

EFFECTS OF NARRATIVE REFUTATIONAL TEXT, EPISTEMOLOGICAL
BELIEFS, EMPATHY, AFFECT, AND SYSTEMATIC AND HEURISTIC
PROCESSING ON CONCEPTUAL CHANGE IN PRESERVICE TEACHERS

By

CLAYTON D. AUSTIN

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To my wife, Wendy, who came into my life in a dark time, and continues to brighten and warm
each day with God's Light

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Abstract of Dissertation Presented to the Graduate School
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Clayton D. Austin

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Preservice teachers enter teacher education programs with many strongly held beliefs that conflict with findings of educational research. In this study two interventions were compared that were designed to enable preservice teachers to recognize the conflicts between their entering beliefs and new research findings and to help them resolve these conflicts in ways that will contribute to their effectiveness as teachers. Conceptual change theorists have identified refutational text that explicitly contrasts naïve and accurate conceptions, as effective in facilitating conceptual change. The effectiveness of adding narrative elements of plot, character and setting to refutational text for effecting change in concepts of motivation in preservice teachers was investigated in this study. Weaknesses of previous conceptual change research, such as failing to investigate the personal characteristics of epistemological beliefs and verbal ability and affective and cognitive factors that could serve as resources for change were addressed.

Pretreatment questionnaires on conceptions of intrinsic and extrinsic motivation and epistemological beliefs were given to 190 students majoring in education. Then participants were randomly assigned to read an expository refutational or narrative refutational text and complete measures of empathy, affect, cognitive processing, and conceptions of motivation. Conceptions

of motivation were measured again one month later. Structural equation modeling was used to test the fit of the proposed model of conceptual change and to analyze hypotheses regarding the relationships among the intervention and individual differences and conceptual change.

The revised model included a significant direct effect of narrative refutational text compared to expository refutational text on changes in conceptions of intrinsic motivation, and, indirectly via empathy, on conceptions of extrinsic motivation. Narrative refutational text was also causally related to positive and negative affect and heuristic processing, but none of the affective or cognitive factors served as a resource for conceptual change. Contrary to prediction, epistemological beliefs in simple and certain knowledge did not affect conceptual change. However, the results show that empathy may influence conceptual change when reading narrative refutational text.

CHAPTER 1 INTRODUCTION

Preservice teachers enter teacher education programs with many conceptions of teaching and learning that conflict with findings of educational research (Holt-Reynolds, 1992; Woolfolk Hoy & Murphy, 2001). Research in a variety of disciplines, including social and developmental psychology as well as education, has shown that many of these concepts are very resistant to change (Chinn & Brewer, 1993; Wideen, Mayer-Smith, & Moon, 1998). Research is needed to enable preservice teachers to recognize the conflicts between their entering conceptions and new research findings and to help them resolve these conflicts in ways that will contribute to their effectiveness as teachers. Therefore, the purpose of this dissertation study was three-fold: first, to compare two interventions designed to foster conceptual change in preservice teachers, second, to explore pre-existing personal characteristics, specifically verbal ability and epistemological beliefs, that may influence their conceptual change, and third, to identify cognitive and affective processes that account for conceptual change.

Teacher Conceptions

As noted by Torff and Sternberg (2001), “Far from being blank slates with little knowledge about education, prospective teachers' prior beliefs, expectations, and knowledge influence what they come to understand, value, and use from courses in teacher education” (p. 21). Prospective teachers come to their teacher education courses with prior conceptions about teaching and learning. Some of these conceptions may have their origins in common human experience, as described by evolutionary or cognitive-developmental psychologists, or in a more specific cultural basis as described by anthropologists or cultural psychologists (Torff & Sternberg, 2001). Yet other conceptions may have their origins in prospective teachers’ unique experiences as students (Lortie, 1975). Although these prior conceptions can be useful frameworks for

effective practice, unfortunately preservice teachers have many conceptions regarding teaching and learning that conflict with research findings (Holt-Reynolds, 1992; Woolfolk Hoy & Murphy, 2001).

For example, one conception of learning that has received significant attention from researchers is characterized as the *transmission model* of learning (Sternberg & Torff, 2001). In the transmission model, the student's mind is "conceived as a vessel to be filled with knowledge that only teachers and texts can provide" (Torff, 1999, p. 200). However, most teacher educators maintain that the transmission model does not adequately capture the complexity of learning, because knowledge is not merely imparted to students, it is actively constructed by students (Torff, 1999; Woolfolk Hoy, 1996). The transmission model of learning is very resistant to correction (Torff, 1999) and even when conceptions are correct, actions may not be. For example, Strauss (2001) described how even professors who do not endorse the transmission model still teach their classes as if they do.

In addition to these misconceptions about teaching and learning, many prospective teachers' conceptions about motivation conflict with contemporary theoretical perspectives. Patrick and Pintrich (2001) claimed that among prospective and novice teachers the most common conception about motivation is that it is a stable trait-like characteristic of students (see Calderhead, 1996; Holt-Reynolds, 1992); however, contemporary researchers characterize motivation as the "ongoing dynamic process of interactions between the student and the context, rather than as an object that students either have or do not have" (p. 129). A related conception contrary to research but commonly held by prospective teachers is that only positive feedback will increase motivation (Pajares & Bengston, 1995; Pajares & Graham, 1998).

Research on extrinsic and intrinsic motivation has led to findings that conflict with many preservice teachers' conceptions of motivation. Extrinsic motivation refers to motivation for a task that originates from outside the individual, typically in the forms of reinforcers such as rewards and punishments. In contrast, intrinsic motivation refers to motivation for a task that originates from within the learner, such as a desire to achieve mastery. Intrinsic motivation for a learning task has been associated with deeper understanding and increased creativity (see Deci & Ryan, 1980, 1985, 1991).

The finding that extrinsic rewards can decrease intrinsic motivation for a learning task initiated a significant debate (see Ryan & Deci, 2000, for summary). However, according to Lepper and Henderlong (2000), over 100 studies performed over three decades has resulted in a consensus among researchers that initial intrinsic motivation for a learning task will likely be diminished when students expect to receive a tangible arbitrary reward (e.g., stickers, prizes) for completion of the task.

Two intervention studies (Kutza, 2000; Salisbury-Glennon & Stevens, 1999) have focused on fostering change in preservice teachers' conceptions of intrinsic and extrinsic motivation. In these studies a text was used to refute the conception that extrinsic or reinforcement motivation is the only or best motivation for learning and explain the concept of intrinsic motivation and its positive effects on learning. I investigated the effect of adding narrative structures to the expository refutational text used in these studies.

Conceptual Change

Researchers investigating changing teachers' prior conceptions to be more consistent with research have looked to the literature on conceptual change as a theoretical framework (e.g., Gill, 2003; Patrick & Pintrich, 2001; Salisbury-Glennon & Stevens, 1999). Important models of conceptual change have emerged from research in developmental and social psychology and

science education (Vosniadou, 1999). Piaget (1975) explained how individuals confronted with a new concept either assimilate it into existing mental schemes or restructure their schemes to accommodate the new concept. This accommodation has been the focus of conceptual change research in science education, a domain that often requires learners to change naïve concepts or theories in favor of scientific ones. Posner, Strike, Hewson, and Gertzog (1982) posited four conditions for conceptual change: (a) *dissatisfaction* with existing concepts, (b) *intelligibility* of new concepts, (c) *plausibility* of new concepts, and (d) *fruitfulness* of new concepts.

Posner et al. (1982) described the relationship between existing and new concepts, but others criticized their model for its narrow conception of conceptual change. Pintrich, Marx, and Boyle (1993), for example, criticized the model as overly “cold” and stressing cognition while ignoring the influence of affect and motivation. Caravita and Halldén (1994) criticized a foundational metaphor of conceptual change models, that of the student as scientist. They claimed students learn more inductively, are more concerned with outcome than method, and have more egocentric peer relations than scientists. Mayer (2002) claimed researchers of conceptual change have yet to identify mechanisms of change or methodologies to effect change.

In response to these criticisms, researchers have looked to social psychological theories on attitude change, particularly Festinger’s (1957) cognitive dissonance theory, and more recent processing models (for reviews, see Dole & Sinatra, 1998; Eagly & Chaiken, 1993). As a result, researchers of conceptual change (e.g., Limón & Mason, 2002; Sinatra & Pintrich, 2003) have begun to identify the complex interplay of knowledge, affect, and motivation that contributes to the process of change in knowledge, beliefs, and attitudes during learning.

From this important new scholarship, I identified key questions: What types of interventions effect the greatest and longest lasting conceptual change? What learner

characteristics play a role in conceptual change? What cognitive and affective processes are used in conceptual change? Then I proposed and tested a model based on these questions.

Specifically, I investigated narrative refutational text as a potentially effective and long lasting intervention, verbal ability and epistemological beliefs as important learner characteristics, and the influence of learners' empathy, affect, and systematic and heuristic processing in conceptual change.

Interventions for Conceptual Change

Given that conceptual change is an important goal of teacher education programs, it is important to identify the kinds of instructional interventions that can be used to effect conceptual change. Guzzetti, Snyder, Glass, and Gamas (1993) conducted a meta-analysis of the interventions used in reading and science education to induce conceptual change. Examples of interventions in their meta-analysis include discussion, demonstration, Socratic questioning, concept mapping, summarizing, activating background knowledge, and reading expository, refutational, and narrative texts. Interventions that made use of some kind of text were more effective and longer-lasting than those that did not (effect size = .49), provided the text was refutational or used with a strategy to induce cognitive conflict.

Expository Refutational Text

Plain expository text, typically used in school textbooks, simply explains concepts. Expository refutational text, in contrast, explains a widely accepted concept and then refutes it by describing a new and conflicting concept. On the basis of their meta-analysis, Guzzetti et al. (1993) concluded that expository refutational text is one of the most effective approaches researchers have used to achieve conceptual change. In eight studies, expository refutational text had a greater effect on conceptual change than a typical expository nonrefutational text (average

effect size = .24). Guzzetti (2000) reported that conceptual change effected from expository refutational text lasted a month or more, which is longer than other methods studied to date.

Expository refutational text has been more effective than plain expository text in inducing conceptual change in preservice teachers. Salisbury-Glennon and Stevens (1999) investigated the use of expository refutational text in changing prospective teachers' conceptions of motivation. Participants read either a plain expository text that simply described intrinsic motivation or an expository refutational text that criticized extrinsic motivation and then described intrinsic motivation. After reading one of the texts, participants responded to 20 brief classroom scenarios that endorsed either an intrinsic or extrinsic view of motivation. Participants who read the expository refutational text demonstrated more evidence of conceptual change than those who read the plain expository text on an immediate posttest (effect size = .71) and a posttest delayed 1 week (effect size = .54).

In her dissertation study, Kutza (2000) used the same text as Salisbury-Glennon and Stevens (1999) but analyzed the 20 scenarios as two 10-item intrinsic and extrinsic subscales to look for more precise and specific evidence of change. Furthermore, she used the texts in conjunction with a contextual variable of reward structure. Kutza found that expository refutational text facilitated conceptual change only with regard to the rejection of an extrinsic theory and only when paired with an external controlling reward structure. This result was observed on the immediate and delayed posttest.

Gill, Ashton, and Algina (2004) contrasted expository refutational and plain expository text in a study of prospective teachers' epistemological beliefs about mathematics, described as either constructivist or proceduralist. Those who hold constructivist beliefs endorse teaching for deep understanding using authentic problems (Hiebert et al., 1996). In contrast, those who hold

proceduralist beliefs endorse using rote drill and practice. Both texts described the more research-based constructivist epistemological beliefs, but the expository refutational text also refuted the proceduralist beliefs.

After reading one of the two texts, participants completed outcome measures designed to assess explicit and implicit epistemological beliefs of mathematics. Explicit beliefs were measured by two subscales of the Cognitively Guided Instruction Belief Survey developed by Peterson, Fennema, Carpenter, and Loef (1989). Implicit beliefs were measured by participants' responses to eight short scenarios the first author constructed to represent either constructivist or proceduralist teaching practices in mathematics. The expository refutational text was superior to the plain expository text in changing explicit and implicit beliefs.

Narrative Text

Although expository refutational and plain expository text were used in the research described above, some researchers have suggested that narrative text may have a stronger positive effect on learning than either expository refutational text or plain expository text (Lipson, 1986; Maria & Johnson, 1990; Valencia & Stallman, 1988). A narrative text is a “symbolic presentation of a sequence of events connected by subject matter and related by time” (Scholes, 1981, p. 205). It may or may not involve human agents and intentions; for example, the description of the formation of a tropical storm would be narrative without human agents. However, a story is a type of narrative that consists of “events, characters, and settings arranged in a temporal sequence implying both causality and significance” (Carter, 1993, p. 6) and “encourages the projection of human values” (Scholes, 1981, p. 206). From this perspective I investigated the use of stories, not merely narrative texts, in conceptual change; however, conceptual change researchers have used the terms *narrative text* and *narrative structures* in describing stories and their characteristics (Alvermann, Hynd, & Qian, 1995; Guzzetti et al.,

1993; Guzzetti, Williams, Skeels, & Wu, 1997). I have followed this convention and refer to stories as narrative texts and their characteristics (characters, settings, and cause and effect sequences) as narrative structures.

Researchers have advocated the use of stories, movies, or videotaped or written case studies in teacher education programs (Putnam & Borko, 1997; Woolfolk Hoy & Murphy, 2001). The use of narrative texts and structures in teacher education programs may be warranted given that preservice teachers' conceptions tend to be in the form of events and stories (Doyle & Carter, 1996) that are often grounded in their experiences as students (Lortie, 1975). However, researchers have also warned against the dangers of using narrative texts and structures for research or communication. Phillips (1994, 1997) warned that narratives must be demonstrated by analytical methods as true, not merely coherent or plausible, especially when they are designed to influence public policy or classroom practice.

Doyle (1997) responded to the criticism of using narratives in teacher education arguing that "story offers the only possibility for 'truth' in the study of teaching" (p. 95). Instead of addressing epistemological questions about whether analytic or narrative text is most representative of truth, Doyle outlined how those who are interested in understanding and improving teaching, an "event and action with respect to a curriculum," can use narratives of teaching as provisional models to capture the "floating value" of truth (p. 95).

Without endorsing Doyle's (1997) view, I believe the use of narrative refutational text in my dissertation study avoids the criticisms of Phillips (1994, 1997). Narrative refutational text consists of narrative structures that have been added to pre-existing expository refutational text that was constructed based on results of the use of analytical methods. Therefore the meaning of both narrative refutational text and expository refutational text, specifically the refutation of a

misconception and explaining a more accurate conception, remains open to analytical tests for truth. Thus, the narrative refutational text is quite different from other narrative texts and structures such as movies, books, or even case studies.

Some researchers have investigated the use of narrative text in effecting conceptual change. Maria and Johnson (1990) noted that expository texts may present scientific conceptions in an abstract or decontextualized manner, making it difficult for students to relate the information to their pre-existing conceptions. To overcome this difficulty Maria and Johnson suggested the use of narrative texts in science classes. Gordon and Rennie (1987) had fifth graders read a short story about a boy and a lion to help them change their misconceptions that wild animals are always ferocious. However, students who read the narrative text in addition to an expository refutational text exhibited more evidence of conceptual change than students who read only the narrative text, casting doubt about the effectiveness of straight narrative in effecting conceptual change.

Other researchers have blended narrative and expository structures in a single text to effect conceptual change. For example, results have been promising for soft expository text, a hybrid of narrative and expository structures. Guzzetti et al. (1993) reported that the largest effect size found in their meta-analysis was for considerate soft expository text. Considerate text exhibits global coherence, such as an overall cause-and-effect or problem-and-solution structure, and local coherence at the sentence level, such as clear references, substitutions, and connections (Armbruster, 1984). Considerate soft expository text demonstrated strong effects when compared with inconsiderate plain expository text (average effect size = -1.26 , $n = 4$) and moderate effects compared against expository refutational considerate text (average effect size = $.59$, $n = 4$). These effect sizes were calculated from Maria and Johnson's (1990) study in which considerate

soft expository text was more effective than inconsiderate text in producing conceptual change as measured on all immediate and delayed recognition and application tests in fifth- and seventh-grade students who were learning about seasonal change in a gifted and talented program.

In contrast with the effectiveness of narrative structures in effecting conceptual change in elementary school students, researchers have not found narrative structures to be more effective than expository structures with secondary or undergraduate students. In their meta-analysis Guzzetti et al. (1993) reported that narrative refutational text was inferior to expository refutational text in producing conceptual change in high school students (average effect size = -.25). This divergence from findings in elementary grades may indicate that students outgrow the need for narrative structures (Guzzetti et al., 1993) or that these structures may distract learners from important information (Guzzetti et al., 1997). For example, Alvermann et al. (1995) investigated the effect of narrative refutational text and expository refutational text in promoting conceptual change in ninth-grade physics students' conceptions of impetus theory and Newtonian mechanics. Expository refutational text was superior to narrative refutational text on two of the three posttests, an application task, and short-answer task. The application task required students to use a diagram to draw the path a projectile would take and explain their conclusions. The short-answer task was comprised of six items that either cued the subjects' free recall of the text or asked them a high-order question about the concepts described in the text. There were no significant differences on a 21-item true/false posttest. The authors suggested that, by ninth grade, students may no longer read everything like a story and may find the story elements distracting from the technical material in the passage, expecting expository text to be tested one way and narrative text in another. Alvermann et al. recommended that future researchers should try to clarify whether the superiority of expository text over narrative text

with high-school students is due to the increase in older students' ability to distinguish their approach to learning depending on the type of text or whether the story grammar of narratives interferes with the learning of technical material. To achieve this understanding, Alvermann et al. (1995) suggested that researchers should include methods, such as talk-alouds or self-reports.

Guzzetti et al. (1997) used the narrative refutational text and expository refutational text texts devised by Alvermann et al. (1995) and a cartoon in a qualitative study of conceptual change in the physics domain. The study included three high school physics classes, a physics honors class for advanced students, a physics class for college-bound juniors and seniors, and basic physical science class for freshmen. Students were randomly assigned to the text conditions. Students were interrupted several times while reading and asked if anything they had read was surprising or new. Later, individual students were interviewed to find out how credible, easy to understand, or helpful they considered the texts. Only 11% to 25% of the class members reported using their textbook at all. Instead of using the textbook, the students in the honors and junior and senior classes preferred hands-on activities and labs, whereas the freshman students preferred studying notes and memorization. When asked how to improve the textbook, most of the students suggested making it easier to understand. Though all types of texts were viewed as credible, 53% of students in the basic classes and 80% of students in the honors classes preferred expository refutational text to plain expository text. The majority of students in each class also preferred expository refutational text to narrative refutational text or the refutational cartoon. To typify this preference, the authors included the response of a student who reported that reading the narrative refutational text was like mixing "pleasure reading with study reading" and made it hard to "put your brain into the gear of learning" (p. 711).

In their meta-analysis of interventions to foster conceptual change, Guzzetti et al. (1993) reported only one study that used narrative refutational text with preservice or inservice teachers. In that study, Marshall (1990) contrasted expository and narrative refutational text in changing preservice teachers' conceptions of seasonal change. Using immediate free recall and delayed multiple-choice and application items to measure conceptual change, no significant differences due to text type were found. The paucity of research on narrative refutational text with preservice teachers reflects a need to further investigate if narrative structure in an expository refutational text might be helpful to preservice or inservice teachers.

In sum, the empirical results demonstrating the benefits of narrative structures combined with expository refutational text on conceptual change differ by grade level. The evidence to date is that narrative structures may effect conceptual change with elementary students but not with secondary students or undergraduates (Guzzetti et al., 1993). However, it is important to note that in their meta-analysis Guzzetti et al. only included research using narrative structures with concepts from the natural science domain.

The possibility that narrative refutational text may be more effective than expository refutational text in producing conceptual change in the social science domain, as opposed to the natural science domain, is intriguing. Concepts from natural science domains should be distinguished from those in social science domains, like teacher education, that involve familiar life experiences (Leean, 1979). Expository refutational text has been effective in the natural science domain (e.g., physics) and the social science domain (e.g., psychology). In regard to preservice teachers, expository refutational text has been effective in producing conceptual change in the social science domain, specifically with theories of motivation (Kutza, 2000; Salisbury-Glennon & Stevens, 1999) and mathematics instruction (Gill et al., 2004). Narrative

refutational text, however, though researched with various age groups including preservice teachers, has only been researched in the natural science domain, where for high school and college students expository refutational texts were more effective in inducing change than narrative refutational texts. Narrative refutational text may be more effective than expository refutational text in the social science domain, like teacher education, because teachers' conceptions about teaching tend to be in the form of events and stories (Doyle & Carter, 1996) that are often grounded in their experiences as students (Lortie, 1975). Like concepts in teacher education, narrative text is "concerned with the explication of human intentions in the context of action" (Bruner, 1985, p. 100). Because teachers' conceptions, concepts in teacher education, and narrative text structures involve human agents in familiar life experiences, conceptual change in the social science domain of teacher education might be more susceptible to influence by narrative text structures. For example, Maria and Johnson's (1990) hypothesis that realistic narrative may help students overcome tendencies to separate real-world knowledge from information learned in texts may be more plausible for social science concepts, such as theories of motivation or learning, than for natural science concepts, such as projectile motion. The narrative structures common to teacher knowledge and narrative refutational text may facilitate conceptual change.

In addition to the study of refutational text, the widespread use of case studies, contrived scenarios, movie clips, and anecdotes in teacher education courses call for research on the effectiveness of narrative structures in affecting conceptual change. Therefore, a major purpose of my dissertation was to examine the question of whether narrative refutational text produces greater and longer-lasting conceptual change than expository refutational text with preservice teachers in the domain of social science, specifically on the topic of motivation.

Augmented Activation

In a conceptual change framework, augmented activation is a brief activity designed to activate and then refute students' prior misconceptions. In contrast, an activation activity merely activates the prior misconception without refuting it. In their meta-analysis, Guzzetti et al. (1993) reported small effects on conceptual change for activation (average effect size = .08) and large effects for augmented activation (average effect size = .80). In a refutational text intervention, augmented activation may take the form of a short paragraph read immediately before the refutational text.

Gregoire (2002) used augmented activation in conjunction with expository refutational text in her study of conceptual change of teaching mathematics in preservice teachers. She administered her control group an activation activity and an expository text, neither of which explicitly refuted the common misconception. As a check of the effects of augmented activation, participants reported to what degree they felt the reading challenged their own beliefs. Consistent with her hypothesis, participants who read the augmented activation and expository refutational text rated the passage as significantly more challenging to their beliefs than did those who were only exposed to the activation activity and the expository text.

The use of augmented activation may be especially salient for a study contrasting expository refutational text and narrative refutational text. Qualitative and quantitative methods have produced evidence that students process expository and narrative texts differently. For example, Guzzetti et al. (1997) reported students' complaints that reading narrative refutational text was like mixing "pleasure reading with study reading" and made it hard to "put your brain into the gear for learning" (p. 711). To increase the likelihood that participants in both the narrative and refutational text conditions in this study would adopt the goal of reading the text for the purpose of study, I included augmented activation in both conditions.

Recent research has demonstrated that reading purpose, specifically reading for study versus reading for entertainment, significantly affects processing of expository text. According to the Landscape model of reading comprehension (van den Broek, Young, Tzeng, & Linderholm, 1999), reading purpose helps determine an individual's standard of coherence, specifically that reading for study is associated with a higher standard of coherence than reading for entertainment. Higher standards of coherence are hypothesized to be associated with more complex processing. Researchers have used data from computer simulations based on the Landscape model to suggest that reading for study is associated with the activation of sentence information across reading cycles for the purpose of making referential, causal, logical, and contrastive relations (Linderholm, Virtue, Tzeng, & van den Broek, 2004). The assertion that those who read to study make more causal connections than those who read for entertainment has also been supported in a related quantitative behavioral study (Linderholm & van den Broek, 2002).

This research on the effects of reading purpose on expository text processing is particularly salient for this study of the processing of narrative refutational text. One could hypothesize that the narrative structures in narrative refutational text may influence readers to adopt the purpose of reading for entertainment. If so, one could expect less complex processing from those in the narrative refutational text condition than from those in the expository text condition. However, augmented activation, which has been shown to facilitate conceptual change, may also address the concern that different text conditions may lead to different reading purposes. The use of an augmented activation that explicitly states that the purpose of the text is to challenge and help clarify readers' beliefs is designed, in part, to influence all readers, regardless of text condition, to adopt the purpose of reading for study. To increase the likelihood that students in both the

narrative and refutational text conditions would adopt the goal of reading the text for study, I included augmented activation in both text conditions in the design of my study.

Mediators of Conceptual Change

Affect

Several influential psychological theories converge on the idea that negative affect is necessary to motivate conceptual change. Piaget's (1975) equilibration theory, the Posner et al. (1982) theory of conceptual change, and Festinger's (1957) theory of cognitive dissonance all explain cognitive change in terms of the human need to reduce negative affect, that is, the feeling of discomfort or tension that results when two ideas conflict. Similarly, with regard to teacher education, Feldman (2000) suggested that teachers need to be "discontent" in order to experience conceptual change (p. 622).

In their meta-analysis of research on instructional interventions for producing conceptual change, Guzzetti et al. (1993) concluded that all the approaches successful in inducing large or moderate effects on conceptual change involved some type of cognitive conflict. In further support of the role of the feeling of dissatisfaction in inducing conceptual change, Kitchener (1992) contended that cognitive conflict is a negative affective state. Does this research mean that "No pain, no gain" should be the motto of those teaching for conceptual change? Direct support for the theorists' claim that negative affect motivates conceptual change is mixed.

Gregoire (2002) provided preliminary support for the idea that expository refutational text is associated with negative affect. She found that students who read an expository text that did not challenge their beliefs generated more favorable thoughts than those who read an expository refutational text that challenged their beliefs, though the effect size (- .28) was relatively small. However, she found no relationship between affect and explicit belief change as measured by self-report, or between affect and implicit belief change as measured by response to teaching

scenarios. Furthermore, contrary to her hypothesis, negative affect was not associated with systematic processing; in fact positive affect was marginally significantly related to systematic processing, $t = 1.94, p = .055$.

In contrast to Gregoire's (2002) hypothesis, Linnenbrink and Pintrich (2002) hypothesized that positive affect would be associated with conceptual change from expository refutational text. In their two studies, Linnenbrink and Pintrich used an expository refutational physics text derived from Qian and Alvermann's (1995) study. In the first study positive affect was positively related, ($r = .22, p < .05$), and negative affect was inversely related, ($r = -.21, p < .05$) to knowledge of physics after reading an expository refutational text. In the replication study with revised self-report scales to measure affect, positive affect was no longer significantly related, but negative affect was still inversely related to physics knowledge after reading an expository refutational physics test, ($r = -.36, p < .001$). These findings raise doubt about the contention that expository refutational text leads to conceptual change through a negatively felt cognitive conflict.

Specifically Linnenbrink and Pintrich (2002) hypothesized that those with mastery or learning goals would have higher positive affect, lower negative affect, and greater use of cognitive strategies resulting in greater conceptual change. They found partial support for this hypothesis. They found evidence that those with mastery goals exhibited more conceptual change mediated by lower negative affect and higher elaborative strategy use. Negative affect was negatively related to conceptual change, suggesting negative affect may distract students from the material to be learned.

As a theoretical basis for their hypothesis that positive affect would lead to increased conceptual change, Linnenbrink and Pintrich (2002) cited Bless's (2000) contention that those in

positive moods are less likely to feel threatened by information that contradicts their existing conceptions and in turn are more likely to link that new knowledge with existing knowledge. Given that researchers agree that negative affect is generally associated with accommodative processing and positive affect is associated with assimilative processing (Bless, 2000; Fiedler, 2001), one might argue that the quality of conceptual change motivated by positive rather than negative affect would be either comparatively weak, short-term, or both. However, Bless (2001) explained that, though positive mood is associated with greater reliance on general knowledge structures (i.e., schemas, heuristics) in an assimilative sense, reliance on those structures can actually free cognitive resources for the accommodative processing of inconsistent information. Therefore, in Bless's view, the assimilation associated with positive affect does not lead to a decrease in the amount of processing as maintained by some theorists (Mackie & Worth, 1989), but rather can lead to cognitive processing that is more efficiently allocated to assimilative and accommodative processing. This view seems particularly salient for my study of narrative refutational text in that I attempted to use it to increase the positive affect and assimilative or heuristic processing associated with narrative structures, but also to encourage the accommodative or systematic processing associated with the refutation of preexisting misconceptions and acceptance of more accurate conceptions.

In sum, two rival hypotheses have been proposed to explain the role of affect in the process of conceptual change. According to one hypothesis, conceptual change occurs because a new idea conflicts with an individual's understanding and this cognitive conflict creates negative affect that motivates the individual to resolve the conflict. According to the other hypothesis, conceptual change is more likely to occur as a result of positive affect because individuals in a positive emotional state are more likely to use general knowledge structures, such as heuristics,

to process consistent information, allowing cognitive resources to process inconsistent but non-threatening information. To test these hypotheses, I investigated how the experience of affect is related to the amount and quality of processing of narrative refutational and expository refutational text.

Empathy

It seems likely that positive affect can be experienced empathically while reading narrative refutational text. For example, reading a narrative in which a character displayed increased competence could be an occasion for empathic positive affect. Furthermore, if this character's increased competence was the result of conceptual change, in which a misconception is refuted by experience and a more accurate conception is strengthened by experience, then readers might be more likely to exhibit similar conceptual change. The empathic experience of positive affect could increase processing and the resulting conceptual change.

Empathy has been described as experiencing someone else's emotional, physical, or psychological state (Zahn-Waxler, Robinson, & Emde, 1992). It is generally accepted that empathy is a cognitive and affective process: (a) interpreting the emotional states of others and (b) having an affective understanding or congruent affective response (Bourg, 1996; Eisenberg, Spinrad, & Sadovsky, 2006). Empathy has been measured variously through self-report, facial expressions, gestures, and picture story verbalizations.

Empathy has been related to comprehension of narratives in a number of studies. Empathic ability of 8- and 9-year old female students has been found to predict reading ability at age 10 and 11 (Feshbach & Feshbach, 1987). Empathizing with a particular character affected how ninth-grade students interpreted a text's theme (Golden & Guthrie, 1986). Sixth-grade students who used an empathy strategy when reading narrative texts comprehended well (Phillips, 1988). Bourg, Ridsen, Thompson and Davis (1993) found that, in sixth grade readers of all ability

levels, empathy led to greater comprehension of coherent narrative texts (texts with many connected goal, action, outcome sequences, see Trabasso, Secco, & van den Broek, 1984). Reviewing these findings, Bourg (1996) suggested a possible causal chain from (a) text coherence to (b) identification of goal-action-outcome (GAO) sequences to (c) inferencing of character emotions to (d) development of empathy with characters to (e) creation of motivation to (f) increased comprehension.

These studies have demonstrated that empathy is an important variable in the comprehension of straight narrative texts, but is there any evidence empathy is associated with the kind of conceptual change that is the goal of narrative refutational texts? Chebat, Vercollier, and Gelinas-Chebat (2003) found empathy plays a key role in attitude change when reading public service newspaper advertisements. They had participants read one of four advertisements, ranging from 11 to 14 sentences in length and comparable in other measures of readability. The advertisements were about a topic predetermined to be of high relevance (AIDS) or low relevance (malaria) to the study participants. The advertisements were also manipulated by message format, either lecture or drama format. The lecture format was a straight expository text, and the drama format was a narrative about an individual who finds his friend has a disease (AIDS or malaria) and becomes motivated to learn more and get involved in finding a cure. The researchers used structural equation modeling to test hypotheses about the direction of the relationship of information processing and empathy in attitude change.

The researchers measured empathy by self-report and information processing by thought-listings. Results indicated that (a) empathy was significantly related to information processing in both high and low self-relevant conditions and (b) the direction of influence between empathy and information processing differed according to self-relevance. In high self-relevant conditions,

information processing increased empathy and subsequent attitude change regardless of message format. However, in low self-relevant conditions, the drama format generated empathy that increased information processing and attitude change.

Will similar results be obtained in a study of conceptual change in preservice teachers using expository refutational text and narrative refutational text? To identify a specific condition, such as text format, and describe how that condition influences the degree and direction of empathy and cognitive processing in conceptual change deserves close attention. Therefore, in this study I explored the role of empathy as a potential mediator of the relationship between narrative refutational text and conceptual change.

In summary, those teaching for conceptual change have attempted to motivate conceptual change by inducing a negatively felt cognitive conflict. Influencing conceptual change by the process of cognitive conflict has met with mixed results, perhaps due to failure in making the conflict salient to students (Limón, 2001). There is yet a further question as to whether cognitive conflict is motivated or accompanied by negative affect. Alternatively, there is theoretical support for the idea that change may be accompanied or motivated by positive affect, perhaps empathically experienced by those reading narrative refutational texts; in this study I looked for empirical support of these possibilities.

Systematic and Heuristic Processing

In the search for processes that account for conceptual change, researchers have looked to the social psychological literature of persuasion and attitude change, specifically the research on dual-process theories (Dole & Sinatra, 1998; Gill, 2003). Dual-process theories were developed to explain why people sometimes adopt attitudes after careful consideration of the evidence, whereas other times they seem to bypass this process and make decisions based on heuristics, or “rules of thumb.” To address this inconsistency, researchers have proposed two independent, yet

interactive, processing systems, one for effortful rational processing and another for automatic processing based on heuristics.

Researchers have proposed several dual-process theories, but the most heavily researched is the heuristic-systematic model (HSM; see Eagly & Chaiken, 1993, for a review). Within the HSM, systematic processing is described as rational, effortful, analytic, and verbal. Those engaged in systematic processing “attend to, evaluate, elaborate, and integrate” information (Maheswaran, Mackie, & Chaiken, 1992, p. 318). In addition to thoughts representative of the message, novel or self-generated thoughts related to the message are also indicative of systematic processing (Chaiken, Duckworth, & Darke, 2000).

In contrast heuristic processing is dominated by rules that are stored in memory and activated by cues (Chen, Duckworth, & Chaiken, 2000). These rules, heuristics, are used to bypass the effort required for systematic processing. To operate, heuristics must be available (learned, stored in memory), accessible, (retrieved from memory), and applicable (relevant to the situation) (Higgins, 1996). Some examples of widely held and well-researched heuristics are “experts can be trusted,” “majority opinion is correct,” and “long messages are valid messages” (Chaiken & Maheswaran, 1994). Stereotypes like “men are assertive” or “Asians are intelligent” can also operate as heuristics (Chen et al., 2000). Heuristics provide expectancies or diagnostic information for decision-making activities (Maheswaran et al., 1992).

Some researchers have hypothesized that systematic processing might serve as a process that mediates the relationship between an instructional intervention and conceptual change (Dole & Sinatra, 1998; Gill, 2003). To date, however, this hypothesis has not been supported by empirical evidence. Gill et al. (2004) sought to identify systematic processing as the process through which an instructional intervention using expository refutational text effected conceptual

change in preservice teachers' epistemological beliefs about mathematics. Participants completed a measure of their general and domain-specific epistemological beliefs and read either a plain expository or expository refutational text on the nature of mathematical knowledge. Gill et al. measured systematic processing by thought-listings about the message of the text generated after reading. The authors hypothesized that an expository refutational text would lead to belief change, with systematic processing serving a mediational role, but the results did not support this hypothesis, raising doubt about the importance of systematic processing in conceptual change. The authors, however, speculated that their measure of systematic processing may not have been sensitive enough to detect its mediating role in conceptual change and suggested investigating alternative measures.

A third alternative is to look for evidence of the combined effects of systematic and heuristic processing. As described in HSM, systematic processing does not occur in isolation, but in conjunction with heuristic processing. This assumption is an implication of the sufficiency principle of HSM. The sufficiency principle holds that thinkers are economy minded, but also desire confidence in their decisions; they want to exert merely sufficient effort to reach the desired confidence level. Systematic processing is used when heuristics alone cannot close the gap between confidence in a decision and desired confidence. Therefore, low motivation leads to only heuristic processing, but high motivation widens the gap and increases the likelihood of systematic processing (Chen et al., 2000).

The sufficiency principle therefore allows for heuristics to operate alone or in conjunction with systematic processing. When both systems operate in conjunction, researchers have described three possible outcomes (Chen et al., 2000): (a) Heuristics may be attenuated; for example, the heuristic "accidents never happen" can be attenuated by systematically processing

incongruent messages describing the danger of a product. (b) Heuristic and systematic processing can be additive in their effects on attitude change. This additive outcome can occur when the message and heuristic cue are congruent. For example, the “consensus implies correctness” heuristic activated by favorable opinion poll results can have an additive effect on endorsement of a product if that product is also logically superior. (c) Finally, heuristics can bias systematic processing. For example, Chaiken and Maheswaran (1994) found that the “experts are right” heuristic will bias systematic processing of a product description of ambiguous quality. From this research, they described how the first two outcomes are likely when the message for systematic processing is unambiguously strong or weak. Unambiguously strong or weak messages should lead to attenuation when the heuristic cues are incongruent with the message and additivity when the heuristic cues are congruent with the message. Messages that are of ambiguous quality will more likely lead to the biasing of systematic processing by heuristic processing.

To understand the processes of conceptual change in order to effect conceptual change, the possibility of additive effects of heuristic and systematic processing is most promising. If the effects of the processing systems are additive, then the likelihood of change, the strength of change, and the duration of change should be greater. If refutational text effects conceptual change by increasing systematic processing, as some have proposed (Dole & Sinatra, 1998; Gill, 2003), then an implication of the sufficiency principle is that refutational text widens the gap between confidence and desired confidence and motivates systematic processing.

If systematic processing is engaged while reading refutational text, another implication of the sufficiency principle is that this systematic processing occurs only in relationship to the default heuristic processing. Specifically, systematic processing is attenuating, adding to, or

being biased by heuristic processing. Theoretically, heuristics that are congruent with an unambiguously strong message should lead to additive effects. For those using refutational text for conceptual change, what text characteristics might serve as congruent cues for heuristic processing, leading to additive effects with systematic processing and producing greater conceptual change? Hynd (2003) claimed that cues such as style, length of argument, and credibility are always heuristics even when experts use them consciously and systematically. She suggested people use every means they can to construct meaning, so those teaching for conceptual change should learn how to harness heuristics.

The possibility that systematic and heuristic processing can have an additive effect on conceptual change is theoretically supported by another important dual-process model, cognitive-experiential self-theory (CEST; Epstein & Pacini, 1999). CEST includes a rational conscious system that operates in a systematic manner and an experiential system that operates by heuristics, specifically those grounded in narrative, metaphor, and affect. Therefore, the heuristic processing described by Hynd (2003) and CEST may be an important process in conceptual change.

Harnessing these heuristics grounded in experience, narrative, metaphor, and affect may have an especially important place in teacher education. Doyle and Carter (1996) pointed to a disturbing mismatch between teacher education programs and teacher knowledge, claiming that teacher education courses are full of abstractions and principles, whereas teachers' knowledge is in the form of concrete events and stories. They suggested the emphasis on abstract rationality may miss the mark because teachers' understandings have a narrative structure.

Thus, it seems possible that, especially for preservice teachers learning social science concepts, narrative refutational text might yield greater heuristic processing and, if congruent

with systematic processing, result in greater conceptual change. It also seems possible that this processing could be motivated by positive affect, perhaps experienced empathically, and without the negative affect assumed to be necessary for conceptual change in the theories of Piaget (1975), Posner et al. (1982), and Festinger (1957). Therefore, I examined the relationship of systematic and heuristic processing as well as empathy and affect as mediators of the relationship between text type and conceptual change.

Personal Characteristics Influencing Conceptual Change

Epistemological Beliefs

Broadly speaking, epistemology is the philosophical study of the nature of knowledge and knowing. Personal epistemology is the empirical study of individuals' beliefs about the characteristics and sources of knowledge (Buehl & Alexander, 2001). Perry (1970) initiated research on personal epistemology using semi-structured interviews and found that male undergraduates construct their own theories about the nature of knowledge. Specifically, he found that these personal epistemologies exist on a developmental continuum from dualism, that is, the idea that knowledge is either true or false, to a more complex relativism that in contrast accounts for differences in knowledge according to perspective and contexts.

A host of researchers followed Perry's (1970) lead with various emphases. King and Kitchener (1994) expanded Perry's work by including females and more age groups but still maintained a very general and stage-like conception of epistemological beliefs. Belenky, Clinchy, Goldberger, and Tarule (1986) focused on the unique beliefs of women, suggesting women's knowledge is not merely dualistic or relativistic but can be classified as subjective, procedural, received, or constructed, for example. Baxter Magolda (1987, 1992) investigated specific academic or subject-centered beliefs rather than general beliefs. In contrast to a unitary and stage-like conceptualization of personal epistemology, Schommer (1990) proposed a

multidimensional approach by identifying five distinct epistemological beliefs: (The beliefs are listed negatively so that strong belief suggests an immature personal epistemology.)

- Simple knowledge: Knowledge is easily grasped.
- Certain knowledge: Knowledge is unchanging.
- Omniscient authority: The source of knowledge is external to the knower.
- Innate ability: The amount learning is determined by one's unchanging intelligence.
- Quick learning: Learning occurs over a short period.

Researchers have identified several problems with Schommer's (1990) five epistemological beliefs. Schraw, Bendixen, and Dunkle (2002) criticized the factor analysis techniques Schommer used in the validation of her 63-item Likert-scale measure of epistemological beliefs. Hofer and Pintrich (1997) questioned if beliefs in innate ability and quick learning are indeed epistemological beliefs, because they concern learning and not knowledge.

Despite these problems, epistemological beliefs continue to have significant explanatory power. For example, in her initial work, Schommer (1990) described how epistemological beliefs are related to the way students process information and monitor comprehension. Specifically, she found that the belief in simple knowledge was related to poorer comprehension, the belief in quick learning was related to oversimplification and overestimation of learning, and the belief in certain knowledge was related to more absolute and definitive conclusions. Kardash and Scholes (1996) had college students read contradictory evidence about HIV/AIDS and found that belief in certain knowledge was associated with a misinterpretation of contradictory evidence, whereas a belief in uncertain knowledge was associated with a more valid inconclusive interpretation of contradictory evidence.

Researchers have also looked to the explanatory power of epistemological beliefs as a contributor to conceptual change. Pintrich (1999) suggested that more mature epistemological

beliefs may lead to more conceptual change, perhaps by fostering a mastery orientation that encourages deeper cognitive processing. Some research has supported this possibility. For example, in her study of the effect of expository and refutational text on conceptual change, Gregoire (2002) used the 11 items identified in Qian and Alvermann's (1995) factor analysis to measure beliefs in simple and certain knowledge and found that those epistemological beliefs were related to conceptual change, as evidenced on measures of explicit and implicit beliefs about teaching mathematics. The Cognitively Guided Instruction Belief Survey (CGI; Peterson et al., 1989) is a self-report measure of explicit beliefs about mathematics. Those who had a belief in simple and certain knowledge exhibited less conceptual change as measured by the CGI ($t = -2.97, p < .002$). As a measure of implicit beliefs about mathematics, Gregoire devised eight teaching scenarios that depicted either constructivist or procedural teaching practices. Belief in simple and certain knowledge was not correlated with conceptual change as measured by agreement with the constructivist scenarios ($t = -1.08, p < .141$), but was as measured by disagreement with procedural scenarios ($t = 2.22, p < .014$). Consistent with this research I investigated the effect of epistemological beliefs on change in conceptions of motivation.

Verbal Ability

In reading refutational texts, students with lower verbal ability might have difficulty recognizing the conflict between theories and, as a consequence, might exhibit less conceptual change than students with higher verbal ability. In her study of conceptual change, Gregoire (2002) examined the relation of verbal ability, as measured by self-reported verbal scores on the SAT, to conceptual change in beliefs about mathematics instruction. However, she found no relationship between verbal ability and conceptual change on measures of either explicit or implicit beliefs. To explore further the role of verbal ability in reading refutational text, I investigated whether verbal ability influenced change in conceptions of motivation in this study.

Purpose of the Study

My purpose in this study was to increase our understanding of conceptual change in preservice teachers by testing the model presented in Figure 1-1, which specifies that instructional text (i.e., narrative refutational text vs. expository refutational text), epistemological beliefs, and verbal ability directly affect conceptual change and that type of text also directly affects systematic and heuristic processing, which in turn directly affect change in conceptions of motivation. Furthermore the model specifies that text directly affects positive and negative affect which in turn affects processing, and conceptual change. Finally, the model specifies that the text directly affects empathy, which in turn affects positive and negative affect, processing, and conceptual change. This model addresses a number of weaknesses in current research. These weaknesses include the need to further identify effective interventions to effect conceptual change, the failure to identify individual characteristics that influence conceptual change, and the lack of specification of cognitive and affective processes involved in conceptual change.

Therefore, the purpose of this dissertation study was three-fold: One purpose was to compare two instructional interventions, expository refutational and narrative refutational text, designed to foster conceptual change in preservice teachers. A second purpose was to explore two personal characteristics, specifically epistemological beliefs and verbal ability that may influence preservice teachers' conceptual change. A third purpose was to investigate whether the affective and cognitive processes of positive and negative affect, empathy, and systematic and heuristic processing mediate the relationship between the instructional intervention and conceptual change in the preservice teachers' conceptions of motivation.

First, I compared instructional interventions designed to effect conceptual change. Specifically I compared the extent of conceptual change in an experimental group that read a narrative refutational text to a comparison group that read a comparable expository refutational

text. Both the narrative refutational and expository refutational text refute an extrinsic theory of motivation and explain an intrinsic theory of motivation, but the narrative refutational text was constructed by adding narrative structures such as setting, character, and plot to the expository refutational text.

Second, I explored two personal characteristics hypothesized to affect the process of conceptual change. Specifically, I investigated the role of general epistemological beliefs and verbal ability in the process of conceptual change. Prior research has demonstrated that some epistemological beliefs, such as the beliefs that knowledge is simple and certain, can influence the relationship between specific instructional interventions and conceptual change (Kardash & Scholes, 1996; Windschitl & Andre, 1998). To further explore this relationship, I tested the hypothesis that individuals who hold epistemological beliefs that knowledge is simple or certain demonstrate less evidence of conceptual change after reading a narrative refutational text. Although Gregoire (2002) did not find a relationship between verbal ability and conceptual change in her study of expository text versus refutational text, I examined whether verbal ability influenced conceptual change in my study to determine whether it affected change in conceptions of motivation when reading two types of refutational text.

The third purpose of my study was to explore cognitive and affective processes hypothesized to account for conceptual change. To do this I investigated whether the positive or negative affect experienced from reading narrative refutational and expository refutational text was associated with conceptual change. Some researchers have hypothesized that, after reading refutational text, an individual who experiences negative affect will allocate the cognitive resources necessary for conceptual change to alleviate the negatively felt disequilibrium (Gregoire, 2002), whereas other researchers have hypothesized that positive affect will increase

the processing for conceptual change (Linnenbrink & Pintrich, 2002). In addition to these affective processes, I explored the cognitive processes of systematic and heuristic processing in conceptual change. Some researchers have claimed that systematic processing may serve an important role in conceptual change (Dole & Sinatra, 1998; Gill, 2003), but others have also looked to heuristic processing (Hynd, 2003). However, in light of work in social psychology suggesting that systematic and heuristic processing have additive effects (Chen et al., 2000), I looked for the additive effects of both systematic and heuristic processing on conceptual change while reading narrative refutational text.

Significance of the Study for Theory

Mayer (2002) recently reviewed the state of the literature on conceptual change. He concluded that researchers have reached consensus that conceptual change is a cognitive process in which the learner actively constructs coherent and useful knowledge. Yet he also concluded researchers do not agree on how change occurs, specifically regarding the mechanisms or processes of conceptual change, and the methods teachers can use to effect conceptual change. My dissertation study was designed to address these theoretical issues of conceptual change in the context of teacher education.

First, this study has the potential to increase our understanding of methodologies used to effect conceptual change in preservice teachers. Expository refutational text, designed to induce a cognitive conflict in the reader, has been among the most effective methodologies to effect conceptual change in the natural science domain among students from elementary school to the university (Guzzetti et al., 1993). Furthermore, expository refutational text has been more effective than plain expository text in effecting conceptual change in the social science domain among preservice teachers (Gregoire, 2002; Kutza, 2000; Salisbury-Glennon & Stevens, 1999). However, research is needed that explores the effect of narrative refutational text in the social

science domain of teacher education on conceptual change in preservice teachers, even though teacher conceptions of teacher education often take the form of narratives rather than general principles (Doyle & Carter, 1996; Lortie, 1975). Given that methods of inducing cognitive conflict may fail because they fail to make the conflict salient to the reader (Limón, 2001), it is important to investigate the effectiveness of narrative refutational text in contrast to expository refutational text in changing these preservice teachers' conceptions of teaching to be more consistent with contemporary research.

Second, this study can help us understand personal learner characteristics that influence the change process. Researchers have identified epistemological beliefs as a personal characteristic that influences the effect of methods of intervention on conceptual change. Specifically individuals with less mature epistemological beliefs, for example the belief that knowledge is simple or certain, show less evidence of change than those with more mature epistemological beliefs when reading an expository refutational text (Gregoire, 2002; Qian & Alvermann, 1995) or when using instructional materials that require hypothesis formation and testing (Windschitl & Andre, 1998). I investigated whether epistemological beliefs influence the effect of reading narrative refutational text on conceptual change to help us further understand how personal characteristics such as preexisting beliefs may influence conceptual change.

The third purpose of this dissertation was to investigate the cognitive and affective processes of conceptual change. Prominent researchers have disagreed on whether positive or negative affect motivates the cognitive processing necessary for conceptual change. Piaget's (1975) equilibration theory, the Posner et al. (1982) theory of conceptual change, and Festinger's (1957) theory of cognitive dissonance all explain cognitive change in terms of the human need to reduce the negative affect that is felt when individuals are confronted with conflicting

information. This negative affect theoretically motivates the cognitive processing necessary to resolve the cognitive conflict and reduce the accompanying dissonance, or feeling of discomfort.

Bless (2000, 2001), in contrast, hypothesized that positive affect will ameliorate the threat posed by conflicting information and lead to the use of general knowledge structures, such as schemas or heuristics, freeing cognitive resources to process conflicting information and achieve conceptual change. I hypothesized that a narrative refutational text about a teacher who increases her competence by changing her conceptions about teaching to be more consistent with research will lead to an increase of positive affect in the reader, either directly or indirectly through the mediation of empathy. If reading a narrative refutational text increases positive affect, then according to Bless's hypothesis, readers will activate their general knowledge structures, specifically those schema or heuristics about teaching that exist in narrative from (Doyle & Carter, 1996; Lortie, 1975), and allocate cognitive resources to the discrepant but non-threatening information and achieve greater conceptual change than those who read expository refutational text.

In addition to the divergent theories about the role of affect in conceptual change, a lack of agreement exists regarding the cognitive processes that influence conceptual change (Mayer, 2002). To identify cognitive processes involved in conceptual change some researchers have looked to dual process models of cognition, such as the heuristic-systematic model (HSM) involving systematic processing and a more automatic or affect-driven type of processing, often described as heuristic (Eagly & Chaiken, 1993). Within this dual process framework, some researchers have suggested that systematic processing, that is, a logical, effortful type of information processing, might be the primary cognitive process involved in conceptual change (Dole & Sinatra, 1998; Gregoire, 2003). Hynd (2003), in contrast, argued for the importance of

heuristic processing, such as thoughts about style, length of argument, and credibility, in conceptual change. Evidence is needed that clarifies the role of these processing types; therefore I investigated the additive effects of these dual processes (see Chen et al., 2000) in conceptual change. The use of narrative refutational text designed to increase heuristic processing by the inclusion of narrative structures and increase systematic processing by the inclusion of refutational text will help us understand how systematic and heuristic processing influence conceptual change.

Significance of the Study for Practice

Preservice teachers possess many conceptions about teaching that are incongruous with findings of educational research (Holt-Reynolds, 1992; Woolfolk Hoy & Murphy, 2001). Research in a variety of disciplines, including social and developmental psychology as well as education, has shown that such conceptions are very resistant to change (Chinn & Brewer, 1993; Wideen et al., 1998). Specifically, preservice teachers have conceptions about motivation that are not consistent with contemporary views (Patrick & Pintrich, 2001), creating a need to identify effective interventions that promote such conceptual change. Expository refutational text has been among the most effective interventions for conceptual change studied to date (Guzzetti et al., 1993), yet important questions regarding text, domain, and reader characteristics remain. For example, is narrative refutational text more effective in inducing conceptual change in the social science domain than expository refutational text? Are these effects influenced by readers' epistemological beliefs or verbal ability? By addressing these questions, this study's purpose was to provide information to writers of texts used in teacher education programs, and those teacher educators who use these texts, as to how different types of text influence conceptual change in preservice teachers.

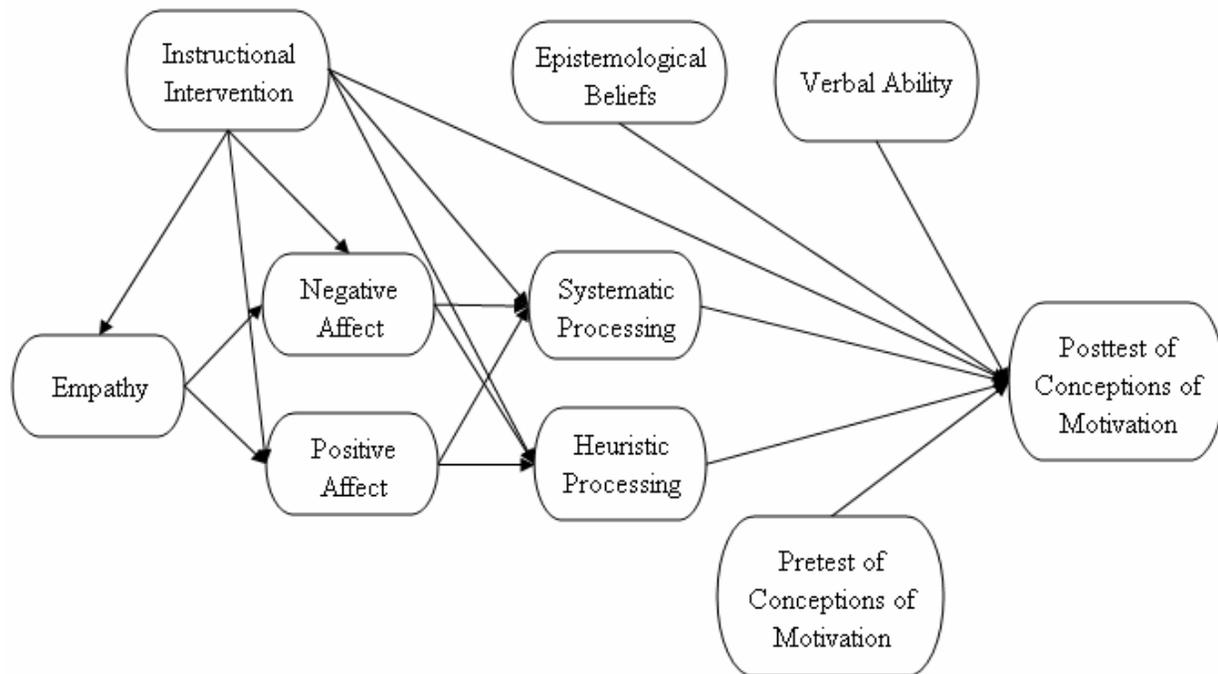


Figure 1-1. Proposed model of conceptual change.

CHAPTER 2 MATERIALS AND METHODS

To investigate the effect of text type, epistemological beliefs and verbal ability on conceptual change and the role of empathy, affect, and systematic and heuristic processing as mediators of the effect of text type, I tested the model of conceptual change illustrated in Figure 1-1. Specific hypothesis implied by the model are presented below.

Research Questions

1. Do epistemological beliefs or verbal ability influence change in preservice teachers' conceptions of motivation immediately after reading narrative refutational text and 4 weeks later?
2. Does reading a narrative refutational text have a stronger effect on conceptual change in preservice teachers' conceptions of motivation than an expository refutational text immediately after the reading and 4 weeks?
3. Does reading a narrative refutational text have a stronger effect on preservice teachers' systematic and heuristic processing of information regarding conceptions of motivation than reading an expository refutational text?
4. Does reading a narrative refutational text elicit more positive emotion in preservice teachers than reading an expository refutational text?
5. Does reading a narrative refutational text elicit less negative emotion in preservice teachers than reading an expository refutational text?
6. Does reading a narrative refutational text have a stronger effect on the empathy that preservice teachers experience after reading than reading an expository refutational text?
7. Do empathy, positive affect, systematic, and heuristic processing mediate the relationship between text type (narrative refutational text vs. expository refutational text) and conceptual change in preservice teachers' conceptions of motivation immediately after the reading and 4 weeks later?

Participants

Two hundred sixteen undergraduate students enrolled in teacher education programs in the 2006-2007 school year participated in the pretest, intervention, and posttest phases of this study. Ninety-five of these participants were enrolled in one of four sections of a required child development course at a large, southern state university in the fall semester. One hundred

twenty-one of these participants were enrolled in one of three sections of a required educational psychology course at a medium-sized, southern state university in the following spring semester. All students recruited were volunteers who signed informed consent agreements to participate in the study and were given course credit up to 1% of their final grade for their participation.

Twenty six students (6 from the large university and 20 from the medium-sized university) did not complete all the measures and were deleted from the analyses. Of the remaining participants ($N = 190$), 89 were from the large university, and 101 were from the medium-sized university. Of the participants 93% were female, and 79% were juniors in their teacher education program. Seventy-nine percent of the participants were Caucasian, 10% were Black, 5% were Hispanic, 1% were Asian, and 3% identified themselves as “Other” or did not respond. Gender, ethnicity, and year in school by university group are reported in Table 2-1.

Experimental Treatments

I compared the effect of an expository refutational text (ERT) and a narrative refutational text (NRT) on conceptual change. The ERT is an expository text, that simply explains concepts such as that typically used in textbooks, but it is also a refutational text in that it first explains a commonly accepted concept and then refutes that concept by contrasting it with a different concept that is better supported by research. I used the ERT devised by Salisbury-Glennon and Stevens (1999). The ERT contrasts a commonly accepted extrinsic or reinforcement theory of motivation to an intrinsic theory of motivation better supported by research. The NRT also contrasts extrinsic and intrinsic theories of motivation, but in a narrative about a preservice teacher who experienced the limitations of an extrinsic view of motivation and realized the benefits of changing her conception of motivation to an intrinsic view.

I created the NRT (Appendix A) by adding narrative structures to the pre-existing ERT. In the NRT, a novice teacher endorses and operates her classroom consistent with an endorsement

of extrinsic motivation. After she notices adverse effects in her classroom, she receives information on how to operate her classroom to facilitate intrinsic motivation from an experienced teacher. I placed as many phrases and whole sentences from the ERT into the NRT as practicable. In previous studies the NRT has differed from the ERT in length or readability or both. For example, in their study of conceptual change in high-school physics students, Alvermann et al. reported a length of 606 words for their ERT and 782 words for their NRT (NRT was 29% longer) and a Fry (1977) readability level of seventh grade for both. In their study of conceptual change in fifth-grade science students, Maria and Johnson (1990) reported a length of 1,075 words for their ERT and 1,533 words for their NRT (NRT was 42% longer), and Raygor (1977) readability scores of sixth grade for the ERT and fourth grade for the NRT. The difference in length, readability, or both may account for the differences in treatment effects rather than differences in the content of the text; therefore, I designed the texts in my study to have nearly identical lengths and levels of readability. The initial draft of the NRT was longer and had a lower readability level than the ERT, so I excised selected monosyllabic words and added polysyllabic words to reduce the word count and increase the readability level to be consistent with the ERT. The ERT has a length of 573 words, and the NRT has a length of 569 words. The Flesch-Kincaid Grade Level score, a function of average sentence and word length, is 13.25 for the ERT and 13.17 for the NRT.

Pretreatment Measures

Conceptual Change

Conceptual change was measured by contrasting pre- and posttest scores on 20 items regarding motivation theories developed by Salisbury-Glennon and Stevens (1999). Each item on the instrument is a short scenario that participants identified as true or false, by marking 0 for true and 1 for false on their response sheet. See, for example, the following item:

Dr. White is pleased to see that his daughter is very motivated to read her biology assignments. In fact, she often reads biology books from the library that are not assigned. In order to encourage her to continue to learn about biology, Dr. White pays her \$3 for every chapter that she reads. This is a good way to motivate her to continue reading the biology books.

For items, like this one, that endorse an extrinsic view of motivation, a response of 1 for false was counted as correct and summed. However, for intrinsic motivation items a response of 1 for false would be incorrect, so I reversed the scores on these items before summing. Therefore in my analysis, higher scores represent conceptions of motivation consistent with Deci's theory of intrinsic motivation (Deci & Ryan, 1985); that is, high scores on the extrinsic pre- and posttests indicated that the respondent did not endorse teacher strategies involving reinforcement as good ways to motivate students for learning, and high scores on the intrinsic measure indicated that the respondent endorsed teacher strategies that assisted students to learn for the sake of learning.

Salisbury-Glennon and Stevens (1999) used this measure of conceptual change as a pretest, posttest, and delayed posttest and reported internal consistency estimates of participants' scores on the total scale of .68, .74, and .74, respectively. In her dissertation study, Kutza (2000) reported a Cronbach's alpha reliability estimate of .70 for participants' scores on the 20-question instrument. However, in her analysis she divided the instrument into two subscales of 10 questions each, using one scale to measure a preference for extrinsic motivation theory and the other to measure a preference for intrinsic motivation theory. Kutza also changed the response options from true or false to a 5-point Likert scale that participants used to rate their level of agreement with each scenario. For the respondents' scores on the extrinsic and intrinsic subscales scores, she reported internal consistency estimates of .81 and .77, respectively. Kutza analyzed the two 10-item subscales rather than the total score in order to assess conceptual change as rejection of an extrinsic theory, endorsement of an intrinsic theory, or both. For these reasons, I

also measured change using the two 10-item subscales, but I maintained the dichotomous response options used by Salisbury-Glennon and Stevens.

For the scores on the pretests of the intrinsic and extrinsic subscales, internal consistency estimates were .58 and .61 for the participants' scores, respectively. For the participants' scores on the posttests of the intrinsic and extrinsic subscales, internal consistency estimates were .59 and .77, respectively. For the delayed posttests administered 4 weeks after the posttest, I obtained internal consistency estimates for the participants' scores on the intrinsic and extrinsic subscales estimates of .63 and .74, respectively.

Epistemological Beliefs

Using Schommer's (1990) Epistemological Beliefs Questionnaire, a 63-item Likert-type scale, researchers have conducted large quantitative studies of epistemological beliefs (e.g., Schommer & Dunnell, 1992; Schommer, Rhodes, & Crouse, 1992). However researchers have identified some methodological and conceptual problems with that instrument (Hofer & Pintrich, 1997; Schraw et al., 2002). To address some methodological problems, Qian and Alvermann (1995) conducted an exploratory factor analysis of Schommer's (Schommer & Dunnell, 1992) Epistemological Belief Questionnaire that led to a three-factor model with factors named Quick Learning, Innate Ability, and Simple-Certain Knowledge.

I used the 11-item Simple-Certain subscale devised by Qian and Alvermann (1995) as a measure of epistemological beliefs in this study. Qian and Alvermann found that responses to this subscale, with a reported alpha of .68, were inversely related to conceptual change in high-school physics students. Subscale items include, for example, "Most words have one clear meaning" and "If scientists try hard enough, they can find the truth to almost anything." Response options for the items ranged from 0 (*strongly disagree*) to 5 (*strongly agree*). Gregoire (2002) used the same subscale in her dissertation study, similarly finding belief in simple-certain

knowledge was inversely related to change in preservice teachers' conceptions of mathematics teaching. She reported a Cronbach's alpha of .73 for the preservice teachers' scores. The Cronbach's alpha of .72 for participants' scores on this instrument in my dissertation sample was consistent with these previous studies.

Verbal Ability

Participants were asked to report their scores on the verbal portion of the SAT or their score on the reading portion of the ACT or both as an indicator of verbal ability. Sixty-six of the 216 participants reported SAT scores, though 4 were obviously incorrect because they were single-digit numbers or exceeded the maximum possible score of 800. Forty-seven of the 216 participants reported their ACT reading scores, though 1 was obviously incorrect. In addition, participants were asked to give their permission for me to request their scores from the registrar to verify the accuracy of their scores or supply missing scores. One hundred twenty-five of the 216 participants gave permission to request their scores from the registrar. If the scores from the registrar differed from the self-reported scores, I used the scores from the registrar. If I had only ACT scores, I transformed them to a metric comparable to the SAT scores by using a transformation based on z-scores¹.

¹ Transformed score = {[ACT score – Mean (ACT)] * [SD(SAT)/SD(ACT)] + Mean (SAT)}

The standard deviation (SAT) and the mean (SAT) for 2004—the year most participants took the exam—were obtained from the College Board website at http://www.collegeboard.com/prod_downloads/about/news_info/cbsenior/yr2004/2004_CBSNR_total_group.pdf

For ACT scores, this information was obtained from www.act.org/news/data/04/data.html

Posttreatment Measures

Affect

To measure affect, I used the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS consists of two 10-item scales. Participants rated their positive and negative affect on a 5-point Likert scale, ranging from (1) *very slightly or not at all* to (5) *extremely*. Examples of positive affect include interested, excited, and attentive; examples of negative affect include distressed, guilty, and afraid. The PANAS can be used for various time frames from the present moment, to the past few weeks, to generally. In an attempt to measure affect induced by the reading I used the PANAS with the instruction, “Indicate how the selection you read makes you feel right now at the present moment.” In initial development and validation studies of the PANAS using the present moment instruction, Watson et al. reported alpha coefficients of .89 for respondents’ scores on the positive affect scale and .85 for their scores on the negative affect scale and a correlation of -.15 between the two scales. In my sample I obtained an alpha coefficient of .90 for the participants’ scores on the positive affect scale and .82 for scores on the negative affect scale and a correlation of .22 between the two scales.

Systematic and Heuristic Processing

Processing type was measured by coding participants’ thought listings (TLs) after reading the text. Gregoire (2002) devised a rubric for coding TLs as either message-based or non-message-based with message-based TLs reflecting systematic processing. I followed Gregoire’s coding procedure for systematic processing. An example of a TL that was coded as systematic processing was “I knew about intrinsic and extrinsic rewards, but I never knew that giving rewards would hinder students’ motivation.” Also like Gregoire, I coded TLs that were fragmented, sweeping affective judgments, or clichés, as non-message-based processing. However, her coding procedure for non-message-based TLs included what is described as

relevant heuristic processing (Hynd, 2003). For example, statements regarding text style, length, difficulty, credibility, or audience reaction are relevant heuristics, but were coded by Gregoire as non-message-based. In my study, I coded relevant heuristic processing in a separate category. An example of a statement coded as relevant heuristic processing was “I think that this reading needs more examples on not rewarding the children with prizes and stickers.” Also, because of the narrative aspects of heuristic processing (Epstein & Pacini, 1999), TLs regarding the story elements (plot, character, and setting) of the NRT were coded as relevant heuristic processing. An example of such a statement was “I understood the anxiousness Wendy had about wanting to motivate her students to learn.” In her dissertation study, Gregoire divided the number of message-based TLs by the total number of TLs to obtain a score for systematic processing; my coding procedures (Appendix B), however, resulted in scores for systematic and heuristic processing.

An assistant transcribed the participants’ TLs word-for-word, including spelling errors, into a table labeled by their identification number, but not by their treatment condition, so the raters were blind as to treatment condition. A second assistant and I coded each TL as an example of systematic, heuristic, or irrelevant processing. As a measure of interrater reliability, Cohen’s kappa for the ratings was calculated at .63, indicating substantial agreement (Landis & Koch, 1977). For each rater’s codings, I divided the number of TLs coded as systematic by the total number of TLs to get a systematic processing score in the form of a ratio that could range from 0 to 1. I repeated the process for the TLs coded as heuristic processing. Cronbach’s α was .89 for participants’ systematic processing scores and .94 for participants’ heuristic processing scores. I then averaged the two raters’ systematic and heuristic processing scores to get one systematic processing score and one heuristic processing score for each participant.

Empathy

I measured empathy using a 5-item, 6-point Likert-type scale, ranging from 1 (*strongly disagree with the statement*) to 6 (*strongly agree with the statement*) published by Coulson (1989), but originally devised by Schlinger (1979) to assess empathic response to television commercials. Chebat et al. (2003) revised the scale for use with public service newspaper advertisements and obtained an internal consistency estimate of participants' scores of .84. I revised the scale by replacing the word *advertisement* with the word *reading*, so that participants indicated the extent to which they "liked the reading because it was personal and intimate," whether they felt they were "right there in the reading experiencing the same thing," whether "the characters were expressing what they felt like at times," whether they were "involved in the reading" and whether the reading represented, "their ideal--the life the reading showed." Cronbach's alpha for participants' scores in this study was .81, slightly lower than that reported by Chebat et al.

Procedures

Phase 1

On the first occasion that lasted approximately 10 minutes, participants completed the informed consent form, the 11-item epistemological belief measure, and the 20-item conceptual change measure as a pretest.

Phase 2

One week after Phase 1, participants were randomly assigned to read the expository refutational text (ERT) or narrative refutational text (NRT) about motivation. After reading, participants reported affect on the PANAS, completed the thought listing, and then completed the 20-item conceptual change measure as an immediate posttest. This phase took approximately 20 minutes.

Phase 3

The final data collection of the study took place approximately 1 month after Phase 2 and lasted approximately 5 minutes. On this third day, the participants completed the conceptual change measure as a delayed posttest.

Analysis

My conceptual model (Figure 1-1) specifies that initial conceptions of motivation, the experimental treatment, epistemological beliefs, and verbal ability directly affect subsequent conceptions of motivation and that the treatment also directly affects systematic and heuristic processing which in turn directly affects change in conceptions of motivation. Furthermore the model specifies that the experimental treatment directly affects positive and negative affect, which in turn affects processing and subsequent conceptions of motivation, and that the treatment directly affects empathy, which in turn affects positive and negative affect, which in turn affects processing, which affects subsequent conceptions of motivation. I used structural equation modeling to estimate the effects. The model contains seven endogenous variables: empathy, positive affect, negative affect, systematic processing, heuristic processing, subsequent conceptions of intrinsic motivation and subsequent conceptions of extrinsic motivation. The model contains five exogenous variables, initial conceptions of intrinsic motivation and initial conceptions of extrinsic motivation, the experimental treatment, epistemological beliefs, and verbal ability.

In a study of conceptual change that utilizes a pretest, the decision must be made whether to use as the outcome variable the posttest scores or the change in scores from pretest to posttest. Using change scores can create the misleading conclusion that pretests scores were negatively related to change. Therefore, similar to the analysis conducted by Gill et al. (2004), I used

posttest scores on the conceptions of extrinsic and intrinsic motivation measures rather than change scores as the outcome variable.

Table 2-1. Descriptive statistics for nominal variables

Measure	Expository Refutational Text		Narrative Refutational Text	
	%	<i>N</i>	%	<i>N</i>
Gender				
Female	96%	89	91%	88
Male	4%	4	9%	9
Ethnicity				
White	78%	73	80%	78
Black	9%	8	11%	11
Hispanic	4%	4	6%	6
Asian	2%	2	1%	1
Other	5%	5	0%	0
Year				
Sophomore	3%	3	4%	4
Junior	74%	69	84%	81
Senior	15%	14	11%	11
Other	2%	2	0%	0

Note: Percentages may not total 100% because in each group one participant did not respond to the ethnicity item, and five participants in the expository refutational text group and one in the narrative refutational text group did not respond to the year-in-school item.

CHAPTER 3 RESULTS

Descriptive Statistics

Demographic statistics for the participants were reported in Table 2-1. The sample, consisting of predominantly white female participants, was fairly typical for the undergraduate education programs at the two universities. Means and standard deviations by experimental condition for all pre-treatment and post-treatment measures are reported in Table 3-1.

The mean SAT verbal score was 7.13 points higher for the narrative refutational text (NRT) group than for the expository refutational text group (ERT), though the difference was not significant, $t(146) = -.53$, $p = .60$. For the pretests of conceptions of intrinsic and extrinsic motivation, scores could range from 0 to 10 with higher scores representing more accurate conceptions. Participants in both conditions scored an average of 3 to 4 points higher on the pretest of intrinsic motivation than on the pretest of extrinsic motivation. This difference suggests that participants had more accurate initial conceptions of intrinsic than extrinsic motivation. Participants' epistemological beliefs were on average more sophisticated than naïve with scores well below the mid-point on the 5-point Likert scale with lower scores representing more sophisticated beliefs. Participants' epistemological beliefs were also more sophisticated than the sample in Gregoire's (2002) dissertation study. Participants in my experimental and control group averaged 1.40 and 1.53 respectively on the measure of epistemological beliefs, whereas participants in Gregoire's groups averaged 2.41 and 2.27. Despite the random assignment of participants to text condition, one pretreatment measure revealed significant differences by text condition. Participants assigned to read the ERT scored significantly higher on the pretest of conceptions of intrinsic motivation than participants assigned to read the NRT with a mean difference of .51 questions correct, $t(189) = 2.04$, $p = .04$.

Manipulation Checks

I assessed the effectiveness of the treatment with a series of manipulation checks that participants completed immediately after reading the assigned text. Specifically, I predicted that participants who read the NRT would describe their text as more familiar, useful, interesting, and more clearly making the distinction between intrinsic and extrinsic motivation than those who read the expository text. Only one significant difference was found. Contrary to my hypothesis, participants who read the ERT described their text as more clearly making the distinction between intrinsic and extrinsic motivation than those who read the NRT ($p < .05$). In addition, on the basis of Bless's (2000) contention that those in positive moods are less likely to feel threatened by information that contradicts their existing conceptions and in turn are more likely to link that new knowledge with existing knowledge, I hypothesized that those who read the NRT would find it less challenging, requiring less effort, and would be more likely to agree with conceptions in the text than those who read the ERT; however, again contrary to my hypotheses, no differences by text type were reported on these manipulation checks.

Analysis of the Correlation Matrix

There were 43 participants, 22 in the NRT and 21 in the ERT condition for whom I was unable to obtain SAT or ACT scores from the participants or the registrar. For these participants I used pattern matching in LISREL to impute values to these missing scores.

As evident in the means presented in Table 3-1, despite random assignment to text condition, those assigned to the NRT had significantly lower scores on the pretest of intrinsic motivation, but there were no significant correlations with other pretreatment measures. For posttreatment measures, reading the NRT was positively correlated with empathy, positive affect, and negative affect. In regard to cognitive processing, the NRT was negatively correlated

with systematic processing and positively correlated with heuristic processing. The NRT had no significant correlation with any posttest or delayed posttest of conceptions of motivation.

Tables 3-2 and 3-3 present the correlation matrices for all pre- and posttreatment measures by treatment condition, ERT and NRT, respectively. A few correlations were significant across both conditions. The tests of conceptions of extrinsic motivation were significantly correlated at pretest, posttest, and delayed posttest, as were the tests of conceptions of intrinsic motivation. For posttreatment measures, empathy and positive affect were positively correlated in both text conditions. Systematic processing was negatively correlated with heuristic processing and delayed posttest of conceptions of extrinsic motivation for both text conditions.

However, several differences by text condition were found in pretreatment and posttreatment measures. For the ERT condition, verbal SAT scores were significantly positively correlated with conceptions of extrinsic motivation at pretest, posttest and delayed posttest. For the NRT, verbal SAT scores were only significantly correlated with epistemological beliefs; specifically, higher SAT verbal scores were negatively correlated with naïve beliefs in certain and simple knowledge. It should be noted that this correlation was close to significant for the ERT condition. For the ERT condition, pretests of conceptions of intrinsic and extrinsic motivation were significantly positively correlated with empathy. Naïve beliefs in simple and certain knowledge were only significantly correlated with other measures in the NRT condition. Specifically these epistemological beliefs were significantly positively correlated with systematic processing and negatively correlated with heuristic processing. Also for the NRT condition only, naïve beliefs in simple and certain knowledge were significantly correlated with lower scores on the delayed posttest of intrinsic motivation.

Some notable differences in correlations of posttreatment measures by text condition were found as well. For the ERT condition, empathy was significantly positively correlated with conception of extrinsic motivation at posttest and delayed posttest. In addition to the significant positive correlation of empathy and positive affect in both conditions, empathy and positive affect were correlated with negative affect for the NRT condition. For the ERT condition, positive affect and heuristic processing were significantly correlated with conceptions of extrinsic motivation at posttest and delayed posttest.

In summary some patterns of correlations were distinct by text condition. For the ERT condition, SAT verbal scores, empathy, positive affect, and heuristic processing were significantly and positively correlated with posttest and delayed posttest of conceptions of extrinsic motivation, though no nontest measure was significantly correlated with any posttest or delayed posttest measure for the NRT condition. Also naïve beliefs in simple and certain knowledge were only significantly correlated with other variables in the NRT condition.

Model Fit

The hypothesized model in Figure 1-1 was estimated from the correlation matrix with LISREL 8.80. Because I had only one measure of each variable I subtracted the internal consistency estimates from 1.00 as the fixed error variance of the observed variables in order to estimate the relationships among latent variables. The model was significantly different from the saturated model at $\chi^2(44) = 221.71$, $p = 0.0$, indicating an overall poor fit of the model to the data. Other indices of fit include a comparative fit index (CFI) of .80, a non-normed fit index (NNFI) of .58, a root mean square residual (RMR) of .09 and a root mean square error of approximation (RMSEA) of .14. All of these indices are further evidence of the poor fit of the hypothesized model to the data.

Suggested Model Modifications

An analysis of the residuals associated with the hypothesized model indicated several relationships that could be significantly improved. The relationship between the indicators of heuristic and systematic processing had the largest fitted residual (-.59) and standardized residual (-9.08), with a modification index for the errors of these indicators of 67.97. Therefore, I allowed the errors of these indicators to correlate. Also the modification index for the errors on observed scores on the pretests of intrinsic and extrinsic motivation was 25.64 and subsequent analyses contained a modification index of 4.65 for the errors on observed scores on the posttests of intrinsic and extrinsic motivation. These were the three sets of errors, all significant at the .05 level, I allowed to correlate in the revised model.

A number of relationships among the latent variables deserve attention and revision. Paths with z -scores less than $|1.96|$ are not statistically significant at the .05 level and subject to deletion, whereas paths not included with a modification index > 3.84 are significant at the .05 level and were candidates for inclusion in the revised model. For example, the model depicted the exogenous variable for text type (narrative refutational text vs. expository refutational text) as having a direct effect on conceptions of motivation, but the path from text type to the posttest and delayed posttest of conceptions of extrinsic motivation was not significant with a parameter of $\gamma = .07, z = .79$, and $\gamma = -.09, z = -1.32$, respectively. Finally, the model depicted text type with a direct effect on positive and negative affect, but the path from text type to positive affect was not significant at $\gamma = .04, z = .56$ so that path was deleted from the revised model.

The model also included the effect of epistemological beliefs on conceptions of intrinsic and extrinsic motivation; however none of the paths from epistemological beliefs to change in conceptions of intrinsic or extrinsic motivation were significant, $\gamma = .12, z = .98$ and $\gamma = .04, z = .34$, respectively at posttest, and $\gamma = -.10, z = -.99$ and $\gamma = -.02, z = -.34$, respectively at delayed

posttest. None of the paths from epistemological beliefs were in the revised model because the hypothesized parameters were not significant.

The relationship from affect to processing was also different than hypothesized. The hypothesized model depicted direct effects for both negative and positive affect on heuristic and systematic processing; however the paths from positive affect to heuristic and systematic processing were not significant, $\beta = -.12, z = -1.59$ and $\beta = .01, z = .09$, respectively. The path from negative affect to heuristic processing was not significant, $\beta = -.14, z = -1.73$, but the path to systematic processing was significant, $\beta = .19, z = 2.00$. However, this path was found nonsignificant in further analyses and was removed from the revised model. In summary, none of the paths from affect to processing were included in the revised model. However, the modification index of 4.81 for the direct effect of positive affect on posttest of intrinsic motivation was significant so that path was included in the revised model. Also the direct effect of empathy to posttest of extrinsic motivation had a significant modification index of 10.18 so that path was included in the revised model.

In the analysis of the hypothesized model, heuristic and systematic processing were differentially related to change in conceptions of intrinsic motivation and extrinsic motivation. Specifically, heuristic processing was not significantly related to either posttest or delayed posttest of conceptions of extrinsic motivation, $\beta = -.08, z = -.98$ and $\beta = -.07, z = -1.10$, respectively. Systematic processing, in contrast, was not significantly related to either delayed posttest of conceptions of intrinsic and extrinsic motivation, $\beta = -.11, z = -1.41$ and $\beta = -.09, z = -1.12$, respectively. These nonsignificant paths were not included in the revised model.

Only the path from SAT verbal to delayed posttest of extrinsic motivation was significant ($\gamma = -.15, z = -2.10$), whereas the paths to posttest of conceptions of intrinsic motivation ($\gamma = .03,$

$z = .30$), extrinsic motivation ($\gamma = -.08, z = -.77$) and delayed posttest of conceptions of intrinsic motivation ($\gamma = .03, z = .41$) were all nonsignificant and were not included in the revised model. However, the modification index from SAT verbal scores to positive affect, 6.49, was significant at the .05 level and was included in the revised model.

Finally the relationships among pretests, posttests, and delayed posttests of conceptions of intrinsic motivation were significant, as were those among conceptions of extrinsic motivation, with the exception of the path from pretest to delayed posttest, $\gamma = .05, z = .17$. There was one significant relationship between tests of conceptions of intrinsic and extrinsic motivation; the pretest of intrinsic motivation was significantly related to the delayed posttest of extrinsic motivation with a modification index of 5.80 and was in the revised model.

The revised model (Figure 3-1) was significantly different from the saturated model, $\chi^2(58) = 75.05, p = .07$, indicating an overall good fit of the model to the data. Other indices of fit include a comparative fit index (CFI) of .98, a non-normed fit index (NNFI) of .97, a root mean square residual (RMR) of .07, and a root mean square error of approximation (RMSEA) of .04. These indices indicated a good fit of the model to the data and allowed for interpretation of the total, direct, and indirect effects of variables in the revised model (Table 3-4).

Research Questions

Research Question 1 was, “Do epistemological beliefs or verbal ability influence change in preservice teachers’ conceptions of motivation immediately after reading narrative refutational text and 4 weeks later?” As described above, epistemological beliefs were hypothesized to be causally related to change in conceptions of motivation; however, none of these paths were significant and did not appear in the revised model and analysis. In regard to the relationship between verbal ability and change in conceptions of motivation, only the effect of verbal ability on conceptions of extrinsic motivation at delayed posttest was significant ($\gamma = -.13, z = -2.40$).

Research Question 2 was, “Does reading a narrative refutational text (NRT) have a stronger effect than reading an expository refutational text (ERT) on conceptual change in preservice teachers’ conceptions of motivation immediately after the reading and 4 weeks later?” The revised model included a direct effect of NRT on conceptions of intrinsic motivation at posttest ($\gamma = .49, z = 4.95$) and delayed posttest ($\gamma = .30, z = 3.85$), suggesting that reading an NRT had a stronger effect than ERT on preservice teachers’ conceptions of intrinsic motivation. In contrast, the direct effects of NRT on conceptions of extrinsic motivation at posttest and delayed posttest were not significant; however, the total effects were significant and were addressed by research question 7 regarding mediation of the effects of NRT on conceptual change.

Research Question 3 was, “Does reading a narrative refutational text have a stronger effect than reading an expository refutational text on preservice teachers’ systematic and heuristic processing of information regarding conceptions of motivation?” The revised model included the direct effects of NRT on both systematic and heuristic processing. Reading the NRT had a direct positive effect on heuristic processing ($\gamma = .44, z = 5.73$) but, contrary to prediction, a direct negative effect on systematic processing ($\gamma = -.28, z = -3.38$).

Research Question 4 was, “Does reading a narrative refutational text elicit more positive emotion in preservice teachers than reading an expository refutational text?” A direct effect of NRT on positive emotion was not included in the revised model. However, results showed that the relationship was totally mediated by empathy. The total effect of NRT on positive affect was significant, ($\gamma = .12, z = 2.06$), and was fully mediated through empathy, given that the inclusion of the paths from NRT to empathy ($\gamma = .18, z = 2.09$) and empathy to positive affect ($\gamma = .68, z =$

9.21) reduced the direct effect of NRT on positive affect to a nonsignificant level. Thus, in the revised model empathy fully mediated the relationship between NRT and positive affect.

Research Question 5 was, “Does reading a narrative refutational text elicit less negative emotion in preservice teachers than reading an expository refutational text?” The direct effect of NRT on negative affect was significant ($\gamma = .25, z = 2.99$), suggesting that, contrary to my hypothesis, reading a NRT elicited greater negative emotion in preservice teachers than reading an ERT. However, empathy was not a significant mediator of the effect of NRT on negative affect, as it was for the relationship between the reading of NRT and positive emotion.

Research Question 6 was, “Does reading a narrative refutational text have a stronger effect on the empathy that preservice teachers experience after reading it than reading an expository refutational text?” As discussed in the preceding description of the mediation of NRT on positive affect by empathy, the hypothesized direct effect of NRT to empathy was significant in the revised model, ($\gamma = .18, z = 2.09$), suggesting that reading an NRT had a stronger effect on empathy in preservice teachers than reading an ERT.

Research Question 7 was, “Do empathy, positive affect, systematic, and heuristic processing mediate the relationship between text type (narrative refutational text vs. expository refutational text) and conceptual change in preservice teachers’ conceptions of motivation immediately after the reading and 4 weeks later?” Though the results provided evidence of mediation of the relationship between reading NRT vs. ERT and conceptions of motivation, the relationship differed by the type of motivation measured. For the intrinsic posttest, the direct effect of NRT was significant ($\gamma = .49, z = 4.95$), and the indirect effect was significant, yet negative, ($\gamma = -.08, z = -2.84$), suggesting a partial mediation of this relationship.

An analysis of this indirect effect revealed two paths of mediation: (a) from NRT to heuristic processing to posttest of intrinsic motivation and (b) from NRT to empathy to positive affect to the intrinsic motivation posttest. For the first path, the direct effect of NRT on heuristic processing was estimated at .44, whereas the direct effect of heuristic processing on the intrinsic motivation posttest was -.15. Multiplying these two parameters yielded an estimate of -.07 for the indirect effect of NRT on the posttest of intrinsic motivation, as mediated by heuristic processing. For the second path, the direct effect of NRT on empathy was estimated at .18, the direct effect of empathy on positive affect was .68, and the direct effect of positive affect on the intrinsic motivation posttest was -.14. Multiplying these three parameters yielded an estimate of the indirect effect of NRT of -.01 on the intrinsic motivation posttest, as mediated by empathy and positive affect.

The same mediational relationships existed for reading NRT to the delayed posttests of intrinsic motivation; the only difference was the additional direct effect of the intrinsic motivation posttest on the delayed posttest of intrinsic motivation. Including this parameter changed the estimated effect of the first mediational path to -.03 and maintained the second at -.01. A third path from NRT to the delayed intrinsic motivation posttest mediated by intrinsic motivation posttest was estimated at .23. Adding the estimates of these three mediational paths yielded a significant and positive indirect effect of reading NRT vs. ERT on delayed posttest of intrinsic motivation, ($\gamma = .19$, $z = 2.99$).

For the extrinsic motivation posttest, the direct effect of NRT was not significant, yet the indirect effect was significant, ($\gamma = .06$, $z = 2.49$), suggesting total mediation. An analysis of these indirect effects revealed two paths of mediation: (a) from NRT to systematic processing to extrinsic motivation posttest and (b) from NRT to empathy to extrinsic motivation posttest. For

the first path, the direct effect of NRT on systematic processing was estimated at $-.28$, whereas the direct effect of systematic processing on posttest of extrinsic motivation was $-.10$.

Multiplying these two parameters yielded an estimate of $.03$ for the indirect effect of NRT as mediated by systematic processing on the extrinsic motivation posttest. For the second path, the direct effect of NRT on empathy was estimated at $.18$, and the direct effect of empathy on the extrinsic motivation posttest was $.20$. Multiplying these two parameters yielded an estimate of $.03$ for the indirect effect of NRT on the intrinsic motivation posttest, as mediated by empathy.

The same mediational relationships existed for reading NRT to the delayed posttests of extrinsic motivation; as with intrinsic motivation the only difference was the additional direct effect of the extrinsic motivation posttest on the delayed extrinsic motivation posttest. Including this parameter maintained the estimated effects of both mediational paths at $.03$. Adding the estimates of these two mediational paths yielded a significant and positive indirect effect of reading NRT vs. ERT on delayed posttest of extrinsic motivation, ($\gamma = .07, z = 2.50$).

Table 3-1. Means and standard deviations for pre- and posttreatment measures by treatment condition

Measure	Pretreatment Measures						<i>t</i>	<i>p</i> ^a	
	Expository Refutational Text			Narrative Refutational Text					
	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>			
SAT-Verbal	547.98	80.51	72	555.11	83.52	75	-.53	.599	
Pretest Intrinsic Motivation	8.32	1.36	93	7.80	1.98	97	2.10	.037	
Pretest Extrinsic Motivation	4.33	2.09	93	4.05	2.23	97	.90	.370	
Epistemological Beliefs	1.40	.58	93	1.53	.63	97	-1.52	.130	
				Posttreatment Measures					
Familiar	3.10	1.14	93	3.04	1.19	97	.33	.372	
Challenged	2.02	1.18	93	2.19	1.18	97	-.96	.170	
Distinction	4.19	.85	93	3.92	1.04	96	2.00	.024	
Effort	3.46	1.10	93	3.60	1.04	96	-.91	.182	
Useful	4.11	.88	93	4.23	.91	96	-.93	.176	
Interesting	3.41	1.02	93	3.46	1.02	96	-.34	.369	
Agreement	3.79	.92	92	3.86	.94	96	-.53	.300	
Empathy	13.31	4.33	93	14.41	4.04	97	-1.81	.036	
Positive Affect	15.97	8.40	93	18.13	8.83	97	-1.73	.043	
Negative Affect	2.94	3.98	93	4.89	5.57	97	-2.77	.003	
Systematic Processing	.56	.33	93	.41	.31	97	3.23	.001	
Heuristic Processing	.16	.21	93	.36	.32	97	-5.07	.000	
Posttest Intrinsic Motivation	8.91	1.46	93	9.06	1.24	97	-.75	.227	
Posttest Extrinsic Motivation	6.34	2.79	93	6.61	2.58	97	-.65	.257	
Delayed Posttest Intrinsic Motivation	8.88	1.48	86	9.14	1.23	81	-1.23	.110	
Delayed Posttest Extrinsic Motivation	6.28	2.73	86	6.28	2.45	81	0.00	.500	

Note: Higher scores on tests of intrinsic and extrinsic motivation represent more accurate conceptions of motivation. Higher scores on epistemological beliefs represent more naïve beliefs in simple and certain knowledge.

^a *p*-values for posttreatment measures were for one-tailed test of directional hypotheses.

Table 3-2. Polychoric correlations for pre- and posttreatment measures for ERT condition ($N = 86$)

	SAT	PRI	PRE	EBS	EMP	AFP	AFN	SPG	HPG	PSI	PSE	DPI	DPE
SAT	1.00												
PRI	-.14	1.00											
PRE	.31**	.10	1.00										
EBS	-.20	-.11	-.14	1.00									
EMP	-.09	.27*	.25*	-.03	1.00								
AFP	-.26*	.19	.20	.02	.57****	1.00							
AFN	-.03	-.10	-.11	-.09	-.05	.02	1.00						
SPG	-.04	.06	-.17	.06	-.04	-.02	.17	1.00					
HPG	.12	.04	.13	-.12	.03	-.01	.01	-.69****	1.00				
PSI	-.02	.70****	.15	-.02	.05	.07	-.08	.02	-.03	1.00			
PSE	.27*	.18	.60****	-.15	.35***	.34**	.08	-.20	.24*	.36***	1.00		
DPI	.03	.67****	.20	-.12	.17	.10	.08	.00	-.02	.74****	.39***	1.00	
DPE	.22*	.23*	.61****	-.20	.38***	.28**	.10	-.23*	.24*	.46****	.80****	.47**	1.00

Note: SAT = SAT verbal scores. PRI = pretest of conceptions of intrinsic motivation; PRE = pretest of conceptions of extrinsic motivation. EBS = naïve epistemological beliefs in simple and certain knowledge. EMP = empathy. AFP = positive affect; AFN = negative affect. SPG = systematic processing; HPG = heuristic processing. PSI = posttest of conceptions of intrinsic motivation; PSE = posttest of conceptions of extrinsic motivation. DPI = delayed posttest of conceptions of intrinsic motivation; DPE = delayed posttest of conceptions of extrinsic motivation.

* = $p \leq .05$. ** = $p \leq .01$. *** = $p \leq .001$. **** = $p \leq .0001$.

Table 3-3. Polychoric correlations for pre- and posttreatment measures for NRT condition ($N = 81$)

	SAT	PRI	PRE	EBS	EMP	AFP	AFN	SPG	HPG	PSI	PSE	DPI	DPE
SAT	1.00												
PRI	.12	1.00											
PRE	.05	.49****	1.00										
EBS	-.29**	-.13	-.06	1.00									
EMP	.02	-.10	-.07	-.10	1.00								
AFP	-.11	.06	-.01	.00	.58****	1.00							
AFN	-.17	-.09	-.04	.07	.32**	.31**	1.00						
SPG	-.10	.01	-.08	.32**	.10	.05	.14	1.00					
HPG	.11	-.03	.07	-.28*	-.18	-.20	-.12	-.76****	1.00				
PSI	.06	.68****	.32**	-.09	-.07	-.08	-.03	-.04	-.03	1.00			
PSE	.17	.09	.57****	-.12	.07	.00	-.08	-.12	.05	.34**	1.00		
DPI	.12	.46****	.29**	-.22*	-.09	-.10	-.06	-.07	.00	.66****	.31**	1.00	
DPE	.14	.20	.58****	-.21	.04	.03	-.02	-.25*	.06	.44****	.85****	.40****	1.00

Note: SAT = SAT verbal scores. PRI = pretest of conceptions of intrinsic motivation; PRE = pretest of conceptions of extrinsic motivation. EBS = naïve epistemological beliefs in simple and certain knowledge. EMP = empathy. AFP = positive affect; AFN = negative affect. SPG = systematic processing; HPG = heuristic processing. PSI = posttest of conceptions of intrinsic motivation; PSE = posttest of conceptions of extrinsic motivation. DPI = delayed posttest of conceptions of intrinsic motivation; DPE = delayed posttest of conceptions of extrinsic motivation.

* = $p \leq .05$. ** = $p \leq .01$. *** = $p \leq .001$. **** = $p \leq .0001$.

Table 3-4. Total, direct, and indirect effects in the revised model ($N = 167$)

Variable	Effect	EMP	AFP	AFN	SPG	HPG	PSI	PSE	DPI	DPE
NRT	Total	.18*	.12*	.29*	-.28*	.44*	.41*	.06*	.49*	.07*
	Direct	.18*	--	.25*	-.28*	.44*	.49*	--	.30*	--
	Indirect	--	.12*	.04	--	--	-.08*	.06*	.19*	.07*
SAT	Total	--	-.17*	--	--	--	.02	--	.01	-.13*
	Direct	--	-.17*	--	--	--	--	--	--	-.13*
	Indirect	--	--	--	--	--	.02	--	.01	--
EMP	Total	--	.68*	.21*	--	--	-.10*	.20*	-.04	.21*
	Direct	--	--	--	--	--	--	.20*	--	--
	Indirect	--	--	--	--	--	-.10*	--	-.04	.21*
AFP	Total	--	--	--	--	--	-.14*	--	-.07	--
	Direct	--	--	--	--	--	--	--	--	--
	Indirect	--	--	--	--	--	-.14*	--	-.07	--
AFN	Total	--	--	--	--	--	--	--	--	--
	Direct	--	--	--	--	--	--	--	--	--
	Indirect	--	--	--	--	--	--	--	--	--
SPG	Total	--	--	--	--	--	--	-.10*	--	-.10*
	Direct	--	--	--	--	--	--	-.10*	--	--
	Indirect	--	--	--	--	--	--	--	--	-.10*
HPG	Total	--	--	--	--	--	-.15*	--	-.07*	--
	Direct	--	--	--	--	--	-.15*	--	--	--
	Indirect	--	--	--	--	--	--	--	-.07*	--

Note: NRT = narrative refutational vs. expository refutational text. SAT = SAT verbal scores. EMP = empathy. AFP = positive affect; AFN = negative affect. SPG = systematic processing; HPG = heuristic processing. PSI = posttest of conceptions of intrinsic motivation; PSE = posttest of conceptions of extrinsic motivation. DPI = delayed posttest of conceptions of intrinsic motivation; DPE = delayed posttest of conceptions of extrinsic motivation.

* = $p \leq .05$.

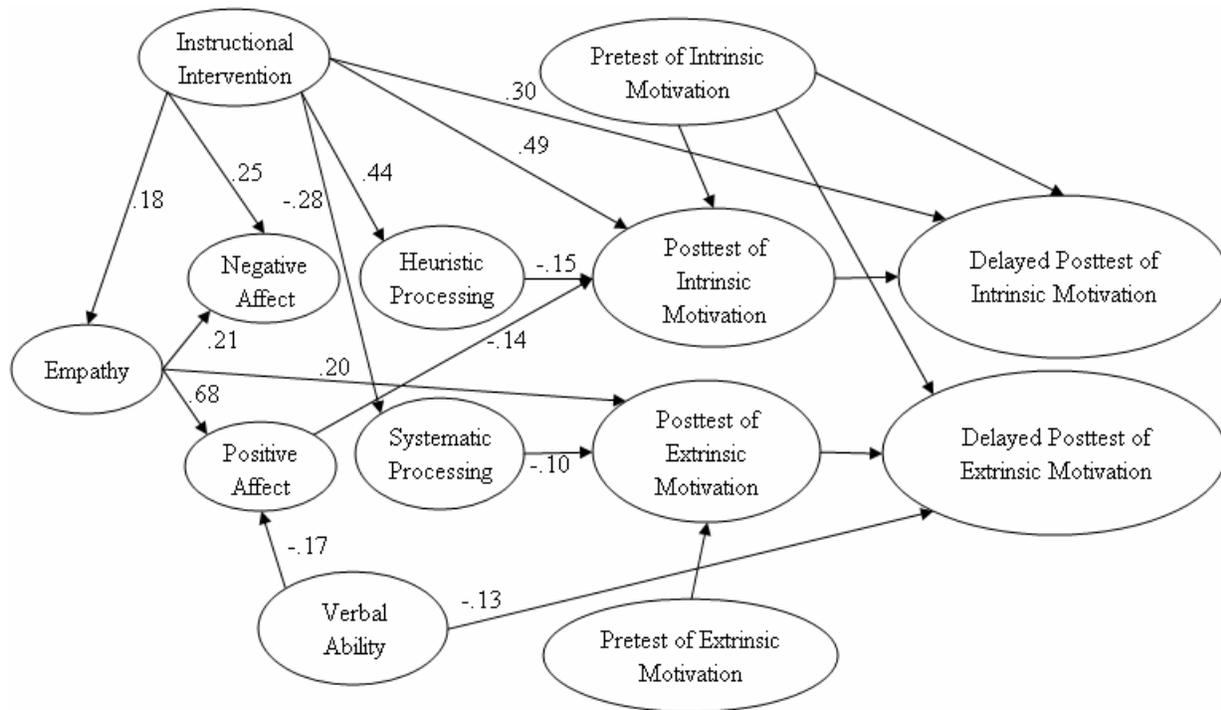


Figure 3-1. Revised exploratory model of change of conceptions of motivation.

CHAPTER 4 DISCUSSION

The purpose of this dissertation study is to increase our understanding of conceptual change in preservice teachers by testing the model of conceptual change, presented in Figure 1-1, which addresses a number of weaknesses in current research. These weaknesses include the need to identify more effective interventions to effect conceptual change, the failure to identify personal characteristics that influence conceptual change, and the lack of specification of cognitive and affective processes involved in conceptual change. The model addresses these weaknesses by specifying that the intervention of instructional text (specifically, narrative refutational text vs. expository refutational text), epistemological beliefs, and verbal ability directly affect change in conceptions of motivation, and that type of text also directly affects systematic and heuristic processing, which in turn directly affect change in conceptions of motivation. Furthermore the model specifies that the text directly affects affect, which in turn affects processing and change in conceptions of motivation, and that the text directly affects empathy, which in turn affects affect, processing, and conceptual change. A preliminary analysis indicated a poor fit of the model to the data, and an analysis of the residuals indicated directions for improving the model fit. Results of the revised model shown in Figure 3-1 will be discussed in terms of seven research questions. In this section I summarize those findings by analyzing the results for proposed influential personal characteristics, interventions, and mediators of conceptual change. Finally, I identify weaknesses of the study, suggest areas for further research, and describe the study's implications for practice and policy.

Personal Characteristics Influencing Conceptual Change

Epistemological Beliefs

The study includes epistemological beliefs as one potential influence on conceptual change when reading narrative refutational text. In the original model it was hypothesized that preservice teachers who hold the beliefs that knowledge is simple and certain exhibit less conceptual change after the instructional intervention. However, no significant relationships were found between epistemological beliefs and change in conceptions of either extrinsic or intrinsic motivation immediately at posttest or 4 weeks later at delayed posttest. This finding was surprising in that previous studies showed those who have less sophisticated epistemological beliefs exhibited less conceptual change after reading expository refutational text (Gregoire, 2002; Qian & Alvermann, 1995). Therefore there is a need to continue to examine this relationship to determine whether this finding was due to chance or some important difference in the treatment in my study compared to other studies.

Verbal Ability

I also investigated verbal ability as another potential influence on conceptual change when reading narrative refutational text. On the basis of Gregoire's (2002) finding that verbal ability did not influence conceptual change, I did not expect a significant direct effect of verbal ability on conceptual change immediately after reading or 4 weeks later. However, in my study, higher verbal ability as measured by SAT or ACT scores has a direct negative effect on conceptions of extrinsic motivation 4 weeks after the instructional intervention, with higher verbal ability resulting in less accurate conceptions of extrinsic motivation. Thus, although verbal ability does not predict students' beliefs about the value of extrinsic motivation strategies immediately after reading the refutational texts, 4 weeks after the intervention those with higher SAT scores are more likely to report that extrinsic motivation strategies are a good way to motivate than are

students with lower SAT scores. This finding was unexpected, and the reason for such a relationship is unclear. Further research is needed to determine whether this finding is a chance occurrence or represents a consistent result in need of explanation.

Another unexpected finding in my study is that higher verbal ability as measured by SAT or ACT scores leads to less positive affect during the instructional intervention. In other words, those with higher verbal ability enjoy reading the text less than those with lower verbal abilities. One possible interpretation of this finding is that participants with higher ability were more capable of understanding the conflict between the two views of motivation, leading them to feel less positive while reading the text. However, in her study Gregoire (2002) did not hypothesize or report any relationship between ability and affect after reading expository or expository refutational text. To advance our understanding of the role of affect in motivating conceptual change, further research on a potential relationship between verbal ability and affect when reading refutational texts seems warranted.

Interventions for Conceptual Change

The primary purpose of this study is to investigate whether reading a narrative refutational text has a stronger effect on conceptual change in preservice teachers' conceptions of motivation than reading an expository refutational text. The results of the study are mixed, as reading NRT had a direct effect on conceptions of intrinsic motivation at posttest and delayed posttest, but no effects on conception of extrinsic motivation at either posttest or delayed posttest. It is interesting and potentially important to note that participants' scores on the intrinsic motivation measure are quite high, with pretest averages of 7.80 for participants in the NRT condition and 8.32 for participants in the ERT condition on a scale of 0 to 10 and posttest averages of 9.06 for the NRT condition and 8.91 for the ERT condition. In contrast, participants' scores are much lower on the extrinsic motivation measure, with pretest averages of 4.05 for NRT and 4.33 for ERT and

posttest averages of 6.61 in the NRT condition and 6.34 in the ERT condition. These results indicate that participants hold very positive views of the scenarios in which intrinsic motivation strategies are used by the teacher but still hold positive attitudes toward some extrinsic motivation strategies even after reading refutational texts focusing on their potential negative effects on students' motivation. Unfortunately it is impossible to directly compare the results of this study with other studies because of differences in the measures of conceptual change. In this study the measure was divided into two subscales, one for extrinsic motivation and the other for intrinsic motivation and a true/false response option was used. In contrast, Salisbury-Glennon and Stevens (1999) reported results for the combined intrinsic and extrinsic subscales and, although Kutza (2000) used the two subscales, she used a 5-point Likert type scale for the response options. It is evident that Kutza's (2000) participants' scores on the 5-point scale were slightly higher than participants' scores in this study for the intrinsic items, with a mean of 3.83 and standard deviation of .60, than for the extrinsic items with a mean of 3.30 and standard deviation of .69. Kutza (2000) reported "moderate agreement among the participants that both intrinsic and extrinsic means are both good ways of motivating students" (p. 52); however, in responding to the dichotomous response options used in this study participants showed a much higher initial acceptance of intrinsic strategies than extrinsic ones. Given that my study occurred more than 5 years after Kutza's (2000) study, it is possible that preservice teachers are learning more about contemporary research on motivation, a possibility supported by several thought-listings in which participants reported having learned these concepts or heard about them already. Of course if they had heard and accepted all these views on motivation, one would expect the pretest scores on the extrinsic subscale to be higher as well.

Potential Mediators of Conceptual Change

In this study I initially proposed a causal model for conceptual change (Figure 1-1) suggesting that the instructional intervention of narrative refutational text would, via empathy, generate affect that would in turn generate cognitive processing resulting in conceptual change. The results of this study failed to support the causal link from affect to processing to conceptual change; however, results of the analysis of the revised model does show that some of these mediating relationships exist for this sample, though the effects are not in the expected direction. I will discuss these specific findings and conclude this section by assessing the causal chain on the whole.

I investigated whether reading a narrative refutational text has a stronger effect on preservice teachers' systematic and heuristic processing of information regarding conceptions of motivation than reading an expository refutational text. I found that reading NRT leads to more heuristic processing and less systematic processing than reading an ERT, but neither type of processing leads to conceptual change. This result is contrary to Gregoire's (2002) finding that neither refutational nor expository refutational text was related to systematic processing, but systematic processing in both conditions did predict conceptual change. In my study, heuristic processing leads to less change in conceptions of intrinsic motivation, and systematic processing leads to less change in conceptions of extrinsic motivation.

Some researchers have looked to systematic processing as a potential mediator of the relationship between instructional interventions and conceptual change (Dole & Sinatra, 1998; Gill, 2003). However, little evidence exists supporting this hypothesis (Gill et al., 2004). The results of this study also fail to support this contention, because systematic processing is unrelated to change in conceptions of intrinsic motivation and inversely related to change of conceptions of extrinsic motivation. I used the same measure of systematic processing as Gill et

al. with different texts, continuing to raise doubts about systematic processing as a significant mediator or about using thought listings with this coding rubric (Appendix B) as a measure of systematic processing. An alternative to this thought-listing methodology is the use of a think-aloud methodology, by which participants are interrupted during the actual comprehension process and asked to report what they are thinking at that moment (Kendeou & van den Broek, 2007). These responses, generated during rather than after reading, can then be coded as indicators of cognitive processing or affect. More thoughtful consideration of the methodologies to measure cognitive processing may help researchers isolate cognitive resources for conceptual change.

A unique component of this study is the effort to identify heuristic processing as a potential mediator of conceptual change. I hypothesized that the narrative refutational text would generate heuristic processing about the narrative elements (characters, setting, and plot) as well as non-message elements of the text such as tone, credibility, and effect on the audience. Though the NRT does lead to an increase in heuristic processing, heuristic processing, in turn, is inversely related to change in conceptions of intrinsic motivation. Heuristic processing did not emerge as a significant resource for conceptual change in this study.

In this study in addition to looking for separate direct effects of heuristic and systematic processing, I also investigated their combined effects. The sufficiency principle of the heuristic-systematic model maintains that systematic processing does not occur in isolation, but occurs only when heuristic processing is not sufficient to reach the desired level of confidence. Therefore, when systematic processing is motivated, it is attenuating, adding to, or being biased by heuristic processing (Chen et al., 2000). The narrative refutational text used in this study was designed to elicit the additive effects of heuristic and systematic processing.

If additive effects are operative, then the NRT would lead to more heuristic and systematic processing than the ERT; however, I found that the NRT leads to more heuristic and less systematic processing than the ERT, suggesting that the NRT did not sufficiently widen the gap between confidence and desired confidence to motivate more systematic processing than the ERT. If the NRT had led to more heuristic and systematic processing, then their effects on conceptual change could be examined to see if there were additive effects, or whether heuristic processing attenuated the effects or biased the effects of systematic processing; however, because the NRT did not yield more systematic processing than the ERT, these questions are not answerable in this study. However, future research that includes a text known to sufficiently widen the gap between confidence and desired confidence and increase systematic processing may help researchers to ask and answer these questions in regard to conceptual change.

I investigated the role of affect in conceptual change after reading a narrative refutational text in contrast to an expository refutational text. I hypothesized that the NRT elicits more positive affect and less negative affect than reading an expository refutational text. As hypothesized, the NRT generates more positive affect via empathy than the ERT. Contrary to my hypothesis, the NRT also generates more negative affect, though this relationship is not mediated by empathy.

Several theorists have speculated about the kind of affect that motivates conceptual change. For example, Piaget's (1975) equilibration theory, the Posner et al. (1982) theory of conceptual change, and Festinger's (1957) theory of cognitive dissonance all explain cognitive change in terms of the human need to reduce negative affect that occurs when two ideas conflict. In contrast, Bless (2000) has proposed that positive affect motivates conceptual change by helping readers overcome the threat of contrary information or by motivating a greater reliance

on general knowledge structures (i.e., schemas, heuristics) that can actually free cognitive resources for the accommodative processing of inconsistent information (Bless, 2001). In support of this contention, Linnenbrink and Pintrich (2002) reported that positive affect was positively related and negative affect was negatively related to conceptual change after reading an expository refutational text.

This study does not provide clear support for either negative or positive affect serving as a resource for conceptual change, in that neither led to conceptual change after reading an NRT. The only significant finding regarding affect is that positive affect is negatively related to change in conception of intrinsic motivation, which does cast doubt on Bless's (2001) contention that positive affect can overcome the threat of inconsistent information or free cognitive resources for accommodation. It is also of interest that the NRT leads to an increase in both positive and negative affect, suggesting that affect is complex and perhaps not best considered in this dichotomous fashion. An alternative approach would be to consider discrete emotions as opposed to generalized positive and negative affect (Izard, 2007). Some discrete emotions that have been proposed to affect conceptual change include anxiety, fear (Gill, 2003), frustration, annoyance (Linnenbrink & Pintrich, 2002) or interest (Andre & Windschitl, 2003; Pintrich, 1999).

I investigated whether NRT has a stronger effect than ERT on the empathy that preservice teachers experience after reading. I found that reading the NRT does lead to more empathy than reading the ERT, but the resulting effects on conceptual change are mixed. Empathy has been identified as an important resource for comprehension and conceptual change. Chebat et al. (2003) found that empathy led to increased conceptual change after reading a public service announcement in either an expository or dramatic format, quite similar to the contrast between

the ERT and NRT used in this study. With a topic determined to have little self-relevance for the sample studied, empathy led to increased conceptual change mediated by information processing, a causal chain similar to the one hypothesized in this study.

In this study, the empathy the NRT generates does lead to conceptual change regarding motivation, but only for the extrinsic subscale. It should be noted empathy is the only endogenous variable with a direct effect on any aspect of conceptual change in this study. Given that change on the intrinsic motivation may have been limited by a ceiling effect, the effect of empathy may not be measurable on that subscale. With these considerations, the possibility of empathy as a potential resource for conceptual change may be the most promising finding in this study for future research.

In addition, it is noteworthy that the effects of empathy on conceptual change are direct and not mediated by either positive or negative affect. Given that Bourg (1996) defined empathy as a cognitive and affective process including (a) interpreting the emotional states of others and (b) having an affective understanding or congruent affective response, and that empathy's effects on conceptual change are not mediated by affect in this study, it may be that the cognitive aspects of empathy are most germane as a resource for conceptual change. Alternatively, given that empathy is related to an increase in both positive and negative affect, neither of which served as a resource for conceptual change, researchers may need to identify more specific emotions rather than look to generic positive or negative affect as a resource for conceptual change.

Finally, I want to discuss the results of this study in view of the proposed causal model for conceptual change. Specifically I hypothesized that the instructional intervention of narrative refutational text, via empathy, would generate affect that in turn would motivate cognitive

processing resulting in conceptual change (Figure 1-1). Generally, the final model presented in Figure 3-1 failed to support the proposed causal chain, in that no measure of conceptual change was influenced in turn by empathy, affect, and cognitive processing. As described above, pieces of that chain exist for conceptual change for either conceptions of extrinsic or intrinsic motivation. For example, there are significant paths from NRT to heuristic processing to change in conceptions of intrinsic motivation and from NRT to systematic processing to change in conceptions of extrinsic motivation. However both of the relationships from processing to conceptual change are negative; more processing is significantly related to less conceptual change, casting doubt that either type of processing could be a resource for conceptual change. As it seems unlikely that conceptual change can occur without some type of cognitive processing, my results considered in light of similar results in Gregoire (2002) raise serious questions about the validity of the measure of thought-listings used in these two studies.

The other piece of the proposed causal chain that found some support in this study pertains to the role of empathy. Specifically, the results revealed significant paths from NRT to empathy to change in conceptions of extrinsic motivation and from NRT to empathy to positive affect to change in conceptions of intrinsic motivation. However the relationship of positive affect to change in conceptions of motivation is negative, casting doubt that this chain could represent a significant resource for conceptual change. The path directly through empathy is the most promising as described in the discussion of empathy, though it should be noted that the overall effect of NRT on change in conceptions of extrinsic motivation (.03) is small. In sum, the results of this study fail to support the proposed causal model, suggesting that if a chain from text to empathy to affect to processing can be a resource for conceptual change it will require different conceptions or measures of affect or processing.

Weaknesses of the Study and Need for Further Research

Several weaknesses in this study may have resulted in an inability to replicate findings from previous studies or find support for novel hypotheses, limiting its implications for policy and practice but providing insight into areas in need of further research. Given that the results of the intervention did not confirm oft-replicated findings and that the manipulation checks did not show any of the predicted differences between the texts (that is, that the narrative refutational text would be evaluated as more familiar, useful, interesting, clear, and persuasive, and less challenging and requiring less effort than the expository refutational text), the effectiveness of the intervention for this group of students is questionable. As I used only two texts, the study might have been strengthened by including a third text type of expository non-refutational text or by including more examples of expository refutational or narrative refutational text. Also with fewer than 1,000 words each, the intervention was brief; perhaps adding a discussion of the text, as suggested by Guzzetti (2000), might have increased the effectiveness of the intervention, perhaps by increasing participants' metacognitive awareness or their ability to engage in intentional learning (Vosniadou, 2007). Furthermore, augmented activation was confounded with each of the two experimental texts. That is, augmented activation in the form of a brief statement alerting students that they might hold a belief about motivation that is contrary to research evidence was combined with each refutational text. This strategy was used because augmented activation has been shown to be effective in facilitating conceptual change in preservice teachers (Gregoire, 2002; Guzzetti et al., 1993), and I believed that augmented activation would set a purpose for reading the narrative refutational text. Gregoire (2002) found differences between an expository text without augmented activation and an expository refutational text with augmented activation, leading her to speculate that augmented activation and not the refutational text might have accounted for the effect of text in her study. Similarly, I found few differences between the

two texts that both included augmented activation, raising further questions as to the extent to which the results of these studies are due to the text or due to augmented activation.

Weakness in the measure of conceptual change used in this study also should be addressed. Though the subscales used to assess conceptual change were designed to measure beliefs about the use of motivation strategies in classroom contexts, they fail to measure anything more than beliefs. Changing beliefs is important, but the need remains for researchers of conceptual change to demonstrate that change in beliefs does in fact lead to change of practice in the classroom, a need underscored by the recent focus on bridging the divide between researchers who examine conceptual change that occurs in the individual mind and those who examine change in participation in communities of practice (Mason, 2007).

In regard to dual processing, I used a rubric (Appendix B) to code thought-listings as evidence of systematic, heuristic, or irrelevant processing. The rubric was modified from the one devised by Gregoire (2002) in which thought-listings were coded as either systematic or irrelevant. I followed Gregoire's coding procedure for systematic processing; however, thought-listings regarding narrative elements such as plot, character, or setting, and non-message based elements such as text style, length, difficulty, credibility, or audience reaction were coded as evidence of heuristic processing. As the coding progressed, one area of difficulty arose. The rubric for systematic processing included thought listings that were "extensions, such as personal examples, if relevant to the text meaning (e.g., relating the text to how she or he was taught)" and "other relevant specific examples." Therefore, thought-listings that connected concepts to the readers' experiences, their personal narratives, were coded as systematic, whereas thought-listings that connected concepts to the characters' experiences were coded as heuristic. Difficulty in distinguishing between systematic processing that reflected personal examples related to text

meaning and heuristic processing related to the narrative became a complication as the purpose of the study was to differentiate between systematic processing characterized by abstractions and principles and heuristic processing characterized by concrete events and stories. The study was designed to explore the weaknesses of many teacher education programs that, as described by Doyle and Carter (1996), emphasize abstract rationality and miss the mark because teachers' understandings have a narrative structure. Therefore this study has made apparent the need to further differentiate between these two types of processing in the heuristic-systematic model (HSM; Eagly & Chaiken, 1993) and in cognitive experiential self-theory (CEST; Epstein & Pacini, 1999).

Conclusion

The ultimate goal of research in education is to improve educational practice. This study was designed to aid textbook authors and teacher educators to help preservice teachers think and act in ways consistent with educational research. If the results of this study had revealed significant advantages of reading narrative refutational text compared to expository refutational text, it would have been the first such finding with teacher education students and would have required replication and extension before confident recommendations could be made. Given that no significant advantages were found for narrative refutational text, this study raises more questions than it answers. However, some valuable insights are evident for those who are interested in helping preservice teachers think and act in ways consistent with educational research.

Patrick and Pintrich (2001) suggested that preservice teachers have conceptions about motivation that are not consistent with contemporary views, a point supported by those who have researched conceptions of intrinsic and extrinsic motivation in preservice teachers (Kutza, 2000; Salisbury-Glennon & Stevens, 1999). Compared to these previous studies, the results of this

study suggest that current preservice teachers exhibit a greater accuracy in their conceptions of motivation, at least in regard to their acceptance of intrinsic motivation. Importantly, preservice teachers still maintain the conception that some use of extrinsic motivation is good for learning. Helping preservice teachers adopt conceptions of extrinsic motivation consistent with educational research should continue to be a focus of instructors in teacher education programs. The results of the pretests and the content of the thought listings suggest that preservice teachers believe that, though intrinsic motivation may be a little better, thorough and long-lasting learning is motivated by both extrinsic and intrinsic motivation and teachers should welcome any motivation for learning regardless of its source. It is not surprising that preservice teachers hold this view given the long and contentious debate about the merits of intrinsic and extrinsic motivation (see Ryan & Deci, 2000, for summary). However, consensus has been reached among motivation researchers that initial intrinsic motivation for a learning task will likely be diminished when students expect to receive a tangible arbitrary reward (e.g., stickers, prizes) for completion of the task (Lepper & Henderlong, 2000). I hope future researchers of conceptual change will find ways to help preservice teachers think and act in ways consistent with this research as they enter the classroom.

Finally, the role of affect in conceptual change is a key finding in this study that, though hypotheses were not entirely supported, is relevant to theory and practice. Gregoire (2002) found that students who read an expository refutational text generated less favorable thought listings than those who read an expository text with refutation, though her measures of affect and belief change were unrelated. Still she maintained that her study demonstrated “cognitive disequilibrium is a negative affective state” (p. 137) consistent with Feldman’s (2000) assertion that “teachers need to be discontent” (p. 600), in order to experience conceptual change. Before

unequivocally recommending this idea to teachers, researchers should take into account findings that conceptual change can be motivated by positive affect (Linnenbrink & Pintrich, 2002) or that interventions designed to facilitate conceptual change may lead to an increase in both positive and negative affect such as occurred in this study. It is my hope that research of the role of affect in conceptual change, recently described as the “warming trend” (Sinatra, 2005), will continue so that researchers can accurately describe this role and provide clearer findings to guide appropriate practice.

APPENDIX A
NARRATIVE REFUTATIONAL TEXT (NRT)

You are about to read a passage that will most likely challenge the way you think about student motivation. To understand why this might be so, read the following sentence and decide whether or not you agree with it:

Teachers who give tangible rewards, like stickers or prizes, will increase their students' motivation to learn.

If you agreed with this statement, you are not alone. Many preservice teachers just like you agree with this statement. The problem is that this statement reflects an underlying belief about student motivation that is *opposed* to what research has demonstrated about student motivation.

In the selection you are about to read, the belief represented by the statement above is called a *reinforcement theory of motivation*. As you read the following text, see if you can clarify your own beliefs about student motivation. Be sure to pay attention to how your own beliefs might differ from the material presented in the following text. Also, notice what implications your beliefs have for instruction.

Intrinsic vs. reinforcement theory of motivation

Wendy Palmer is excited about beginning her first position as a fifth grade teacher, but she is concerned with her students' motivation. Wendy shared her thoughts with Mary, who has taught fifth grade for seven years.

Wendy explained to Mary, "I have rewards, like stickers and prizes, to motivate my students to learn."

"I'm definitely no expert," Mary shrugged, "but students also possess an internal or intrinsic motivation to learn. Students don't work only for external reinforcement"

"Absolutely," replied Wendy, but she didn't think a theory could help her practically.

Initially Wendy's class proceeded smoothly. Her students exhibited curiosity and eagerness for their studies. Most talking was regarding the lessons, and the students appreciated the rewards Wendy provided.

However, the situation deteriorated when students grew apathetic about the rewards. When one student didn't receive a sticker for completing his homework he said nonchalantly, "That's okay, I already have five of those."

In science class, Wendy offered the students little water-powered rockets as prizes for satisfactory achievement on their test about the planets. Initially the students were interested in learning about the planets. However they quickly became more concerned about getting the rocket. The distractions were mounting, so Wendy decided to seek the advice of her friend, Mary.

"Many beginning teachers have similar experiences," Mary replied, "Remember intrinsic motivation? We cannot rely solely on external or extrinsic factors. Rather, motivation must come from within, from students' own internal beliefs and emotions."

"But how can I facilitate my students' intrinsic motivation, isn't that just a theory?" Wendy was frustrated and desperately wanted practical help.

“Yes, it’s a theory but so is the reinforcement theory you’ve been using,” Mary explained, “Research has shown although motivation may occur as the result of reinforcers, it’s often short-lived. Students may grow tired of the reinforcers and they may cease to be motivating. Reinforcement may actually decrease an individual's intrinsic motivation to engage in a task. Often, receiving the reinforcer becomes the primary goal for the student rather than learning the information.”

“I don’t need research to demonstrate that,” Wendy laughed, “My classroom demonstrates that. But what should I do instead?”

“Well,” Mary continued earnestly, “an intrinsic theory of motivation does provide some practical advice. For example, conditions that draw upon student interest and foster choice and autonomy facilitate intrinsic motivation within students. This happens in classrooms where teachers encourage students to choose tasks based on their own interests, and take responsibility for their own learning.

“That will make all the difference?” Wendy asked hopefully.

“Well, I can’t promise you that” Mary grinned, “but I do know that intrinsic motivation facilitates conceptual learning. When information is learned at a conceptual level, it’s more likely to be retained, applied, or transferred. In contrast, when students engage in learning because they are reinforced or externally motivated, they are less likely to become actively involved in the task itself and do only as much as is necessary to receive the reward.”

“Yes, my students thought more about the water-powered rocket than about the material they needed to learn,” Wendy said sheepishly.

“Yes, research has also demonstrated that conditions supporting intrinsic motivation foster greater creativity. In contrast, reinforcement has been shown to cause students to develop negative attitudes about their learning and has been shown to hinder creativity,” Mary finished a little out of breath, “Sorry to go on, but I think it’s a message that needs to be heard.”

“Well, I need to hear it!” Wendy smiled.

APPENDIX B
CODING RUBRIC FOR THOUGHT LISTINGS

Systematic Processing (S)	Heuristic Processing (H)	Irrelevant Processing (X)
<p><u>Recall of the text</u></p> <ul style="list-style-type: none"> • Paraphrases of text meaning • Restatements of the text meaning (phrases not single words) 	<p><u>Recall of the text</u></p> <ul style="list-style-type: none"> • Summary of narrative structure (i.e., plot, setting, character) • Restatement of the narrative structure 	<p><u>Recall of the text</u></p> <ul style="list-style-type: none"> • Isolated fragments or single words
<p><u>Reactions to the text</u></p> <ul style="list-style-type: none"> • Counterarguments • Qualifications (e.g. “I agree because...” or “X is good because...” or “I agree with [restatement of text meaning]”) • Replies to text’s argument • Elaborations (e.g. “Motivation is an important part of learning” or “Good teachers help students be motivated”) • Extensions, such as personal examples, if relevant to the text meaning, e.g., relating the text to how s/he was taught • Other relevant specific examples • Pertinent questions 	<p><u>Reaction to the text</u></p> <ul style="list-style-type: none"> • Reactions or judgments to narrative structure (e.g. “I like how the teacher helped the other” or “I didn’t like how the teacher changed her style”). • Broad, general, sweeping statements or clichés that do pertain to the text meaning or structure (e.g. ““I like learning from stories”) • Thoughts about the audience reading the text (e.g., “Teachers won’t understand this”) • Comments about the text itself (i.e., its difficulty level, the usefulness of specific examples in the text, the quality of writing, the length of the text) 	<p><u>Reaction to the text</u></p> <ul style="list-style-type: none"> • Reactions or judgments without reference to text meaning or structure (e.g. “I like it” or “I agree with it”) • Broad, general, sweeping statements or clichés that do not pertain to the text meaning or structure (e.g. “Teaching is a calling” or “Teachers make learning fun.”) • Irrelevant statements (e.g., “I’m hungry”)

Notes

- Just writing that something in the text meaning is good or bad, or I agree or disagree, without restating or paraphrasing part of the message argument (more than a single word or concept), e.g., “I agree with intrinsic motivation” should be coded as ‘X’.
- However, stating agreement or liking for something while restating or paraphrasing the text should be coded as ‘S.’
- Just writing that the narrative structure is good or bad, or I agree or disagree, without restating or paraphrasing part of the structure, e.g., “I agree with how she acted” should be coded as ‘X’. However, stating agreement or liking for something while restating or paraphrasing the text should be coded as ‘S.’
- Unclear pronouns, e.g. “I agree with this idea” or “It is good” should be considered to be referring to the main topic of both passages – facilitating students’ intrinsic motivation.
- If in doubt about the meaning of a particular thought listing, you can always check back to the previous thought listing (if it has the same ID code) to help understand the context of the thought listing.

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BIOGRAPHICAL SKETCH

Clay Austin was born and raised in Frankfort, Kentucky, the home of horse racing, bourbon making, and tobacco farming. He was the only child of a single parent, an elementary teacher and librarian; when school was not in session he was still often in school and around teachers, growing accustomed to their laughter and complaints. One day, he went downtown with the other fifth graders to hear a distinguished man tell them to read “great books” and take part in the “great conversation.” In that crowded coliseum Mortimer Adler seemed to him like a rock star of reading.

Upon graduation, Clay commenced his “Great Tour of Southern Colleges and Universities” an eight-year course of study at Florida State University, Eastern Kentucky University, Belmont College, and finally University of North Florida, where he graduated with a degree to teach social studies in grades 6-12, and still maintains the world record of most credit hours earned toward a bachelor’s degree at 192. He then took a position teaching a combined class of eleven third- and fourth-grade students at St. John’s Academy, a one-year old classical Christian school. Mortimer Adler no doubt smiled from heaven, as Clay spent the next 10 years teaching classics, history, religion, logic and rhetoric to students from grades 3 through 12, spending 8 of those years also serving as assistant principal, an experience that deterred him, thankfully, from pursuing graduate studies in educational leadership.

Instead, he took a master’s degree in education in the Department of Curriculum and Instruction of the University of North Florida, where the graduate course in educational psychology allowed Clay to wonder how philosophy, psychology, and education might be related. Now, 5 years, 120 graduate credits, and a Ph.D. later, he still wonders.