benefit for “yes” over “no” suggests that we were not successful at creating a baseline condition to compare the choice effect against. In fact, it is worth

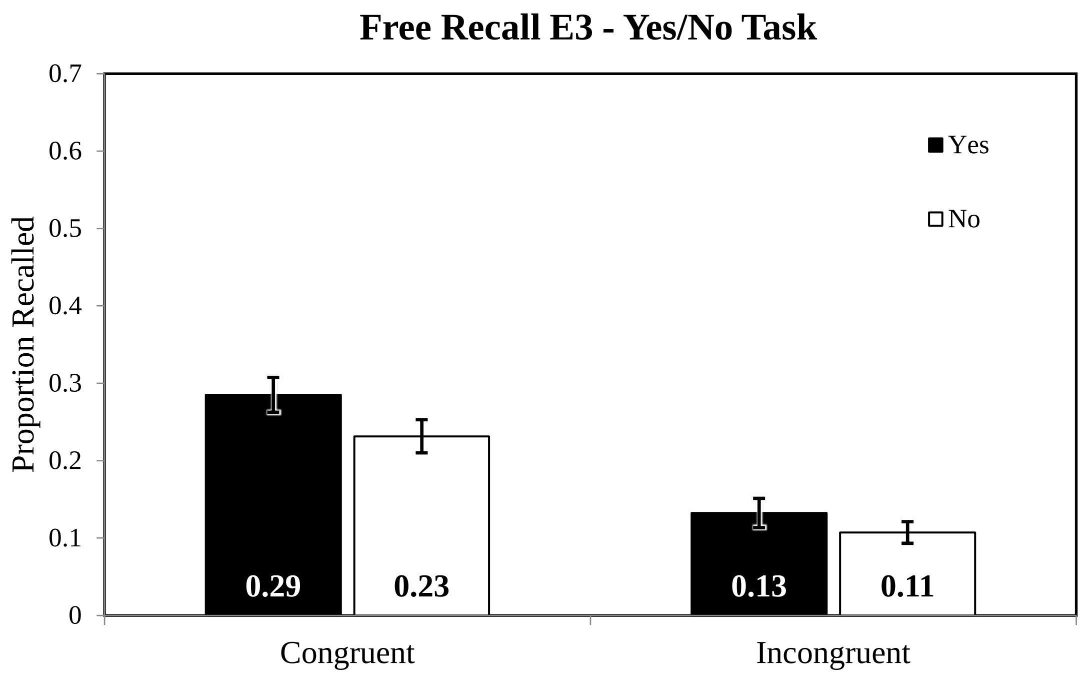

Figure 4. Free recall performance by response and congruity. Congruent-Yes is the proportion recall for words that were given a “yes” response when they were presented with a congruent category. Congruent-No is the proportion of recall for words that were given a “no” response when they were presented with a congruent category. Incongruent-Yes is the proportion recall for words that were given a “yes” response when they were presented with an incongruent category. Incongruent-No is the proportion of recall for words that were given a “no” response when they were presented with an incongruent category. Error bars represent the standard error of the mean.

considering the similarity of these two effects and the possibility that they might be different manifestations of the same effect. It may be that the act of endorsing an item, either by choosing it or by giving it a “yes” response, enhances the recallability of that item. Whether or not a “yes” over “no” benefit can be considered a type of choice effect is beyond the scope of these experiments, however, it merits further investigation. Unfortunately, because recall differed in the yes and no conditions we were unable to use the yes/no task as an intended baseline condition for comparison.

An additional factor that makes the results of this experiment difficult to interpret is that due to the same programing error that was present in Experiment 2, half of the participants made more “yes” responses than “no” responses and the other half made more “no” responses than “yes” responses. Though this error did not impact the results of either the choice task in Experiment 2 or the choice task in the current experiment, it did have a significant impact on the results of the yes/no task. Specifically, we found a significant interaction between the effect of response (yes/no) on recall and which response had been selected more times ($F(1, 50) = 6.14$, $p < .03$, $MSE = .02$, $\eta^2 = .11$) such that participants who made more “yes” responses showed a larger benefit for “yes” responses over “no” responses in recall than those who made more “no” responses. However, there was not a significant overall difference in recall between participants who made more “yes” responses and participants who made more “no” responses ($F(1, 50) = .33$, $p > .10$, $MSE = .03$, $\eta^2 = .007$) and number of “yes” responses did not interact with either the main effect of congruity ($F(1, 50) = .23$, $p > .10$, $MSE = .02$, $\eta^2 = .005$) or the interaction between response and congruity ($F(1, 50) = 1.36$, $p > .10$, $MSE = .02$, $\eta^2 = .03$).

Considering that participants made more of one type of response than the other, which interacted with the effect of response on recall, it is difficult to interpret the recall results from the yes/no task. For this reason, in addition to the fact that we were not successful at creating a baseline condition, we did not compare recall for the two tasks (left/right and yes/no) as we had initially planned. This means that although we replicated the chosen item benefit that we had shown in Experiments 1 and 2, we were unable to determine if this benefit is due to a memory enhancement for chosen items or a memory detriment for not chosen items. Nonetheless, we successfully demonstrated that the chosen item benefit holds even when participants click on the words “left” and “right” to make choices.

GENERAL DISCUSSION

We designed three experiments to dissociate the congruity effect from the mnemonic benefit for chosen items. Nairne et al. (2018) showed in two experiments that participants remembered more words that had been chosen as being more useful to a given situation than unchosen alternatives, suggesting that there may be a mnemonic benefit for chosen words over unchosen. However, in those experiments choice was confounded with congruity – that is, the words that were chosen were also more congruent with the situation. For that reason, it was unclear whether there was a benefit for chosen words over unchosen words, or merely a benefit for congruent words over incongruent words. In the current experiments, we disentangled choice and congruity effects by having participants make half of their choices based on which word was more congruent and the other half of their choices based on which word was less congruent.

We found in three experiments that not only did participants have better memory for congruent words than incongruent words, but they also had better memory for chosen words than for unchosen words. Furthermore, these effects did not interact– that is, the size of the choice effect did not depend on the level of congruity between the word and the encoding situation/category. These results suggest that something other than congruity is responsible for the chosen-item mnemonic benefit.

We also found that the chosen item benefit did not depend on participants physically interacting with the word while making their selections. In the third experiment, we replicated the pattern of effects found in Experiments 1 and 2 but crucially, participants did not click on the chosen word to make their decisions, instead they clicked on the words “left” or “right” to choose which of the two words they wanted to select. This indicates that the choice benefit found in Experiments 1 and 2 was not an artifact of increased attention induced by having participants choose the word by clicking on it with the computer mouse.

In Experiment 3 another goal was to compare recall of chosen and unchosen words to a baseline condition. The purpose of this comparison was to see if the mnemonic difference between chosen and unchosen items was due to a memory enhancement for the chosen items or due to memory impairment for the unchosen items. Unfortunately, we were unable to compare these two conditions because we did not successfully create a baseline condition against which to compare the choice task. When participants made yes/no judgments regarding sentences about which of two words was more (or less) representative of a category, we found a benefit for words that had been given a “yes” response over those that have been given a “no” response, as well as a benefit for congruent words over incongruent words. In short, the pattern of results in the yes/no condition mimicked the pattern found in the choice task. Considering that both Staresina et al. (2009) and Marks et al. (1992) obtained a congruity effect but no effect of response type (yes/no) it is unclear why we found a benefit for “yes” responses. It is possible that our failure to replicate their null effect of response type was due to the memory test that we used. Staresina et al. (2009) used a recognition memory test to measure memory for the items and Marks et al. (1992) used both recognition and cued recall tasks. It is possible that this response type effect is only present in free recall tasks and not in cued recall or recognition memory. Additional experiments are needed to determine if this is the case.

Because we were unable to compare the choice task to a baseline task, we were not able to gain additional information about the source of the mnemonic benefit for chosen items. Thus, the question remains: Why are chosen items better remembered than unchosen items? Because congruity cannot account for the benefit of chosen items over unchosen items we can rule out Toyota and Kobayashi's (2009) integration hypothesis as an explanation of the chosen item benefit. They claimed that if participants have a clear dimension along which to make their choices, then their choices will be more memorable because they will be better integrated into existing cognitive structures (Toyota, 2015). We found that the effect of choice did not depend on level of congruity meaning that better integration of items into cognitive schemas does not change the effect of choice.

Given that we observed both a benefit for chosen over unchosen items as well as a benefit for items that had been given a “yes” response, it could be that there is something about the act of endorsing an item that improves memory for that item. It is possible that this effect is related to the mere ownership effect (e.g., Beggan, 1992). When someone chooses something, even if they are choosing it as being less useful for survival, they feel a sense of ownership over the choice which may then lead to better memory for the chosen item. An alternative explanation is that value drives the mnemonic benefit for chosen items. It has been suggested that due to the vast amount of information humans encounter daily, it is important that we selectively remember information that is important or relevant while forgetting information that is not (Stefanidi, Ellis, & Brewer, 2018). It has been shown that participants have better memory for items that are assigned a higher value at encoding (Ariel & Castel, 2014; Castel, Farb, & Craik, 2007; Stefanidi et al., 2018), an effect known as value-directed remembering. If subjects perceive things that they choose or endorse as being more valuable, then value-directed remembering could account for the mnemonic benefit of chosen items over unchosen items. Neither of these accounts, however, provides much insight into the proximate mnemonic mechanisms that actually produce the advantage. We have shown that chosen items are more memorable than unchosen items, and that this chosen-item effect is independent of the effect of contextual congruity, but more research is needed to determine what causes this chosen-item benefit.

It is also important to investigate how the chosen-item benefit can be harnessed to improve learning outcomes. Pedagogical aids that induce choice, particularly of a correct over an incorrect answer, are likely to aid learning relative to a pure study condition. There is now considerable evidence that retrieval practice, during which people recall or endorse items that have occurred previously, can significantly improve long-term learning (e.g., Roediger & Karpicke, 2006). One could conceive of choice as a form of retrieval practice, albeit one in which people access prior knowledge rather than temporal occurrence to provide a response. Perhaps assigning students to do easy multiple-choice questions (questions where they would be able to successfully select the correct answer most of the time) for home work would lead to better final exam performance. In addition to the implications of this research for the field of education, this work has potential application in the field of consumer science. If consumers choose one product over another, say because it is on sale, it could improve their memory for that product in the future.

In summary, we conducted three experiments which showed that the mnemonic benefit for chosen items is independent of the congruity effect – that is, participants have better memory for chosen items and for congruent items, but the effect of choice does not depend on whether items are congruent or incongruent. This suggests that the chosen-item effect is caused by something other than the congruity of the items to the encoding situation. These experiments will hopefully lay a foundation for future research investigating the source of the chosen-item effect as well as potential applications for this effect in the fields such as education. It is important that we explore and improve our understanding of the effect of choice on memory. Choices are an integral part of our lives; we choose what to eat, which products to consume, and how to delegate our time (to name only a few examples). As shown in these experiments, such simple choices can influence our memory.

FOOTNOTE

[1]For a within-subject ANOVA in G*Power 3.1, the program assumes only one within-subjects factor (and in this case, one between). Our design had two within-subject factors, and thus, the estimated sample size is a conservative estimate of sample size because it does not take into account the correlation between the congruent and incongruent conditions.

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APPENDIX A – EXPERIMENT 1 STIMULI

Word Pairs	
basket	lemon
football	bullet
ruler	bowl
purse	dress
watch	flag
fork	trumpet
pipe	sponge
pencil	drum
book	saw
umbrella	sock
rope	telephone
bread	belt
lamp	boot
key	apple
candy	tie
hammer	cake
vase	hat
jar	bell
shirt	cup
envelope	whistle
map	candle
ring	pillow
bottle	doll
broom	tomato

APPENDIX B – EXPERIMENTS 2 AND 3 STIMULI AND CATEGORIES

Word Pairs		Categories - Version A	Categories - Version B
golf	boot	A sport	A type of footwear
sleet	tent	A type of human dwelling	A weather phenomenon
dollar	noun	A kind of money	A part of speech
drill	doll	A toy	A carpenter’s tool
ruby	book	A precious stone	A type of reading material
coal	boat	A transportation vehicle	A fuel
beer	grass	An alcoholic beverage	A thing that is green
sofa	corn	A vegetable	An article of furniture
floor	kite	A part of a building	A thing that flies
copper	waltz	A type of dance	A metal
bowl	valley	A kitchen utensil	A natural earth formation
door	grape	A fruit	A thing made of wood
bell	sage	A thing that makes noise	An herb
piano	rake	A gardener’s tool	A musical instrument
wool	salt	A type of fabric	A substance for flavoring food
yard	knife	A weapon	A unit of distance
daisy	juice	A flower	A liquid
glove	chapel	A building for religious services	An article of clothing
week	rock	A unit of time	A type of music
maple	iron	A chemical element	A tree