Congruency effects on recognition memory: A context effect

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Abstract

Two recent studies have reported that incongruent selective attention items are better remembered than congruent items on a surprise recognition memory test (Krebs, Boehler, De Belder, & Egner, 2013; Rosner, D'Angelo, MacLellan, & Milliken, 2014). These findings suggest that an increased need for cognitive control may trigger encoding mechanisms at the time of study that result in better recognition of those items at test, a form of the desirable difficulty effect (Bjork, 1994). The experiments in the present paper demonstrate that this effect can depend on whether differences in selective attention difficulty are blocked or intermixed at the time of encoding. These results suggest that additional encoding time itself does not invariably result in better recognition for more difficult selective attention items. Instead, the dependence of recognition memory on encoding difficulty appears to reflect a context-sensitive control response to encoding difficulty.

Keywords: congruency; recognition; cognitive control; selective attention; desirable difficulty

Introduction

Congruency effects are a commonly used tool to study selective attention. For example, in the Stroop task, colour identification times are slower for incongruent (e.g., the word RED presented in green) than for congruent (e.g., the word RED presented in red) trials, an effect commonly attributed to control over selective attention (MacLeod, 1991; Stroop, 1935). An important insight offered by recent research on congruency effects is that they are sensitive to episodic learning and memory processes (e.g., Crump, Gong, & Milliken, 2006; Egner, Delano, & Hirsch, 2007; Funes, Lupiáñez, & Humphreys, 2010; Jacoby, Lindsay, & Hessels, 2003; Kiesel, Kunde, & Hoffmann, 2006; Spapé & Hommel, 2008; Wendt, Kluwe, & Peters, 2006). This observation led to two recent studies that examined the relation between congruency effects and episodic remembering more directly.

Congruency Effects on Recognition

Krebs, Boehler, De Belder, and Egner (2013) had participants complete a face-word Stroop-like task. Male or female faces were overlaid with the word “MAN” or “WOMAN”, thus creating both congruent and incongruent face-word stimuli. Participants were slower to indicate the gender of the face on incongruent than on congruent trials. In a following recognition memory task, memory was better for the incongruent than congruent faces. In a conceptually similar study, Rosner, D’Angelo, MacLellan, and Milliken (2014) presented participants with a pair of red and green spatially interleaved words, and asked them to read the red word aloud. The word pair was congruent (the two words were the same) or incongruent (the two words were different). Once again, in a following recognition memory task, performance was better for the incongruent than congruent items.

Taken together, these results fit at least loosely with the influential conflict monitoring framework, in which response conflict triggers adjustments in cognitive control (see Botvinick, Braver, Barch, Carter, & Cohen, 2001). Increased cognitive control for difficult incongruent items could in turn produce better encoding and improved recognition. However, the results need not implicate difficulty-induced adjustments in cognitive control at all. Rather, the additional time allocated to encoding of the more difficult incongruent items on its own could conceivably produce the improved recognition performance. According to this alternative time-on-task view, recognition memory performance ought to be better for any condition in which more difficult-to-process items are responded to more slowly than easy-to-process items.

The Present Study

A challenge in teasing apart the time-on-task and cognitive control accounts is that difficult tasks that require more time to complete are often met with cognitive control adjustments to complete them. In other words, time-on-task and cognitive control often vary hand-in-hand. To tease these two factors apart, we took advantage of the idea that cognitive control differences between easy and difficult items might well depend on whether easy and difficult items are presented in separate blocks or intermixed randomly within block (see Los, 1996 for a review). When presented in separate blocks, a long sequence of easy trials can be prepared for with one strategic set, whereas a long sequence of difficult trials can be prepared for with a different strategic set. In contrast, when presented intermixed within a single block, the unpredictability of trial type might well invite identical strategic preparation for the two trial types.

We employed a task similar to that in Rosner et al. (2014), with participants reading aloud the red word in a pair of red and green spatially interleaved words during an incidental study phase, followed by a surprise recognition memory test. However, rather than congruent and incongruent items, all items were incongruent. Half of these incongruent items were easy-selection (bright red target, dim green distractor), and the other half were hard-selection (dim red target, bright green distractor; see Figure 1). In Experiment 1, the easy-selection and hard-selection items were presented in two separate blocks during the study phase, whereas in Experiment 2 they were intermixed randomly in the study phase. Presenting the two conditions in different blocks ought to maximize the opportunity for the hard-selection and easy-selection items to be subject to different cognitive control processes, whereas intermixing the two conditions could effectively homogenize cognitive control across the two item types. Better recognition for hard-selection than easy-selection items in only the blocked presentation condition would suggest that cognitive control indeed contributes to the recognition memory effect.

Experiment 1

Method

Participants. Forty-eight participants (33 females, mean age = 19 years) were recruited from the McMaster University student pool in exchange for course credit or $10. All participants had normal or corrected-to-normal vision and spoke English fluently.

Apparatus and stimuli. The experiment was run on a Dell computer using PsychoPy software (Peirce, 2007). Participants sat 50 cm from a BENQ LED monitor on which the stimuli were displayed. The stimuli consisted of a pair of red and green spatially interleaved words in Ludica sans console font presented on a black background. Each word subtended 5.95 degrees of visual angle horizontally, and 0.74 degrees vertically. The two words together subtended 6.52 degrees horizontally and 1.03 degrees vertically. Easy-selection items contained a bright red word (RGB values of 255,0,0) and a dim green word (RGB values of 0,20,0). Hard-selection items contained a dim red word (RGB values of 50,0,0) and a bright green word (RGB values of 0,255,0; see Figure 1). All words were five-letter, high frequency nouns (Kučera & Francis, 1967).

Figure 1 Example of experimental stimuli. The item on the left is an example of an easy-selection item (RGB values of 255,0,0 for the target; 0,20,0 for the distractor) and the item on the right is an example of a hard-selection item (RGB values of 50,0,0 for the target; 0,255,0 for the distractor).

Design. Eight lists of 60 words were used to construct the stimuli (Appendix A). Four lists were used for old items shown in both study and test phases, while the other four lists were used for new items shown only in the test phase. Counterbalancing of items to conditions across participants ensured that each word appeared equally often as an old or new item, and within the old condition equally often as a bright target, dim target, bright distractor, and dim distractor. For new items, the assignment of words to each of the above four roles was random. Target and distractor words for a given display were paired randomly for both old and new items.

For each participant, there were 120 old items and 120 new items (two words per item), half of which were easy-selection and half were hard-selection. The position of the target item (either top or bottom) was randomly selected for each of the conditions defined by the easy-selection/hard-selection and old/new variables.

The order of presentation of items in the study phase was random with the constraint that all easy-selection items were shown in one block, and all hard-selection items were shown in the other block. Block order was counterbalanced across participants. Blocks were separated by a short break, the duration of which was controlled by the participants. Easy-selection and hard-selection items were intermixed at random in the test phase. Old items were presented at test in the exact same manner as they were presented at study, with the same target and distractor pairings, same brightness of target and distractor, and same relative position of target and distractor.

Procedure. Participants completed two tasks: an incidental study task, and a recognition memory task with a remember/know requirement (Rajaram, 1993). In the study phase, participants were presented with a central fixation cross for 2000 ms, followed by a pair of red and green interleaved words for 1000 ms. The task was to read the red word aloud as quickly and accurately as possible. Response times (RTs) were recorded at the onset of a vocal response via microphone, and accuracy of responding was recorded by the experimenter. Following a ten minute distractor math task, participants were given detailed instructions for the recognition memory task (see Rosner et al., 2014 for details). In the recognition task, participants were presented with a fixation cross for 2000 ms, followed by a pair of red and green interleaved words. If participants remembered reading the red word at study, they were to indicate it was old by pressing the "A" key; otherwise, they were to classify the word as new by pressing the "L" key. If the word was judged "old," participants were then asked to indicate if their recognition was based on a feeling of remembering by pressing the "A" key, or a feeling of knowing by pressing the "L" key. Reminders for which key corresponded to which response were presented at the bottom of the screen. The remember/know data (Appendix B) were exploratory and are not discussed further.

Results

Study phase. Correct RTs were submitted to an outlier analysis (Van Selst & Jolicoeur, 1994), removing 2.7% of observations from further analysis. Mean RTs and error rates are displayed in Table 1. The RTs were analyzed using a 2 x 2 mixed-factors ANOVA, with difficulty (easy-selection/hard-selection) as a within-subject factor, and block order (easy-first/hard-first) as a between-subjects factor. The analysis revealed only a main effect of difficulty, $F(1,46) = 43.39$, $p < .001$, $\eta_p^2 = .48$, with faster RTs for easy-selection (721 ms) than hard-selection items (821 ms).

Table 1 *Mean RTs (ms) and error rates for the study phase.*

Experiment	Easy-selection	Hard-selection
1	721 (.016)	821 (.029)
2	751 (0)	870 (.056)

Note. Table displays RTs with error rates in parentheses.

Test phase. Items responded to incorrectly during the study phase were excluded from all test phase analyses. The mean proportion of "old" responses in each condition is presented in Figure 2. Recognition performance was evaluated using *d'* as a measure of sensitivity (see Table 2). These *d'* values were analysed with a 2 x 2 mixed-factors ANOVA, with difficulty (easy-selection/hard-selection) as a within-subject factor and order (easy-first/hard-first) as a between-subjects factor. This analysis also revealed only a significant main effect of difficulty, $F(1,46) = 4.99$, $p = .030$, $\eta_p^2 = .10$, with higher *d'* values for hard-selection (1.39) than easy-selection items (1.25). A corresponding analysis of bias was conducted on beta values and revealed no significant effects, all *p*'s > .10.

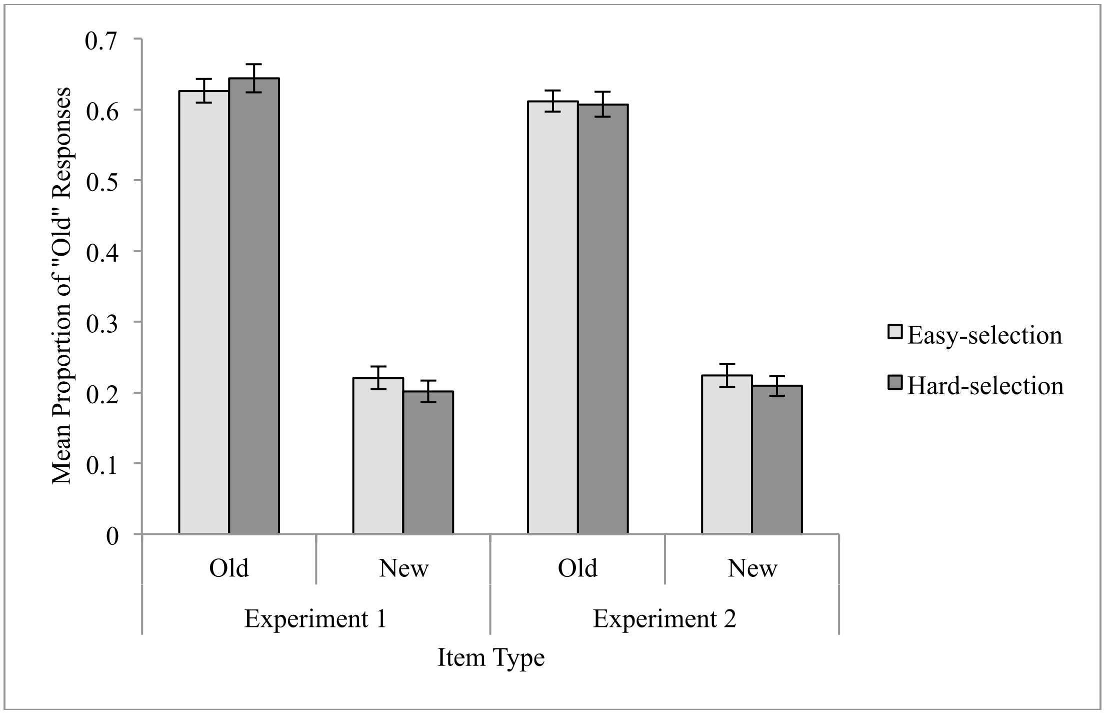

Figure 2 The mean proportion of "old" responses during the test phase for Experiments 1 and 2. Error bars represent the standard error of the mean corrected for between-subject variability (Morey, 2008).

Table 2 *Mean values of d' for the test phase.*

Experiment	Easy-selection	Hard-selection
1	1.25 (1.86)	1.39 (1.92)
2	1.20 (1.94)	1.25 (1.95)

Note. Table displays *d'* with beta in parentheses.

Discussion

The results of Experiment 1 indicate that hard-selection items were named 100 ms slower than easy-selection items during the study phase. Furthermore, in line with other recent studies (Krebs et al., 2013; Rosner et al., 2014), recognition memory was better for hard-selection than for easy-selection items. As such, the present results converge with others indicating that increased processing demands associated with disambiguating a target from a distractor can lead to improved recognition memory.[1]

Experiment 2

Experiment 2 was identical to Experiment 1, with the exception that easy- and hard-selection items were intermixed at study, rather than blocked. If intermixing item types were to eliminate the recognition effect observed in Experiment 1, without also eliminating the naming time difference observed in Experiment 1, then it would suggest that cognitive control differences associated with the blocked/mixed manipulation across experiments can impact recognition memory. More precisely, such a pattern of results would favour a cognitive control account over a time-on-task account of the dependence of recognition memory on selective attention difficulty.

Method

Participants. Forty-eight participants (40 females, mean age = 19 years) were recruited from the McMaster University student pool in exchange for course credit or $10. All participants had normal or corrected-to-normal vision and spoke English fluently.

Apparatus, stimuli, design, and procedure. The methods used were identical to Experiment 1 with the following exception. During the study phase, the order of presentation of items was completely randomized, with easy-selection and hard-selection items presented in a mixed fashion.

Results

Study phase. Correct RTs were submitted to the same outlier analysis as in Experiment 1, removing 2.4% of observations from further analysis. Mean RTs and error rates are displayed in Table 1. Mean RTs for the two difficulty conditions were compared with a one-tailed paired sample t-test. RTs were faster for easy-selection (751 ms) than hard-selection (870 ms) items, $t(47) = 8.32$, $p < .001$, $d = 1.70$.

Test phase. The proportion of "old" responses in each condition is depicted in Figure 2. Recognition performance was again evaluated using *d'* as a measure of sensitivity (see Table 2). A two-tailed paired sample t-test revealed no difference in remembering between easy-selection (1.20) and hard-selection items (1.25), $t(47) = .89$, $p = .367$, $d = 0.18$. A corresponding analysis on beta values also failed to reveal a significant effect, $p > .10$.

Discussion

The key result in Experiment 2 was two-fold. First, RTs were 119 ms slower for the hard-selection than easy-selection items during the study phase. Second, the encoding difficulty effect on recognition was clearly not observed in this experiment. This result suggests that increased time-on-task is not sufficient to produce differences in recognition.

General Discussion

The purpose of the present study was to determine whether recently demonstrated effects of congruency on remembering (Krebs et al., 2013; Rosner et al., 2014) owe to an increase in cognitive control in response to conflict (e.g., Botvinick et al., 2001), or more straightforwardly to increased time-on-task. Superior recognition for the difficult encoding condition was observed only in Experiment 1, in which blocked presentation of the two selection difficulty conditions maximized the opportunity for differences in cognitive control. The fact that recognition differed for the selection difficulty conditions only in Experiment 1 argues strongly against the time-on-task account.

Blocked/Mixed Difficulty Effects

Note that we are not making the general claim that encoding difficulty effects on recognition should occur only when encoding difficulty is blocked at the time of study. In fact, in our prior work (Rosner et al., 2014), a robust effect on recognition memory was observed with congruent and incongruent items intermixed rather than blocked at the time of study. A key issue to consider is that congruency (i.e., two identical words) offers a relatively immediate cue of processing ease, whereas perception that a red target word is more salient than a green distractor word may require a more time-consuming binding of target colour (i.e., red) with relative salience. The implication is that intermixing two trial types that are sufficiently distinct (e.g., congruent and incongruent items) may allow for on-line selection of different forms of control for those two item types. In contrast, intermixing two trial types that are less distinct may require the homogenization of control for easy and difficult item types that appeared to occur in the present study. This distinction fits with the view that cognitive control can be rapid and reactive in some contexts, and slower, strategic, and proactive in other contexts (Braver, 2012).

A similar issue has received extensive study in the negative priming literature. Lowe (1979) reported that priming effects for prime-probe trial pairs can depend on the selection demands of probes, with negative priming observed for probes with a selective attention requirement (e.g., an incongruent Stroop item) and positive priming observed for probes without a selective attention requirement (e.g., a congruent Stroop item). However, whether these opposite effects were observed for the two probe types when intermixed randomly within a block hinged on the ease with which they could be discriminated (see also Moore, 1994). Moreover, a related set of results was observed in a recent study that used stimuli similar to those in the present study (D'Angelo & Milliken, 2012). When easy-selection (bright red target word, dim green distractor word) and hard-selection (bright red target word, bright green distractor word) probes were intermixed randomly, similar negative priming effects were observed for the two probe types. In contrast, when these two probe types were presented in separate blocks, opposite priming effects were observed. These results dovetail nicely with those in the present study, demonstrating different cognitive control consequences for blocked and intermixed presentation of trial types that are difficult to discriminate from each other.

Desirable Difficulty

The present results may also speak to the broader principle of desirable difficulty, according to which remembering benefits from processing difficulty at the time of encoding (Bjork, 1994). A wide variety of results support this principle, with memory benefits observed for processing difficulty induced by pattern masking (e.g., Hirshman & Mulligan, 1991; Nairne, 1988), difficult-to-read fonts (Diemand-Yauman, Oppenheimer, & Vaughan, 2011), and perceptual blurring[2] (Rosner, Davis, & Milliken, 2015). More accurate recognition for incongruent than for congruent items (Krebs et al., 2013; Rosner et al., 2014), and for hard-selection than for easy-selection items (Experiment 1 of the present study), also fits with the desirable difficulty principle. Yet, it is not clear whether a single mechanism triggered by processing difficulty can accommodate all of these diverse results.

In particular, we previously suggested that recognition may be better for incongruent than for congruent items because conflict on incongruent items leads to an increase in cognitive control, as outlined in the conflict monitoring theory (Botvinick et al., 2001). The conflict monitoring theory fits particularly well in this case because it operationalizes conflict at the response level, and it is easy to see how incongruent items might lead specifically to "response conflict". In contrast, response conflict is less obviously central to the encoding difficulties associated with pattern masking, an unusual font, or perceptual blurring. To accommodate these results within the conflict monitoring framework, one might propose that all of these manipulations trigger a cognitive control mechanism aimed at reducing response *ambiguit*y. By this view, cognitive control may be heightened to reduce incorrect responses generally (e.g., when two conflicting responses are activated, or when impoverished perceptual information holds the potential for an incorrect response). Although speculative at this point, further development of a framework that integrates the conflict monitoring theory with the desirable difficulty principle may prove worthwhile.

Conclusion

The results in this study demonstrate that better recognition for items presented under difficult selective attention encoding conditions is not simply an artefact of time-on-task. We conclude that an increase in cognitive control in the face of response conflict, and perhaps in the face of processing difficulty more generally, can improve subsequent recognition.

Footnotes

[1] In the present experiments, distractors were presented with targets during both the study and test phases. As such, the effects observed could reflect memory for both the distractors and targets rather than solely memory for targets. However, in a prior study we demonstrated that the recognition advantage for incongruent over congruent items does not hinge on presenting the distractors in the test phase (see Rosner et al., 2014). Interestingly, in that study, inclusion of distractors at test produced higher false alarm rates for new congruent than new incongruent items, an effect produced perhaps by the greater fluency with which the new congruent items were processed (see Jacoby & Whitehouse, 1989). This false alarm effect was accompanied by lower hit rates for old congruent than old incongruent items, which together produced the well-known mirror effect in recognition memory (Glanzer & Adams, 1985). Together, these results suggest that distractors at test can impact memory performance, but that the recognition advantage for items that were difficult to process over items that were easy to process at study does not hinge on the presence of distractors at test.

[2] A recently published study failed to reveal effects of perceptual blurring on both recall and recognition (Yue, Castel, & Bjork, 2013). However, we have since learned that this failure to produce an effect of perceptual blurring on remembering likely owed to the requirement that participants produce judgments of learning during the study phase (Rosner et al., 2015; see also Besken & Mulligan, 2013, 2014; Koriat, Bjork, Sheffer, & Bar, 2004).

Appendix A

Word Lists

Word list 1: BLINK, BOAST, BRAIN, BROIL, CANDY, CHILL, CLEAN, CLIMB, COAST, COUCH, DEPTH, DOUGH, ERROR, FANCY, FETCH, FLAME, FLOUR, FRONT, FRUIT, GRASS, GRATE, HURRY, JUDGE, LAUGH, LIMIT, LINEN, LOBBY, MAGIC, MAPLE, MONTH, OFFER, OLIVE, PAPER, PEACH, PENNY, PHOTO, PIECE, RANGE, ROAST, SCALE, SHINE, SHOCK, SLOPE, SMALL, SPEED, SPILL, SPLIT, STAGE, STAIN, STEAM, STEEP, STERN, STORM, STRAW, STUFF, TIMER, TREND, TRUCK, UNDER, YIELD

Word list 2: AGENT, BAKER, BENCH, BLADE, BLOOM, BOARD, BOOTH, BREAD, BRICK, CABLE, CHIEF, CHILD, CLASS, CLICK, CROSS, DAILY, DANCE, DRINK, DRIVE, EAGLE, FIELD, FORUM, GLASS, GLEAM, GRAPE, GRAVY, GRIEF, GROOM, GUESS, HOTEL, MIDST, MIGHT, NOISE, NOVEL, OTHER, OWNER, PAINT, PANEL, PLAIN, PLANT, PORCH, QUOTE, RIVAL, ROUND, SHELF, SHIRT, SHOUT, SIGHT, SPELL, STALK, STEAL, STOCK, SUGAR, TIGER, TODAY, TOWER, TRUNK, TWEED, UNCLE, VOTER

Word list 3: BASIS, BLANK, BREAK, BRIDE, BUGGY, BUNCH, BURST, CHARM, CHEEK, COUGH, CRUSH, DRAIN, EARTH, FLOAT, FRAME, GHOST, JEWEL, JOINT, LEASE, LEAST, LOCAL, MAJOR, MATCH, MODEL, MONEY, NERVE, NOBLE, ONION, OUNCE, PHASE, PILOT, PRICE, PRINT, PRIZE, RADIO, RANCH, REBEL, RIVER, ROUTE, SAINT, SCARF, SCORN, SHAPE, SHARP, SOLID, SPACE, SPRAY, STAKE, START, STOUT, STRIP, SWEAT, TABLE, TENSE, TRACK, VISIT, VOICE, WHIRL, WOMAN, WRIST

Word list 4: ALARM, BIRTH, BLAZE, CHEAT, CHEST, CHOKE, CIGAR, COACH, CRACK, CROWD, DROVE, ELDER, EVENT, EXTRA, FAIRY, FLASH, FLOCK, FLUSH, GLARE, GLOVE, GRIND, HASTE, HEDGE, HOUSE, IDEAL, JUICE, LEAVE, METAL, MORAL, MUSIC, NIGHT, OCEAN, ORDER, PLANK, PLUMP, QUICK, SAUCE, SCORE, SHORE, SHORT, SLICE, SMOKE, SNEAK, SPARK, SPOIL, SPOKE, STATE, STOOP, STOVE, SWAMP, SWEET, TEETH, TOUGH, TRAIN, TRUST, WHEAT, WHEEL, WHILE, WHINE, WORLD

Word list 5: ALERT, ANKLE, BLUSH, BOUND, BRIEF, CABIN, CHASE, CHECK, CHEER, CLASP, CLIFF, CLOCK, COURT, CRAFT, CRASH, CRUST, FENCE, FEVER, FOCUS, FORCE, GIANT, GROAN, GROUP, HONEY, HORSE, ISSUE, LAYER, LODGE, LUNCH, PARTY, PEARL, PIANO, PITCH, PRESS, PRUNE, RIDGE, SALAD, SCARE, SCENE, SERVE, SHAME, SHIFT, SHOVE, SHRED, SLUMP, SPECK, STAFF, STICK, STRAP, SURGE, SWARM, SWING, TEASE, TOTAL, TRADE, TRICK, TRUTH, TWIST, VALUE, WOUND

Word list 6: ASIDE, ATTIC, BLIND, BRASS, BRUSH, BUYER, CARGO, CATCH, CHAIN, CLAIM, CLOTH, CORAL, CRAWL, CROOK, CRUMB, DOUBT, DRESS, FAINT, FLARE, FLOOR, FROST, FROWN, GUARD, GUIDE, IVORY, JELLY, KNIFE, KNOCK, MOTOR, MOUTH, PASTE, PAUSE, POISE, POUND, PRIDE, PURSE, REACH, SATIN, SCENT, SCOUT, SHAKE, SHEER, SHRUG, SMELL, SPOON, SPORT, STACK, STEAK, STILL, STUMP, THING, THROW, THUMB, TOAST, TOUCH, TRACE, TRAIL, TRIBE, WASTE, WORST

Word list 7: ACTOR, ADULT, AISLE, APPLE, APRON, BATHE, BEAST, BERRY, BREED, CLOUD, COVER, CROWN, CURVE, DREAM, DRIFT, ELBOW, ELECT, EQUAL, FLEET,

GLORY, GRANT, GRASP, IMAGE, INNER, LEMON, LIGHT, MERIT, MOVIE, NURSE, OPERA, PERCH, PHONE, PINCH, POINT, PROOF, PULSE, PUNCH, ROUGH, SCRAP, SCRUB, SHARE, SHEET, SHELL, SHRUB, SLEEP, SLIDE, SMILE, SQUAD, STAMP, STEEL, STONE, STORY, STUNT, SWEAR, SWORD, TREAT, UPPER, WAGON, WATER, WRECK

Word list 8: ALLEY, ANGLE, BLAST, BLEND, BLOCK, BRACE, BRAKE, BRAND, BROOK, BUNNY, CANAL, CHAIR, CHANT, CHART, CLERK, CLUMP, COUNT, CREEK, DELAY, DITCH, DODGE, EMPTY, GRADE, GRAIN, GUEST, HEART, LABEL, LEVEL, ORGAN, PIPER, PLANE, PLATE, PUPIL, QUIET, RIGHT, SCOWL, SENSE, SHADE, SHEEP, SKILL, SKIRT, SMART, SMASH, SNARL, SNORT, SOUND, STAND, STARE, STEER, STOLE, STORE, STUDY, STYLE, SUITE, SWIFT, TASTE, TITLE, TROOP, WATCH, YOUTH

Appendix B

Recollection and Familiarity Analyses

The separate contributions of recollection and familiarity were estimated from the proportions of “remember” (R) and “know” (K) responses to old items using the independence remember-know procedure (Yonelinas & Jacoby, 1995; Yonelinas, 2002). The contribution of recollection is estimated by R and familiarity is estimated based on K given that a remember response was not made (1-R). Estimates were determined for the hit and false alarm rates, allowing for a comparison of the hit minus false alarm difference score between easy-selection and hard-selection items. The results of these analyses are in Table A1.

Table A1.
Estimates of recollection and familiarity based on the independence remember-know procedure.

	Recollection		Familiarity	
Experiment	Easy-selection	Hard-selection	Easy-selection	Hard-selection
1	0.264	0.285	0.284	0.319
2	0.249	0.279	0.248	0.236

Note. No differences were significant when evaluated with two-tailed paired sample t-tests, using a *p*-value of .025, corrected for multiple comparisons on recollection and familiarity.

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