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Use of task-value instructional inductions for facilitating engagement and conceptual change

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USE OF TASK-VALUE INSTRUCTIONAL INDUCTIONS FOR FACILITATING
ENGAGEMENT AND CONCEPTUAL CHANGE

by

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Bachelor of Science
University of California, Davis
2004

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A dissertation submitted in partial fulfillment
of the requirements for the

Doctor of Philosophy in Educational Psychology
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ABSTRACT

Use of Task-Value Instructional Inductions for Facilitating Engagement and Conceptual Change

by

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In this study, 166 undergraduates from an Educational Psychology subject pool were randomly assigned to different task value instructional inductions (utility, attainment, and control) to determine whether inducing students with differing task values would be effective and result in different degrees of engagement for a learning task, as well as result in different degrees of conceptual change on the topic of the causes of the common cold. It was hypothesized participants would adopt characteristics that were consistent with the task value with which they were induced, that the participants in the utility, attainment, and control conditions would differ in their engagement, and that participants in the utility, attainment, and control conditions would experience differing degrees of conceptual change. A pretest-posttest control group experimental design was utilized for the study, in which a pretest and posttest measure of participants' conceptual understandings of the causes of the common cold was employed to determine the degree of conceptual change each participant experienced over time.

Results from the analyses of participants' responses to measures of their approaches to the reading task on the causes of the common cold, as well as measures of perceived task value, revealed that participants tended to adopt approaches to the reading

task that were consistent with the task value they received. Statistical differences were observed among the participants in the utility, attainment, and control conditions on perceived engagement, as well as conceptual change. The results indicate that the participants who were in the utility condition rated their engagement as significantly higher than those in the control condition. Furthermore, participants in the utility condition demonstrated the most conceptual change, followed by the participants in the attainment condition. Those in the control condition experienced the least amount of conceptual change.

The findings that the participants in the utility condition approached the reading task for this study in a utility oriented fashion, rated greater engagement for the task than the participants in the control condition, and experienced the greatest amount of conceptual change, suggest that the stressing of a utility value for a task may facilitate engagement and conceptual change to a greater degree, than would stressing an attainment value or no value. Furthermore, results from this study can inform the generation of new models of conceptual change, as this study lends new insight into the role task values may play in the conceptual change process. Although future research pertaining to investigations on the application of motivational interventions for promoting conceptual change is encouraged, the utility of this study's findings and implications set the foundation for the use of task value instructional inductions for facilitating engagement and conceptual change.

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CHAPTER 1

INTRODUCTION

Ameliorating Misconceptions

Conceptual knowledge is defined as understanding the “interrelationships among basic elements that enable them to function together” (McMillan, 2007, p. 163).

Conceptual knowledge involves deep cognitive processing by an individual for it to be obtained and sustained. An example of acquiring conceptual knowledge would be understanding that viral diseases cannot be treated with antibiotics because viruses (unlike bacteria) lack a cellular structure (for which many antibiotics are commonly meant to target bacterial cell walls and/or cell membranes). In this example, there are many pieces of declarative knowledge (i.e. viruses lack cellular structures; many antibiotics target cellular structures), that need to interact with one another for an individual to conceptualize why antibiotics may be ineffective towards treating viral diseases.

Acquiring conceptions, such as antibiotics are ineffective for treating viral diseases, is important for students intending to make decisions based on their conceptual understandings (i.e. health professionals). For example, it would be inappropriate for nurses to administer antibiotics to a person who just has the common cold, or influenza A virus (subtype H1N1). Institutions of higher education may be more concerned with placing emphasis on conceptual learning because many claim responsibility for preparing individuals for health and environmental related professions, along with many other professions that require high cognitive demands and the application of appropriate

conceptual understandings. (See Mackenzie, 2008 and Maclellan, 2005 for more on the importance of conceptual learning in higher education).

Despite the desire institutions of higher education may have to promote conceptual learning and the acquisition of appropriate conceptual understandings by students, many students enter the classroom with weak/naïve conceptions and/or misconceptions that are deeply rooted in their personal beliefs and are difficult to change. In regards to the previous example, a deeply rooted belief that individuals may hold when they enter the classroom is the notion that viruses and bacteria are terms that can be used interchangeably (Gillen & Mayor, 1995). News outlets, historical summaries, journal articles, textbook descriptions, and internet resources (Bell & Linn, 2002) may in fact reinforce notions that viruses and bacteria are terms that can be used interchangeably, especially when referred to in a manner that emphasizes shared characteristics of viruses and bacteria (i.e. “we know that some viruses and bacteria can live two hours or longer on surfaces, such as doorknobs,” (Vergano & Szabo, 2009).

In academic areas where weak conceptions or misconceptions are abundant, educators may turn to literature on conceptual change to look for effective instructional strategies that may help their students better acquire appropriate conceptual understandings (see Bahar, 2003). Some of this literature suggests inducing cognitive conflict, whereby students become aware of the weaknesses in their conceptions, is a first step in facilitating conceptual change (Limon, 2001). In the above example, an educator may begin describing to students how viruses fail to meet three requisite characteristics of life (specifically, lacking a cellular structure, not being able to metabolize on their own, and cannot replicate without invading a host cell). It is traditionally recommended

that educators demonstrate the correct conception, allow students to recognize the conflict between the correct conception and their own, allow students to apply the correct conception to diverse situations. Other conceptual change instructional strategies include the use of refutational texts (Palmer 2003), argumentation (Nussbaum & Sinatra, 2003), and promoting ontological shifts (Slotta & Chi, 2006). (See Duit & Treagust, 2003, for more on applications of conceptual change theory to instructional practices).

Facilitating Conceptual Change

According to the work of Jean Piaget (circa 1950s), which reflects more of a cognitive perspective of learning, changes to individuals' mental representations can occur in one of two fashions, assimilation or accommodation. In assimilation, learners attempt to understand a new phenomenon in terms of their existing conceptions. Accommodation on the other hand, involves modifying and restructuring one's core conceptions. The research area, called conceptual change, is dedicated to investigating the underlying mechanisms of the latter process (accommodation).

Conceptual change research has primarily been concerned with investigating how naïve or non-scientific conceptions develop, the structure of misconceptions, and the processes involved in correcting and/or restructuring naïve conceptions. In an early theory of conceptual change, Posner, Strike, Hewson, and Gertzog (1982) proposed four conditions, for which conceptual change can be facilitated. These conditions include helping students to become aware of the inadequacies in their existing conceptions (dissatisfaction), appreciate how a new and/or appropriate concept works (intelligible), perceive the new concept to be a reasonable explanation of the phenomena (plausible),

and apply the new concept to other areas of inquiry (fruitful). Empirical studies that have designed instructional interventions around Posner et al.'s conditions have occasionally been successful in getting students to undergo conceptual change (see Jensen and Finley, 1995). Nevertheless, Chan et al. (1997) argued that conceptual change may be better facilitated if interventions were designed to get students to achieve “meaningful conflict.” Chan et al. (1997) argued that the condition of dissatisfaction may not be successfully met by merely presenting students with materials that contradict their existing conceptions. Instead, they argue that students need to reach a point during instruction in which they perceive that changes to their existing conceptions are necessary and in need of resolution (meaningful conflict). In this sense, students need to be active in the conceptual change process and motivated to change their existing conceptions.

Contemporary models of conceptual change identify motivation as an instrumental construct in facilitating conceptual change, when it enhances engagement and deep information processing strategies (see Dole & Sinatra, 1998; and Gregoire, 2003). The hypotheses of these models suggest that motivation can stimulate and sustain the engagement necessary for promoting conceptual change (Mason, Gava, & Bordin, 2008). Engagement on a task affords individuals with the opportunities to make meaningful connections and deeply process the information that individuals use to restructure their existing conceptions. In a study by Linnenbrink and Pintrich (2002b), the motivational construct of mastery goal orientation was found to be associated with conceptual change in students with low background knowledge for the learning task, and that engagement (as determined by students' perceived use of elaborative strategies) mediated the influence of mastery goals on conceptual change.

Additional empirical studies (to be presented in the next chapter) offer some support to the hypotheses made by these contemporary (motivation-laden) models of conceptual change, however, few motivational frameworks have been applied to conceptual change interventions. The contemporary models of conceptual change explain motivation in relatively general terms, thus generating hypotheses and explanations about how specific motivational frameworks fit into the conceptual change process remains to be difficult, as many associations between various motivational constructs and conceptual change have yet to be established. Task values (reasons for engaging in a task) are motivational constructs that have not been investigated in conceptual change research, however, they have been found to be associated with deep cognitive engagement (Greene et al., 1999). Applying task values to conceptual change interventions may result in students' increased engagement for a learning task, and subsequently promote conceptual change. Nevertheless, empirical studies have not investigated the role task values may play in the conceptual change process, thereby leaving such a hypothesis untested and a gap in the conceptual change literature unfilled.

Purpose of Study

The purpose of the following study is to investigate the role of task values in facilitating conceptual change, by applying a motivational intervention designed to induce students with differing task values. The three research questions that guide the study are: 1) Would the participants in the utility, attainment, and control conditions differ in their task values? 2) Would the participants in the utility, attainment, and control

conditions differ in their engagement for the learning task? 3) Would the participants in the utility, attainment, and control conditions differ in their conceptual change?

The purpose in structuring each of the research questions in the above order, is to systematically determine whether my method of inducing differing task values in undergraduate students is effective in getting students to adopt characteristics that are consistent with the task value they are induced with; determine whether engagement enhances the effect of task values on conceptual change; and finally establish which of the task value inductions best facilitates conceptual change. Potential implications that can be generated from this study's results may influence how conceptual change theories model motivation, as well as inform educators about which task values may best facilitate conceptual change, if any. Therefore, the results of this study can contribute to the theoretical literatures on conceptual change research, as well as research pertaining to effective instructional practices.

Overview of the Study

This study combines two areas of research in the field of Educational Psychology, specifically motivation research and conceptual change. The intersection of these two areas of research has been termed “hot” conceptual change (Sinatra, 2005) because it diverges from traditional theories of conceptual change, like Posner et al.'s (1982), which do not account for the motivational or affective characteristics of learners. Conceptual change requires an individual to overcome a resistance to change and conceptual change theorists acknowledge that an individual's motivations can play a role in whether this takes place. In “hot” models of conceptual change, motivation is illustrated as a

mechanism that can instigate and sustain the engagement necessary for one to undergo conceptual change (see Dole & Sinatra, 1998). What these models do not explain, however, is how specific motivational frameworks may influence the conceptual change process.

According to an expectancy-value model of motivation, there are four task values (e.g. utility values, attainment values, intrinsic values, and costs) students may have to engage in a learning task (Eccles & Wigfield, 2002). Two of these task values are utility values and attainment values. Utility values describe an individual finding a task to be useful to their future goals. Attainment values describe an individual finding a task to be important to their self-schema. Arguably, all task values can motivate students to engage in a learning task, however, they may motivate students in different ways, activate engagement on a task to differing degrees, and result in individuals experiencing different degrees of conceptual change. Nevertheless, it is unclear from contemporary models of conceptual change how particular task values influence conceptual change. Both utility and attainment values have been found to be more predictive of positive achievement outcomes than alternative task values (i.e. intrinsic values) (Cole et al., 2008). Furthermore, the task value of utility has been found to be associated with deep cognitive engagement (Greene et al., 1999), and according to Dole and Sinatra (1998) high engagement should result in strong conceptual change.

Based on this literature, three research questions guided this study: 1) Would the participants in the utility, attainment, and control conditions differ in their task values? 2) Would the participants in the utility, attainment, and control conditions differ in their engagement? 3) Would the participants in the utility, attainment, and control conditions

differ in their conceptual change? I hypothesized that inducing a group of students with utility values would result in that group behaving in accordance with a utility value, report the greatest amount of engagement, and experience the greatest amount of conceptual change. Potential implications from this study may influence how conceptual change theories model motivation, as well as inform educators about which task values may best facilitate conceptual change.

Methods. At a large public university in the Southwest, 166 education undergraduates (129 female, 34 male, and 3 not reported) participated in this study. Fifty-four participants were randomly assigned to the utility condition, 54 to an attainment condition, and 58 to a control condition. Upon signing up for this online study, participants were pretested on their conceptual understandings about the causes of the common cold and then given their respective instructional induction. All participants then received the reading task on the causes of the common cold, followed by posttests for conceptual understandings of the causes of the common cold, confirmation questions, and demographics.

Instructional inductions were developed to induce participants with a “utility value” or “attainment value,” since previous studies have reported (Cole et al., 2008) these values as more predictive of positive achievement outcomes than alternative task values (i.e. intrinsic values). Participants read a brief story about a student who behaved in accordance with a specific task value. Participants were then asked to reflect on whether they knew of any colleagues who had behaved in this manner and/or times in which they themselves behaved like the student in the story. Participants were then instructed to approach the reading task in accordance with the task value being induced.

Finally, participants were asked to describe ways in which the reading task could be applied to their future careers (for the utility condition) or ways in which their performance on the assessments could be a reflection of their academic abilities (for the attainment condition). Control condition participants were simply directed to complete the reading task.

A 985 word refutaional text was developed to refute common misconceptions about the causes of the common cold, based on published literature on the common cold (Turner & Hendley, 2005; Pittet & Boyce, 2003; and Roberts et al., 2000). Items were generated from the text's content to construct a pretest/posttest measure (16 selected response items) assessing students' conceptual understandings about the causes of the common cold. Finally, confirmation items were used to assess participants' perceptions about how they approached the reading task and the degree to which they were engaged. An item for "utility approach" asked participants to rate whether they tried to relate the content to issues useful to their career (i.e. preventing the spread of colds in their future classroom). An open-ended confirmation question asked participants to describe their goal for the reading. An item for perceived engagement asked participants to rate how engaged they were in the reading.

Results. Multiple approaches to test my research questions and hypotheses were utilized throughout the study, and of the many statistical analyses employed, a one-way ANOVA was used to determine whether the participants in the utility, attainment, and control conditions differed in task values. Groups were compared on the confirmation item for utility approach, and a statistical difference among the groups was observed, $F(2, 162) = 4.52, p = .01, \eta^2 = .05$. Tukey Post-hoc comparisons suggest that utility

condition participants ($M = 5.28$, $SD = 1.53$) had significantly higher scores for their utility approach than did those in the control condition ($M = 4.42$, $SD = 1.60$) ($p = .02$), but not the attainment condition ($M = 4.57$, $SD = 1.63$) ($p = .07$).

An analysis of participants' responses to the confirmation item "... describe your overall goal for the previous reading task," revealed that 48.1% of utility condition participants indicated that their "... goal was to understand the text so I could apply it to future situations," compared to 11.5% from the attainment condition and 21% from the control condition. The response "I want my performance to be outstanding because my performance is a reflection of me as a student," was expressed by 59.6% of the attainment condition participants, compared to 20% from the control condition and 15.4% from the utility condition. Participants in the control condition did not show any favoritism toward a utility or attainment oriented approach to the reading. These results suggest that participants tended to adopt approaches to the reading that were consistent with the task value inductions they received.

A one-way ANOVA was employed to test whether the groups would differ on engagement. A statistical difference was observed, $F(2, 162) = 7.56$, $p = .001$, $\eta^2 = .085$. Tukey post-hoc comparisons revealed that the utility condition participants rated their perceived engagement higher ($M = 5.60$, $SD = 1.28$) than control condition participants ($M = 4.54$, $SD = 1.66$) ($p = .001$). Utility condition participants' ratings did not significantly differ from those in the attainment condition ($M = 5.18$, $SD = 1.37$). The control and attainment conditions did not statistically differ.

To determine whether the groups differed in their conceptual change, a repeated measures ANOVA was employed. Pretest and posttest conceptual understanding scores

were used as the repeated measure. A significant difference was observed between groups on their posttest scores of conceptual understanding, $F(2, 162) = 3.5, p = .03, \eta^2 = .04$. There was a statistically significant interaction between condition and time, $F(2, 162) = 15.94, p = .01, \eta^2 = .20$. The effect of time on the dependent variable was also significant $F(1, 162) = 301.31, p = .01, \eta^2 = .65$. Gains in conceptual understanding scores from pretest to posttest suggest that the utility condition participants demonstrated the greatest degree of conceptual change ($M = 5.74, SD = 3.05$), followed by those in the attainment condition ($M = 3.98, SD = 3.2$), and finally the control condition ($M = 2.51, SD = 2.8$).

To investigate whether condition assignment would be enhanced by perceived engagement to better predict conceptual change, regression analyses were performed. In the first regression model, where utility condition and perceived engagement were entered sequentially as predictor variables, perceived engagement ($b = .17, t = 2.35, p = .02$) accounted for an additional 3% of the variance in conceptual change over that accounted for by utility condition ($b = .32, t = 4.33, p = .01$), which accounted for 13% of the variance. In the second regression model, where attainment condition replaced utility condition as a predictor variable, perceived engagement ($b = .25, t = 3.28, p = .01$) accounted for an additional 6.2% of the variance in conceptual change over that accounted for by attainment condition ($b = -.03, t = -.32, p = .75$), which was 0%. In the third regression model, where control condition was entered as a predictor variable, perceived engagement ($b = .17, t = 2.23, p = .027$) accounted for an additional 3% of the variance in conceptual change over that accounted for by control condition ($b = -.30, t = -2.23, p = .03$), which was 12%. The significant positive standardized beta coefficient for

the regression model using utility condition as a predictor variable and accounting for perceived engagement, suggests that being in the utility condition was predictive of conceptual change, more so than being in an alternative condition.

Discussion. Theoretical implications drawn from this study's results include that conceptual change models should account for task values. The finding that both the utility and attainment conditions experienced more conceptual change than did the control condition can inform conceptual change theorists about the role of task values in promoting conceptual change. Utility values may promote conceptual change to a greater degree, than attainment values, because the usefulness of a task to one's future goals may allow learners to make more meaningful connections between new concepts and things they may already know. Conversely, attainment values may focus a learner's attention away from the learning task and more on an alternative goal (i.e. doing well on assessments). The third theoretical implication of the study is that engagement contributes to the conceptual change process, and helps explain why stressing utility values may effectively promote conceptual change. The observed difference between the utility and control conditions on perceived engagement, suggests that the utility condition participants (who also experienced the greatest amount of conceptual change) perceived that they were more actively engaged with the reading than the control condition. These theoretical implications should inspire new directions for contemporary models of conceptual change, as new empirical evidence continues to emerge.

In a practical sense, I also infer that 1) stressing utility and attainment values may be an effective way for educators to promote the adoption of utility and/or attainment oriented approaches to learning tasks by students; and that stressing a utility value 2) may

promote higher engagement on learning tasks than not stressing any type of task value; and 3) may promote conceptual change more effectively than stressing an attainment value or no value at all. Based on the results of the first research question, I would encourage educators to consider emphasizing utility or attainment values for learning tasks as a way to promote the adoption of such values by students. Educators may also find it beneficial to emphasize the utility value of a learning task, since our findings suggest that engagement can be bolstered by the stressing of a utility value; and that a stressing of a utility value may be the most potent task value in facilitating conceptual change.

The findings from this study provide new and original insight into the role of task values in the conceptual change process, in that I was able to facilitate students' adoption of approaches to a learning task that were consistent with the task values with which they were induced; I found that inducing students with a utility value can instigate greater engagement on tasks than if students were not induced with a task value; and I found support that different task values can promote conceptual change to differing degrees. These results suggest that educators who are interested in facilitating conceptual change, should consider stressing the utility of tasks to their students. Additionally, I contend that task values should be accounted for in models of conceptual change, so that scholars can better understand the patterns of student behaviors and experiences during the conceptual change process. The utility of this study's findings and implications set the foundation in the use of task value instructional inductions for facilitating engagement and conceptual change.

CHAPTER 2

BACKGROUND LITERATURE

Conceptual Learning/Change

Theoretical frameworks about conceptual learning and conceptual change can be traced back to theorists such as Jerome Bruner and Jean Piaget. Conceptual learning, as described by Bruner, Goodnow, and Austin (1956) is a process of forming and testing hypotheses. Bruner et al., envisioned conceptual learning to involve the building of hypotheses based on features and rules of a concept, which can be confirmed or rejected by positive or negative instances. Changes to a concept occur as a result of confirming or rejecting hypotheses. Jean Piaget (circa 1950s), described two types of conceptual learning as accommodation or assimilation. Assimilation refers to one's understanding of new phenomena in terms of their existing conceptions, whereas accommodation involves the restructuring of one's conceptions. According to Piaget, only through disequilibrium (a state in which an individual becomes dissatisfied with their current understanding) can accommodation take place. In a process called equilibration, individuals move between states of equilibrium and disequilibrium to achieve complex conceptual understandings.

It is through both Bruner's and Piaget's work where the research area of conceptual change arises. Acknowledging that learners do not enter the classroom as blank slates, but often have existing conceptions about many scientific matters (Strike & Posner, 1992), a theory of conceptual change was proposed by Posner et al. (1982). Posner and his colleagues suggested that learning is a rational activity and that students make judgments on the basis of evidence. "Learning is fundamentally coming to comprehend and accept ideas because they are seen as intelligible and rational," (Posner

et al., 1982, p. 212). Posner et al. proposed a list of conditions for conceptual change. These conditions are dissatisfaction, intelligibility, plausibility, and fruitfulness of the new conception. Dissatisfaction may occur when the learner recognizes that their conceptions may be inadequate or inconsistent with new information (e.g. disequilibrium). This increases the possibility that the learner will perceive that changes in their original conception are needed. Learners' must find the new conception to be intelligible and plausible, that is, the learner needs to appreciate how the new concept works and perceive it to be a reasonable explanation of the phenomena. Finally, the new conception should be fruitful, in that the new conception should be applicable to other areas of inquiry. Posner et al. viewed conceptual change as a gradual adjustment of a conception, with each new adjustment building upon other adjustments, resulting ultimately in the reorganization of one's conception.

A decade after Posner et al. (1982) proposed their theory of conceptual change, Strike and Posner (1992) suggested five revisions to their earlier perspective. Strike and Posner acknowledged that their previous work was more rational than learners are likely to be when confronted with conceptions that conflict with their own. Therefore, Strike and Posner suggested that a new theory of conceptual change should "focus on the learner's conceptual ecology and how that ecology structures learning" (p. 160). Strike and Posner describe a conceptual ecology as form and composition of a conception, as well as beliefs of the individual (i.e. epistemological beliefs, knowledge from other areas of inquiry, etc.). Strike and Posner's second critique is that their initial theory failed to acknowledge the ways in which conceptions or misconceptions interact with learner's conceptual ecology. That is, all parts of a conceptual ecology must be seen as dynamic

and interactive with the new conception. The third critique acknowledges that the initial theory was overly rational and did not account for affective factors (i.e. emotions and motivation) that may influence the structure of learners' representations of concepts. The last two points made by Strike and Posner suggest that new theories should consider developmental and interactionist views of conceptual ecologies, "our view of conceptual change must therefore be more dynamic and developmental, emphasizing the shifting patterns of mutual influence between the various components of an evolving conceptual ecology" (p. 164).

"Hot" Conceptual Change. In Posner et al.'s (1982) initial conception of a theory of conceptual change, motivational and affective factors were set aside because Posner et al. noted that they intended to "focus [their] attention on what learning is, [and] not what learning depends on" (p. 212). It was not until Strike and Posner (1992) began to acknowledge the various aspects influencing a learner's conceptual ecology, that motivation and affective factors were reconsidered as integral components to the conceptual change process. Pintrich, Marx, and Boyle (1993) echoed Strike and Posner's claims that their early theory of conceptual change was overly rational (cold, mechanical, and without emotion), and that new models of conceptual change needed to become "hotter," accounting for constructs such as motivation and affect. Since conceptual change involves overcoming a resistance to revise one's beliefs and adopt alternative beliefs, Pintrich et al. suggested that motivational constructs (goals, values, self-efficacy, and control beliefs) could influence the process of conceptual change.

In a study by Jensen and Finley (1995), a conceptual change intervention was designed around Posner et al.'s (1982) conditions of conceptual change. Though Jensen

and Finley report an overall trend of students' changing their existing conceptions of evolution towards more scientifically appropriate ones, many conceptually important aspects of evolution remained difficult to change. A possible reason as to why Jensen and Finley's conceptual change intervention was not potent enough to promote changes in all of the students' evolutionary conceptions is explained by Chan et al. (1997), who suggest that the overly rational conditions pitched by Posner et al. may not allow students to achieve meaningful conflict (dissatisfaction). Thus, despite the fact that information can be presented in a manner that contradicts students' existing conceptions, students may not perceive that a change is necessary and the condition of dissatisfaction is never truly met. Motivation can be the mechanism that sustains a student's desire to resolve conflict and may promote conceptual change, as motivational constructs may allow students to make meaning out of contradictory information and may give students a reason to persist in their attempts to overcome any resistance to change.

Warming Trend. Following Pintrich et al.'s (1993) calls for conceptual change theories to become "hotter," a warming trend (Sinatra, 2005) occurred whereby conceptual change researchers integrated motivation into their frameworks. Two influential models that contributed to this warming trend include Dole and Sinatra's (1998) Cognitive Reconstruction of Knowledge Model (CRKM) and Gregoire's (2003) Cognitive-Affective Model of Conceptual Change (CAMCC). In Dole and Sinatra's CRKM, characteristics of the learner (which includes a learner's motivation) interact with characteristics of a message (that is to be learned) to establish the degree to which the learner engages with the new concept. It is the degree of engagement which ultimately determines the degree of change one experiences. In a similar fashion, Gregoire's

CAMCC suggests that motivational constructs may influence how individuals process (or engage with) a new concept, thereby contributing to the degree to which one undergoes conceptual change.

Though “hot” models of conceptual change inform studies that apply motivational constructs to conceptual change interventions, specific hypotheses about the behaviors of motivational constructs within the conceptual change process are difficult to generate. This is because “hot” conceptual change models account for motivation in general terms and do not specify or single out any one particular motivational framework, for which there are many. This generality allows for many motivational constructs to be investigated in the context of conceptual change, however, it should not be assumed that all motivational constructs behave similarly. As investigations continue to contribute to the warming trend described above, models of conceptual change will inevitably have to undergo modifications to accurately characterize the behaviors of specific motivational constructs.

Expectancy-Value Theory

One theoretical framework of motivation that has not received a lot of attention in conceptual change models and lacks hypotheses for how its components may fit into conceptual change models is that of expectancy-value theory (EVT). EVT has its historical roots in Lewin’s (1935) and Atkinson’s (1957) notions of valences (values) and expectancy, and relies on the basic premise that individuals are motivated by their reasons for engaging in a task and their expectations to succeed. Expectancy can be conceived as one’s belief in the probability for success on a learning task. Contemporary

models of EVT identify two distinct types of expectancies, outcome expectations and efficacy expectations (Wigfield & Eccles, 2000). Outcome expectations refer to one's belief that a certain action will produce a certain outcome, and efficacy expectations refer to one's belief that they can produce a particular behavior (Eccles & Wigfield, 2002).

The value component of EVT refers to task values, or reasons individuals have for engaging in a task. Eccles and Wigfield (2002) describe four types of task values: utility value, attainment value, intrinsic value, and cost. Utility value refers to the belief that a task is somehow applicable or instrumental to one's future goals (i.e. I want to take a course in calculus because I believe I will utilize calculus in my future career as an engineer). Attainment value refers to the degree of importance an individual places on a task for confirming or refuting salient aspects of one's self-schema (i.e. I want to get a good grade in my math class because I believe my grade is a reflection of my ability as a student). Intrinsic value can be defined as the enjoyment or interest one has in a task (i.e. I want to take a course in calculus because I enjoy working with numbers). Finally, the task value of cost can be defined as the expense or negative consequences for engaging in a task (i.e. I attend my calculus courses because I have already paid my tuition; and it would be a waste of my money if I do not attend).

Each of the aforementioned task values and expectancies has their own unique history, and conceptualizations about how task values and expectancies interact, continues to be a point of debate today. In Atkinson's (1957) model of EVT, incentive values (defined as one's pride in accomplishment; similar to what is now called intrinsic value) are thought to be inversely related to the probability of success (which is now conceived to be outcome expectancies). The problem that arose from Atkinson's

conceptualization is that it failed to explain circumstances in which an individual has a high incentive value for a task and perceives a high probability of success (see Wigfield & Eccles, 1992). As EVT equations that attempted to mathematically articulate an individual's motivation on a task were debated and revised, so too did the terminology used to define expectancies and values change. Definitions for the various task values that Eccles and Wigfield (2002) describe are far removed from the general use and descriptions of individuals' personal value priorities described by Rokeach, (1973, 1975) (i.e. values for family security, pleasure, sense of accomplishment, etc.). Nonetheless, it is from Rokeach's work and Atkinson's definition of incentive values that finer-grained categories of task value developed. Intrinsic value took shape from notions of curiosity and interest (Harter, 1981); attainment value from self-schema (Markus & Wurf, 1987); utility value from extrinsic reasons for doing a task (i.e. to develop a skill) (Deci & Ryan, 1985); and cost from negative aspects of engaging in a task (Eccles et al., 1983).

Despite the changes that were made in the terminology and mathematical equations of EVT, what remained constant is the underlining assumption that student motivation to engage in a learning task consists of task values and expectancies. Eccles and Wigfield's (2002) model of EVT subsumes many motivational constructs (including goals, self-efficacy, affect, self-schemas, etc.) that are expressed in alternative theoretical frameworks of motivation, yet hypothesizes that only expectancies and values directly affect achievement behaviors (i.e. effort, persistence, choice, and achievement). Greene et al. (2004) illustrate in a path model that the task value of utility has direct effects on goal orientations, as well as an indirect effect on academic achievement, when mediated by engagement (as measured by strategy use). In Cole, Bergin, and Whittaker (2008)

attainment value and utility value were found to better predict achievement in various subject matters, when mediated by perceived effort, than intrinsic values.

In considering again how motivational constructs tie back to models of conceptual change, the various task values described by EVT may be applicable to the conceptual change process. If conceptual change interventions were to include task values as an added condition of conceptual change, then students may be able to successfully achieve meaningful conflict (Chan et al., 1997) because they may be able to tie contradictory conceptions back to the task value. Task values may allow students to make meaningful connections with new conceptions by instigating and sustaining the cognitive engagement necessary to facilitate conceptual change. Thus, task values can be hypothesized to enhance cognitive engagement and thereby influence conceptual change. It should be noted however, that the differing task values may lead students to lend their attention to differing aspects of a new conception, and therefore lead students to differing degrees of conceptual processing. This is because the task values themselves provide different meanings for which new conceptions can be tied back to (i.e. future career goals or self-schema).

Promoting Conceptual Change: Empirical Findings

In a study by Jensen and Finley (1995), an instructional intervention was modeled after Posner et al.'s (1982) conditions for conceptual change. To promote college students' acquisition of the most appropriate scientific conceptions of evolution, Jensen and Finley began their instructional intervention by giving students a general introduction to the nature of evolution; taught Lamarckian principles (e.g. the inheritance of acquired

traits [i.e. giraffes stretching their necks and passing it down to their offspring]); presented materials that opposed Lamarckian principles, thereby inducing cognitive conflict; taught Darwin's theory of evolution; and allowed students to practice solving evolutionary problems from both Lamarckian and Darwinian perspectives. Jensen and Finley report that improvement in test scores on conceptual understanding from pretest to posttest was statistically significant. Students' appeared to display an overall increase in their ability to respond to questions about evolution in more Darwinian terms. Jensen and Finley conclude that:

It appears that if instruction recapitulates events in the development of the Darwinian theory of evolution by natural selection in a way that meets the conditions for conceptual change, then students replace their initial conceptions with a more Darwinian conception. (p. 164)

Jensen and Finley (1995) caution, however, that despite the improvement in students' test scores, fewer than 50% of students' responses to the posttest questions were given in strictly Darwinian terms. Furthermore, some key evolutionary concepts remained difficult for students to understand. From the limitations discussed in Jensen and Finley's study, one may conclude that the mere presentation of information that is in opposition to previously taught materials may not be potent enough to engender dissatisfaction, thereby restricting the degree to which students change their conceptual understandings. Chan et al. (1997) state that "even when students are confronted with contradictory information, they are often unable to achieve meaningful conflict or to become dissatisfied with their prior conceptions," (p.2). Chan et al. describe "meaningful conflict," as conflict that

actually brings about a state of dissatisfaction with existing knowledge (Dreyfus, Jungwirth, & Eliovitch, 1990).

In their study involving the testing of a model designed to investigate the role of knowledge processing on conflict and conceptual change, Chan et al. (1997) found that higher levels of knowledge processing mediated the effect of conflict and change in high school students' conceptions of evolution. Meaning that when students were confronted with information that contradicted what they believed, students who treated new information as something problematic and in need of an explanation (making it meaningful and processing it more deeply), were more likely to undergo conceptual change. This echoes the arguments made by Dreyfus et al. (1990), who found that high school students appeared to favor conceptions about biology that were meaningful to them, regardless of whether the conceptions were correct or weak. Dreyfus et al. argued that in order for students to learn a new concept, they must be actively involved in the process of changing and/or restructuring their existing conception(s).

This notion of being actively involved in the conceptual change process is something that is expressed to a greater degree in the works pertaining to intentional conceptual change and "hot" conceptual change (see Sinatra & Pintrich, 2003, and Sinatra, 2005). It is these perspectives where affective and motivational constructs are accounted for to explain the mixed results obtained in previous studies that have applied Posner et al.'s (1982) conditions of conceptual change (Limon, 2001). I now turn to some of these "hotter" conceptual change studies to illustrate some of the contemporary and "hotter" departures from Posner et al.'s conditions.

Inducing Goal Orientations

Linnenbrink and Pintrich (2002b) considered the motivational constructs of achievement goal orientations as an induction strategy designed to promote conceptual change. These scholars argued that conceptual change requires high levels of engagement and the use of adaptive cognitive strategies, thereby suggesting that students' motivation plays a role in determining the degree to which students may undergo conceptual change. Achievement goal theory (AGT) is a social cognitive theory of motivation that postulates that achievement goals are linked to different behavioral, cognitive, and affective outcomes (Linnenbrink & Pintrich, 2002a). Dominating much of the previous literature on AGT, the dichotomous framework of AGT describes achievement goals as either mastery-oriented or performance-oriented. Mastery goal oriented individuals seek to master a task for the sake of gaining competence and performance goal oriented individuals seek to gain favorable judgments of competence and avoid situations that may lead to unfavorable judgments (Elliot & Dweck, 2005). Of the two goal orientations, mastery goals are often deemed to be the most favorable and advantageous in learning environments, because they have been found to be associated with positive well-being, positive attitudes towards academia, the use of effective cognitive and metacognitive strategies, long-term retention of information, more effort while studying, and intrinsic motivation (Kaplan, Gheen, & Midgley, 2002; Elliot, 1999).

In the context of conceptual change, Linnenbrink and Pintrich (2002a) argue that because mastery goals are characterized as one's focus on the task, and because performance goals are characterized more as one's focus on themselves, students with mastery goals should be better situated to identify inadequacies in their existing

conceptions, than students with performance goals. Furthermore, a focus on the self may be what distracts a performance oriented individual from engaging in a learning task, whereas a focus on the task at hand may allow mastery oriented individuals to engage in the task and make meaningful connections with new conceptions. In their investigation of goal orientations on conceptual change, Linnenbrink and Pintrich (2002b) present two studies that examine the role of motivational beliefs in the changing of college students' conceptions of projectile motion. In Study 1, Linnenbrink and Pintrich set out to test a general model of the direct and mediating effect of achievement goals, affect, and cognitive strategy use on conceptual change. Using the dichotomous framework of AGT, Linnenbrink and Pintrich (2002b) hypothesized that mastery goals would be the greatest predictor of conceptual change, whereas performance goals would not be associated with change. Linnenbrink and Pintrich (2002a) state:

With a mastery orientation comes a focus on the task at hand; this focus on the information as opposed to the self [(i.e. performance orientation)] . . . should allow mastery-oriented students to more readily detect a discrepancy between their current understanding and the information they are learning . . . [and] more likely to try to connect what they are learning to their prior knowledge. (p.358)

Students in the Linnenbrink and Pintrich (2002b) study were first given a pretest on their physics understanding and then induced with either a mastery goal orientation or performance goal orientation through instructional text (directions to “do your best” to induce mastery goals and “beat all of the other students” to induce performance goals). Students then read a passage about Newtonian physics, worked on a word puzzle as a buffer task, before finishing with a posttest measure on their physics understanding and

self-report measures for affect and cognitive strategy use. For students with low prior physics knowledge, mastery goals were the greatest predictor of change, whereas performance goals were not associated with change; mastery goals were not related to change for those with high prior knowledge. Linnenbrink and Pintrich also reported that despite being related to mastery goals and conceptual change, neither cognitive strategy use nor affect seemed to have been a mediating factor between mastery goals and conceptual change in their first study. Nevertheless, Linnenbrink and Pintrich expressed retesting their model in their second study, where more refined measures of affect and strategy use could be employed. In Study 2, Linnenbrink and Pintrich replicated their procedures from Study 1 and tested a path model to determine whether mediating variables could be used to explain the effect mastery goals had on conceptual change. Both elaborative strategy use and negative affect mediated the relationship between mastery goals and conceptual change. Linnenbrink and Pintrich suggested that because mastery goals are positively related to elaborative strategies, and because mastery goals are negatively associated with negative affect, students with mastery goals are in a state conducive to change.

Though Kang, Scharmann, Noh, and Koh (2005) did not employ any instructional strategies involving the induction of goal orientations in their study on the relationships among cognitive and motivation variables, cognitive conflict, and changes in Korean middle school students' conceptions of weight-density, they report that mastery goals are not related to conceptual change. Kang et al. explained this lack of a relationship on the notion that motivational variables, such as goal orientations, are relatively situation specific and that mastery goal orientations may have been negated by the generality of

the tasks being presented to students throughout their study. Kang et al. did however find a significant relationship between their measure of failure tolerance (degree to which a student can tolerate failing at a task) and conceptual change. Kang et al. explain this result by concluding that it may be a matter of students' persistence and the degree of conflict students can withstand that is more important to predicting conceptual change; which in itself does not implicate mastery goals.

Despite the somewhat contradictory ideas expressed in Kang et al. (2005) and Linnenbrink and Pintrich (2002b), these two studies inspire further investigations into the relationships and behaviors of motivational variables in conceptual change. In a study by Johnson and Sinatra (2009), an instructional strategy to induce students with goal orientations was employed to facilitate conceptual change, however, instead of utilizing the dichotomous framework of AGT applied by Linnenbrink and Pintrich (2002b), instructions were tailored to reflect the goal orientations described by the 2x2 framework of AGT¹ (i.e. mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance). The rationale behind the Johnson and Sinatra study was in part inspired by the assumptions of Gregoire's (2003) Cognitive-Affective Model of Conceptual Change (CAMCC), which postulated that individuals with "approach" intentions would process information in a more direct manner and undergo conceptual change, if any change at all; and individuals with "avoidance" intentions would process

¹ The 2x2 framework of AGT (Elliot & McGregor, 2001) emerged due to ambiguous results found with performance goals in the dichotomous framework of AGT. Though hypothesized to be associated with maladaptive behaviors such as low academic efficacy and low achievement (Dweck & Leggett, 1988), some studies have reported that in competitive learning environments, performance goals are associated with high academic achievement (Midgley, Kaplan, & Middleton, 2001). Returning to Atkinson's (1957) notion of approach and avoidance motives, which postulates that individuals are motivated to maximize satisfaction by approaching successes or to avoid negative consequences that may bring about pain, goal theorists applied approach and avoidance valences to mastery and performance goal orientations to account for the discrepancies found in previous achievement goal studies.

information in a more superficial manner and undergo superficial belief change, if any change at all.

To induce the four goal orientations defined by the 2x2 framework of AGT, which integrates approach and avoidance valences to the traditional mastery and performance goal dimension, Johnson and Sinatra (2009) provided college biology students instructional texts intended to induce a specified goal orientation. This induction event followed a pretest of students' conceptual understandings of HIV/AIDS. The instructional inductions consisted of a description of a fictional student named Jordan, who behaved in accordance with one of the specified goal orientations described by the 2x2 framework of achievement goal theory. Following this description students were asked to reflect on whether they knew of any colleagues who have behaved like Jordan, and times in which they themselves behaved like Jordan. Finally, students were asked to maintain the goal behavior of Jordan for a reading task that was to follow. This latter portion of the instructional inductions reflected that which were developed and utilized in Linnenbrink and Pintrich (2002b), whereby students were informed that they should do their best (to induce mastery) or outperform other students (to induce performance goals). Additional alterations were made for the inductions with avoidance valences, whereby the mastery-avoidance priming asked students to do their best by avoiding the making of mistakes, and performance-avoidance priming asked students to avoid being the worst performer (as opposed to striving to be the best performer).

After the induction of goal orientations, students were given a 1,000 word reading text on HIV/AIDS, given a posttest on HIV/AIDS, and finally given a demographic questionnaire. Utilizing several analyses of covariance (ANCOVAs), Johnson and Sinatra

(2009) identified that students primed with approach goals (both mastery-approach and performance-approach goals) differed significantly from those primed with avoidance goals. No additional significant differences between the primed groups were found; not even along the mastery and performance dimension. Johnson and Sinatra concluded that the priming of approach goals was activating in nature, meaning that students primed with approach goals were activated to apply their attention and efforts towards the content presented in the HIV/AIDS text; whereas the priming of avoidance goals was deactivating in nature, meaning that students primed with avoidance goals were deactivated to engage with the task and perhaps lent more of their cognitive resources to alternative behaviors (i.e. worrying about making mistakes).

Much like the Kang et al. study, the Johnson and Sinatra (2009) study did not report a direct effect of mastery goals on conceptual change. This is unique for both the motivation literature and conceptual change literature, because goal theorists have often described mastery goals as being the most adaptive goal orientation for learning contexts and having stronger associations to cognitive engagement than performance goals (Dupeyrat & Marine, 2005; Meece, Blumenfeld, & Hoyle, 1988). The absence of a reported significant relationship between mastery goals and conceptual change does not however suggest that the two constructs are unrelated. Instead, the results of studies like Johnson and Sinatra (2009) and Kang et al. (2005) suggest that there may be motivational elements that are more potent in facilitating conceptual change, than mastery goals alone.

The Warming Trend

In addition to goal orientations, Pintrich et al. (1993) suggest that alternative motivational constructs, such as self-efficacy, values, epistemological beliefs, control beliefs, and personal interest, may be mediators in the conceptual change process (see also Sinatra, 2005). Recent conceptual change studies involving the motivational constructs of students' epistemological beliefs and topic interest², include the work of Mason and her colleagues (Mason, & Boscolo, 2004; Mason, Gava, & Boldrin, 2008). In their study on the interaction between type of text (refutational vs. traditional), epistemological beliefs, and topic interest on conceptual change, Mason et al. (2008) pretested fifth grade students' knowledge about the topic of light, reading comprehension, and epistemological beliefs about scientific knowledge (e.g. is it complex and evolving, or simple and certain). In a second session (one week later) with the fifth grade students, Mason et al. assigned students to a reading condition in which one condition received a refutational text reading on light, or a traditional text reading about light that was derived from a traditional science textbook. Participants then rated their opinion of the text they received and were asked open-ended questions about what they retained from the text (immediate posttest). Finally, in a third session (two months later) with the same students, Mason et al. asked students what they retained from the text (delayed posttest). Utilizing a repeated measures analysis of covariance (ANCOVA), Mason et al. compared students who received different text types (refutational vs. traditional), had differing epistemological beliefs (complex/evolving vs. simple/certain), and topic interest (high liking vs. low liking), on immediate and delayed posttest

² Topic interest is "the likelihood of attending to particular subject content . . . or positive feelings for content," (Renninger, 2000, p. 376).

scores, with text comprehension being used as a covariate. Mason et al. found that fifth grade students in the refutational text condition, who had high topic interest, and who had advanced beliefs about scientific knowledge (complex/evolving), attained higher scores on both the immediate and delayed posttest, than other fifth grade students with alternative circumstances. Mason et al. concluded that the motivational factors of epistemological beliefs and interest may interact with instructional materials that are meant to facilitate conceptual change.

[Advanced epistemological beliefs] were best as resources in conjunction with attention arousal, which was stimulated by topic interest, and in relation to reading a text that helped students recognize the limitations of their conceptions and the value of scientific ones. Activities and contexts devised to sustain the development of beliefs about the nature of knowledge are more or less indirect ways to favor the knowledge revision process. (Mason et al., 2008, p. 304)

In further explaining their results, Mason et al. (2008) contend that the motivational construct of interest promotes the activation of students' attention in a manner whereby the students' engagement for a learning task is sustained (see also Mason & Boscolo, 2004). A greater degree of engagement should afford students more time working with and processing new information that can contribute to the revisions of one's existing conception(s). Engagement can be conceived as one's interaction with a task that is simultaneously motivated and strategic (Guthrie et al., 2004). Additional claims about the nature of engagement are that it should correlate with achievement and that instruction can be designed to increase engagement. According to Dole and Sinatra's (1998) Cognitive Reconstruction of Knowledge Model (CRKM), engagement is

hypothesized to exist on a continuum from low to high, and mediates the influence of motivation on conceptual change. Dole and Sinatra contend that only individuals who fall on the high end of the engagement continuum are more likely to achieve strong conceptual change, as they should be more likely to make meaningful connections with their existing conceptions by utilizing deep processing strategies, elaborative strategies, and/or reflection.³

Using Dole and Sinatra's (1998) CRKM, along with theoretical frameworks for persuasion ("the process by which a given message alters individual's understandings," Murphy et al., 2005, p.419), Murphy et al. (2005) explain their finding of a relationship between need for cognition (the tendency to engage in and enjoy effortful thinking) and conceptual/belief change. Murphy et al. (2005), examined the motivational constructs of need for cognition (the tendency to engage in and enjoy thinking), topic interest (i.e. interest towards isolated topics within a reading), and text interestingness (i.e. interest towards the overall reading texts) for predicting college students' belief change. A stratified random sample of college students responded to two persuasive articles (one on doctor-assisted suicide and a second on school integration) that were presented through either a computer or paper medium. Murphy et al. found that need for cognition emerged as the only significant predictor of belief change, regardless of the mode of text delivery (paper or computer).

Though the motivational constructs of topic interest and text interestingness were hypothesized to be strong predictors of belief change, Murphy et al. suggest that the lack of statistically significant predictors of belief change in their study may be due to their

³ Recall that Linnenbrink and Pintrich (2002b) found elaborative strategy use to be one of the mediating factors between mastery goals and conceptual change. In their terms, Linnenbrink and Pintrich referred to elaborative strategies as engagement.

ineffectiveness in increasing engagement on the task. “While motivating a student through text interestingness or topic interest may activate energy for learning, the energy must be directed into focused activities of processing that will produce positive results” (Murphy et al., 2005, 435). Need for cognition on the other hand assumes an exertion of effort towards processing new information. The findings and implications of the Murphy et al. (2005) and Mason et al. (2008) studies suggest an explanation for the contributing role of engagement in the relationship between motivation and conceptual change. It is clear from the conclusions of Murphy et al. that motivational constructs may not be enough to facilitate conceptual change, especially if they do not direct students’ focus on the information being presented.

Motivation, Cognitive Engagement, and Conceptual Change

Nussbaum and Sinatra (2003) tested a conceptual change intervention based on argumentation. College students were either asked to argue in favor of a scientific explanation about the trajectory of a falling object or simply asked to solve a physics problem regarding the trajectory of a falling object without argumentation. Nussbaum and Sinatra contended that the former condition fosters high engagement and affords students the opportunities to juxtapose ideas against one another. Results indicated that students asked to argue in favor of a scientific explanation, showed improved reasoning on the physics problem regarding the trajectory of a falling object. Nussbaum and Sinatra advocate that argumentation may be an effective and efficient instructional technique that promotes the engagement that is necessary for facilitating conceptual change.

Nussbaum and Sinatra's (2003) study illustrates that task engagement can potentially be effective in promoting conceptual change. Nevertheless, in recalling the conclusions made by Chan et al. (1997) [discussed earlier in this chapter], a conceptual change intervention may not be entirely effective if the learner cannot achieve any meaningful conflict. Thus, if a learning task was designed to be engaging but not motivating, the risk of failing to get students to achieve meaningful conflict may remain. In a similar fashion, if a learning task was designed to be motivating and not engaging, the risk of students lending their attention to elements outside the task may remain (Murphy et al., 2005). This suggests that both motivation and engagement may need to be considered simultaneously to optimally facilitate conceptual change.

Several studies involving the motivational construct of task value describe some motivational elements that may stimulate and sustain cognitive engagement on learning tasks (Cole et al., 2008; Greene et al., 2004; Miller, DeBacker, & Greene, 1999). For example, Greene et al. note that,

A smaller, more recent body of research . . . has linked effective cognitive engagement to perceived instrumentality [utility value]. The conceptual underpinnings of this relationship are as follows: as tasks increase in their perceived instrumentality, the incentive value of success also increases. Students invest greater effort and more appropriate cognitive resources to tasks perceived as having high personal incentive value. (p. 476)

In a study by Greene et al. (2004), a path analysis was used to test the impact of the motivational constructs (i.e. achievement goals, self-efficacy, and the task value of utility [perceived instrumentality]) on engagement (strategy use), and high school students'

achievement. Greene et al. reported a positive indirect effect of utility value on achievement, when mediated by engagement. In addition to predicting engagement, utility value was also predictive of students' mastery goals. Additional relationships in the model include a direct effect of self-efficacy on achievement, as well as indirect effects of mastery goals and self-efficacy on achievement, mediated by engagement. The relationships expressed in this path model echo what Greene and her colleagues have found in their previous work (see also Miller, DeBacker, & Greene, 1999; Greene & Miller, 1996; Miller et al., 1996). In all cases, the authors argue that utility values should be fostered in educational settings as they are predictive of engagement, achievement, and/or mastery goals.

If students do not perceive current academic activities as instrumental to attaining personally relevant future goals, we question whether those activities will have sufficient incentive value to foster the level of student cognitive engagement necessary to produce meaningful learning. (Miller, DeBacker, & Greene, 1999, p. 258)

In a separate study involving three task values (intrinsic, attainment, and utility), Cole et al. (2008) did not explore the relationship between task values and engagement, but instead tested path models of task values on college students' achievement on low stakes tests, when mediated by students' reported effort. Of the three task values, only attainment value and utility value significantly predicted students' effort and subsequently their achievement on the English, math, science, and social studies tests. In all four path models, utility value yielded the strongest positive direct effects on students' reported effort. To explain the lack of direct and indirect effects of intrinsic value on

effort and achievement, Cole et al. stated that “interest to do well on the exam without appropriate levels of importance to do well is not conducive to test performance” (p. 621). Cole et al. made similar instructional recommendations as those expressed in Miller, DeBacker, and Greene (1999), in that students’ effort and/or engagement on a task may suffer if they do not perceive a task to be useful and/or important.

Present Study

From the empirical studies I presented in the previous sections, it is clear that relationships between engagement and conceptual change and between task value and engagement are relatively established in the literature. Additionally, the models hypothesizing engagement as a contributing variable in the relationship of motivation on conceptual change are also firmly expressed in the conceptual change literature (Dole & Sinatra, 1998; Linnenbrink & Pintrich, 2002b). What is missing from the literature, however, is an empirical study that applies the motivational constructs of task values to a conceptual change intervention with the potential to demonstrate that engagement enhances the influence of motivation (specifically task value) on conceptual change.

Research Questions

The proposed study is designed to address three research questions. 1) Would the participants in the utility, attainment, and control conditions differ in task values? 2) Would the participants in the utility, attainment, and control conditions differ in their engagement for the learning task? 3) Would the participants in the utility, attainment, and control conditions differ in their conceptual change?

Hypotheses

In regards to the first research question pertaining to the conditions differing in their task values, I hypothesized that the participants in each condition would adopt characteristics that were consistent with the instructional induction they received; and therefore differences should be observed among the conditions on measures of task value (i.e. subscales for utility value and attainment value) and/or assessments pertaining to how participants approached the reading task. Any observed differences among the conditions would help determine whether the instructional inductions were effective. In regards to research question 2, pertaining to differences among the participants in the utility, attainment, and control conditions on engagement, I hypothesized that statistical differences among the participants in the utility, attainment, and control conditions would emerge. Based on Cole et al.'s (2008), as well as Greene et al.'s (2004), findings that perceived utility was predictive of cognitive engagement (as well as many other adaptive learning behaviors, such as achievement and effort), I expected that participants in the utility condition would experience the greatest level of engagement. Finally, in regards to research question 3 pertaining to differences among the participants in the utility, attainment, and control conditions on conceptual change, I hypothesized that the participants in the utility, attainment, and control conditions would statistically differ from one another. I hypothesized that participants in the control condition would differ from both those in the utility and attainment conditions, as the participants in the utility and attainment conditions were expected to process the conceptual materials more deeply and undergo greater amounts of conceptual change. Based on Cole et al.'s work, I hypothesized that those in the utility condition would experience the greatest amount of

conceptual change, since utility values have previously been associated with positive learning and achievement outcomes.

CHAPTER 3

METHODS

Design of Study

In this study, participants were randomly assigned to different task value instructional inductions to determine whether inducing students with differing task values would be effective and result in different degrees of engagement for a learning task, as well as conceptual understandings about the causes of the common cold (an explanation of this conceptual topic is provided in greater detail below). The design of this study can be described as a pretest-posttest control group experiment, whereby participants were randomly assigned to different instructionally induced task value conditions (or a control condition), and all other materials remained constant.

Participants

For this study, 179 datasets were recorded however, 13 entries were incomplete and/or repeated attempts by participants who launched the survey multiple times. Once these 13 erroneous entries were removed, 166 undergraduate students (129 female, 34 male, and 3 unknown) from an Educational Psychology subject pool were identified as having completed the survey. Students enrolled in Educational Psychology courses where this study took place, were automatically enrolled in the subject pool and required to fulfill at least three research credit hours per course, for which one hour of research credit was awarded to each student for having participated in this study (see IRB approval in Appendix G and recruitment information in Appendix H). Approximately 82% of the participants designated themselves as education-related majors. Overall, this sample had

a mean cumulative GPA of 3.14 and the age range of the participants was 18 to 59, with an average age of 24. In this sample, 37 participants identified themselves as seniors, 71 as juniors, 47 as sophomores, 4 as freshmen, and 7 unknown. The ethnic breakdown of this sample could be described as 61% Caucasian, 15% Hispanic/Latino, 8.4% Black/African-American, 11% Asian/Pacific Islander, 4.6% Other/Unknown. These demographics are on par with previous studies that have utilized the same subject pool (Johnson & Nussbaum, in press). (See Chapter 4 for more details pertaining to the demographics of the participants in each task value condition).

Materials

Task Value Instructional Inductions. For the purposes of this study, I developed two instructional inductions that were specific to inducing participants with the task values of “utility value” and “attainment value.” The rationale in developing inductions for utility value and attainment value stemmed from the ease to which instructions could be generated that reinforce the specified values and due to previous findings in which utility value and attainment value appeared to be more predictive of adaptive characteristics (i.e. effort and achievement) than alternative task values (i.e. interest). In a statistical model that included task values, effort, and achievement in various academic domains, only usefulness (utility value) and importance (attainment value) were predictive of effort, as well as achievement when mediated by effort (Cole et al., 2008). The task value of interest (intrinsic value), was not a statistically significant predictor of variables like math achievement when mediated by effort.

Methods of inducing students with various motivational constructs have included subliminally activating goals by embedding motivational-laden words into word-search puzzles (see Bargh et al., 2001; Custers & Aarts, 2005). Alternative methods, such as those employed by Johnson and Sinatra (2009), Jang (2008), Reeve et al. (2002), Linnenbrink and Pintrich (2002b), and Reitman (1960), have all used task instructions to prime and reinforce varying motivational constructs. Johnson and Sinatra's instructional inductions directed students to "try your best" (to elicit mastery-approach goals), "avoid making errors" (to elicit mastery-avoidance goals), "beat all of the other students" (to elicit performance-approach goals), or "avoid being at the bottom [of the class]" (to elicit performance-avoidance goals). In Jang's study, rationales for engaging in a task were embedded into the task's instructions ("once learned, the correlations featured in today's lesson will open the door for you to gain useful skills, ones that will be very handy when you need to interpret information presented through statistical tools," Jang, 2008, p. 802). Jang claims that the provision of rationales adds to participants' identification with the task, and explains subsequent effort.

For the present study, the task value inductions were formatted in a manner that encompasses the task instructions utilized by Jang (2008), as well as Johnson and Sinatra (2009). Participants were asked to read a brief story about a fictional student who behaved in accordance with a specific value (i.e. for attainment value "Jordan's goal is to demonstrate that he is a good student. Doing poorly in the course would be a bad reflection upon Jordan's academic abilities . . ." (See Appendix C for the task value instructional inductions). Participants were then asked to reflect on whether they know of any students or colleagues who behaved in such a manner or share similar beliefs as

Jordan. Additionally, participants were asked to reflect on times in which they behaved in a similar manner or shared similar beliefs as Jordan. By having participants reflect on times in which they, and others, have behaved in accordance with a specified task value, it is intended that the task value itself was reinforced and internalized by participants for the learning task. Finally, participants were provided instructions to approach the reading task in accordance with the task value being induced (i.e. for utility value induction: “While you are reading the passage, consider how the information can be applied to future situations. Approach the reading task like Jordan. I will be interested to see if, for the remainder of this survey, you can find the information useful for your future career pursuits”). Instructions for the control group were free of statements that reflect those of the task value inductions, and simply inform participants that “on the next page I will be giving you a reading about the causes of the common cold.” I determined readability scores (Flesch Kincaid Grade Level)⁴ of 8.3 for the attainment value instructional induction, and 9.4 for the utility value instructional induction using.

Task Value. The Motivated Strategies for Learning Questionnaire (MSLQ) is a popular and well-established measure of motivational constructs, as well as cognitive learning strategy use (Pintrich et al., 1993b). The entire MSLQ consists of 81 (7-point Likert-scale) items, 31 of which are reserved for assessing students’ academic motivation characteristics; consisting of subscales for intrinsic goal orientation (4 items), extrinsic goal orientation (4 items), task-value (6 items), control of learning beliefs (4 items), self-efficacy for learning and performance (8 items), and test anxiety (5 items). Pintrich et al. report coefficient alphas ranging from .68-.93 for the motivation subscales. Additionally,

⁴ Flesch Kincaid Grade Level readability scores are obtained from running the Microsoft Word 2007 application for Spelling and Grammar check and selecting “show readability statistics.”

Pintrich et al. reported that with exception to the extrinsic goal orientation subscale, that the MSLQ had reasonable predictive validity, as the remaining motivation subscales were strong predictors of college students' final course grades (in various subject matters). For the purposes of this study, the task value subscale, consisting of 6 items, was utilized to assess any changes in students' perceived task values across a learning task. The subscale has previously produced a Cronbach's alpha coefficient of .93 (Duncan & McKeachie, 2005).

These 6 items were further categorized into three different task values, as described by Eccles and Wigfield (2002). Two items were categorized as utility value items, because they are phrased in a manner that suggests that a task is useful and/or applicable to obtaining future goals (i.e. "I think I will be able to use what I learn in this course in other courses"). Two items were categorized as attainment value items, because they simply specified that the task is important to the individual (i.e. "Understanding the subject matter in this course is very important to me"). Finally, the remaining two items from the task-value subscale were categorized as intrinsic value items, because they specify that the task is interesting (i.e. "I am very interested in the content area of this course").

To ensure robust reliability scores for measuring perceived utility and attainment value, I developed four additional items for both attainment and utility value (see Appendix D). With a total of 6 items for both perceived utility and attainment value, pretest and posttest Cronbach alpha reliability coefficients ranging from .87-.94 were obtained. The task value items that correspond to utility value, attainment value, and

intrinsic value were scored separately and employed twice, as a pretest and posttest measure.

Engagement. DeBacker and Crowson (2006) described the Approaches to Learning Survey as a measure of achievement goals and cognitive engagement. Cognitive engagement items were categorized as shallow cognitive engagement (“referring to rote memorization, underlining and other shallow study strategies,” p. 542) and meaningful (deep) cognitive engagement (“referring to strategies associated with deeper cognitive processing and meaning making,” p. 542). Debacker and Crowson cited the work of Greene, Miller, and colleagues, as having previously utilizing versions of the survey and determining reliability and validity support of the subscales (Greene et al., 2004; Greene & Miller, 1996; Miller et al., 1996). Items for both deep and shallow cognitive engagement can be obtained from Greene and Miller (1996) and Miller et al. (1996). In total, I modified 11 items for deep cognitive engagement and five items for shallow cognitive engagement in a manner that was consistent with the learning task for this study (the reading text). For example, an item for deep cognitive engagement, “when I read for this exam I stopped to ask myself whether or not I am understanding the material,” was modified for this study to read “when I read for the previous text, I stopped to ask myself whether or not I am understanding the material.”

Greene and Miller reported reliability coefficients (Cronbach’s alphas) of .90 and .81 for the three deep cognitive engagement items and the three shallow cognitive engagement items respectively. After appropriate modifications and additions were made to the items for deep cognitive engagement in this study, Cronbach alpha coefficients of .84 and .89 were obtained for the deep and shallow cognitive engagement items

respectively. In their path model involving goals, cognitive engagement, and achievement, Greene and Miller found that deep cognitive engagement had a positive direct effect on achievement outcomes, whereas shallow cognitive engagement had a negative direct effect on achievement outcomes. For this study, engagement was determined by summing participants' responses to items of deep cognitive engagement. (See Appendix E for list of the deep cognitive engagement items).

Causes of the Common Cold Text and Tests. The learning task for this study involved a text that pertains to causes of the common cold. Many people believe that exposure to cold weather or not wearing enough clothing in cold weather are causes of the common cold, or other upper-respiratory infections (Larson et al, 2009; Johnson & Eccles, 2005). Though cases of individuals with the common cold increase around the onset of the Winter season when outdoor temperatures are cooler, the mere exposure to cold weather does not cause one to acquire the common cold. More appropriate conceptions about the relationship between the weather and the acquisition of the common cold would involve an individual understanding that as temperatures outside get cooler, people are more likely to spend time indoors and in close proximity to other people. Thus, exposure and close proximity to others increases the likelihood of the contagious rhinovirus to spread amongst individuals.

Other common misconceptions that have been expressed about the causes of the common cold include the belief that bacteria, germs, and viruses are all causes of the common cold, and the terms themselves can be used interchangeably (Gillen & Mayor, 1995). Another misconception involves the notion that antibiotics can be used to treat colds (see Lee et al., 2003, for more on misconceptions pertaining to the “common

cold”). I developed a 985 word refutaional text (see Appendix A) on the topic of the causes of the common cold. Details about the design, results, and conclusions of published research studies that refute the common misconceptions about the causes of the common cold were presented along with information pertaining to effective methods for reducing the spread of the common cold (Journal of Environmental Health, 2006; Turner & Hendley, 2005; Pittet & Boyce, 2003; and Roberts et al., 2000). I determined the reading text (excluding headings) to have a readability score (Flesch Kincaid Grade Level) of 13.9, which is at the readability level of the targeted sample. Items were generated from the text’s content to construct a pretest/posttest measure about students’ conceptual understandings about the causes of the common cold. A 16 item measure (consisting of 10 true/false, and 6 multiple-choice items) (see Appendix B), was given to participants as a pretest measure before the instructional induction of a task-value (or control) and as a posttest that followed the reading text. Items were scored for their correctness (1 point per correct response) and summed.

Confirmation Questions. In addition to the aforementioned materials, I placed five items (on 7-point Likert scale) toward the end of the materials to explicitly confirm participants’ perceptions about how they perceived their approaches to the reading task (i.e. “was your primary goal to relate the material to issues that are useful to your career or future pursuits”), the degree to which they believe they were engaged, and finally the degree to which they believed their conceptions had changed. The first of these items was utility value oriented, asking participants whether they tried to relate the reading content to issues useful to their career. The second question was more attainment value oriented, asking whether participants had the goal of doing well on the reading due to the

importance of the information. The third item was an ambiguous question about whether participants had the goal of just getting through the reading. The final two items were meant to assess the degree of conceptual change students perceived they experienced, and the degree to which they felt engaged in the reading.

In addition to these five Likert-scale items, I employed an open-ended confirmation question to ask participants to respond in their own words about their “. . . overall goal for the previous reading task.” This item allowed participants to describe how they approached the reading and helped answer the first research question of this study, pertaining to differences among the conditions on their task values. I coded responses as utility oriented if participants provided an answer that referenced the usefulness of the information to future situations; attainment oriented if participants provided an answers that referenced the importance of doing well on the assessments; or neutral/non-categorized if participants simply responded with “to learn more about the causes of the common cold.”

Pilots and Procedure

Piloted Materials. Before the study was executed, I conducted two pilot studies to confirm student misconceptions about the causes of the common cold, and to determine the appropriateness of this study’s materials. For the first of these pilot procedures, 13 undergraduate students enrolled in Educational Psychology courses volunteered to participate in interviews meant to assess students’ conceptions about the causes of the common cold. Participants responded to approximately 20 open-ended questions. Common misconceptions that were expressed by the bulk of these volunteers

included, bacteria can cause the common cold, antibiotics can be used to treat the common cold, and the common cold agent (bacteria and/or virus) travels and infects cells throughout the body. Due to the high frequency of these misconceptions, the topic of the causes of the common cold was deemed appropriate to target in this study.

The final pilot procedure included 47 graduate student participants (25 female, 14 male, 8 unknown) enrolled in an Educational Psychology course. Of the 47 participants, 16 were randomly assigned to the utility condition, 17 to the attainment condition, and 14 to the control group condition. Though the groups did not statistically differ from one another in a significant manner on any measure or subscale of interest (i.e. pretest/posttest utility value, deep cognitive engagement, etc.), a finding of concern was the observed trends in the mean scores for both perceived utility and attainment value. For the participants in the utility condition, both perceived utility value and perceived attainment value decreased (yielding mean changes from pretest to posttest of -2.3 and -.4 respectively), whereas those in the control and attainment conditions illustrated increases in perceived utility value and perceived attainment value for the reading task. I modified both the utility and attainment value instructional inductions to ensure the potency of the inductions. Specifically, I added an additional reflection question to both the utility value instructional induction and the attainment value instructional induction (i.e. for the attainment value instructional induction, participants were asked to respond to the question “In what ways could your performance on an assessment about the causes of the common cold, be a reflection of your academic abilities?). I added these questions to further reinforce the task value that was being induced. Participants in all three conditions (utility, attainment, and control) demonstrated gains in their conceptual understandings

about the causes of the common cold. This helped me to confirm that the refutational text and pretest/posttest measures of participants' conceptual understandings about the causes of the common cold were effective in facilitating and assessing conceptual change.

Procedure. Participants were recruited from the Educational Psychology research subject pool beginning in the 13th week of a 17 week Spring semester. Data collection continued until the 16th week of the semester. Students who participated and signed up for the study received 1 hour of research credit, to fulfill the research requirements specified by their course enrollment. Upon signing up for the study, I provided participants a link which randomly launched one of three versions of the electronic survey specified to a task value or control condition. Participants had to read the terms and conditions and acknowledge an agreement of consent to participate, in accordance with an approved proposal by the Institutional Review Board associated with the university where this study took place. After the consent page, participants were directed to the pretest page, where they were asked to provide responses to the perceived task value items (derived from the MSLQ), as well as selected-response items that were meant to assess their conceptual understandings about the causes of the common cold. Upon completion of the pretest page, participants were directed to an instructional induction page, in which each participant received one of three instructional inductions (utility value, attainment value, or control condition [no inducing of a value]). After the instructional inductions, all participants, regardless of the instructional induction they received, were then directed to the reading task on the causes of the common cold. Following the reading, students were directed to the final pages of the electronic survey, which included the posttest of students' conceptual understandings of the causes of the

common cold, as well as a measure of deep cognitive engagement, the posttest of perceived task value, confirmation questions, and demographics. I downloaded the data was electronically into an excel file (to be saved) and transferred it into an SPSS file. Analyses are discussed in the next chapter.

CHAPTER 4

RESULTS AND ANALYSES

In this chapter, I report the results from the collected data. Various statistical analyses were employed to confirm and/or refute this study's three hypotheses regarding differences in task value, differences in engagement, and finally differences in conceptual change among the participants in the utility, attainment, and control conditions. These statistical analyses include one-way analyses of variance and repeated measures analyses of variance. Yet before these aforementioned procedures were executed, a number of preliminary analyses were conducted to determine the distribution of characteristics of the participants in each of the conditions, determine the appropriateness of this study's materials, and finally confirm relationships among variables of interest.

Preliminary Analyses

Participants. As mentioned previously 166 undergraduates participated in this study. Using the removal criteria of an absolute value of a z-score of 3 on the pretest and posttest measures for conceptual understanding about the causes of the common cold, I excluded only 1 individual in the control condition from the final dataset as an outlier. Of the 165 participants, 54 participants (42 female, 10 male, 2 unknown) were assigned to the utility condition, 54 participants (42 female, 12 male) were assigned to the attainment condition, and 57 (45 female, 11 male, 1 unknown) were assigned to the control condition. (See Table 1 for the means and standard deviations for the variables of interest, by condition). A total of 12 participants had missing values on measures of perceived task value and engagement, for which multiple regression equations were utilized to

replace those missing values. When a missing value was identified for a utility value item (i.e. MSLQ2.1), I generated a correlation matrix of all the utility value items. Items that had statistically significant relationships with the missing item were selected as independent variables (MSLQ2.1 would have been selected as the dependent variable) for the regression analysis, from which a regression equation was generated to calculate a score to fill in the missing value. Regression equations were not used to fill in missing values for demographic information (i.e. gender). Table 1 lists the demographic breakdown of each condition. Variables such as gender, year in school, and ethnicity were randomly distributed across conditions.

Measures. Using posttest items for task value (both utility and attainment), as well as the items for deep and shallow cognitive engagement, I conducted a factor analysis using a principal component analysis extraction method, promax rotation method, and forcing four fixed factors to be extracted (see Table 3). The analysis produced a distinct utility value factor (with an eigenvalue of 12.48 and accounting for 44.58% of the total variance) and a distinct attainment value factor (with an eigenvalue of 3.34 and accounting for 11.94% of the total variance). With the exception of four items for deep cognitive engagement and one item for shallow cognitive engagement, all remaining engagement items loaded onto the two other factors, where one appears to be uniquely oriented for deep cognitive engagement (with an eigenvalue of 1.56 and accounting for 5.58% of the total variance) and the other shallow cognitive engagement (with an eigenvalue of 1.29 and accounting for 4.63% of the total variance). The one shallow cognitive engagement and four deep cognitive engagement items that did not clearly load onto the factors for deep and shallow cognitive engagement were excluded

from the summation of scores for deep and shallow cognitive engagement. A Cronbach's alpha reliability coefficient of .86 was obtained with the seven items now used for deep cognitive engagement, and .82 for the four shallow engagement items. (See Appendix E for a list of items that were used to generate summed scores for deep cognitive engagement and shallow cognitive engagement).

Correlation Matrix. Following the factor analysis, a correlation matrix of the variables of interest was generated (see Table 5). One of the main purposes of generating the correlation matrix was to identify relationships among the variables of interest, such as those between engagement and overall conceptual change. Based on Dole and Sinatra's (1998) CRKM, which illustrates motivation as a mechanism that can instigate and sustain the engagement necessary to promote conceptual change, I hypothesized that the different conditions would differ in their engagement for the learning task (since they should be motivated to differing degrees based on the instructional inductions they received). Therefore, if engagement enhances the influence of motivation on conceptual change, it should be related to the outcome variables of interest.

Deep cognitive engagement was significantly correlated with participants' posttest scores for conceptual understandings about the causes of the common cold ($r = .23$). The correlation between perceived engagement (a confirmation item) and posttest scores of conceptual understanding yielded a slightly stronger relationship ($r = .30$) than scores of deep cognitive engagement. In fact, perceived engagement had a significant positive relationship with participants' overall conceptual change (the difference between posttest and pretest scores of conceptual understanding), whereas the deep cognitive engagement variable did not yield a significant relationship with overall conceptual

change. Perceived engagement may have produced stronger relationships with the outcome variables of interest due to the explicit wording of the item for perceived engagement. Whereas the measure of deep cognitive engagement asked participants to rate their use of engaging/regulatory strategies (i.e. I stopped to ask myself whether or not I am understanding the material), the item for perceived engagement was more specific in that it asked participants to rate the degree to which they felt engaged with the reading (“how engaged were you in the reading on the causes of the common cold”). Due to the clearer relationship between perceived engagement and the outcome variables of interest, perceived engagement was used in later analyses that compared participants in the utility, attainment, and control conditions on engagement.

Other notable relationships include the significant positive correlations among utility condition and utility approach (a confirmation question), perceived engagement, and overall conceptual change. These relationships suggest that participants in the utility condition yielded greater scores on utility approach, perceived engagement, and overall conceptual change. The attainment condition variable did not yield any significant relationships with these same variables. The control condition demonstrated negative correlations with the same variables. Comparisons of the participants in the utility, attainment, and control conditions on the variables of overall conceptual change and utility approach are discussed in further detail later in this chapter.

Results Pertaining to Research Question #1

The first research question of this study was “would the participants in the utility, attainment, and control conditions differ in task values?” I hypothesized that differences

would emerge among the participants in the utility, attainment, and control conditions. To determine whether the groups would differ in their task values, I conducted a series of analyses on multiple indicators of participants' task values. This includes the variables of utility and attainment value scores derived from the MSLQ items (and items modeled on the task value subscale of the MSLQ), as well as the indicators of participants' approaches to the reading task (determined by the confirmation items for utility approach, attainment approach, and the open-ended item "describe your overall goal . . .").

Two repeated measures ANOVAs were employed to compare the participants in the utility, attainment, and control conditions on pretest to posttest task value (utility and attainment value) scores. Using condition as the between-subjects variable (utility, attainment, and control) and pretest to posttest utility value scores as the within-subjects variable in a repeated measures ANOVA, there were no statistically significant differences among participants in the utility, attainment, and control conditions, $F(2, 162) = .41, p = .66, \eta^2 = .01$. The interaction effect of time by condition was not significant $F(2, 162) = .61, p = .55, \eta^2 = .01$. The effect of time on the dependent variable, however, was significant $F(1, 162) = 30.18, p = .01, \eta^2 = .16$. Though the participants in the utility condition yielded a greater mean posttest score on utility value ($M = 36.37, SD = 6.00$) than did those in the attainment ($M = 35.72, SD = 5.97$) and control ($M = 35.23, SD = 6.20$) conditions, the groups did not statistically differ from one another. It is important to note that the participants in the utility condition scored higher at pretest ($M = 34.70, SD = 6.12$) than did those in the attainment ($M = 33.78, SD = 6.22$) and control ($M = 34.05, SD = 5.11$) conditions.

A similar pattern of results were obtained in the repeated measures ANOVA using the conditions as the between-subjects variable, and pretest to posttest scores of attainment value as the within-subjects variables. Again, there was no statistical differences among participants in the utility, attainment, and control conditions, $F(2, 162) = 1.21, p = .30, \eta^2 = .02$; nor a significant interaction effect, $F(2, 162) = .10, p = .91, \eta^2 = .01$. The effect of time on the dependent variable, however, was significant $F(1, 162) = 48.80, p = .03, \eta^2 = .03$. As with the utility value scores, the participants in the utility condition yielded a greater mean score on the attainment value posttest ($M = 31.54, SD = 7.34$) than did those in the attainment ($M = 30.13, SD = 7.30$) and control ($M = 29.81, SD = 7.27$) conditions; though the utility condition participants had higher pretest scores on the attainment value variable ($M = 30.96, SD = 6.15$) than did those in the attainment ($M = 29.18, SD = 7.35$) and control ($M = 29.01, SD = 6.92$) conditions.

These results seem to suggest that changing perceptions about the instrumentality and/or importance of the topic of the causes of the common cold was not evident by participants' task value scores. Nonetheless, as seen in the correlation matrix (Table 5), the relationship between the utility condition variable and the utility approach variable [a confirmation item which explicitly asked participants whether their goal was "to relate the material to issues that are useful to your career or future pursuits"] suggests that the participants in the utility, attainment, and control conditions may have differed in their approach to the learning task. Unlike the utility value and attainment value scores, which are obtained by summing items pertaining to the degree to which participants find the topic about the causes of the common cold to be useful information and/or important to do well on, the utility approach variable and attainment approach variable (another

confirmation item) pertain to measuring the degree to which participants approached the reading task in a utility and/or attainment oriented manner.

Two one-way ANOVAs were employed to determine whether the participants in the three conditions differed in their utility approach or attainment approach. In the first one-way ANOVA where the conditions were designated as the independent variable and the utility approach variable as the dependent variable, a statistically significant difference among the participants in the utility, attainment, and control conditions was observed, $F(2, 162) = 4.52, p = .01, \eta^2 = .05$. Tukey Post-hoc comparisons suggest that those in the utility condition ($M = 5.28, SD = 1.53$) had significantly higher scores for their utility approach than did those in the control condition ($M = 4.42, SD = 1.60$) ($p = .02$). The utility condition did not statistically differ from the attainment condition ($M = 4.57, SD = 1.63$) ($p = .07$). In an ANOVA, where the conditions were the independent variable and the attainment approach variable served as the dependent variable, no statistically significant differences were found, $F(2, 162) = 1.54, p = .22, \eta^2 = .02$.

Further evidence can be gleaned from an analysis of participants' responses to the open-ended item "in a sentence, please describe your overall goal for the previous reading task." In response to this item, 48.1% of the participants in the utility condition indicated that their "... goal was to understand the text so I could apply it to my career as a teacher," compared to 11.5% from the attainment condition and 21% from the control condition. The most common response to the same question for the participants in the attainment condition (59.6%) was to paraphrase, "I want my performance to be outstanding because my performance is a reflection of me as a student," and/or "to learn the material and do well on the assessment," compared to 20% from the control condition

and 15.4% from the utility condition. The most common response from the participants in the control condition (40%) was “to expand my understanding of the common cold,” with no further elaboration as to whether understandings would be applied in the future or a whether they felt a need to do well on this study’s assessments. Approximately 23.1% of the participants in the attainment condition and 34.6% of the participants in the utility condition provided responses that reflected the goal of simply expanding understandings of the causes of the common cold. These results suggest that participants tended to adopt approaches to the learning task that were consistent with the task value inductions they received.

Results Pertaining to Research Question #2

The second research question of this study was “would the participants in the utility, attainment, and control conditions differ in their engagement for the learning task?” I conducted an ANOVA to test the second hypothesis of this study that the participants in the utility, attainment, and control conditions would differ on engagement. Using condition as the between-subjects variable and perceived engagement as the within-subjects variable, a statistically significant difference was observed between participants’ perceived engagement dependent on condition, $F(2, 162) = 7.56, p = .001, \eta^2 = .085$. Tukey post-hoc comparisons suggest that the utility condition participants rated their engagement as significantly higher ($M = 5.60, SD = 1.28$) than those in the control condition ($M = 4.54, SD = 1.66$) ($p = .001$). Participants in the utility condition did not significantly differ from the attainment condition ($M = 5.18, SD = 1.37$), nor did the control and attainment conditions statistically differ from one another. The statistical

difference between the utility condition participants and those in the control condition suggests that the utility condition participants believed they were more actively engaged with the reading content than those who were not induced with a task value. This result lends additional evidence to supporting the claim that the participants in each condition differed in their approach to the reading; and the different approaches influenced how participants engaged and/or processed the reading content. Inducting participants with a utility value may have facilitated the generation of more meaningful connections with the reading content, thereby allowing for greater opportunities for such participants to engage with the materials.

Results Pertaining to Research Question #3

Overall, the entire sample demonstrated gains in conceptual knowledge regarding the causes of the common cold, with an average gain of four points from pretest to posttest scores. This pretest to posttest gain suggests that participants in each condition experienced conceptual change however, the third and final question of this study was whether the participants in the utility, attainment, and control conditions would differ in their conceptual change. I hypothesized that the conditions would differ. To answer this question, I employed an initial repeated measures ANOVA, where participants' pretest and posttest conceptual understanding scores were used as the repeated measure, and condition served as the between-subjects variable. A significant difference was observed between participants on their posttest scores of conceptual understanding by condition, $F(2, 162) = 3.5, p = .03, \eta^2 = .04$. There was also a statistically significant interaction between condition and time, $F(2, 162) = 15.94, p = .01, \eta^2 = .20$, (see Figure 1). The

effect of time on the dependent variable was also significant $F(1, 162) = 301.31, p = .01, \eta^2 = .65$. Though participants were randomly assigned to the conditions, those in the utility condition ($M = 6.54, SD = 2.86$) started out with the lowest mean pretest score of conceptual understanding about the causes of the common cold, compared to participants in the attainment ($M = 8.55, SD = 3.53$) and control ($M = 7.96, SD = 2.86$) conditions. Tukey post-hoc comparisons suggest that the utility condition participants ($M = 12.28, SD = 2.14$) did not statistically differ from those individuals in the attainment condition ($M = 12.54, SD = 3.07$) or those control condition ($M = 10.47, SD = 3.71$) on posttest scores of conceptual understandings about the causes of the common cold. Participants in the attainment condition, however, did significantly differ from those in the control condition ($p = .04$).

To more directly examine the question pertaining to which group of participants experienced the greatest conceptual change, I subtracted participants' pretest scores from their posttest scores of conceptual understanding to create a difference score, and I employed a one-way ANOVA to determine whether the participants in the utility, attainment, and control conditions statistically differed from one another on overall degree of conceptual change. Using condition as the independent variable and difference score as the measure of conceptual change and the dependent variable, a statistically significant difference was observed among the conditions on their overall conceptual change, $F(2, 162) = 15.94, p = .01, \eta^2 = .16$. Specifically, the Tukey post-hoc comparisons suggest that participants in the utility condition ($M = 5.74, SD = 3.05$) demonstrated a statistically greater degree of change from pre to post than the participants in the attainment condition ($M = 3.98, SD = 3.19, p = .01$), as well as those in

the control condition ($M = 2.51$, $SD = 2.80$, $p = .01$). The participants in the attainment condition also showed statistically greater conceptual change in terms of change in their pre to post test scores over those participants in the control condition ($p = .03$). Overall, these results suggest that the participants in the utility condition demonstrated the greatest degree of conceptual change, followed by those in the attainment condition. The control condition participants demonstrated the least conceptual change.

Multiple Regressions. To further explore the role of engagement, I conducted two sets of regression analyses to examine the relationships among each condition (conditions were dummy coded [i.e. participants in utility condition = 1, all remaining participants = 0]), perceived engagement, and change in conceptual understanding (pre-post, and overall). The purpose of the first regression set was to determine whether membership in the utility, attainment, or control condition, along with engagement, would best predict posttest scores after controlling for pretest scores. In the first of these regressions, pretest scores on conceptual understanding of the causes of the common cold was entered first, then utility condition and perceived engagement were entered next. This was done so that changes in the variance in posttest scores could be identified after controlling for participants' pretest scores. The outcome variable was posttest scores. These variables combined accounted for a significant proportion of variance in posttest scores, $F(3, 161) = 31.07$, $p = .01$. The utility condition ($b = .20$, $t = 2.96$, $p = .01$) and perceived engagement ($b = .22$, $t = 3.3$, $p = .01$) accounted for an additional 10% of the variance in posttest scores over and above that accounted for by pretest scores, which was 26% of the total variance.

In the second regression analysis, pretest scores were entered first, then attainment condition and perceived engagement were entered next, with posttest scores serving as the outcome variable. Again, the predictor variables accounted for a significant proportion of variance in posttest scores, $F(3, 161) = 27.11, p = .01$. The attainment condition ($b = .06, t = .91, p = .36$) and perceived engagement ($b = .26, t = 4.1, p = .01$) accounted for an additional 7% in the variance in posttest scores over and above that accounted for by pretest scores.

A third regression model was generated in which pretest scores were entered first, then control condition and perceived engagement were entered next, with posttest scores serving as the outcome variable. The predictor variables combined accounted for a significant proportion of variance in posttest scores, $F(3, 161) = 34.12, p = .01$. The control condition ($b = -.25, t = -3.86, p = .01$) and perceived engagement ($b = .20, t = 3.05, p = .01$) accounted for an additional 12.6% in the variance in posttest scores over and above that accounted for by pretest scores. These results suggest that engagement may play a significant role in facilitating conceptual change, as perceived engagement was a statistically significant predictor variable in all three of the above regression models, after controlling for participants' pretest scores. Additionally, it can be inferred from the standardized beta coefficients, that among the different conditions, the utility condition was the strongest positive predictor of posttest scores when accounting for perceived engagement. The negative standardized beta coefficient for the control condition, suggests that those in the control condition were more likely to have lower posttest scores (than those in the attainment and utility conditions combined) when accounting for perceived engagement. These results suggest that when pretest scores are

accounted for, participants who receive a utility instructional induction may have activated the engagement necessary to outperform those who received the alternative inductions.

I performed a second set of regression analyses using difference scores (posttest minus pretest) as the outcome variable. Whereas the first set of regression analyses investigated whether membership in a particular condition would better predict achievement on the posttest, after statistically controlling for participants pretest scores, this second set of regression analyses was meant to investigate whether being in a particular condition would be enhanced by engagement to better predict conceptual change. In the first of these regression analyses with overall conceptual change serving as the dependent variable, utility condition was entered first and then perceived engagement was entered next. The predictor variables accounted for a significant proportion of variance in overall conceptual change, $F(2, 162) = 15.31, p = .01$. Perceived engagement ($b = .17, t = 2.35, p = .02$) accounted for an additional 3% of the variance in overall conceptual change over and above that accounted for by utility condition ($b = .32, t = 4.33, p = .01$), which accounted for 13% of the variance. In the second regression analysis difference scores as the dependent variable, attainment condition was entered first and then perceived engagement was entered next. The predictor variables accounted for a significant proportion of variance in conceptual change, $F(2, 162) = 5.39, p = .01$. Perceived engagement ($b = .25, t = 3.28, p = .01$) accounted for an additional 6.2% of the variance in conceptual change over and above that accounted for by attainment condition ($b = -.03, t = -.32, p = .75$), which was 0% of the variance. Finally, in the third regression analysis using difference scores as the dependent variable, the control condition was

entered first and then perceived engagement was entered next. The predictor variables accounted for a significant proportion of variance in conceptual change, $F(2, 162) = 513.55, p = .01$. Perceived engagement ($b = .17, t = 2.23, p = .027$) accounted for an additional 3% of the variance in conceptual change over and above that accounted for by control condition ($b = -.30, t = -2.23, p = .03$), which was 12% of the variance.

From these regression models, it can again be inferred that perceived engagement can help explain some of the variance in conceptual change. The significant positive standardized beta coefficient for the regression model using utility condition as a predictor variable and accounting for perceived engagement, suggests that being in the utility condition was predictive of overall conceptual change, more so than being in an alternative condition. Results from both regression sets suggest that when engagement is accounted for, being in the utility condition is most predictive of high achievement on posttests of conceptual understanding, as well as conceptual change, than being in an alternative condition.

CHAPTER 5

DISCUSSION

In this chapter, I begin by summarizing the findings presented in Chapter 4. The main focus of this chapter is on the implications of the results for practice and future research. In particular, I focus on the role of task values in the conceptual change process. Additionally, I build the case for incorporating task value into instruction for conceptually rich topics. Finally, I describe new directions for expanding this line of research.

Summary of the Findings

All three of this study's hypotheses, predicting statistical differences among the participants in the utility, attainment, and control conditions on task value, engagement, and conceptual change found some support. Statistical differences were observed among the participants in the three conditions on the utility approach variable (an item assessing the degree to which participants adopted a utility oriented approach towards the reading), perceived engagement, and conceptual change. Participants in the utility and control conditions statistically differed from one another on utility approach and perceived engagement. Participants in the three conditions also statistically differed from one another on the measure of conceptual change. Participants in the utility condition demonstrated the greatest amount of conceptual change, followed by participants in the attainment condition, and finally the participants in the control condition. I contend that the aforementioned results help build a picture of how motivation, specifically task

values contributed to the conceptual change process. I summarize the major findings as they pertain to each of this study's hypotheses below.

Question 1 (Differences in Utility Approach). The first research question of this study was “would the participants in the utility, attainment, and control conditions differ in task values.” I hypothesized that participants in each condition would adopt task values that were consistent with the instructional induction they received, and therefore, expected to see differences among the conditions. The results of both the quantitative and qualitative findings indicated that those in the utility condition reported greater scores of utility approach than did those in the control condition. Additionally, utility condition participants provided more utility oriented responses to the open-ended item (pertaining to what their goal was for the reading task) than did those in the attainment and control conditions; attainment condition participants provided more attainment oriented responses. Collectively the results suggest that the participants in each condition differed from one another on their approaches to the reading task. Participants in each condition appear to have adopted an approach to the reading task in a manner consistent with the task value being induced. I interpret these findings as evidence that the instructional inductions were effective in altering participants' approaches to the reading task.

Question 2 (Differences in Perceived Engagement). The second question of this study was “would the participants in the utility, attainment, and control conditions differ in their engagement for the learning task.” I hypothesized that differences among the participants in the three conditions would emerge. Based on Dole and Sinatra's (1998) CRKM, which described motivation (i.e. task values, goal orientations, interest, etc.) as a mechanism that can instigate and sustain the engagement necessary to facilitate

conceptual change (Mason et al., 2008), I predicted that differences in motivation (in this case, task values) would result in different levels of engagement. Results indicated that the participants in the utility condition perceived their engagement to be greater for the reading task than those in the control condition. I interpret this result as suggesting that the utility induction was more effective in promoting engagement than not using any task value induction.

Question 3 (Differences in Overall Conceptual Change). The third and final research question of this study was “would the participants in the utility, attainment, and control conditions differ in their conceptual change.” Based on the previous literature in which the task values of utility and attainment have been associated with positive learning outcomes (Cole et al., 2008), I hypothesized that statistical differences among the participants in the three conditions on conceptual change would be observed (i.e. the utility and attainment conditions experiencing greater conceptual change than the control condition). Overall, participants in all three of the conditions experienced conceptual change as evidenced by significant gains from pretest to posttest scores of conceptual understandings about the causes of the common cold. Nevertheless, statistical differences among all of the conditions indicate that the utility condition participants experienced the greatest amount of conceptual change, followed by those in the attainment condition, and the participants in the control condition experienced the least amount of conceptual change. I interpret these results as evidence that the utility and attainment instructional inductions were effective in facilitating more conceptual change than the control; and that of the two task value inductions, the utility induction was the most effective in facilitating conceptual change.

Practical Implications

I see the results of this study as having practical relevance to educators teaching for conceptual change. Support for each of this study's hypotheses, allows me to infer that 1) stressing utility and attainment values may be an effective way for educators to promote the adoption of utility and/or attainment oriented approaches to learning tasks by students; 2) stressing a utility value may promote higher engagement on learning tasks than not stressing any type of task value; and 3) stressing a utility value may promote conceptual change more effectively than stressing an attainment value or no value at all. Based on the results of the first research question and hypothesis, I argue that the strategy used in this study to induce participants with differing task values was effective, and I would encourage educators to consider emphasizing utility or attainment values for learning tasks as a way to promote the adoption of such values by students. Previous studies such as Linnenbrink and Pintrich (2002b) and Johnson and Sinatra (2009), illustrate how difficult it is to identify differences among conditions induced with differing motivational characteristics (i.e. goal orientations). In Linnenbrink and Pintrich's (2002b) first study, differences among the conditions on goal orientations were hypothesized, but were not immediately observed. The observed differences among conditions in this study as evidenced from the results of participants' responses to the way they approached the reading task, suggests that utility and attainment oriented approaches can be adopted by students in a short period of time (i.e. for a conceptually rich reading task).

The utility and attainment conditions may have expressed and adopted approaches to the reading in a manner consistent with the task value being induced due to the explicit

instructions for participants to “approach” the reading task in a specific manner. For example, the participants in the utility condition were instructed to “find the information useful to your future career pursuits.” Participants in the attainment condition were instructed to “. . . take into account the importance of doing well on the tasks that follow.” In classroom settings, an incorporation of these utility and attainment oriented phrases may make the adoption of such task values by students more likely.

The second reason educators may find it beneficial to emphasize the utility value of a learning task, is that the utility instructional inductions used in this study appear to garner more engagement from students on the reading task pertaining to the causes of the common cold, than instructional inductions for the control condition. According to the work of Greene and her colleagues (Greene et al., 2004; Greene et al., 1996) engagement is associated with positive learning and achievement outcomes. My findings suggest that engagement can be bolstered by the stressing of a utility value for a task; and taking into account the work of Greene and her colleagues, if an emphasis on utility values bolsters engagement, and engagement garners greater achievement, then an emphasis on utility values should beget higher levels of achievement (or in this case, conceptual change). In fact, this deductive reasoning resonates with Miller et al.’s (1996) claims that the engagement necessary to produce meaningful learning can be supported by values of utility; bringing me to my third inference, that educators who stress utility values may simultaneously be fostering ideal conditions to facilitate conceptual change.

My results, which indicate that the utility condition participants experienced the greatest amount of conceptual change, followed by those in the attainment condition, and finally those in the control condition, inform me that not only is inducing students with

task values more advantageous than inducing no task value, but between utility and attainment values, emphasizing the utility of a task is the most potent of the two task values in facilitating conceptual change. Although Cole et al. (2008) advocate for educators to stress both utility and attainment values in their instruction, I would contend that of the two values, utility values are the most adaptive and appropriate to emphasize for instructional conceptual change because utility values appear to instigate and sustain the engagement necessary to facilitate conceptual change to a greater degree than attainment values, as evidenced by the results of this study. In circumstances where a utility value may not be readily available for a task, (such as inducing English majors to adopt appropriate conceptualizations of the trajectory of falling objects), emphasizing the attainment value of the task may be more suitable. I would agree with Cole et al. (2008) that stressing no task values for a learning task would be a disservice to students' learning, knowing that utility and attainment values can play a significant role in the learning and conceptual change process.

Theoretical Implications

In addition to the practical implications stated above, I also see the results from this study as having several theoretical implications. Support for each of this study's hypotheses allow me to infer that 1) conceptual change models should account for task values; 2) utility values may promote conceptual change to a greater degree than attainment values and/or no task values; 3) engagement contributes to explaining why an emphasis on the utility value of a task may better facilitate conceptual change; and 4)

expectancy-value models of motivation may need to consider the role of engagement in predicting achievement related outcomes (i.e., conceptual learning).

My first claim, that conceptual change models should account for task values, derives from the results of testing the first and third research questions of this study. The finding that students adopt approaches to a learning task consistent with the task values with which they were induced, along with the finding that both the utility and attainment conditions experienced more conceptual change than did the control condition, informs me that stressing different task values influences the degree of conceptual change students can experience. In this study, the utility condition appears to have experienced the most conceptual change, but that is not to ignore the fact that the attainment condition too experienced more conceptual change than the control condition. Therefore, a model of conceptual change that accounts for the task values of utility and attainment can better predict and explain the behavior and experiences of learners in the conceptual change process.

Two previously mentioned models of conceptual change, Dole and Sinatra's (1998) CRKM and Gregoire's (2003) CAMCC, account for motivation. However few hypotheses can be generated from these models as to how different motives (task values, goal orientations, expectancies, etc.) behave in the promotion of conceptual change. The fact that motivation plays a role in the conceptual change process is apparent in this study's results, whereby the two motivating constructs, utility value and attainment value, promoted greater change than the condition that did not receive any motivating instructions. Reporting that motivated students undergo greater conceptual change does not, however, sufficiently capture the results found in this study. Although utility and

attainment values are both motivating factors, they motivate individuals in different ways, and conceptual change theorists should therefore taking into consideration how different task values can result in different patterns of change. My results can be used to inform the generation of new conceptual change models that take into account the role of task values in the conceptual change process.

My second theoretical implication expands upon this first theoretical implication, whereby I contend that upon a new model of conceptual change that takes task values into account, utility values should be illustrated as promoting stronger conceptual change, than attainment values. This second theoretical implication builds upon the finding that the utility condition in this study experienced the greatest amount of conceptual change, more so than the attainment and control conditions. Utility values may promote conceptual change to a greater degree, than attainment values, because the usefulness of a task to one's future goals and career pursuits may allow learners to make more meaningful connections between new concepts and things they may already know. Conversely, attainment values may be less effective than utility values in promoting conceptual change, because the attainment value may focus a learner's attention away from the learning task itself and more on an alternative goal, such as doing well on an assessment. A student with an attainment value for a task may make fewer meaningful connections with the conceptually rich materials because less background knowledge may be activated. An absence of a task value is perhaps the poorest facilitator of conceptual change, because no prior knowledge or points to make meaningful connections are activated.

Making meaningful connections and simultaneously working with new and prior knowledge presupposes engagement. According to Miller et al. (1996), values of utility are assumed to foster the engagement necessary for the production of meaningful learning. Similarly, Mason et al. (2008) contend that motivational factors, such as interest, can sustain the engagement necessary to facilitate conceptual change. The findings from this study extend the “warming trend” (Sinatra, 2005) in conceptual change research by demonstrating not only that motivation plays a role, but describing more specifically, how motivation plays that role.

The third theoretical implication of the study is that engagement contributes to the conceptual change process, and helps explain why stressing utility values may effectively promote conceptual change. The observed difference between the utility and control condition on perceived engagement, informs me that the utility condition (which also experienced the greatest amount of conceptual change) perceived that they were working more actively (more engaged) with the reading material than the control condition. The explained variance that engagement added to multiple regression models reported in the previous chapter, also lends evidence that engagement contributes to the conceptual change process and illustrates that a utility value for a task may instigate the engagement necessary to facilitate conceptual change. The three aforementioned theoretical implications not only support existing models of conceptual change, like Dole and Sinatra’s (1998) CRKM, but inspire directions for appreciating “hot” models of conceptual change, as new empirical evidence continues to emerge.

The fourth and final theoretical implication of the study is that expectancy-value models of motivation may need to consider the role of engagement in predicting

achievement related outcomes (i.e. conceptual learning). Eccles and Wigfield (2002) only model expectations of success and task values as mechanisms that lead to and predict achievement related outcomes. Such an expectancy-value model of motivation does not illustrate how the differing task value may activate different levels of engagement or cognitive processes that may ultimately result in different achievement related outcomes. The finding that participants in this study who were assigned to the utility condition were more engaged than those in the control condition, and experienced the greatest amount of conceptual change, suggests that a utility value may be a strong predictor of achievement because it may activate engagement. Although future research will have to be done to better specify the role of engagement in an expectancy-value model of motivation, however, I argue that expectancy-value theorists may be able to better predict achievement related outcomes if they account for engagement.

Limitations of the Study

There are limitations and threats to validity in all research designs, however, strategies to reduce threats to the internal validity of this study were considered during the planning and execution of this study. Specifically, a pretest-posttest control group experimental design was employed, to reduce the threats of instrumentation effects, maturation, history, and differential attrition. Participants were randomly assigned to conditions; all materials remained the same for each condition, with exception to the instructional inductions; and a control condition was used along with pretest and posttest measures of various constructs to ensure that any differences observed in comparing the conditions are due to the instructional inductions and not a confounding construct.

A limitation of this study, however, stems from the self-report nature of its instruments and absence of behavioral data. Although qualitative and quantitative data were triangulated to validate differences among the participants in each condition on how they approached the reading task, the lack of face-to-face interactions with the participants made the collection of richer qualitative data, such as observations of participants' behaviors, unattainable. The analyses I reported in the previous chapter relied on self-report measures only. Although the use of self-report measures, like the ones used in this study, can be convenient and have moderate convergent validity with similar measures (Richardson, 2004), methodological limitations remain a concern as to the extent to which self-report measures accurately reflect real-world behaviors (for more on the concerns of self-report measures in education, see Karabenick et al., 2007; Mayer et al., 2007; Fulmer & Frijters, 2009).

Future Research

According to Fulmer and Frijters (2009), new directions for measuring motivation-related constructs (i.e. engagement, goals, task values, etc.) should consider an integration of methodologies, such as phenomenological, physiological, and behavioral measures (in addition to self-report). As the absence of behavioral data is a limitation of this study, an integration of measurement methodologies should be considered for future research. Measures of time on task and/or recordings of participants' eye movements during a reading task could provide an opportunity for such data to be triangulated with the quantitative data for perceived engagement, thereby offering greater insight into the degree of engagement participants had during the

reading. Further piloting and applying different measures of engagement should continue to be a part of this type of research, specifically measures designed around explicitly asking subjects about the degree to which they believe they were engaged with the learning task, as opposed to employing traditional measures that may be designed more around assessing strategies associated with self-regulation and deep cognitive processing. An integration and triangulation of diverse self-report and behavioral data may give a stronger picture of how engaged students are during a reading task.

Alternative avenues to be considered for future research include the use of alternative student populations (i.e. high school students, engineering students, art students, etc.), different sampling techniques, and different content areas to determine whether the findings and implications of this study are generalizable to other populations and/or other learning contexts. Sampling techniques, such as stratified random sampling, may be considered in future studies to better ensure that conditions do not differ from one another on pretest measures (i.e. stratifying students along pretest scores for conceptual understandings about the causes of the common cold, into a high, medium, and low group; and then randomly assigning students to conditions from each group). The utilization of different student populations and different content areas would allow future researchers to determine whether the stressing of a utility value for a task is ineffective in promoting conceptual change for particular students, for particular concepts, and/or for particular pairings of students and concepts (i.e. stressing a utility value for a task on the trajectory of falling objects, to English majors).

Additional research questions I consider fruitful to pursue include: How stable are task values? How long can a utility value be emphasized before it no longer acts as a

motivator? Would the stressing of both utility and attainment values be more advantageous than the stressing of a utility value alone? This and many other research questions have yet to be pursued thoroughly. Results from future research investigating the effectiveness, stability, and potency of task value inductions can have practical implications for how educators motivate their students and facilitate conceptual change. Furthermore, future research regarding the identification of psychological mechanisms that certain task values can activate and sustain (i.e. utility values may better promote engagement than attainment values), would help improve the theoretical models of conceptual change, as well as allow conceptual change scholars to better predict and understand the patterns of behaviors and experiences learners encounter during the conceptual change process.

Conclusions

My findings from this study provide new and original insight into the role of task values in the conceptual change process, in that I was able to successfully facilitate students' adoption of approaches to a learning task that were consistent with the task values with which they were induced; I found that inducing students with a utility value can instigate greater engagement on tasks than if students were not induced with a task value; and I found support that different task values can promote conceptual change to differing degrees. These results inform me that, not only were my instructional inductions effective, but that the emphasis of a utility value for a task may instigate and sustain the engagement necessary for promoting conceptual change. I therefore advocated in this

chapter, for educators who are interested in facilitating conceptual change, to strongly consider stressing the utility values of tasks to their students. In regards to the theoretical implications of my results, I built a case for why and how task values should be accounted for in models of conceptual change, specifically so that conceptual change scholars can better predict and understand the patterns of behaviors and experiences students encounter during the conceptual change process. Future research on the effectiveness, stability, and potency of task values in the conceptual change process will undoubtedly contribute further to the literature regarding educational practices for facilitating conceptual change, as well as the literature pertaining to theoretical models of conceptual change. Nonetheless, the utility of this study's findings and implications set the foundation for the use of task value instructional inductions for facilitating engagement and conceptual change.

TABLES & FIGURE

Table 1

Demographic Means by Condition

Variable	Utility (n = 54)	Attainment (n = 54)	Control (n = 57)
Mean Age	22.1	24.7	23.8
Mean GPA	3.13	3.11	3.17
Gender Distribution	77.8% Female 18.5% Male 3.7% Unknown	77.8% Female 22.2% Male	80.4% Female 19.6% Male
Ethnicity	57.4% Caucasian 14.9% Asian/Pacific-Islander 13% Hispanic/Latino 9.3% Black/African-American 5.6% Other/Unknown	61.1% Caucasian 7.4% Asian/Pacific-Islander 24.1% Hispanic/Latino 1.9% Black/African-American 3.7% Other/Unknown	64.9% Caucasian 10.5% Asian/Pacific-Islander 8.8% Hispanic/Latino 12.3% Black/African-American 3.5% Other/Unknown
Year in School	1.9% Freshman 33.3% Sophomore 38.9% Junior 22.2% Senior 3.7% Other/Unknown	3.7% Freshman 22.2% Sophomore 53.% Junior 20.4% Senior	1.8% Freshman 30.4% Sophomore 37.5% Junior 25% Senior 5.4% Other/Unknown

Table 2

Means and Standard Deviations of Variables by Condition

	Utility Value		Attainment Value		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Conceptual Knowledge Pretest (Max. possible score of 16)	6.54	2.86	8.55	3.53	7.96	2.86
Conceptual knowledge Posttest (Max. possible Score of 16)	12.28	2.14	12.54	3.07	10.47	3.71
Utility Value Pretest (Max. possible score 42)	34.70	6.12	33.78	6.22	34.05	5.11
Utility Value Posttest (Max. possible score of 42)	36.37	6.00	35.72	5.97	35.23	6.20
Attainment Value Pretest (Max. possible score of 42)	30.96	6.15	29.18	7.35	29.01	6.92
Attainment Value Posttest (Max. possible score of 42)	31.54	7.34	30.13	7.30	29.81	7.27
Deep Cognitive Engagement (Max. possible score of 49)	37.65	7.58	36.74	7.22	35.60	7.37
Shallow Cognitive Engagement (Max. possible score of 28)	18.46	5.81	16.80	5.70	17.93	4.91
Utility Approach * (Max. possible score of 7)	5.28	1.53	4.57	1.63	4.42	1.60
Attainment Approach * (Max. possible score of 7)	4.92	1.65	4.55	1.42	4.40	1.72
Perceived Conceptual Change * (Max. possible score of 7)	5.42	1.33	4.67	1.66	4.61	1.57
Perceived Engagement * (Max. possible score of 7)	5.60	1.28	5.18	1.37	4.54	1.66
Overall Diff. in Utility Value (Posttest – Pretest)	1.67	4.23	1.94	2.74	1.18	4.02
Overall Diff. in Attainment Value (Posttest – Pretest)	.57	4.82	.94	4.42	.79	3.95
Overall Conceptual Change (Posttest – Pretest)	5.74	3.05	3.98	3.19	2.51	2.80

* These refer to the confirmation questions asked at toward the end of the survey.

Table 3

Factor Loadings for Utility Value, Attainment Value, and both Deep and Shallow Cognitive Engagement.

Variable (Item #)	Component			
	1	2	3	4
Utility (ENG23)	.93			
Utility (ENG10)	.92			
Utility (ENG12)	.88			
Utility(MSLQ2.1)	.86			
Utility (ENG8)	.85			
Utility (MSLQ2.10)	.73			
Deep(ENG21)		.80		
Deep(ENG5)		.68		
Deep(ENG19)		.67		
Deep(ENG7)		.62		
Deep(ENG17)		.61		
Deep(ENG18)		.57		
Deep(ENG22)		.54		
Deep(ENG15)				
Deep(ENG1)				
Deep(ENG14)				
Shallow(ENG2)			.96	
Shallow(ENG4)			.81	
Shallow(ENG6)			.81	
Deep(ENG3)			.72	
Shallow(ENG16)			.53	
Attainment (ENG13)				.87
Attainment(ENG9)				.76
Attainment(ENG11)				.66
Attainment(ENG24)				.66
Shallow(ENG20)				.57
Attainment(MSLQ2.12)				.55
Attainment(MSLQ2.4)				.53

^a Coefficients less than .50 are suppressed and therefore do not appear in the table above.

Table 4

Coefficient Alphas and Items Comprising the Scored Variables of Utility Value, Attainment Value, and both Deep and Shallow Cognitive Engagement.

Variable	Items Comprising each Variable	α
Utility Value	ENG8, ENG10, ENG12, ENG23, MSLQ2.1, MSLQ2.10	.94
Attainment Value	ENG9, ENG11, ENG13, ENG24, MSLQ2.4, MSLQ2.12	.91
Deep Cognitive Engagement	ENG5, ENG7, ENG17, ENG18, ENG19, ENG21, ENG22	.86
Shallow Cognitive Engagement	ENG2, ENG4, ENG6, ENG16	.82

^a Items comprising each variable was determined from the factor analysis (seen in Table 3). Cronbach coefficient alpha scores were obtained for the items listed.

Table 5

Correlation Matrix of Variables (n = 178)

Variable	1	2	3	4	5	6	7
Utility Condition [Dummy]	1						
Attainment Condition [Dummy]	-.49	1					
Control Condition [Dummy]	-.51	-.51	1				
Pretest Conceptual Knowledge	-.25**	.19*	.06	1			
Posttest Conceptual Knowledge	.11	.16*	-.3**	.51**	1		
Perceived Utility Pretest	.06	-.05	-.02	.18*	.21**	1	
Perceived Utility Posttest	.07	.16*	-.06	.17*	.29**	.80**	1
Perceived Attainment Pretest	.13	-.05	-.07	.13	.03	.76**	.62**
Perceived Attainment Posttest	.10	-.03	-.07	.11	.11	.66**	.71**
Deep Cognitive Engagement	.10	.01	-.10	.12	.23**	.59**	.66**
Utility Approach	.23**	-.08	-.15	.05	.09	.52**	.48**
Attainment Approach	.13	-.03	-.10	.04	.06	.53**	.50**
Perceived Engagement	.23**	.04	-.27**	.06	.30**	.46**	.55**
Perceived Conceptual Change	.24	-.10	-.13	-.33**	.09	.21**	.22**
Overall Conceptual Change	.36**	-.01	-.34**	-.44**	.55**	.05	.14

* $p < .05$, ** $p < .01$

Table 5 (continued)

Correlation Matrix of Variables (n = 178)

Variable	8	9	10	11	12	13	14	15
Utility Condition [Dummy]								
Attainment Condition [Dummy]								
Control Condition [Dummy]								
Pretest Conceptual Knowledge								
Posttest Conceptual Knowledge								
Perceived Utility Pretest								
Perceived Utility Posttest								
Perceived Attainment Pretest	1							
Perceived Attainment Posttest	.81**	1						
Deep Cognitive Engagement	.59**	.62**	1					
Utility Approach	.51**	.51**	.41**	1				
Attainment Approach	.69**	.73**	.50**	.55**	1			
Perceived Engagement	.46**	.55**	.54**	.41**	.54**	1		
Perceived Conceptual Change	.18*	.25**	.30**	.26**	.26**	.51**	1	
Overall Conceptual Change	-.10	.01	.13	.05	.03	.25**	.42**	1

* $p < .05$, ** $p < .01$

Figure 1

Changes in Pretest-Posttest Scores of Conceptual Understandings, by Condition.

APPENDICES

Appendix A: Reading “Causes of the Common Cold”

CAUSES OF THE COMMON COLD

Some people believe that bacteria cause the common cold. But, actually, it is viruses, and viruses alone that cause the common cold. The common cold is a contagious, viral infectious disease of the upper respiratory system primarily caused by a category of viruses called rhinoviruses; though there are over 200 different viral types that can cause colds. Rhinoviruses (“rhinos” Greek meaning nose) attach, enter, and replicate inside of cells in the back of a person’s nose. The back of the nose is an ideal place for this category of viruses to reside because the temperature is a few degrees cooler than the rest of the body. Rhinoviruses fail to efficiently replicate at a person’s regular body temperature, and orally ingesting rhinovirus contaminated items does not typically lead to an infection. Unlike other viruses, like the human immunodeficiency virus (HIV), rhinoviruses remain localized. The fatigue and muscle discomfort some people experience with the common cold can be attributed more to the body’s immune response, and is not due to the virus traveling in one’s blood stream.

Though discomfort is a typical symptom of the common cold, one should not generally experience pain, which is more of a characteristic of a bacterial infection. Though both viruses and some bacteria can be pathogenic (causing infectious diseases), their origins, behaviors, and structures are vastly different. Unlike viral infections, bacterial infections (i.e. ear infections) can be painful, last more than two weeks, and can be treated with antibiotics. Viral infections, like the common cold, tend to last less than two weeks. Symptoms from the common cold begin to recede as the body produces antibodies that can prevent the infecting virus from attaching and infiltrating healthy cells.

Many people believe antibiotics are needed to treat colds, and even seek antibiotic prescriptions from their doctors. Unfortunately, antibiotics are ineffective in treating the common cold because antibiotics (“anti” meaning “against”; and “bios” meaning “life”) are substances that inhibit the growth and/or kill bacteria, not viruses. Unlike bacteria, viruses lack a cell body (which is considered the most basic unit of life) and cannot grow or reproduce on their own; and for these reasons are not even considered living organisms. Instead, a virus needs a host cell to attach to, enter, replicate itself, and burst out of to then infiltrate other cells. Misusing antibiotics to treat viral infections may actually do more harm than good, since they can contribute to building a person’s antibiotic resistance, thereby making it difficult for such individuals to combat future bacterial infections.

COLD SEASON

Many people believe that being exposed to wet and chilly weather can activate the onset of the common cold. Due to this belief, many parents and teachers often recommend children wear warm clothing when it is cold outside, to not walk around barefoot, and to not go to sleep with wet hair. Although common colds are seasonal, with more occurring during the fall and winter (between September and April), experiments so far have failed

to produce any evidence that short-term exposure to cold weather or direct chilling increases susceptibility to infection by cold viruses, nor are rhinoviruses spontaneously created at the onset of cold weather. The seasonality may be due to the start of the school year, or due to people spending more time indoors and in closer proximity with each other, increasing the chance of viral transmission. It should be noted that individuals can catch the common cold during the spring and summer months too. It is very common, however, for a person to mistakenly blame cold symptoms during the spring and summer months on seasonal allergies, since their symptoms are often similar.

DIFFICULTIES IN MANAGING THE COMMON COLD

Both misdiagnoses and misconceptions arguably contribute to the mismanagement of common cold cases. Many people believe that an individual can catch the common cold only once a year. However, due to the variety and constant mutation of cold causing viruses, a person may build antibodies for one strand but come down with multiple colds in a year if they become infected with strands they have not previously encountered. Adults can have between two to four respiratory infections annually. Children may have six to twelve colds a year. Not everyone exposed to rhinovirus becomes symptomatic; 25% of infected persons do not develop symptoms.

A person who believes that they can only catch the common cold once a year may misdiagnose a second or third cold as allergy or bacterial related and unnecessarily seek medical consultation, despite there is very little physicians can do to treat an infected person, aside from recommending plenty of rest, drinking fluids to maintain hydration, and giving time to let the viral infection run its course. Again, due to the large variety and constant mutations of cold causing viruses, the development of a single vaccine for the common cold has been unsuccessful. Additionally, substances like Echinacea, vitamin C supplements, and other herbal remedies have not been shown to have any effects on the frequency of infection, the duration of infection, or the severity of symptoms of the common cold in normal populations. Analgesics (such as ibuprofen), nasal decongestants, and lozenges for sore throat can at best relieve cold symptoms, but not cure the viral infection. As previously mentioned, antibiotics are also ineffective in treating the common cold, because antibiotics can only kill and/or inhibit the growth of bacteria but not viruses. Because viruses are dormant outside of a host cell, it cannot be biologically attacked; and when occupying a host cell, the virus is free to replicate without being disrupted by external substances like antibiotics.

The best way to avoid a cold is thorough and regular hand washing. Use of alcohol-based hand sanitizers, sanitary disposal of facial tissue, not placing your fingers around the eyes and nose areas, minimizing physical contact with infected individuals, and educating students may reduce the numbers of common cold cases.

Appendix B: Conceptual Questions

TRUE/FALSE

1. One can catch a cold from ingesting food that an infected person has touched. (False)
2. A cold is caught from being exposed to wet and chilly weather. (False)
3. Wearing warm clothing, can help prevent children from catching the common cold. (False)
4. Antibiotics are effective in treating the common cold (False)
5. There is NO known cure for the common cold (True)
6. Bacteria are the leading cause of catching the common cold? (False)
7. Viruses are living microbes, just like bacteria. (False)
8. Parents of children with the common cold should seek emergency and/or ambulatory services. (False)
9. Parents should ask their physicians for antibiotics to treat their child's colds. (False)
10. Going to sleep with wet hair may increase ones susceptibility to catching the common cold (False).
11. Which of the following statements is FALSE about causing one to catch the common cold?
 - a. Scientists may use the terms bacteria, germs, and viruses interchangeably when talking about the causes of the common cold.
 - b. An individual can catch multiple 'colds' within a year.
 - c. Children are more likely than adults to catch a 'cold.'
 - d. All of the above are true.
 - e. All of the above are false.
12. What is the greatest limitation about using vaccines as a preventative measure for the common cold?
 - a. Vaccinations are only available for the flu and not the common cold.
 - b. A single vaccine CANNOT account for the variety and constant mutations of cold causing agents.
 - c. Individuals may actually catch the common cold from a vaccination.
 - d. All of the above are limitations.
 - e. All of the above statements are NOT true.
13. Which of the following can contribute the most to a child catching the common cold?
 - a. Going outside with wet hair in cold weather.
 - b. Walking outside barefoot.
 - c. Teething.
 - d. All of the above are equally feasible contributors.
 - e. None of the above are contributors.

14. Which of the following statements is FALSE?
- a. A person can catch the cold in summer and spring seasons.
 - b. Chilly weather can activate the onset of the common cold.
 - c. NOT everyone exposed to a cold causing virus may become symptomatic.
 - d. Most colds get better without medicine.
15. The BEST measure to prevent children from catching the common cold, is to:
- a. Keep children indoors with others
 - b. Promote appropriate hand hygiene techniques
 - c. Keep children bundled up when they are outdoors
 - d. Have children take cold medicines before they catch it.
 - e. Use aerosol fresheners frequently and often.
16. Which of the following statements is TRUE?
- a. Ingesting food that was sneezed on by a person with the common cold, is a common way to catch the cold.
 - b. Using products like Echinacea, vitamin C supplements, and Airborne, are scientifically proven products that prevent one from acquiring the common cold.
 - c. All of the above are true statements.
 - d. None of the above are true statements.

Appendix C: Task Value Instructions Induction

Instructional Induction for the Utility Condition

1. Jordan is an education major who is taking a microbiology course to fulfill a required science credit. A portion of the course is dedicated to the causes of the common cold. Jordan's goal is to connect everything he learns in the course to issues involving children's health that may be useful to him once he becomes a teacher. Jordan finds the material to be useful for understanding what measures to take to prevent illness in his future students, how to respond to ill students, and how to stop the spread of colds and other illness in his classroom. Jordan connects all of the microbiology materials to educational situations. Jordan is motivated to learn more about microbiology because of its relevance and utility to his future career as a teacher.

Do you know people like Jordan, who always find ways to make course materials useful and applicable to their future pursuits?

- Yes
- No
- I don't know / Not applicable

2. Think back to a time when you felt and/or behaved like Jordan.

Write a sentence or two about how you felt, behaved, or acted like Jordan.

3. I will be giving you a reading about the causes of the common cold. After you've done the reading, I will give you a set of questions to respond to pertaining to the causes of the common cold. Please read the passage carefully so that you really learn and understand the ideas in it. You may go back and review the passage so that you can really try to understand it; once you've started answering questions that follow the passage, you may not return to the passage. While you are reading the passage, consider how the information can be applied to future situations. Approach the reading task like Jordan. I will be interested to see if, for the remainder of this survey, you can find the information useful for your future career pursuits.

To show that you understand this, please state in a sentence or two what your goal is.

4. In what ways could knowing the causes of the common cold be useful to your future career pursuits?

Instructional Induction for the Attainment Condition

1. Jordan is an education major who is taking a microbiology course to fulfill a required science credit. A portion of the course is dedicated to the causes of the common cold. Jordan's goal is to demonstrate that he is a good student. Doing poorly in the course would be a bad reflection upon Jordan's academic abilities. Jordan finds it important to do well in the course and believes that the subject matter is important. Jordan is motivated to demonstrate competence in this course.

Do you know people like Jordan, who believe that a poor performance would be a bad reflection of their academic abilities?

- Yes
- No
- I don't know / Not applicable

2. Think back to a time when you felt and/or behaved like Jordan.

Write a sentence or two about how you felt, behaved, or acted like Jordan.

3. I will be giving you a reading about the causes of the common cold. After you've done the reading, I will give you a set of questions to respond to pertaining to the causes of the common cold. Please read the passage carefully so that you can later demonstrate your ability to be a good student. Once you've started answering questions that follow the passage, you may not return to the passage. While you are reading the passage, consider how Jordan would approach this reading. I will be judging you based on your performance. For the remainder of this survey, take into account the importance of doing well on the tasks that follow because I will be interested to see how well you perform on the tasks.

To show that you understand this, please state in a sentence or two what your goal is.

4. In what ways could your performance on an assessment about the causes of the common cold, be a reflection of your academic abilities?

Instructional Induction for the Control Condition

1. On the next page I will be giving you a reading about the causes of the common cold.

Appendix D: Utility Value and Attainment Value Items

Utility Value Items	Attainment Value Items
<p><u>Items from the MSLQ</u></p> <ol style="list-style-type: none"> 1. I think I will be able to use what I learn in this reading in other occasions. (MSLQ2.1) 2. I think the reading material in this study is useful for me to learn. (MSLQ2.10) <p><u>Additional Items</u></p> <ol style="list-style-type: none"> 1. Knowing what causes the common cold is useful information. (ENG8) 2. My learning about what causes the common cold can be applied in future circumstances. (ENG10) 3. Mastering the ideas about what causes the common cold will be helpful in the future. (ENG12) 4. Knowing what causes the common cold can be useful information to teachers. (ENG23) 	<p><u>Items from the MSLQ</u></p> <ol style="list-style-type: none"> 1. It is important for me to learn the material in the reading. (MSLQ2.4) 2. Understanding the subject matter of this reading is very important to me. (MSLQ2.12) <p><u>Additional Items</u></p> <ol style="list-style-type: none"> 1. Doing well on the assessments pertaining to the causes of the common cold is important to me. (ENG9) 2. My performance in knowing what causes the common cold is important. (ENG11) 3. Doing well on the reading task is important because my performance is a reflection of who I am. (ENG13) 4. It is important for teachers to do well on assessments, especially those concerning issues of health. (ENG24)

() Denotes the coded name for each item.

Appendix E: Subscales for Deep and Shallow Cognitive Engagement

Items from Greene and Miller (1996)	Modified Items for this Study.
<u>Deep Cognitive Engagement</u> <ol style="list-style-type: none"> 1. I made a plan for achieving the grade I wanted on this exam. 2. When I read for this exam I stopped to ask myself whether or not I am understanding the material. 3. When learning the new material, I summarized it in my own words. 	<u>Deep Cognitive Engagement</u> <ol style="list-style-type: none"> 1. When I read for the previous text, I stopped to ask myself whether or not I am understanding the material. (ENG1) 2. I tried to combine different pieces of information from the text in new ways. (ENG3) 3. When I came across new information presented in the text, I summarized it in my own words. (ENG5)* 4. When I came across new information presented in the text, I tried to connect it with things I already know and am familiar with. (ENG7)* 5. To understand the material, I thought about my personal experiences and related them to the reading about the causes of the common cold. (ENG14) 6. I applied what was presented in this reading to my observations of the real world. (ENG15) 7. I tried to identify the big picture about what causes the common cold. (ENG17)* 8. I compared my personal understanding about common colds to what was presented in the reading. (ENG18)* 9. Sometimes I recognized that my way of thinking about how people catch the common cold was inconsistent with what was presented in the reading. (ENG19)* 10. I sometimes reflected on my understanding of the common cold to see if it matched what was presented in the reading. (ENG21)* 11. After I completed the reading, I felt

	like I was able to better conceptualize what causes the common cold. (ENG22)*
<u>Shallow Cognitive Engagement</u> <ol style="list-style-type: none"> 1. I tried to write down exactly what my instructor said during lectures. 2. I tried to memorize answers to questions from test study guides. 3. In order for me to understand what technical terms meant, I memorized the text-book definitions. 	<u>Shallow Cognitive Engagement</u> <ol style="list-style-type: none"> 1. I tried to memorize answers to previously asked questions presented in the text. (ENG2)** 2. In order for me to understand what technical terms meant, I memorized the definitions given in the text. (ENG4)** 3. I tried to memorize the key points presented in the text. (ENG6)** 4. I tried to remember exactly what was presented in the reading material. (ENG16)** 5. I tried to memorize the exact steps for the progression of the common cold. (ENG20)

() Denotes the coded name for each item.

* Indicates the items used to generate summed scores for deep cognitive engagement.

** Indicates the items used to generate summed scores for shallow cognitive engagement.

Appendix F: Survey (Utility Condition Example)

1. MSLQ 1

1. The following questions ask about your behaviors on tasks like reading articles about the causes of the common cold. There are no right or wrong answers. Please respond to the best of your ability. Use the scale below to respond to each item.

Selecting 7 indicates that the statement is very true of you.

Selecting 1 indicates that the statement is NOT at all true of you.

	Not at all true of me 1	2	3	4	5	6	Very true of me 7
1. I think I will be able to use what I learn in this reading in other occasions.	☐	☐	☐	☐	☐	☐	☐
2. I believe I will receive an excellent score for assessments pertaining to this material.	☐	☐	☐	☐	☐	☐	☐
3. I'm certain I can understand the most difficult material presented in the reading.	☐	☐	☐	☐	☐	☐	☐
4. It is important for me to learn the material in the reading.	☐	☐	☐	☐	☐	☐	☐
5. I'm confident I can learn the basic concepts taught in this reading.	☐	☐	☐	☐	☐	☐	☐
6. I'm confident I can understand the most complex material presented in the reading.	☐	☐	☐	☐	☐	☐	☐
7. I am very interested in the content area of this reading.	☐	☐	☐	☐	☐	☐	☐
8. I'm confident I can do an excellent job on the assessment for this reading.	☐	☐	☐	☐	☐	☐	☐
9. I expect to do well in the assessments.	☐	☐	☐	☐	☐	☐	☐
10. I think the reading material in this study is useful for me to learn.	☐	☐	☐	☐	☐	☐	☐
11. I like the subject matter of this reading.	☐	☐	☐	☐	☐	☐	☐
12. Understanding the subject matter of this reading is very important to me.	☐	☐	☐	☐	☐	☐	☐
13. I'm certain I can master the skills being taught in this reading.	☐	☐	☐	☐	☐	☐	☐
14. Considering the difficulty of this study's reading task, the topic, and my skills, I think I will do well on assessments pertaining to the covered material.	☐	☐	☐	☐	☐	☐	☐

2. The following questions ask about your perceptions of the importance of learning about the common cold. Use the scale below to answer the questions.

Selecting 7 indicates that you strongly agree with the statement.

Selecting 1 indicates that you strongly disagree with the statement.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
1. Knowing what causes the common cold is useful information.	☐	☐	☐	☐	☐	☐	☐
2. Doing well on the assessments pertaining to the causes of the common cold is important to me.	☐	☐	☐	☐	☐	☐	☐
3. My learning about what causes the common cold can be applied in future circumstances.	☐	☐	☐	☐	☐	☐	☐
4. My performance in knowing what causes the common cold is important.	☐	☐	☐	☐	☐	☐	☐
5. Mastering the ideas about what causes the common cold will be helpful in the future.	☐	☐	☐	☐	☐	☐	☐
6. Doing well on the reading task is important because my performance is a reflection of who I am.	☐	☐	☐	☐	☐	☐	☐
7. Knowing what causes the common cold can be useful information to teachers.	☐	☐	☐	☐	☐	☐	☐
8. It is important for teachers to do well on assessments, especially those concerning issues of health.	☐	☐	☐	☐	☐	☐	☐

2. Cold Knowledge 1

Instructions: This page has both True/False, Multiple-choice, and short-response items about catching the common cold. Please answer the questions to the best of your ability.

1. Please respond to the following short-response items in 1-5 sentences each.

1. What is the "common cold"?
2. How does one catch the common cold? (Provide as many examples as possible, if necessary).
3. What role might temperature, weather, and/or season play in people catching the common cold?
4. How does the common cold progress once a person is infected?
5. Is the cause of the common cold isolated, or does it travel throughout the body?
6. What might you do to treat the common cold?
7. How might taking antibiotics affect a person infected with the common cold?
8. If you were a K-12 teacher what could prevent the spreading of the common cold among students?
9. Might you recommend children to wear warm clothing when they go outdoors, as a way of reducing their chances of catching the common cold?
10. How many times a year can a person catch the common cold?
11. What precautions can be made to avoid catching the common cold?
12. How might viruses be similar to bacteria?
13. How might viruses be different from bacteria?

2. True/False.

	True	False
1. One can catch a cold from ingesting food that an infected person has touched.	☐	☐
2. A cold is caught from being exposed to wet and chilly weather.	☐	☐
3. Wearing warm clothing, can help prevent children from catching the common cold.	☐	☐
4. Antibiotics are effective in treating the common cold.	☐	☐
5. There is NO known cure for the common cold.	☐	☐
6. Bacteria are the leading cause of catching the common cold.	☐	☐
7. Viruses are living microbes, just like bacteria.	☐	☐
8. Parents of children with the common cold should seek emergency and/or ambulatory services.	☐	☐
9. Parents should ask their physicians for antibiotics to treat their child's colds.	☐	☐
10. Going to sleep with wet hair may increase one's susceptibility to catching the common cold.	☐	☐

3. Which of the following statements is FALSE about causing one to catch the common cold?

- ☐ a. Scientists may use the terms bacteria, germs, and viruses interchangeably when talking about the causes of the common cold.
- ☐ b. An individual can catch multiple 'colds' within a year.
- ☐ c. Children are more likely than adults to catch a 'cold.'
- ☐ d. All of the above are true.
- ☐ e. All of the above are false.

4. What is the greatest limitation about using vaccines as a preventative measure for the common cold?

- ☐ a. Vaccinations are only available for the flu and not the common cold.
- ☐ b. A single vaccine CANNOT account for the variety and constant mutations of cold causing agents.
- ☐ c. Individuals may actually catch the common cold from a vaccination.
- ☐ d. All of the above are limitations.
- ☐ e. All of the above statements are NOT true.

5. Which of the following can contribute the most to a child catching the common cold?

- ☐ a. Going outside with wet hair in cold weather.
- ☐ b. Walking outside barefoot.
- ☐ c. Teething.
- ☐ d. All of the above are equally feasible contributors.
- ☐ e. None of the above are contributors.

6. Which of the following statements is FALSE?

- ☐ a. A person can catch the cold in summer and spring seasons.
- ☐ b. Chilly weather can activate the onset of the common cold.
- ☐ c. NOT everyone exposed to a cold causing virus may become symptomatic.
- ☐ d. Most colds get better without medicine.

7. The **BEST** measure to prevent children from catching the common cold, is to:

- ☐ a. Keep children indoors with others.
- ☐ b. Promote appropriate hand hygiene techniques.
- ☐ c. Keep children bundled up when they are outdoors.
- ☐ d. Have children take cold medicines before they catch it.
- ☐ e. Use anti-bacterial aerosol fresheners frequently and often.

8. Which of the following statements is **TRUE**?

- ☐ a. Ingesting food that was sneezed on by a person with the common cold, is a common way to catch the cold.
- ☐ b. Using products like Echinacea, vitamin C supplements, and Airborne, are scientifically proven product that prevents one from acquiring the common cold.
- ☐ c. All of the above are true statements.
- ☐ d. None of the above are true statements.

3. Instructions

1. Jordan is an education major who is taking a microbiology course to fulfill a required science credit. A portion of the course is dedicated to the causes of the common cold. Jordan's goal is to connect everything he learns in the course to issues involving children's health that may be useful to him once he becomes a teacher. Jordan finds the material to be useful for understanding what measures to take to prevent illness in his future students, how to respond to ill students, and how to stop the spread of colds and other illness in his classroom. Jordan connects all of the microbiology materials to educational situations. Jordan is motivated to learn more about microbiology because of its relevance and utility to his future career as a teacher.

Do you know people like Jordan, who always find ways to make course materials useful and applicable to their future pursuits?

☐ Yes

☐ No

☐ I don't know / Not applicable

2. Think back to a time when you felt and/or behaved like Jordan.

Write a sentence or two about how you felt, behaved, or acted like Jordan.

3. I will be giving you a reading about the causes of the common cold. After you've done the reading, I will give you a set of questions to respond to pertaining to the causes of the common cold. Please read the passage carefully so that you really learn and understand the ideas in it. You may go back and review the passage so that you can really try to understand it; once you've started answering questions that follow the passage, you may not return to the passage. While you are reading the passage, consider how the information can be applied to future situations. Approach the reading task like Jordan. I will be interested to see if, for the remainder of this survey, you can find the information useful for your future career pursuits.

To show that you understand this, please state in a sentence or two what your goal is.

4. In what ways could knowing the causes of the common cold be useful to your future career pursuits?

5. How much would you say you know about what causes of the common cold?

Very Little

2

3

Some 4

5

6

Very Much

1

7

Select a response.

☐☐☐☐☐☐☐

4. Reading: Causes of the Common Cold

CAUSES OF THE COMMON COLD

Some people believe that bacteria cause the common cold. But, actually, it is viruses, and viruses alone that cause the common cold. The common cold is a contagious, viral infectious disease of the upper respiratory system primarily caused by a category of viruses called rhinoviruses; though there are over 200 different viral types that can cause colds. Rhinoviruses ("rhinos" Greek meaning nose) attach, enter, and replicate inside of cells in the back of a person's nose. The back of the nose is an ideal place for this category of viruses to reside because the temperature is a few degrees cooler than the rest of the body. Rhinoviruses fail to efficiently replicate at a person's regular body temperature, and orally ingesting rhinovirus contaminated items does not typically lead to an infection. Unlike other viruses, like the human immunodeficiency virus (HIV), rhinoviruses remain localized. The fatigue and muscle discomfort some people experience with the common cold can be attributed more to the body's immune response, and is not due to the virus traveling in one's blood stream.

Though discomfort is a typical symptom of the common cold, one should not generally experience pain, which is more of a characteristic of a bacterial infection. Though both viruses and some bacteria can be pathogenic (causing infectious diseases), their origins, behaviors, and structures are vastly different. Unlike viral infections, bacterial infections (i.e. ear infections) can be painful, last more than two weeks, and can be treated with antibiotics. Viral infections, like the common cold, tend to last less than two weeks. Symptoms from the common cold begin to recede as the body produces antibodies that can prevent the infecting virus from attaching and infiltrating healthy cells.

Many people believe antibiotics are needed to treat colds, and even seek antibiotic prescriptions from their doctors. Unfortunately, antibiotics are ineffective in treating the common cold because antibiotics ("anti" meaning "against"; and "bios" meaning "life") are substances that inhibit the growth and/or kill bacteria, not viruses. Unlike bacteria, viruses lack a cell body (which is considered the most basic unit of life) and cannot grow or reproduce on their own; and for these reasons are not even considered living organisms. Instead, a virus needs a host cell to attach to, enter, replicate itself, and burst out of to then infiltrate other cells. Misusing antibiotics to treat viral infections may actually do more harm than good, since they can contribute to building a person's antibiotic resistance, thereby making it difficult for such individuals to combat future bacterial infections.

COLD SEASON

Many people believe that being exposed to wet and chilly weather can activate the onset of the common cold. Due to this belief, many parents and teachers often recommend children wear warm clothing when it is cold outside, to not walk around barefoot, and to not go to sleep with wet hair. Although common colds are seasonal, with more occurring during the fall and winter (between September and April), experiments so far have failed to produce any evidence that short-term exposure to cold weather or direct chilling increases susceptibility to infection by cold viruses, nor are rhinoviruses spontaneously created at the onset of cold weather. The seasonality may be due to the start of the school year, or due to people spending more time indoors and in closer proximity with each other, increasing the chance of viral transmission. It should be noted that individuals can catch the common cold during the spring and summer months too. It is very common, however, for a person to mistakenly blame cold symptoms during the spring and summer months on seasonal allergies, since their symptoms are often similar.

DIFFICULTIES IN MANAGING THE COMMON COLD

Both misdiagnoses and misconceptions arguably contribute to the mismanagement of common cold cases. Many people believe that an individual can catch the common cold only once a year. However, due to the variety and constant mutation of cold causing viruses, a person may build antibodies for one strand but come down with multiple colds in a year if they become infected with strands they have not previously encountered. Adults can have between two to four respiratory infections annually. Children may have six to twelve colds a year. Not everyone exposed to rhinovirus becomes symptomatic; 25% of infected persons do not develop symptoms.

A person who believes that they can only catch the common cold once a year may misdiagnose a second or third cold as allergy or bacterial related and unnecessarily seek medical consultation, despite there is very little physicians can do to treat an infected person, aside from recommending plenty of rest, drinking fluids to maintain hydration, and giving time to let the viral infection run its course. Again, due to the large variety and constant mutations of cold causing viruses, the development of a single vaccine for the common cold has been unsuccessful. Additionally, substances like Echinacea, vitamin C supplements, and other herbal remedies have not been shown to have any effects on the frequency of infection, the duration of infection, or the severity of symptoms of the common cold in normal populations. Analgesics (such as ibuprofen), nasal decongestants, and lozenges for sore throat can at best relieve cold symptoms, but not cure the viral infection. As previously mentioned, antibiotics are also ineffective in treating the common cold, because antibiotics can only kill and/or inhibit the growth of bacteria but not viruses. Because viruses are dormant outside of a host cell, it cannot be biologically attacked; and when occupying a host cell, the virus is free to replicate without being disrupted by external substances like antibiotics.

The best way to avoid a cold is thorough and regular hand washing. Use of alcohol-based hand sanitizers, sanitary disposal of facial tissue, not placing your fingers around the eyes and nose areas, minimizing physical contact with infected individuals, and educating students may reduce the numbers of common cold cases.

5. MSLQ 2 and Eng.

1. The following questions ask about your behaviors in the previous learning task and your perceptions of the importance of learning about the common cold. Please respond to the best of your ability. Use the scale below to respond to each item.

Selecting 7 indicates that the statement is very true of you.

Selecting 1 indicates that the statement is NOT at all true of you.

	Not at all true of me 1	2	3	4	5	6	Very true of me 7
1. When I read for the previous text, I stopped to ask myself whether or not I am understanding the material.	☐	☐	☐	☐	☐	☐	☐
2. I tried to memorize answers to previously asked questions presented in the text.	☐	☐	☐	☐	☐	☐	☐
3. I tried to combine different pieces of information from the text in new ways.	☐	☐	☐	☐	☐	☐	☐
4. In order for me to understand what technical terms meant, I memorized the definitions given in the text.	☐	☐	☐	☐	☐	☐	☐
5. When I came across new information presented in the text, I summarized it in my own words.	☐	☐	☐	☐	☐	☐	☐
6. I tried to memorize the key points presented in the text.	☐	☐	☐	☐	☐	☐	☐
7. When I came across new information presented in the text, I tried to connect it with things I already know and am familiar with.	☐	☐	☐	☐	☐	☐	☐
8. Knowing what causes the common cold is useful information.	☐	☐	☐	☐	☐	☐	☐
9. Doing well on the assessments pertaining to the causes of the common cold is important to me.	☐	☐	☐	☐	☐	☐	☐
10. My learning about what causes the common cold can be applied in future circumstances.	☐	☐	☐	☐	☐	☐	☐
11. My performance in knowing what causes the common cold is important.	☐	☐	☐	☐	☐	☐	☐
12. Mastering the ideas about what causes the common cold will be helpful in the future.	☐	☐	☐	☐	☐	☐	☐
13. Doing well on the reading task is important because my performance is a reflection of who I am.	☐	☐	☐	☐	☐	☐	☐
14. To understand the material, I thought about my personal experiences and related them to the reading about the causes of the common cold.	☐	☐	☐	☐	☐	☐	☐
15. I applied what was presented in this reading to my observations of the real world.	☐	☐	☐	☐	☐	☐	☐
16. I tried to remember exactly what was presented in reading material.	☐	☐	☐	☐	☐	☐	☐
17. I tried to identify the big picture about what causes the common cold.	☐	☐	☐	☐	☐	☐	☐
18. I compared my personal understanding about common colds to what was presented in the reading.	☐	☐	☐	☐	☐	☐	☐
19. Sometimes I recognized that my way of thinking about how people catch the common cold was inconsistent with what was presented in the reading.	☐	☐	☐	☐	☐	☐	☐
20. I tried to memorize the exact steps for the progression of the common cold.	☐	☐	☐	☐	☐	☐	☐
21. I sometimes reflected on my understanding of the common cold to see if it matched what was presented in	☐	☐	☐	☐	☐	☐	☐

the reading.

22. After I completed the reading, I felt like I was able to better conceptualize what causes the common cold.	☐	☐	☐	☐	☐	☐	☐
23. Knowing what causes the common cold can be useful information to teachers.	☐	☐	☐	☐	☐	☐	☐
24. It is important for teachers to do well on assessments, especially those concerning issues of health.	☐	☐	☐	☐	☐	☐	☐

2. The following questions ask about your behaviors on tasks like reading articles about the causes of the common cold. There are no right or wrong answers. Please respond to the best of your ability. Use the scale below to respond to each item.

Selecting 7 indicates that the statement is very true of you.

Selecting 1 indicates that the statement is NOT at all true of you.

	Not at all true of me 1	2	3	4	5	6	Very true of me 7
1. I think I will be able to use what I learn in this reading in other occasions.	☐	☐	☐	☐	☐	☐	☐
2. I believe I will receive an excellent score for assessments pertaining to this material.	☐	☐	☐	☐	☐	☐	☐
3. I'm certain I can understand the most difficult material presented in the reading.	☐	☐	☐	☐	☐	☐	☐
4. It is important for me to learn the material in the reading.	☐	☐	☐	☐	☐	☐	☐
5. I'm confident I can learn the basic concepts taught in this reading.	☐	☐	☐	☐	☐	☐	☐
6. I'm confident I can understand the most complex material presented in the reading.	☐	☐	☐	☐	☐	☐	☐
7. I am very interested in the content area of this reading.	☐	☐	☐	☐	☐	☐	☐
8. I'm confident I can do an excellent job on the assessment for this reading.	☐	☐	☐	☐	☐	☐	☐
9. I expect to do well in the assessments.	☐	☐	☐	☐	☐	☐	☐
10. I think the reading material in this study is useful for me to learn.	☐	☐	☐	☐	☐	☐	☐
11. I like the subject matter of this reading.	☐	☐	☐	☐	☐	☐	☐
12. Understanding the subject matter of this reading is very important to me.	☐	☐	☐	☐	☐	☐	☐
13. I'm certain I can master the skills being taught in this reading.	☐	☐	☐	☐	☐	☐	☐
14. Considering the difficulty of this study's reading task, the topic, and my skills, I think I will do well on assessments pertaining to the covered material.	☐	☐	☐	☐	☐	☐	☐

6. Cold Knowledge 2

Instructions: This page has both True/False, Multiple-choice, and short-response items about catching the common cold. Please answer the questions to the best of your ability.

1. Please respond to the following short-response items in 1-5 sentences each.

1. What is the "common cold"?
2. How does one catch the common cold? (Provide as many examples as possible, if necessary).
3. What role might temperature, weather, and/or season play in people catching the common cold?
4. How does the common cold progress once a person is infected?
5. Is the cause of the common cold isolated, or does it travel throughout the body?
6. What might you do to treat the common cold?
7. How might taking antibiotics affect a person infected with the common cold?
8. If you were a K-12 teacher what could prevent the spreading of the common cold among students?
9. Might you recommend children to wear warm clothing when they go outdoors, as a way of reducing their chances of catching the common cold?
10. How many times a year can a person catch the common cold?
11. What precautions can be made to avoid catching the common cold?
12. How might viruses be similar to bacteria?
13. How might viruses be different from bacteria?

2. True/False.

	True	False
1. One can catch a cold from ingesting food that an infected person has touched.	☐	☐
2. A cold is caught from being exposed to wet and chilly weather.	☐	☐
3. Wearing warm clothing, can help prevent children from catching the common cold.	☐	☐
4. Antibiotics are effective in treating the common cold.	☐	☐
5. There is NO known cure for the common cold.	☐	☐
6. Bacteria are the leading cause of catching the common cold.	☐	☐
7. Viruses are living microbes, just like bacteria.	☐	☐
8. Parents of children with the common cold should seek emergency and/or ambulatory services.	☐	☐
9. Parents should ask their physicians for antibiotics to treat their child's colds.	☐	☐
10. Going to sleep with wet hair may increase one's susceptibility to catching the common cold.	☐	☐

3. Which of the following statements is FALSE about causing one to catch the common cold?

- ☐ a. Scientists may use the terms bacteria, germs, and viruses interchangeably when talking about the causes of the common cold.
- ☐ b. An individual can catch multiple 'colds' within a year.
- ☐ c. Children are more likely than adults to catch a 'cold.'
- ☐ d. All of the above are true.
- ☐ e. All of the above are false.

4. What is the greatest limitation about using vaccines as a preventative measure for the common cold?

- ☐ a. Vaccinations are only available for the flu and not the common cold.
- ☐ b. A single vaccine CANNOT account for the variety and constant mutations of cold causing agents.
- ☐ c. Individuals may actually catch the common cold from a vaccination.
- ☐ d. All of the above are limitations.
- ☐ e. All of the above statements are NOT true.

5. Which of the following can contribute the most to a child catching the common cold?

- ☐ a. Going outside with wet hair in cold weather.
- ☐ b. Walking outside barefoot.
- ☐ c. Teething.
- ☐ d. All of the above are equally feasible contributors.
- ☐ e. None of the above are contributors.

6. Which of the following statements is FALSE?

- ☐ a. A person can catch the cold in summer and spring seasons.
- ☐ b. Chilly weather can activate the onset of the common cold.
- ☐ c. NOT everyone exposed to a cold causing virus may become symptomatic.
- ☐ d. Most colds get better without medicine.

7. The **BEST** measure to prevent children from catching the common cold, is to:

- ☐ a. Keep children indoors with others.
- ☐ b. Promote appropriate hand hygiene techniques.
- ☐ c. Keep children bundled up when they are outdoors.
- ☐ d. Have children take cold medicines before they catch it.
- ☐ e. Use anti-bacterial aerosol fresheners frequently and often.

8. Which of the following statements is **TRUE**?

- ☐ a. Ingesting food that was sneezed on by a person with the common cold, is a common way to catch the cold.
- ☐ b. Using products like Echinacea, vitamin C supplements, and Airborne, are scientifically proven product that prevents one from acquiring the common cold.
- ☐ c. All of the above are true statements.
- ☐ d. None of the above are true statements.

7. Demographics

Please respond to the following items to the best of your ability.

1. In a sentence, please describe your overall goal for the previous reading task.

2. What do you think this study was about?

3. To what degree do you believe you approached the task?

	Definitely Not	2	3	Somewhat	5	6	Definitely Yes
	1			4			7
Was your primary goal to relate the material to issues that are useful to your career or future pursuits?	☐	☐	☐	☐	☐	☐	☐
Was your primary goal to do well on the task because it was on important information?	☐	☐	☐	☐	☐	☐	☐
Was your primary goal to get through the reading?	☐	☐	☐	☐	☐	☐	☐

4. Please rate the following:

	Very Little	2	3	Somewhat	5	6	Very Much
	1			4			7
To what degree do you think you've changed in your knowledge about the causes of the common cold?	☐	☐	☐	☐	☐	☐	☐
How engaged were you in the reading on the causes of the common cold?	☐	☐	☐	☐	☐	☐	☐

5. Age

(i.e. 21 years old)

6. Gender

- ☐ Male
- ☐ Female

7. Year in College

- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior
- ☐ Other/Graduate

8. Academic Major

9. Number of science classes taken in high school:

(please provide a number)

10. Number of science classes taken in college:

(please provide a number)

11. Number of Biology classes taken in high school:

(please provide a number)

12. Number of Biology classes taken in college, besides this course:

(please provide a number)

13. Ethnicity (select the one you most identify with)

- ☐ Caucasian
- ☐ Hispanic/Latino
- ☐ Native American
- ☐ Black/African-American
- ☐ Asian
- ☐ Pacific-Islander
- ☐ Other

14. What is your cumulative GPA? (on a 4 point scale)

15. What is your overall GPA for all of the college Education-related courses you have taken? (on a 4 point scale)

16. What is your current grade for this Educational Psychology class?

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ F

17. What is your expected grade for this Educational Psychology class?

- ☐ A
☐ B
☐ C
☐ D
☐ F

18. What are the grades you have received for this class's exams?

(Answer what you can, and leave blank if it is NOT applicable).

	A	B	C	D	F
Exam 1	☐	☐	☐	☐	☐
Exam 2	☐	☐	☐	☐	☐
Exam 3	☐	☐	☐	☐	☐

19. Thank you for your participation in this survey! If you have any questions or comments, please use the box below.

Click on the "Done" button to complete this survey (and print the next page, if needed).

Debriefing:

The tasks I asked you to perform, are for this research study ONLY! Research suggests that the best way to approach tasks is to try to master the content.

Appendix G: IRB Approval

Social/Behavioral IRB – Exempt Review Approved as Exempt

DATE: January 11, 2010

TO: **Dr. Gale Sinatra**, Educational Psychology

FROM: Office for the Protection of Research Subjects

RE: Notification of IRB Action by Ms. Brenda Durosinmi, MPA, CIP, CIM
Protocol Title: Task CC
OPRS# 0912-3317M

This memorandum is notification that the project referenced above has been reviewed by the UNLV Social/Behavioral Institutional Review Board (IRB) as indicated in Federal regulatory statutes 45CFR46.

The protocol has been reviewed and deemed exempt from IRB review. It is not in need of further review or approval by the IRB.

Any changes to the exempt protocol may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a **Modification Form**.

If you have questions or require any assistance, please contact the Office for the Protection of Research Subjects at OPRSHumanSubjects@unlv.edu or call 895-2794.

Appendix H: Recruitment Letter

You are invited to participate in a research study. The purpose of this study is to collect data pertaining to individuals' learning behaviors for topics like how people acquire the common cold.

If you volunteer to participate in this study, you will be asked to do the following: Provide responses to survey items about your learning behaviors and your understandings about how individuals acquire the common cold. You will also be asked to read several pages of text pertaining to the topic of the common cold and respond to the items in the survey(s) and readings to the best of your ability. Many of the survey items will ask you to reflect on your behaviors and attitudes towards your academic experiences.

The study will take approximately 30-45 minutes of your time. You may withdraw from the study at any point with no penalty. Participation in this study is worth 1 hour of research credit. Research credit will be awarded within a period of one week of submitting this survey. If you would like to participate, the steps are:

- 1) Sign-up to participate in the study.
- 2) Send an email with 'Task CC-Undergraduate' in the subject line to Marcus Johnson at johns769@unlv.nevada.edu
- 3) Say in the email "Please send link for the Task CC-Undergraduate survey to [insert your email address]
- 4) A link to the electronic survey and its consent form will be emailed back to you within 24 hours.
- 5) Once you've received the survey link, you will be given one week to complete the study.

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