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Learning more from feedback: Elaborating feedback with examples enhances concept learning

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ABSTRACT

Two experiments investigated whether elaborating practice-test feedback with conceptual examples could increase conceptual understanding. In the present study, participants studied psychology terms and definitions. During the practice test phase, the definition was presented and participants attempted to recall the corresponding concept term. Immediately after responding, half of the participants were given feedback that provided the correct term. The other half was shown the correct term, followed by presentation of a concept example. To assess concept learning, in Experiment 1 participants were given a final cued recall test in which they were presented with either the previously studied definition or a new example and were prompted to provide the correct concept term. The results of Experiment 1 showed that elaborated feedback enhanced performance on tests of both the definitions and the new examples. In Experiment 2 participants took final classification tests to rule out the possibility that feedback elaborated with examples primarily facilitated access to the term name rather than strengthening conceptual understanding. Results demonstrated that presentation of examples during feedback bolstered performance across all test types and formats.

Providing students with feedback during the course of learning has clear benefits. Feedback not only helps to correct students' mistakes over the long term, but it can also shore up knowledge held with low confidence (Butler & Roediger, 2008). Over the last several decades a large body of research has sought to identify the conditions under which feedback is most effective for learning (e.g., Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Butler & Winne, 1995; Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Shute, 2008). Across studies, there is widespread agreement that feedback that provides the student with the correct response is superior to feedback that only verifies whether the student's answer was correct or incorrect (for a review see e.g., Pashler, Cepeda, Wixted, & Rohrer, 2005).

But can elaborating the content of feedback boost learning further than the correct response alone? Any method that goes beyond providing just the correct response is generally considered elaborated feedback (Kulhavy & Stock, 1989). Elaborated feedback includes, in addition to the correct answer, supplementary information designed to foster deep learning of the target information. There are a variety of ways that feedback can be elaborated: explanations, follow up questions, location of the correct information in the text, or a combination of multiple types of information. In general, the rationale for use of the elaborated feedback methodology is that the additional information that accompanies corrective feedback provides more response relevant information to the learner. According to Kulhavy and Stock (1989), when there is more information available, students should more easily be able to understand why they were initially wrong (and presumably, be more confident when they were initially correct), which should facilitate error correction and long-term retention of the correct information.

There is not yet consensus among researchers about whether more extensive, elaborated feedback benefits learning more than provision of the correct answer alone (for a review, see Shute, 2008). Separate meta-analyses conducted by Schimmel (1983) and by Bangert-Drowns et al. (1991) evaluated the effectiveness of a variety of feedback methodologies across a variety of content domains and found conflicting evidence for whether providing students with additional information during feedback benefited learning. For example, while some of the studies included in the Bangert-Drowns et al. meta-analyses found that providing explanations in addition to the correct answer was more helpful than correct answer only feedback (e.g., Heald, 1970), other studies

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reported that simply giving the correct answer was more effective and efficient than giving explanations (e.g., Kulhavy, White, Topp, Chan, & Adams, 1985; Sassenrath & Gaverick, 1965).

One explanation that has been forwarded for why elaborated feedback may provide little additional benefit to learning is that the added information may be too lengthy or complex to be learned successfully (Kulhavy et al., 1985). If the feedback message is too long, learners may not read the information, making it irrelevant. If it is too complex, it may even offset the impact of the corrective content (Schimmel, 1983; Shute, 2008). Despite the feasibility of this argument, a number of the studies that reported no additional benefit from elaborated feedback did in fact control for feedback complexity (Butler, Godbole & Marsh, 2013), suggesting that there may be other factors underlying the inconsistent demonstration of an elaboration effect.

An alternative explanation for the failure to consistently find an elaborated feedback effect was offered by Bangert-Drowns et al. (1991). In many of the studies included in their meta-analysis, participants were tested and then retested on specific facts. They argued that elaborated feedback, theorized to foster a deeper understanding of underlying concepts, would be more likely to support complex learning and testing scenarios, such as the development of conceptual knowledge and inferential reasoning. In a test-retest scenario, students could have simply learned the specific response for a given question rather than the underlying conceptual content. According to their reasoning, elaborated feedback may have been superfluous in test-retest scenarios that are constrained to specific fact recall.

Bangert-Drowns et al.'s (1991) argument is in line with the transfer appropriate processing (TAP) theory of memory, which proposes that memory performance is related to the degree to which the cognitive processes at encoding overlap with the cognitive processes involved at retrieval (Morris, Bransford, & Franks, 1977). TAP has theoretical similarities with the theory of encoding specificity, which also emphasizes the importance of the match between the cues present at encoding and retrieval (Tulving & Thompson, 1973). Similarly, Jacoby, Shimizu, Daniels, and Rhodes (2005) suggest that retrieval involves reinstating the same depth of cognitive processing engaged during the initial encoding of information. Together, these theoretical accounts suggest that deeper cognitive processing during learning may support better performance on tests that also require deeper cognitive processing. For instance, if elaborative feedback encourages the learner to engage in conceptual reasoning, then later tests that draw on those same reasoning skills should benefit more from the elaborated feedback than tests that emphasize more shallow information processing.

Butler et al. (2013) recently tested the claim that elaborative feedback effects may depend on a match between intervening practice tests (which may be considered a "learning context") and final tests. The researchers hypothesized that the advantages of elaborated feedback were more likely to be in evidence on transfer tests than on questions repeated from an earlier test, which may engage more shallow information processing such as memorization of a cue-target association. In contrast, transfer tests ask participants to apply their knowledge in novel contexts, ruling out the possibility that performance will be based on memorization of a cue-target association. Instead, application of conceptual learning in a novel context relies on deep conceptual understanding. The rationale was that if elaborative feedback engages deep conceptual processing, it should benefit performance on subsequent tasks that also engage deep conceptual processing. However, it may not benefit tasks that have lower processing overlap, such as a test of repeated questions, which may engage more shallow processes, such as retrieval of the cue-target association.

To test their hypothesis, Butler et al. conducted a study in which participants read several passages and were then tested on ideas from each of the passages. During the test, participants either received explanation feedback (the correct answer in addition to two sentences from the passage that helped to explain the correct answer), correct answer only feedback, or no feedback. On a final test participants answered questions that were repeated verbatim from the initial test as well as new inference questions that required application of the concept in a new context. Not surprisingly, participants in both feedback conditions were more accurate on both types of tests than participants were in the no feedback condition. Accuracy on repeated test questions did not differ between the correct answer feedback and explanation feedback conditions. On the inference questions, however, receiving explanation feedback on the practice tests led to superior performance on the final test compared to correct answer feedback and no feedback conditions. Butler et al. concluded that the types of test questions played a role in the demonstration of elaborated feedback effects: new inference questions that probed deep conceptual knowledge were more likely to show effects than repeated questions that could be answered based on more superficial learning of cue-target associations.

In the current study, this reasoning was extended to an evaluation of whether elaborated feedback with examples would benefit declarative concept learning. Declarative concepts are foundational to most, if not all, instructional domains (e.g., concepts of attribution in psychology, modernism in architectural design, and polynomials in mathematics). In the current study, participants studied and were tested on judgment and decision making concepts. During an initial test, feedback was elaborated with an illustrative example of the tested concept. A primary goal was to evaluate whether feedback that was elaborated with an example would enhance declarative concept learning to a greater extent than correct answer feedback alone. Elaboration effects were measured on a follow up test of previously tested information and a transfer test in which participants were asked to identify new examples of the concept.

Examples are a common pedagogical tool used by instructors to illustrate an abstract declarative concept. For instance, declarative concepts are often introduced in textbooks and in classrooms first by providing the term together with the definition of the concept followed by presentation of an example that embodies the core elements associated with that concept (Rawson, Thomas, & Jacoby, 2015). Examples may be particularly beneficial in learning by making an abstract declarative concept more specific and concrete; indeed, prior research suggests that concrete words (Paivio, Clark, & Khan, 1988) and texts (Sadoski, Goetz, & Rodriguez, 2000) are better remembered compared to those that are more abstract.

Recently, Rawson et al. (2015) assessed whether presenting concrete examples during an initial study session was beneficial for declarative concept learning. The researchers noted that despite the frequent use of examples in instructional practice, little experimental research had evaluated their effectiveness (Hamilton, 1990). In their study, participants studied human judgment and decision making concepts either with or without examples. In the definitions and examples group, participants studied each of the 10 terms and definitions once. This was followed by an additional five study trials in which participants studied the terms with examples. A unique example was presented on each of the five trials. In the definition only group, examples were never provided during study. Participants studied the term and definition over all six trials. On the final test, participants were presented with examples of each