



## Confidence in prior knowledge, self-efficacy, interest and prior knowledge: Influences on conceptual change



Jacqueline R. Cordova<sup>a,\*</sup>, Gale M. Sinatra<sup>b</sup>, Suzanne H. Jones<sup>c,1</sup>, Gita Taasobshirazi<sup>d</sup>, Doug Lombardi<sup>e</sup>

<sup>a</sup> University of Nevada, Las Vegas, United States

<sup>b</sup> University of Southern California, United States

<sup>c</sup> Utah State University, United States

<sup>d</sup> Kennesaw State University, United States

<sup>e</sup> Temple University, United States

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### ABSTRACT

This study explored how confidence in prior knowledge, self-efficacy, interest, and prior knowledge interact in conceptual change learning. One hundred and sixteen college students completed an assessment of confidence in prior knowledge, self-efficacy, interest, prior scientific understanding, and prior misconceptions before reading a refutation text on seasonal change. Students' misconceptions and scientific understanding of seasonal change was then assessed before and after reading a refutation text, and again at a two week delayed posttest. Three profiles of students emerged based on their confidence in prior knowledge, self-efficacy, interest, prior scientific understanding, and prior misconceptions. The profiles included: (1) Low (low confidence, self-efficacy, interest, and prior scientific understanding and high prior misconceptions), (2) mixed (high confidence, self-efficacy, and interest, but low prior scientific understanding and high prior misconceptions), and (3) high (high confidence, self-efficacy, interest, and prior scientific understanding and low prior misconceptions). Results indicated that the mixed profile appeared to be most productive for conceptual change and that learner characteristics most productive for conceptual change learning may differ from those most productive in other learning situations.

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### 1. Introduction

Several affective and motivational variables are hypothesized to play an important role in conceptual change learning. However, the role of these variables is quite complicated. For instance, the potential influence of self-efficacy on conceptual change has been described as paradoxical (Pintrich, Marx, & Boyle, 1993). On one hand, self-efficacy for learning about a specific topic has been hypothesized to facilitate conceptual change through fostering confidence in one's ability to gain understanding and change one's ideas. On the other hand, self-efficacy has been hypothesized to hinder conceptual change through fostering confidence in one's own conceptions to the point of reluctance to accept alternative ideas (Pintrich et al., 1993). Despite the vast amount of research and theory demonstrating the pivotal role of self-efficacy in

learning for knowledge acquisition (Bandura, 1997; Bandura, 2006a; Linnenbrink & Pintrich, 2002; Pajares, 2002; Zimmerman & Cleary, 2006), some research indicates that when considered alone, self-efficacy seems to have no impact on conceptual change learning (Linnenbrink-Garcia, Pugh, Koskey, & Stewart, 2012). However, when considered in conjunction with other individual difference variables such as interest and prior knowledge, self-efficacy does influence conceptual change learning (Linnenbrink-Garcia et al., 2012).

Confidence in prior knowledge is another variable whose exact role in conceptual change may be complex. It is possible that high confidence in prior knowledge could negatively impact the willingness of a learner to engage with new, contradictory information as proposed by Pintrich et al. (1993) and supported by research conducted by Maria (1998). However, it is also possible that confidence in prior knowledge could aid in conceptual change learning when combined with other individual difference variables and when using specially designed conceptual change strategies that alert a learner to their misconception, refute it, and provide the scientifically accurate conception. In the study of the role of

\* Corresponding author. Address: University of Nevada, Las Vegas, Department of Educational Psychology & Higher Education, CEB 321, 4505 S. Maryland Parkway, Las Vegas, NV 89154-3003, United States. Fax: +1 702 895 1658.

E-mail address: [cordova1@unlv.nevada.edu](mailto:cordova1@unlv.nevada.edu) (J.R. Cordova).

<sup>1</sup> Suzanne H. Jones formally published under Suzanne H. Broughton.

performance feedback on learning, a ‘hypercorrection effect’ has been extensively reported in which errors made on an assessment were more likely to be corrected with informational feedback when confidence in the incorrect answer was high as opposed to when confidence was low (Butterfield & Metcalfe, 2001). However, confidence in prior knowledge has seldom been examined within the context of conceptual change learning, and never in combination with other variables even though research suggests that it is not any one learner characteristic alone, but the unique, dynamic blend of learner characteristics that may best account for differences in conceptual change outcomes (Linnenbrink-Garcia et al., 2012; Mason, Gava, & Boldrin, 2008). Linnenbrink-Garcia et al. (2012) found that although academic self-efficacy, individual interest, and prior knowledge independently did not account for differences in conceptual change, varying combinations of these learner characteristics did differentially account for differences in conceptual change by gender. In their study of the role of text, topic interest, and epistemological beliefs, Mason et al. (2008) also found that an interaction among the variables best explained conceptual change learning.

Although, the potential interplay among confidence in prior knowledge, self-efficacy, interest, and prior knowledge has been discussed by conceptual change researchers (Pintrich et al., 1993; Sinatra, 2005), prior studies have not empirically tested how unique combinations of these specific variables may impact knowledge reconstruction and whether these learner characteristics play the same role in conceptual change learning as has been previously demonstrated in the knowledge acquisition literature. The answer to this question has important implications for our understanding of warm conceptual change and for conceptual change pedagogy.

The current study extends the extant research by further investigating how combinations of learner characteristics account for differences in conceptual change learning. More specifically, along with topic specific self-efficacy, interest, prior scientific understanding, and prior misconceptions, this study is novel in that it also includes confidence in prior knowledge to form learner profiles, which has not been done in prior research.

This study is grounded in the Cognitive Reconstruction of Knowledge Model (CRKM) developed by Dole and Sinatra (1998). According to the CRKM, interactions between message and learner characteristics determine the level of engagement with a topic. In turn, the level of engagement influences the likelihood of conceptual change. Message characteristics refer to the learner’s perceptions of the message, and specifically whether the learner finds the content comprehensible, coherent, plausible, and compelling. Learner characteristics include differences in background knowledge and motivational factors such as dissatisfaction, need for cognition, social context, and personal relevance, which includes “motivation stemming from interest, emotional involvement, self-efficacy and having a stake in the outcome” (Sinatra, 2005, p. 110). Below we describe the research on confidence in prior knowledge, self-efficacy, interest, and prior knowledge using the CRKM as a framework.

### 1.1. Confidence in prior knowledge

Dole and Sinatra (1998) point out that other factors, beyond the four main aspects of motivation they discuss (dissatisfaction, personal relevance, social context, and need for cognition), likely impact engagement and, as a result, the likelihood of conceptual change. We posit that confidence in prior knowledge is one important factor that has not been examined in conjunction with other variables that probably impacts a learner’s likelihood of engaging with new, conflicting information.

Confidence in prior knowledge should not be confused with self-efficacy. Whereas self-efficacy in this context refers to a prospective judgment of one’s capabilities to learn about a specific topic, confidence in prior knowledge refers to a retrospective judgment of whether one’s current understanding of the topic is correct.

A metacognitive judgment refers to a judgment a learner makes of their own performance before, after, or during the performance (Schraw, 2009). Retrospective judgments tend to be more accurate than prospective judgments of knowledge (Nelson & Narens, 1994). However, students still generally tend to be overconfident (Dunlosky & Lipko, 2007). Some research indicates that accurately judging what one knows is related to knowledge acquired in a particular domain (Glaser & Chi, 1988). However, other research indicates that although domain knowledge may be related to improved performance, it does not impact the accuracy of a person’s metacognitive judgments (Morris, 1990; Schraw, 2009). In fact, some researchers have found that expertise in a particular domain may actually be more likely to result in overconfidence (Glenberg & Epstein, 1987).

Overconfident metacognitive judgments may be of particular concern when it comes to conceptual change learning. As hypothesized by Pintrich et al. (1993), students who are highly confident that their prior knowledge is accurate may be more committed to that knowledge and, as a result, more resistant to new, conflicting ideas (Dole & Sinatra, 1998; Pintrich et al., 1993). Research conducted by Maria (1998) provides support for this hypothesis. This resistance to new, conflicting information could likely lead to a reduced likelihood for conceptual change (Pintrich et al., 1993).

On the other hand, however, there is evidence in the feedback literature that suggests it may actually be easier to change incorrect knowledge if one has high confidence in that knowledge than knowledge held with low confidence. Termed the “hypercorrection effect,” research demonstrates that when given feedback, people are more likely to correct errors on an exam when they were highly confident rather than errors made with lower confidence (Butterfield & Metcalfe, 2001; Metcalfe & Finn, 2012). Some suggest that this effect is likely due to attention factors, for instance the learner may experience surprise when confronted with feedback information that contradicts their strongly held beliefs, thereby increasing their attention to the feedback provided (Butterfield & Mangels, 2003; Butterfield & Metcalfe, 2006; Fazio & Marsh, 2009). Feedback research suggests however, that although high confidence errors may be more easily corrected, they may also be more likely to return over time if a learner forgets the correct answer (Butler, Fazio, & Marsh, 2011).

### 1.2. Self-efficacy

Self-efficacy, which is an important learner characteristic and motivational factor described in the CRKM, is defined as one’s belief in one’s personal capabilities to coordinate and implement the actions necessary to complete a given task or goal (Bandura, 1997; Dole & Sinatra, 1998). These domain-specific self-beliefs have been found to be positively related to students’ motivation, use of cognitive, metacognitive, and self-regulatory strategies, persistence during challenging academic tasks, engagement, achievement, and learning across many academic domains (Bandura, 1997; Bandura, 2006a; Linnenbrink & Pintrich, 2002; Pajares, 2002; Zimmerman & Cleary, 2006).

Despite the well-documented importance of self-efficacy in learning for knowledge acquisition or knowledge “accretion” (Rumelhart & Norman, 1978), Linnenbrink-Garcia et al. (2012) found that self-efficacy alone did not account for differences in conceptual change. This may be because self-efficacy beliefs may play a more complex role in conceptual change than what has been

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