

Final Report for “Uniting Cognitive and Motivation Science: An Opportunity Cost Model of Self-Regulated Learning”

Students make bad study choices. They highlight and re-read notes when they should test themselves, and they cram the night before an exam rather than study over time. What explains such poor choices?

Answering this question was the purpose of our LRDC Internal Award “Uniting Cognitive and Motivation Science: An Opportunity Cost Model of Self-Regulated Learning.” This work brought together PI Fraundorf’s expertise in self-regulated learning with PI Galla’s expertise in motivational science to provide a novel and integrated perspective on failures of self-regulated learning.

We developed what we term the *misinterpreted-effort hypothesis* of self-regulated learning decisions. This hypothesis has its root in the fact that most students have *not* been instructed on what is normatively most effective for learning (Geller et al., 2018; Hartwig & Dunlosky, 2012; Kornell & Bjork, 2007; McCabe, 2011). Thus, they must infer their knowledge and learning from various heuristics (Koriat, 1997; Schwartz, Benjamin, & R. Bjork, 1997). In particular, learners may rely on their *current* ease of processing as a proxy for their future retention (Kornell, Rhodes, Castel, & Tauber, 2011). Although this heuristic may be reasonable in many circumstances (Benjamin, Bjork, & Hirshman, 1998), it is unfortunately misleading in many educational contexts because many study strategies effective for long-term retention require more initial effort (the principal of *desirable difficulties*; Bjork & Schmidt, 1992). Our misinterpreted-effort hypothesis thus proposes that a major challenge in self-regulated learning is that learners often use in-the-moment fluency as a proxy for learning, which causes them to

misinterpret the effort associated with these strategies as less potent for learning, in turn discouraging them from choosing those strategies in the future.

Although this hypothesis is *suggested* by the literature, little or no work had simultaneously examined all of the relevant constructs: perceived effort, perceived learning, and study strategy choice. We tested the hypothesis in a series of four experiments led by our graduate student researcher, Afton Kirk-Johnson. In these experiments, we presented college and other learners with experience with two different study strategies (e.g., re-reading vs. practice retrieval; Roediger & Karpicke, 2006) as applied to educationally relevant materials. We measured learners' perceptions of mental effort and learning after trying each strategy, as well as their choice of strategy to apply to further material. Mediation analysis supported our misinterpreted-effort hypothesis: Perceived mental effort exerted an indirect effect on study strategy choices because effort was negatively related to perceived learning, which in turn determined study strategy choices (accounting for up to 78% of the variance). Further, learners who chose a normatively more effective (e.g., retrieval practice) better retained the material 48 hours later, demonstrating the importance of overcoming these misperceptions to make effective learning decisions.

This work has resulted in several conference presentations and a peer-reviewed publication (in press at *Cognitive Psychology*), all first-authored by Afton. In addition, the PI plan to continue this work with external funding. We recently submitted an IES grant proposal; although not recommended for funding, the proposal reached panel review and received favorable scores, and we will submit a revision next year. We also are developing a proposal to be submitted to the National Science Foundation (EHR Core).

More broadly, this award allowed both PIs to extend their research programs in novel, synergistic directions. This project extended PI Fraundorf's research in cognitive psychology to incorporate motivational influences on self-regulated learning; for PI Galla, this project extended research on academic motivation to more fine-grained observations about the particular study strategies that students implement. We believe that these new directions are particularly meritorious because they synthesize cognitive and motivational perspectives on self-regulated learning. Substantial work in motivation science has studied the factors modulating mental effort and its effect on learning, but our results suggest that it is ultimately the *cognitive interpretation* of that effort that is the most important influence on behavior. Conversely, our results use motivation science to explain why efforts by cognitive psychologists to teach effective study strategies to students may not have always change their behavior: explicit instruction on the effectiveness of particular strategies may be outweighed by the visceral *experience* of mental effort, which many learners appear to interpret as an indicator of poor learning. Together, our results suggest that a new, interdisciplinary approach may be most fruitful in understanding how learners make decisions in self-regulated learning.

This award also allowed us to provide two years of mentorship to a graduate student researcher (Afton Kirk-Johnson), who met weekly with the PIs. Both PIs mentored Kirk-Johnson in statistical analysis skills (e.g., mediation analysis), experimental design, and scientific writing skills, resulting in her first first-authored publication. The award further supported Kirk-Johnson to travel both nationally and internationally to present her work at a total of three conferences, providing with her opportunities for networking and developing her oral presentation skills. Lastly, PI Fraundorf in turn supervised Kirk-Johnson's development as a

mentor as she supervised undergraduate research assistants in the Psychology Department's Directed Research program and participated on a B.Phil. thesis committee.

Works Supported by this Award

Kirk-Johnson, A. R., Galla, B. M., & Fraundorf, S. H. (in press). Perceiving effort as poor learning: The misinterpreted-effort hypothesis of how experienced effort and perceived learning relate to study strategy choice. *Cognitive Psychology*.

Kirk-Johnson, A.R., Fraundorf, S.H., & Galla, B.M. (2018, November). Direct evidence that perceived learning mediates the relationship between perceived difficulty and study strategy choices. Paper presented at the 10th Bi-Annual Meeting of the International Association for Metacognition, New Orleans, LA.

Kirk-Johnson, A.R., Galla, B.M., & Fraundorf, S.H. (2018, May). Direct evidence that judgments of learning mediate the relationship between perceived difficulty and study strategy choice. Poster presented at the 30th Annual Convention of the Association for Psychological Science, San Francisco, CA, and at the International Workshop on Advanced Learning Sciences, Pittsburgh, PA.

Kirk-Johnson, A.R., Fraundorf, S.H., & Galla, B. M. (2017, November). Cognitive and motivational appraisals of study strategies: The importance of experienced effort within self-regulated learning. Poster presented at the 58th Annual Meeting of the Psychonomic Society, Vancouver, BC.