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REPORT

Cross-modality translations improve recognition by reducing false alarms

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ABSTRACT

Conway and Gathercole [(1990). Writing and long-term memory: Evidence for a "translation" hypothesis. *The Quarterly Journal of Experimental Psychology*, *42*, 513–527] proposed a translation account to explain why certain types of encoding produce benefits in memory: Switching modalities from what is presented to what is encoded enhances item distinctiveness. We investigated this hypothesis in a recognition experiment in which the presentation modality of a study list (visual vs. auditory) and the encoding activity (speaking vs. typing vs. passive encoding) were manipulated between-subjects. Manipulating encoding activity between-subjects ruled out any potential influence of the relationally distinct processing that can occur in a within-subject manipulation (in which all previous translation effects have been demonstrated). We found no overall difference in memory for words presented auditorily vs. visually nor for visual vs. auditory encoding, but critically presentation modality and encoding activity did interact. Translating from one modality to another – particularly from auditory presentation to visual encoding (typing) – led to the best memory discrimination. This was largely because of reduced false alarms, not increased hits, consistent with the distinctiveness heuristic.

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According to the *translation hypothesis* (Conway & Gathercole, 1990), there is a memory benefit of encoding information across different modalities relative to encoding within a single modality. Conway and Gathercole found support for this hypothesis in two experiments in which words were presented visually or auditorily, and each word was studied either by writing or by silent reading/listening. Writing enhanced the memorability of words that were presented auditorily but had little effect on those presented visually. Conway and Gathercole argued that this was because writing words that had been presented auditorily involved a translation (auditory-to-visual) whereas writing words that had been presented visually did not. This translation resulted in distinctive encoding (for more on distinctive encoding, see Hunt, 2013).

The translation hypothesis was largely overlooked by memory researchers – with the exception of a failure to replicate (deHaan, Appels, Aleman, & Postma, 2000) to which we will return shortly – until it was recently revisited by Rackie, Brandt, and Eysenck (2015). Rackie et al. made a compelling case that the benefit to memory of translating information across modalities (a "translation effect") constitutes a straightforward learning strategy, akin to both the production effect (superior memory for words that are read aloud vs. silently; MacLeod, Gopie, Hourihan, Neary, & Ozubko, 2010; for a review, see MacLeod & Bodner, in press) and the generation effect (superior memory for words that are generated from a cue vs. read aloud; Slamecka & Graf, 1978).

Extending the work of Conway and Gathercole (1990), Rackie et al. (2015) had participants study words that were presented either visually or auditorily (manipulated between-subjects) using three different encoding activities: speak, write, and silently read/listen (manipulated within-subject), followed by either a free recall test (Experiment 1) or a recognition test (Experiment 2). The pattern of recall performance for auditory presentation was consistent with an auditory-to-visual translation effect (write > speak = listen), while the pattern of recognition performance for visual presentation was consistent with a visual-to-auditory translation effect (speak > write = read). Because the translation effect for recognition was driven by "remember" responses, Rackie et al. (2015) proposed that "the processing of distinctive memories associated with translation involves elaborate encoding, thereby resulting in high remember responses" (p. 325).

This encoding distinctiveness account for the translation effect suggests a potential boundary condition: a within-subject design in which at least one encoding activity does not involve cross-modal processing. Indeed, thus far every experiment that has observed a translation effect has manipulated encoding activity within-subject (Conway & Gathercole, 1990; Mama & Icht, 2016; Rackie et al., 2015). But there may be a second prerequisite: the

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presence of a "baseline" passive encoding activity (i.e., silent reading/listening). All prior experiments that have observed a translation effect featured a baseline condition, whereas the only published experiment that found nonsignificant translation effects (deHaan et al., 2000) did not (participants only spoke or wrote words). Thus, it is possible that the baseline condition was in fact the key ingredient in yielding the pattern of results observed by Rackie et al. (2015) and that cross-modal translation was itself nonessential.

An alternate account for Rackie et al.'s (2015) results is that baseline encoding activity encourages relational processing across conditions, and encoding activities that feature a greater number of processing dimensions stand out as relationally distinct (see Hunt, 2013) relative to those that involve fewer processing dimensions (see Conway & Gathercole, 1987). In research on the production effect, Forrin, MacLeod, and Ozubko (2012) advanced this relational distinctiveness account to explain a speak > write > read silently pattern of recognition results for words presented visually at study (the same pattern of results subsequently obtained by Rackie et al., 2015, Experiment 2). Relative to the silent reading baseline, writing involves one additional process (motor) and speaking involves two additional processes (motor *and* auditory). Mama and Icht (2016, Experiment 3) also evoked a relational distinctiveness account to explain their write > speak > listening pattern of recall results for words that were presented auditorily at study (replicating Rackie et al., 2015, Experiment 1). Relative to the passive listening baseline, speaking involves one additional process (motor) and writing involves two additional processes (motor *and* visual).

Our goal in the present article was to test the translation hypothesis in a context that would preclude relationally distinct processing, allowing us to isolate the influence of cross-modal translation on memory. We therefore manipulated *both* presentation modality (visual vs. auditory) and encoding activity (speak vs. type vs. passive reading/listening) between-subjects, thereby ensuring that memory for words could not benefit from relationally distinct processing – but could still, potentially, benefit from cross-modal processing.

A between-subjects design has the additional advantage of yielding separate hits *and* false alarms (FAs) for each condition, in contrast to a within-subject (mixed-list) design in which separate FAs cannot be obtained (e.g., Rackie et al., 2015; see Forrin, Groot, & MacLeod, 2016, for a discussion of experimental design and FAs), thereby providing a more nuanced examination of the translation effect. The distinctiveness heuristic (Israel & Schacter, 1997) – the finding that participants are able to use distinctive information diagnostically at test to avoid false alarming to lures – suggests that cross-modal translations might have a stronger influence on FAs than on hits in a between-subjects design. For example, Dodson and Schacter (2001) found that a speech distinctiveness heuristic reduced FAs to lures on a recognition test, but did not increase hits to studied items.

The speech distinctiveness heuristic (Dodson & Schacter, 2001) is consistent with the finding that there often is a nonsignificant between-subjects production effect in hits (e.g., MacLeod et al., 2010) that becomes significant in d' because d' takes into account both hits *and* FAs (Bodner, Taikh, & Fawcett, 2014; Forrin et al., 2016; see Fawcett, 2013, for a meta-analysis). As noted in Forrin et al. (2016), it is important to examine d' in recognition because it provides a more comprehensive measure of memory performance than does hit rate alone. Individuals in a translation effect experiment might similarly use a "translation distinctiveness heuristic" to reject lures. For example, for participants who studied auditorily presented words by typing, the absence of any specific recollection at the time of test would constitute evidence that the word was not studied. Thus, just as the between-subjects production effect is evident in d', and appears to be stronger for FAs than for hits, the same pattern of results could arise for the between-subjects translation effect.

In the present experiment, participants studied a list of words, all of which were presented either visually or auditorily. The encoding activity (speak vs. type vs. silent reading/hearing) was also manipulated between-subjects. Memory was then assessed using a yes/no recognition test. We used typing instead of writing in this experiment to enhance the applicability of our results to the context of note-taking in the classroom, in which typing has become far more common than writing, and yields better memory for lecture material (Bui, Myerson, & Hale, 2013). Based on the translation account (Conway & Gathercole, 1990; Rackie et al., 2015), we predicted that in the auditory presentation condition typed words would be better remembered than spoken words or silently heard words, whereas in the visual presentation condition spoken words would be better remembered than typed words or silently read words.

Method

Participants

Two hundred and forty University of Waterloo undergraduate students participated in the experiment and were reimbursed with course credit. Forty participants were assigned to each of the six between-subjects conditions resulting from the combination of the two presentation modalities (visual, auditory) and the three encoding activities (speak, type, silently read/listen).

Apparatus

A PC computer with a 17-inch colour monitor was used for testing. The controlling program was written in E-prime 2.0.

Stimuli

The word pool consisted of 120 nouns from the MRC Psycholinguistic Database (http://www.psy.uwa.edu.au/

mrcdatabase/uwa_mrc.htm) that were four to six letters long and had frequencies of at least 14 per million. Homophones were excluded. Audio files were created by recording a female research assistant saying each word using a Logitech microphone. Audacity 2.0 was used to save each word in.wav format (with a bit rate of 1411 kbps).

Procedure

Participants were informed prior to study that a memory test would follow the study list; the nature of the test was not disclosed. They then studied a list of 60 words randomly selected from the 120-word pool. In the three visual study conditions, words were presented in the centre of a white screen in 18-point bold Courier New black font. Each word was presented for 5000 ms, with a 500-ms blank ISI. In the three auditory study conditions, the recording of a word was played every 5500 ms. Icons denoting the encoding activity also appeared on each trial for 5000ms, immediately above the word in the visual presentation conditions and in the same position in the auditory study conditions. Across conditions, the icons were of a talking head (speak), a keyboard (type), or an eye/ear (silently read/listen).

For trials in which the encoding activity was typing, a cursor appeared immediately below the word in the visual study condition, and in that same position in the auditory study condition. Participants could see their typed responses, and were instructed to press the ENTER key after typing a word, which removed the typed word from the screen.

Immediately following the study phase, memory was assessed using a self-paced yes/no recognition test consisting of a randomisation of all 120 words from the pool: 60 studied and 60 unstudied. Test words were presented individually in the centre of the screen in 18-point bold Courier New black font. Participants used the "m" and "c" keys to classify words as "studied" and "new" respectively. As a reminder, "m – studied" was printed in the bottom-right corner of the screen, and "c – new" in the bottom-left corner.

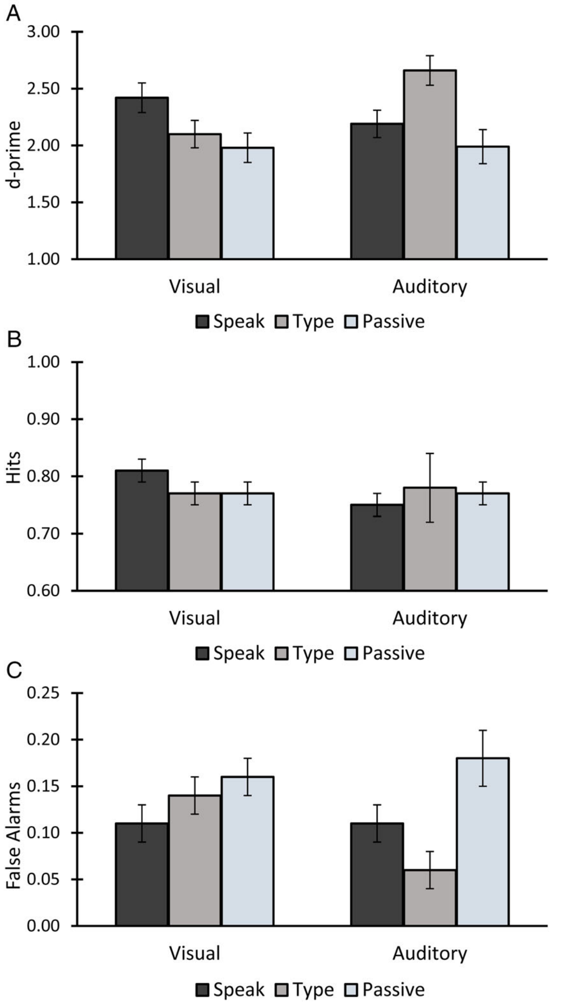

Figure 1. (A) Mean d-primes, with standard errors. (B) Mean hits, with standard errors. (C) Mean FAs, with standard errors.

Table 1. Mean hits, FAs, and d-primes (with SEs) for words presented either visually or auditorily and studied in one of three ways: speaking, typing, or passive encoding (silent reading for visual presentation and listening for auditory presentation), and overall (averaging visual and auditory presentation).

	Hits	False alarms	*d′*
Visual presentation			
Speak	0.81 (0.02)	0.11 (0.02)	2.42 (0.13)
Type	0.77 (0.02)	0.14 (0.02)	2.10 (0.12)
Passive	0.77 (0.02)	0.16 (0.02)	1.98 (0.13)
Auditory presentation			
Speak	0.75 (0.02)	0.11 (0.02)	2.19 (0.12)
Type	0.78 (0.06)	0.06 (0.02)	2.66 (0.13)
Passive	0.77 (0.02)	0.18 (0.03)	1.99 (0.15)
Overall			
Speak	0.78 (0.01)	0.11 (0.01)	2.30 (0.09)
Type	0.78 (0.01)	0.10 (0.01)	2.38 (0.09)
Passive	0.77 (0.02)	0.17 (0.02)	1.99 (0.10)

Results

The data of one participant were excluded because their *d′* score (−1.59) was an extreme outlier (−3.87 *SD*s below their group's mean), which clearly indicated noncompliance with the experimental instructions. No other participant had a *d′* score that was greater than 2.25 standard deviations from their group's mean. The analyses therefore included 239 participants.

d-prime

Table 1 displays participants' mean hits, FAs, and memory discrimination (*d′*) scores. To preface the analyses, the pattern of means in *d′* supports the hypothesis that translation enhances memory (see also Figure 1). For visual presentation, memory discrimination was best for spoken words (a visual-to-auditory translation); for auditory presentation, memory discrimination was best for typed words (an auditory-to-visual translation).

A two-way Presentation Modality (visual vs. auditory) by Encoding Activity (speak vs. type vs. passive) between-subjects ANOVA revealed a nonsignificant main effect of Presentation Modality ($F < 1$). The main effect of Encoding Activity was significant, $F(2, 233) = 5.09$, $MSE = 0.69$, $p = .007$, $\eta^2 = 0.04$. Overall, d' was higher for spoken words than for passively encoded words, $t(158) = 2.37$, $p = .02$, $d = 0.37$, and for typed words than for passively encoded words, $t(157) = 2.92$, $p = .004$, $d = 0.46$, but was nonsignificantly different between spoken words and typed words ($t < 1$). Critically, the significant main effect of Encoding Activity was qualified by a significant Presentation Modality × Encoding Activity interaction, $F(2, 233) = 4.79$, $MSE = 0.69$, $p = .009$, $\eta^2 = 0.04$.

To unpack this significant interaction, separate one-way ANOVAs were conducted for each presentation modality to examine the influence of the three encoding activities. These were followed by two planned comparisons. Of main interest, the first contrast tested whether d' was greater in the condition that involved a modality translation relative to the average of the other two, non-translation conditions. For completeness, the second contrast tested for a difference between the two non-translation conditions. For visual presentation, the ANOVA was significant, $F(2, 116) = 3.06$, $MSE = 2.02$, $p = .05$, $\eta^2 = 0.05$. The first contrast revealed that d' for spoken words was significantly higher than d' for the average of typed and passively encoded (silently read) words, $t(116) = 2.39$, $p = .02$, $d = 0.47$. The second contrast revealed a nonsignificant difference between typed and passively encoded words ($t < 1$). For auditory presentation, the ANOVA was also significant, $F(2, 116) = 6.73$, $MSE = 0.71$, $p = .002$, $\eta^2 = 0.10$. The first contrast revealed that d' for typed words was significantly higher than d' for the average of spoken and passively encoded words, $t(117) = 3.51$, $p = .001$, $d = 0.68$. The second contrast revealed a nonsignificant difference between spoken and passively encoded (listened) words, $t(117) = 1.08$, $p = .29$, $d = 0.25$.

Independent *t*-tests comparing memory discrimination for each encoding activity between modalities provided further support for the auditory-visual translation effect. For typed words, d' was significantly higher for auditory presentation than for visual presentation, $t(77) = 3.22$, $p = .002$, $d = 0.72$. For spoken words, d' was nonsignificantly higher for visual presentation than for auditory presentation, $t(78) = 1.27$, $p = .21$, $d = 0.29$. For passively encoded words, d' did not differ across the two modalities ($t < 1$).

Thus, the pattern of results unambiguously supported the translation account. Visual-to-auditory and auditory-to-visual modality translations at study enhanced memory discrimination, with the latter effect being particularly robust. Next, we asked whether the observed pattern of d' results was driven by hits, FAs, or a combination of the two.

Hits

Table 1 shows that the differences in hit rates across the six conditions were quite small, with all of the means between 0.75 and 0.81 (see also Figure 1). A two-way ANOVA revealed that the Presentation Modality × Encoding Activity interaction was nonsignificant, $F(2, 233) = 1.22$, $MSE = 0.02$, $p = .30$, $\eta^2 = 0.01$. The main effects of Presentation Modality and of Encoding Activity were also nonsignificant (*F*s < 1). Hence, there was no reliable evidence that modality translation influenced hit rates.

False alarms

Table 1 shows that the pattern of FAs was consistent with the translation account (see also Figure 1). For visual presentation, FAs were lowest for speaking; for auditory presentation, FAs were lowest for typing.

A two-way ANOVA revealed a nonsignificant main effect of Presentation Modality ($F < 1$). The main effect of Encoding activity was, however, significant, $F(2, 233) = 7.47$, $MSE = 0.01$, $p = .001$, $\eta^2 = 0.06$. Overall, FAs were lower for spoken words than for passively encoded words, $t(158) = 2.65$, $p = .009$, $d = 0.42$, and for typed words than for passively encoded words, $t(157) = 3.47$, $p = .001$, $d = 0.55$, but were nonsignificantly different between spoken words and typed words ($t < 1$). Importantly, the main effect of Encoding Activity was qualified by a significant Presentation Modality × Encoding Activity interaction, $F(2, 233) = 4.03$, $MSE = 0.01$, $p = .02$, $\eta^2 = 0.03$.

To elucidate the significant interaction, one-way ANOVAs followed by planned comparisons were conducted for each presentation modality. For visual presentation, the ANOVA was nonsignificant, $F(2, 116) = 1.73$, $MSE = 0.01$, $p = .18$, $\eta^2 = 0.03$. The first contrast revealed that FAs for spoken words tended to be slightly lower than FAs for the average of typed and passively encoded words, $t(116) = 1.69$, $p = .09$, $d = 0.33$. The second contrast revealed a nonsignificant difference between typed and passively encoded words, ($t < 1$). For auditory presentation, the ANOVA was significant, $F(2, 70.09) = 9.75$, $MSE = 0.02$, $p < .001$, $\eta^2 = 0.13$ (a Welch test adjusted for unequal variances between groups). The first contrast revealed that FAs for typed words were significantly higher than FAs for the average of spoken and passively encoded words, $t(104.46) = 4.42$, $p < .001$, $d = 0.68$. The second contrast revealed that FAs tended to be slightly lower for spoken relative to passively encoded words, $t(66.57) = 1.92$, $p = .06$, $d = 0.46$.

Independent *t*-tests comparing FAs for each encoding activity between presentation modalities provided further support for the auditory-to-visual translation effect. FAs for typed words were significantly lower for auditory presentation than for visual presentation, $t(77) = 3.75$, $p < .001$, $d = 0.84$, whereas FAs for spoken words and for passively encoded words were both nonsignificantly different between presentation modalities (*t*s < 1).

Overall, then, we found strong evidence that modality translations at study (in particular, auditory-to-visual translations) lower FAs. On the other hand, the evidence was modest that visual-to-auditory translations lowered FAs (only the numeric pattern of the means was consistent with this possibility).

Discussion

In the present experiment, we did not observe an overall difference in memory for spoken vs. typed words, nor for visual vs. auditory encoding. Instead, consistent with the translation account (Conway & Gathercole, 1990), what was crucial was the interaction between the presentation modality and the encoding activity. Having to translate from one modality to another had the largest benefit on recognition, a pattern consistent with what Conway and Gathercole (1990) observed.

Examining this translation benefit more closely, it is evident that it derived primarily from decreased FAs, not increased hits. Our results therefore diverged from those of Rackie et al. (2015, Experiment 2), who found a translation effect in hits (FAs could not be compared due to the mixed-list design). Moreover, whereas they found evidence of only a visual-to-auditory translation effect, we found significant translation effects in both directions (indeed, our auditory-to-visual effect was the stronger and more reliable of the two). These disparate results suggest that the influence of the translation effect on memory may vary based on the context created by the experimental design. In the within-subject design used by Rackie et al. (2015), words studied using a modality translation could be distinctively encoded, leading to increased hits. In contrast, in our between-subjects design, where the "translated" words could not be distinctively encoded, participants could still use a distinctiveness heuristic at the time of test (Dodson & Schacter, 2001) to correctly reject unstudied test items, thereby lowering FAs.

The present experiment therefore provides novel theoretical insight into the translation effect by demonstrating that the benefit of translation on memory is evident at retrieval, consistent with the distinctiveness heuristic. Interestingly, modality translation appears to belong to the same category as other encoding activities, such as speech, in which the benefit to memory between-subjects is larger in decreasing FAs than in increasing hits (see Schacter & Wiseman, 2006, for other encoding activities that have produced this pattern of results). Indeed, this same pattern of results has been obtained in production effect research: Bodner et al. (2014) found a significant between-subjects production effect in d' ($p = .002$) that was driven by a robust effect in FAs ($p < .001$), whereas the effect in hits was nonsignificant ($p = .16$).[1]

Our finding that the translation effect appears to be stronger in the auditory-to-visual direction than in the visual-to-auditory direction is more difficult to account for. Possibly this difference simply rests on the particular encoding techniques that have been examined. But it may be that there is something richer about moving from auditory to visual than the reverse. Typing (and handwriting) seems more effortful than speaking and consequently may lead, for example, to distinctive recollections of spelling the heard word correctly. In the absence of any such recollections at test, participants may conclude – on the basis of the distinctiveness heuristic – that the word was not studied (Dodson & Schacter, 2001), incrementing the likelihood of a FA. Investigation of other translations will help to solve this puzzle.

It is worth noting that recent research has shown a downside to typing: Relative to writing, typing results in both inferior note-taking and inferior subsequent test performance, because typing encourages shallow, rote transcription of lecture material (Mueller & Oppenheimer, 2014). Nonetheless, the transcription of key facts (e.g., names, dates, terminology) is often an inherent part of note-taking. The present research suggests that students may still benefit from typing (or writing) such key facts when they are presented auditorily as opposed to visually. (The auditory-to-visually translation of such facts may be especially beneficial for ruling out lures on a multiple choice exam.) Educators should therefore consider presenting key facts auditorily rather than visually and encouraging selective note-taking.

To conclude, our results support the claim made by Rackie et al. (2015) that translation has potential as a simple yet powerful learning strategy. Indeed, the translation effect may partially underlie the benefits observed in encoding techniques such as the production effect and the generation effect, and perhaps in other well-known encoding effects such as imagery and levels of processing, in all of which translation necessarily occurs. The present results suggest a particular memory benefit of translation – that, relative to non-translated material, translation reduces the incidence of false memories.

Note

1. See Forrin et al. (2016) for Bodner et al.'s (2014) mean hits and FAs.

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References

Bodner, G. E., Taikh, A., & Fawcett, J. M. (2014). Assessing the costs and benefits of production in recognition. *Psychonomic Bulletin & Review*, *21*, 149–154.

Bui, D. C., Myerson, J., & Hale, S. (2013). Note-taking with computers: Exploring alternative strategies for improved recall. *Journal of Educational Psychology*, *105*, 299–309.

Conway, M. A., & Gathercole, S. E. (1987). Modality and long-term memory. *Journal of Memory and Language*, *26*, 341–361.

Conway, M. A., & Gathercole, S. E. (1990). Writing and long-term memory: Evidence for a “translation” hypothesis. *The Quarterly Journal of Experimental Psychology*, *42*, 513–527.

deHaan, E. H. F., Appels, B., Aleman, A., & Postma, A. (2000). Inter- and intramodal encoding of auditory and visual presentation of material: Effects on memory performance. *The Psychological Record*, *50*, 577–586.

Dodson, C. S., & Schacter, D. L. (2001). “If I had said it I would have remembered it”: Reducing false memories with a distinctiveness heuristic. *Psychonomic Bulletin & Review*, *8*, 155–161.

Fawcett, J. M. (2013). The production effect benefits performance in between-subject designs: A meta-analysis. *Acta Psychologica*, *142*, 1–5.

Forrin, N. D., Groot, B., & MacLeod, C. M. (2016). The d-prime directive: Assessing costs and benefits in recognition by dissociating mixed-list false alarm rates. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*, 1090–1111.

Forrin, N. D., MacLeod, C. M., & Ozubko, J. D. (2012). Widening the boundaries of the production effect. *Memory & Cognition*, *40*, 1046–1055.

Hunt, R. R. (2013). Precision in memory through distinctive processing. *Current Directions in Psychological Science*, *22*, 10–15.

Israel, L., & Schacter, D. L. (1997). Pictorial encoding reduces false recognition of semantic associates. *Psychonomic Bulletin and Review*, *4*, 577–581.

MacLeod, C. M., & Bodner, G. E. (in press). The production effect in memory. *Current Directions in Psychological Science*.

MacLeod, C. M., Gopie, N., Hourihan, K. L., Neary, K. R., & Ozubko, J. D. (2010). The production effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*, 671–685.

Mama, Y., & Icht, M. (2016). Auditioning the distinctiveness account: Expanding the production effect to the auditory modality reveals the superiority of writing over vocalising. *Memory*, *24*, 98–113.

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological Science*, *25*, 1159–1168.

Rackie, J. M., Brandt, K. R., & Eysenck, M. W. (2015). Interaction between mode of learning and subjective experience: Translation effects in long-term memory. *Memory*, *23*, 318–328.

Schacter, D. L., & Wiseman, A. L. (2006). Reducing memory errors: The distinctiveness heuristic. In R. R. Hunt & J. B. Worthen (Eds.), *Distinctiveness and memory* (pp. 89–107). New York, NY: Oxford University Press.

Slamecka, N. J., & Graf, P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory*, *4*, 592–604.