Educational Leadership and Cognitive Change: A Transdisciplinary (Education, Cognitive Psychology, Neuroscience) Model

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This study addressed the complex issues surrounding cognitive change in educators. It analyzed qualitative data gathered from an online Experiential Simulation© (ES©). ES© (Brunner, 2002) uses synchronous chats and written reflections to prompt cognitive dissonance around areas of power and identity. Research data was iteratively compared with education, cognitive psychology, and neuroscience literature to build a model of educator cognitive change. The model explains factors required for individual cognitive change and provides leaders with a model to diagnose barriers and remediate them.

Keywords: change, change model, cognitive change, education, leading change, paradigm shift, teacher beliefs

INTRODUCTION

Educational leaders manage change in schools. Successful organizational change results from the collective change of individuals' behaviors (Reeves, 2009). Affecting individual change, therefore, is at the core of school leadership. Further, the phenomenon of educator cognitive change has been well-documented in educational literature. The literature discusses educators' deep-seated beliefs that influence their practice (Delpit, 1988; Dewey, 1933; Fang, 1996; Pajares, 1992). These beliefs are the product of years of experience with classroom culture (Lortie, 1975; Mezirow, 1991; Richardson, 1990). Educators' belief-systems change rarely, and when they do, the experience can be intensely emotional (Kennedy, 2005; Richardson, 1990). The transformation of an educator's beliefs and actions requires reflection (Dewey, 1933; York-Barr, Sommers, Ghere, & Montie, 2006), new practices (Ertmer, 2005; Guskey, 2002) and job-embedded training with opportunities for collaboration (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009). Despite these understandings, the process of educator cognitive change and the educational leader's role in influencing it remain clouded. Explorations of educator cognitive change are limited when informed solely by education research without support from the disciplines of cognitive psychology and neuroscience. In this study, cognitive change is defined in a shift or change in one's meaning perspective (Mezirow, 1991).

PROBLEM

While cooperative efforts between education, cognitive psychology, and neuroscience have led to new understandings of educational problems, there currently exists no transdisciplinary model to enable these same disciplines to communicate with each other about the problem of educator cognitive change.

PURPOSE

In order to address the problem identified above, the twofold purpose of this exploratory qualitative study is to: 1) gain a transdisciplinary understanding of educator cognitive change; and 2) use that understanding to develop a model of educator cognitive change, in the hope that the model will be instructive for educational leaders, and others, who lead change initiatives.

1. How might qualitative data be analyzed to capture observable phenomena associated with cognitive change?
2. How might an original transdiciplinary model that incorporates education, cognitive psychology, and neuroscience literature provide explanation for educator cognitive change and, in turn, serve educational leaders and others interested in transformational change?

THEORETICAL PERSPECTIVES

The study of cognitive change is not unique to education. Rather, it is central to the work of researchers and theorists in a variety of disciplines and fields, including fields focused on leadership and organizations. However, understanding change is still elusive despite researchers' varied approaches. Some researchers identified steps in the process of change (Armenakis & Bedeian, 1999; Cavanaugh & McGuire, 1994; Quinn, 1996). Others were more concerned with studying the conditions that foster or inhibit change (Barnard, 1938; Duke, 1993; Hage, 1999; Seashore-Louis, 1998; Weick & Quinn, 1999; Wheatley, 1999). Still others theorized about the mental constructs that give rise to cognitive change (Bandura, 1993; Dewey, 1933; Mezirow, 1991). Even so, the study of cognitive change has been limited thus far to examining the behaviors with which cognitive change is associated and then advancing speculations about the mental processes that give rise to cognitive change. Such studies make use of response times measurements, psychological tests, questionnaire-type measurement tools, and qualitative data.

Researchers only recently obtained the tools and methods to allow one to examine the mental processes that underlie human cognition (Geake & Cooper, 2003). And, because such examinations are simultaneously occurring across fields and disciplines, the study of cognitive change may best be conducted through a transdisciplinary lens. Indeed, educators and neuroscientists have collaborated successfully around some educational problems. For example, one ray of hope is in the study of dyslexia, a reading disorder. Using a cognitive model for phonological processing, researches have located neurological evidence of a phonological processing deficit. This finding helps educators identify targeted interventions for remediating the disorder (Varma et al., 2008; Willingham & Lloyd, 2007). Another sign that transdisciplinary approaches can suggest solutions is found in math. Again, guided by cognitive psychological theories, neuroscience studies have demonstrated that increased efficiency in the retrieval of simple math facts occurs when facts are retrieved by verbal processing areas rather than visual-spatial ones (Varma et al., 2008). This finding allows educators to select the best methods to teach simple math facts and provides evidence of the value of transdisciplinary studies.

METHODS

To satisfy its purpose and questions, this research employed a qualitative, exploratory study in which narrative data was gathered from participants who took part in a specific educator development process. The narrative data was analyzed for evidence of educator cognitive change. Once analyzed, the data was interpreted in light of related literature in education, cognitive psychology, and neuroscience.

The study methods are grounded in interpretivist philosophy. Guided by interpretivist philosophy the researcher assumed a relativist ontology (Ponterotto, 2005; Williamson, 2006) that values the perceived reality of the individual as central to understanding. The researcher's goal was to achieve an in-depth understanding of the individual's lived experience from an emic perspective (Ponterotto, 2005; Schwandt, 2000). Obtaining such insight required a detailed analysis of a few individuals who provided a rich set of personal interview data. Small numbers of participants were purposely selected on the basis of their

potential to provide rich data for the intended phenomenon (Stake, 2003; Williamson, 2006). Thus, the study highlighted in this paper focuses on participant data selected for its potential to reveal cognitive change in each of six participants.

DESIGN

Data Source

This research used previously collected data for analysis. The data set comes from a unique technology-assisted learning environment known as Experiential Simulations© (ES©). The ES© environment developed by Brunner (2005) was specifically designed as "an innovative leadership preparation approach that provides experiences designed to encourage ontological shifts in its participants" (p. 4). The process engages educators in cognitive conflict by masking identities without participant awareness for the purpose of disrupting typical power relationships in an anonymous, synchronous, virtual environment. Additionally, ES© captures written records of all participant communication in a synchronous chat space and of all private reflections written in reaction to discussion prompts. Findings from several ES© studies indicate its potential for creating cognitive change conditions such as cognitive overload, cognitive dissonance, and reflection (Brunner, Hammel, & Miller, 2003; Brunner, Opsal, & Oliva, 2006; deLeon-Denton & Brunner, 2013; Miller & Brunner, 2008; Rusch & Brunner, in press; Shollen & Brunner, 2011), making it a likely source of data demonstrating educator cognitive change.

Qualitative data is collected from all phases of the ES© process, which is embedded in a graduate-level, educational leadership course. A major compenent of ES© is conducted in an online environment using small group synchronous chats and private asynchronous, threaded reflections, or interviews, with the instructor. Each small group uses problem-based learning on instructor designed tasks. Each group is told to prepare a presentation of its work for the fourth class period, which is the class's first face-to-face encounter (Brunner, 2005).

Before the ES© begins, each participant gives consent and is interviewed privately. They are asked to keep their identity hidden and to provide written responses to the following prompts (10 minutes per question): 1) Define power; 2) How do you make decisions? 3) How do you get things done?

During the first four- to five-hour chat, the students are only identified as an alphanumeric symbol. As they negotiate the chat, they are instructed to omit any information that might reveal aspects of their identity such as race, gender, religion, education, position, or other identity cues. Following this first session, students reflect on the experience through private reflective interview questions posed by the instructor (Brunner, 2005).

Prior to the second chat session, participants are directed to view the photos of their classmates. Each participant is randomly assigned a false photograph to represent them, thus masking their identities. When participants view the photos, they see the masked or pseudo identities of the other group members, but their personal photos are not masked. At this point, participants do not know that a) the pictures of their classmates are not their real identities, and b) they are being represented to others with a false identity. Using this incorrect information about each other, the participants continue to work on the assigned task in the second chat (Brunner, 2005).

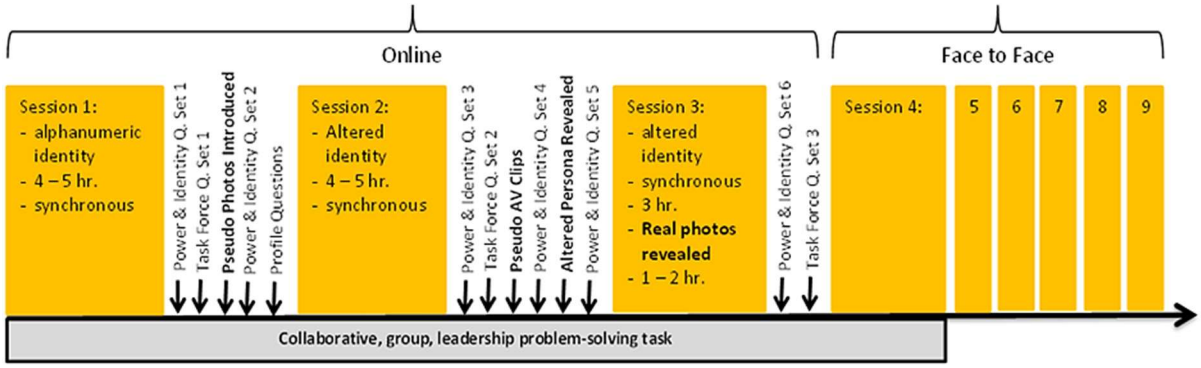
After the second chat, participants are again directed to take part in private reflective interviews conducted by the instructor. They then are asked to view an audio- visual clip of the group members introducing themselves. As before, the only real depictions are of themselves. Participants are directed to respond to another set of questions. After this fourth reflective interview, participants view the photo that has represented them (Modified Persona: MP) to the others since the beginning. This brings the realization to most that others also have MPs, and that their assumptions of other participants based on their photos is incorrect (Brunner, 2005).

During the third, and final, chat session (one hour before the chat is over) participants are directed to view the actual photos of their group members and record their reactions. They also respond to private reflective interview questions after the session ends. Beginning with the fourth session, students meet face

to face. The fourth session begins with participants writing their reactions to seeing the classmates with whom they have been communicating anonymously (Brunner, 2005).

Qualitative data are generated and collected from transcripts of chats and from individual, written reflective interviews. The reflective interviews consist of responses to prompts from the instructor. Six sets of prompts relate to issues of power and identity. Three sets of prompts gather responses to questions about the task and group processing. A final prompt induces reflections on imagined profiles of others in the class. The collected data is recorded and stored within the online course management system (See Figure 1).

FIGURE 1
EXPERIENTIAL SIMULATIONS© VISUAL MODEL



Participant Selection

A superintendency course utilizing the ES© process and having 15 participants was selected for the study. Nine participants in the course were women and six were men. Thirteen were Caucasian and two were African American. An initial analysis of chat session transcripts from within that course revealed six promising cases for full analysis.

It was presumed that periods of high conflict and/or high emotion provide external evidence of the disorientation preceding cognitive change (Mezirow, 1991; Quinn, 1996). A 2 x 2 model in which conflict was represented on the vertical axis from low to high, and emotion on the horizontal axis from low to high was created. Each individual chat entry was analyzed and coded according to the corresponding quadrant (see Table 1).

After all three chat sessions were analyzed for conflict and emotion, the coding for the 4,363 total chat entries was aggregated. This provided an overall picture of each participant's experience across the three chat sessions. The aggregated results were used to select individual cases for in-depth analysis. Participants were selected according to the following criteria: 1) they were highly engaged, and 2) they either displayed high conflict and/or high emotion or low conflict and low emotion. Those with high conflict and/or high emotion were considered more likely to be candidates for cognitive change, and the others were to serve as a baseline.

TABLE 1
SUMMARY: PARTICIPANTS' TRANSCRIPT DATA FROM ONLINE CHAT SESSIONS

Participants	Participant entries(n)	% of total[a]	Low conflict low emotion		High conflict low emotion		High conflict high emotion		Low conflict high emotion	
			Entries	(% of n)	Entries	(% of n)	Entries	(% of n)	Entries	(% of n)
Participant *	162	(3.7%)	145	(90%)	8	(5%)	3	(2%)	6	(4%)
Participant *	162	(3.7%)	160	(99%)	1	(1%)	0	-	1	(1%)
Participant *	177	(4.1%)	172	(97%)	4	(2%)	0	-	1	(1%)
Participant *	186	(4.3%)	177	(95%)	4	(2%)	0	-	5	(3%)
Participant *	187	(4.3%)	182	(97%)	4	(2%)	0	-	1	(1%)
Participant *	196	(4.5%)	191	(97%)	4	(2%)	0	-	1	(1%)
Participant *	227	(5.2%)	219	(96%)	2	(1%)	0	-	6	(3%)
Participant *	242	(5.5%)	236	(98%)	3	(1%)	0	-	3	(1%)
Participant *	279	(6.4%)	274	(98%)	5	(2%)	0	-	0	-
Participant *	337	(7.7%)	323	(96%)	4	(1%)	2	(1%)	8	(2%)
Participant *	341	(7.8%)	342	(98%)	15	(4%)	6	(2%)	32	(9%)
Participant *	349	(8.0%)	342	(98%)	5	(1%)	1	-	1	-
Participant *	480	(11%)	407	(85%)	32	(7%)	17	(4%)	24	(5%)
Participant *	519	(11.9%)	392	(76%)	34	(7%)	51	(10%)	42	(8%)
Participant *	519	(11.9%)	502	(97%)	8	(2%)	4	(1%)	5	(1%)

Note. Participants are unidentified to preserve anonymity and are ordered according to overall participation (low to high).
[a]total = 4,363, or total entries for all fifteen participants. If all participants had equal participation, each would contribute 1/15 (6.7%) of the entries. The horizontal line distinguishes those with less than 6.7% participation from those with greater.

This initial analysis was useful to select the individual cases (see Table 2). First, only those with high engagement, or greater than 6.7% of total chat entries, were considered for selection. Among those determined to be highly engaged, the three participants with more than 10% of their chat entries identified as high conflict and/or high emotion (less than 90% low conflict and low emotion) were selected as likely to undergo cognitive change. The three participants with over 90% of their chat entries identified as low conflict and low emotion were selected for baseline comparison. The result of the initial analysis yielded six participants who warranted further study. They were randomly assigned numeric identifiers (1 – 6) to maintain participant anonymity. Five were white and four were women. The conflict and emotion categories used to select cases were for initial analysis of the chat transcripts only and were not useful for the in- depth analysis of the six cases.

TABLE 2
AGGREGATED CHAT SESSION DATA: SIX CASES SELECTED FOR ANALYSIS

Participants	Entries (n)	% of Total[a]	LC-LE[b]	(% of n)	HC-HE[c]	(% of n)
High conflict / high emotion						
Participant 1	519	(12%)	392	(76%)	127	(24%)
Participant 2	341	(8%)	288	(84%)	53	(16%)
Participant 4	480	(11%)	407	(85%)	83	(15%)
Low conflict / low emotion						
Participant 3	349	(8%)	342	(98%)	7	(2%)
Participant 5	337	(8%)	323	(96%)	14	(4%)
Participant 6	519	(11%)	502	(97%)	17	(3%)

Note. Selected participants were assigned random numeric pseudonyms for anonymity.
[a]Total = 4,363, or total entries for all fifteen participants. If all participants had equal participation, each would contribute 1/15 (6.7%) of the entries. Selected participants contributed greater than 6.7% of the entries.
[b]LC-LE = number of entries coded for *low conflict and low emotion.*
[c]HC-HE = number of entries coded for *high conflict and/or high emotion.*

Data Analysis

An interpretive approach relies on inductive analysis (Merriam, 2009; Walsham, 2006). Analysis begins with open identification of concepts/themes within a single sample (Merriam, 2009; Walsham, 2006). These themes are then used and appropriately adjusted during the analysis of additional cases so that patterns cutting across samples are identified (Merriam, 2009; Ponterotto, 2005). In this study, an inductive approach is evident in the idiographic and nomothetic analysis.

Idiographic Analysis

The analysis began ideographically by beginning with one case and reading through all ten reflective interviews. Using an open coding process, concepts emerged from the data based upon the participant's own words (Merriam, 2009; Walsham, 2006) and enabled the researcher to gain an understanding of the phenomenon from the individual's perspective (Ponterotto, 2005; Schwandt, 2000). Themes were inductively created related to participant's emotions, the Experiential Simulation©, and the literature such as *power over*, and *power with/to* (Brunner, 2002; 2005), *anomalies* (Kuhn, 1962), *disorientation – loss of sense making* (Weick, 1993), *efficacy* (Bandura, 1993; Mezirow, 1991), *willingness – openness to change* (Dewey, 1933), *reflection* (York-Barr et al., 2006), *resistance* (Barnard, 1938), and *background knowledge for problem solving* (Stanovich & West, 2008a).

Analysis of subsequent participants' reflections prompted narrowing some themes into subthemes (Merriam, 2009) such as *perception of other's influence* and *self-perception of influence*, and lack of influence. In this way, all six participants' data was coded and analyzed.

By tracing the experience of each of the six selected participants, the researcher was able to identify incidents of cognitive change. The most interesting changes occurred around conceptions of power, with two individuals moving from a power over to a power with/to understanding (see Table 3). Participants 2 and 3 underwent a cognitive change, in slight contrast to the initial conflict-emotion analysis that participants 1, 2, and 4 were most likely to change.

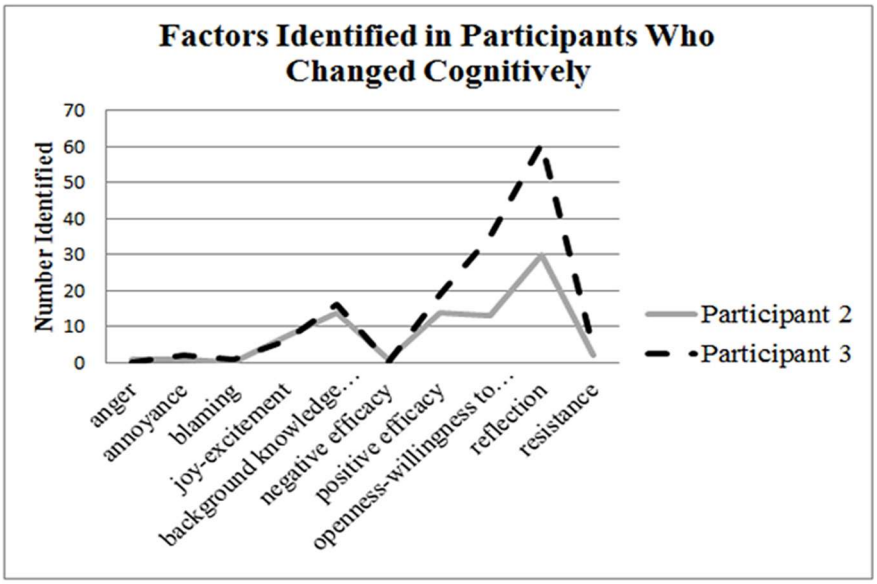
TABLE 3
PARTICIPANTS' VIEWS ABOUT POWER

Participant	Change	Race	Gender	Initial concept of power	Final concept of power
1	No	White	F	Power over	Same
2	Yes	Black	F	Power over	Power with/to
3	Yes	White	M	Power over	Power with/to
4	No	White	F	Power with/to	Same
5	No	White	F	Power with/to -situational	Same
6	No	White	M	Power over	Same

Nomothetic Analysis

A nomothetic approach to data analysis provides a broad picture of educator cognitive change dynamics aggregated across individuals. This approach helps detect the presence or absence of patterns in participants' experiences. For example, *openness* (Dewey, 1933) and *reflection* (York-Barr, Sommers, Ghere, & Montie, 2006) are suggested as necessary for cognitive change. The number of incidents of each were positively correlated (r = .87). Coded incidents of *resistance* and *reflection* were negatively correlated (r = -.66). While there were no clear patterns for any single factor across all participants to explain why some changed and others did not, the two participants who did undergo cognitive change had a similar frequency pattern among all factors (r = .92) (See Figure 2).

FIGURE 2
FACTOR COMPARISONS BETWEEN PARTICIPANTS WHO CHANGED



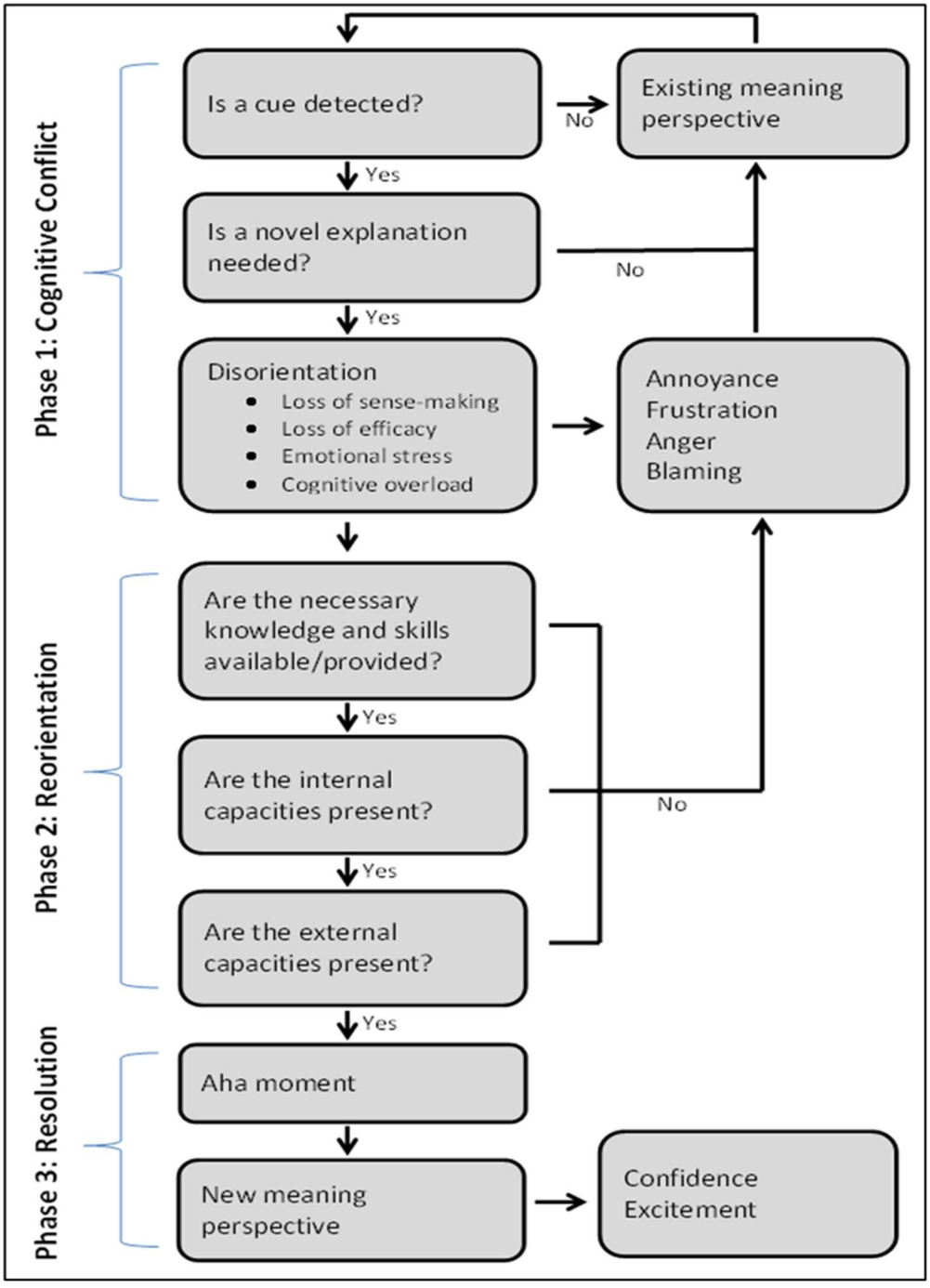
RESULTS

The result of the qualitative data analysis and an iterative use of literature and research in education, cognitive psychology, and neuroscience was the creation of an educator cognitive change model (See Figure 3).

This transdisciplinary model seeks to explain why some participants changed cognitively while others in the same situation did not. The model is transdisciplinary because it is informed by the qualitative data together with literature and research studies from education, cognitive psychology, and neuroscience.

Cross-over communication between education and neuroscience is difficult because the two operate on different levels of complexity (Willingham & Lloyd, 2007). Those interested in such transdisciplinary work suggest that cognitive psychology lies in the overlap between education and neuroscience and can help provide a communication link (Blakemore & Frith, 2005; Szucs & Goswami, 2007; Willingham & Lloyd, 2007). Work by Evans (2003, 2008), Stanovich and West (2008a, 2008b), and Willingham (2009) provide cognitive psychology links between education and neuroscience on the topic of educator cognitive change. In particular, Stanovich and West's (2008b) "framework for individual difference in heuristics and biases tasks" (p. 687) served as a starting point for the cognitive change model in this study.

FIGURE 3
VISUAL MODEL: EDUCATOR COGNITIVE CHANGE



Prephase: Meaning Perspective

Mezirow (1991) described a cognitive change as a transformation of one's meaning perspective. One's meaning perspective is described as an orienting framework influencing one's perception, understanding, and interpretation of reality. It guides action and decision making and rarely changes—even in the face of conflicting evidence. The participants in this study held meaning perspectives about the use of power as an educational leader. Their perspectives were challenged during their participation in ES©.

Cognitive psychologists describe neural processes in terms of automatic and controlled systems (Evans, 2003; 2008; Willingham, 2009). Controlled processes rely upon working memory and are slow, sequential, and capacity limited. Controlled processes are usually intentional, higher order functions and rely upon executive processes found in the lateral prefrontal cortex to exert control over more automatic processes (De Neys et al., 2008; Deppe et al., 2005b; Egner, 2009; Raz & Buhle, 2006).

Automatic processes do not require working memory and are rapid and preconscious. They can supply content for conscious, controlled processes (Evans, 2008). Automatic neural regions include the limbic system, amygdala, hippocampus, and ventromedial prefrontal cortex (Bechara & Damasio, 2005; Blakemore & Frith, 2005; Evans, 2003; Goel & Dolan, 2002; Summerfield et al., 2006).

As neural regions associated with one system come online, those of the other region often become less active (Lieberman, 2010). In authentic contexts, the same neural regions may be active for a variety of controlled processes (Lieberman, 2010), or different neural regions may work parallel to one another (Egner, 2008).

Toplak et al., (2010) have described the brain as a "cognitve miser." Whenever possible, it defaults to automatic processes that leave working memory free for other tasks. Accordingly the brain relies on automatic processes to rapidly react to its surrounding, and it preferentially recruits existing memories and beliefs (Evans, 2008). The brain does so regardless of a person's intelligence or ability for more reflective thought (Stanovich & West, 2008b), and regardless of whether one realizes that his understanding is inaccurate (De Neys et al., 2008). Reliance on these automatic processes is especially important when working memory load is high (Kelley & Lavie, 2010; Willingham, 2009) or when time is pressing (Amodio et al., 2004; Evans, 2008).

This model proposes that what Mezirow (1991) described as meaning perspectives and meaning schemes are the result of these neural processes. Unless cued otherwise, people default to automatic processes whenever possible (Stanovich & West, 2008b). The mind biases toward expected patterns (Bechara & Damasio, 2005; Deppe et al., 2005b; Evans, 2008; Goel & Dolan, 2002; Kuperberg, Lakshmanan, Caplan, & Holcomb, 2006) and is vulnerable to the effects of framing (De Martino et al., 2006; Deppe et al., 2005a; Fugelsang & Dunbar, 2005) resulting in decision-making and behaviors that are based more upon emotions (Bechara & Damasio, 2005) and previous experience than on rational thought (Amodio, Harmon-Jones, Devine, Curtin, Hartley, & Covert, 2004; Evans, 2008; Lieberman, 2010).

It is important to note that controlled and automatic processes are not necessarily at odds. Intentional, controlled thought is supported by the patterns, perceptions, feelings, and memories automatically generated enabling efficiency. At the same time, controlled processes provide a way to justify or explain unconscious decisions and behaviors (Evans, 2008).

Since one's meaning perspectives operate automatically by default, they often express themselves without conscious thought. Amodio et al., (2004) found that people often answered stereotypically regardless of their stated egalitarian beliefs when asked, under condition of time restraints, if a briefly viewed photo of a person with a gun was white or black. Similarly, Brunner (2002) found that power over and power with/to have "high fidelity" (p. 703) to one's actual performance as opposed to one's stated position. Participant 2 reflected on her use of power over others: "I consider the ideas of others, yet, I have been accused of already knowing what I want . . . I believe that people will think that I can be stubborn and keep at it until I get what I want." These findings support the common expression that actions speak louder than words.

Phase 1: Cognitive Conflict

Cognitive conflict is a necessary first step toward a meaning perspective change. Cognitive conflict occurs when a cue signals that one's prepotent, automatic perspective may be inadequate, but an alternative, more explanatory response is not immediately available, resulting in a period of mental disorientation. Two factors contribute to disorientation in this first phase of educator cognitive change. The first is whether a ***cue is detected***. A cue may be new data that is inconsistent with what one expects, or the presence of external or internal feedback signaling an error in personal judgment (De Neys et al., 2008; Egner 2007, 2009; Gehring & Fenscik, 2001). If a cue is not present or goes undetected, a person continues to operate

within the existing meaning perspective—regardless of whether it correctly informs decision making or actions (De Neys, Vartanian, & Goel, 2008; Inzlicht, McGregor, Hirsch, & Nash, 2009; Blakemore & Frith, 2005; Quinn, 1996; Stanovich & West, 2008b; Westen, Blagov, Harenski, Kilts, & Hamann, 2006).

The second factor is ***whether a novel explanation is needed*** to satisfactorily fit the phenomenon into one's meaning perspective (Stanovich & West, 2008b). One first attempts to use existing knowledge and skills to accommodate the discrepant data. If a satisfactory solution is not readily available and negative feedback continues, a period of disorientation ensues.

Disorientation occurs when a person knows the meaning perspective is wrong, but is unable to devise a better one. The automatic systems upon which one usually relies for understanding and decision making are exposed as unreliable. The feeling of disorientation can have several sources. The unpleasant feeling of disorientation can be caused by 1) *physiological and emotional changes*, making the logically incorrect response feel right (Bechara & Damasio, 2005; Mohanty et al., 2007; Rubia et al., 2003); 2) *a loss of sense making* (Weick, 1993); 3) *low self-efficacy* resulting from the sudden loss of control (Bandura, 1993); or 4) *cognitive overload*. Participant 2 described her disorientation: "I actually could not respond on the computer for a moment. It wasn't shock so much as needing time to think about what I said and how I said it in previous sessions."

Disorientation is unsettling and leads participants to seek ways to resolve the conflict, thereby entering a second phase called reorientation. Unresolved cognitive conflict results in anxiety, frustration, and anger. It may express itself in excuses, justification, self-deception, and blaming (Heifetz, 1994: Mezirow, 1991; Pfeffer, 1997). Participant 1 expressed her frustration: "I might punch 6 right in the face. So far I think he is a self-righteous pseudo-intellectual."

Phase 2: Reorientation

Reorientation is the cognitive process required to resolve cognitive conflict. It involves inhibiting a prepotent response, considering alternatives, and often gaining new knowledge or skills (Stanovich & West, 2008b). This second phase of educator cognitive change has three necessary components: 1) the requisite background knowledge or skills, 2) certain capacities within the individual (internal), and 3) certain capacities outside the individual (external). All three components must be present for reorientation to occur.

If one's meaning perspective is inadequate to explain a phenomenon, then one must draw on ***required knowledge or skills*** to expand or alter that perspective. It is possible that a person already has the necessary knowledge or skills but needs to associate them in a new way. This is how experts make paradigm-shifting discoveries (Kuhn, 1962). Often, however, new knowledge must come to light in order for the person to gain a new perspective. Participant 2 wrote about her new knowledge: "The articles we read last week about giving orders and power really stuck with me." Regardless of whether new information is needed or new connections made between existing pieces of information, one must have the internal and external capacities available to support the acquisition and consideration of that knowledge.

Successful reorientation also depends on the presence of certain ***internal capacities***. An educator must possess sufficient *self-efficacy* to believe meaning perspective change is possible and to allow current beliefs to be scrutinized.(Bandura, 1993). The person also needs a *willingness to be open* to new beliefs (Dewey, 1933; Stanovich & West, 2008b) and to *reflect critically* (Mezirow & Associates, 1990). Finally, one must be able to resist defaulting to an automatic response while gathering new information and considering alternative responses—what Stanovich and West (2008b) call *cognitive decoupling*.

Participant 3, who experience cognitive change revealed his internal capacity: "I am energized when a challenge or task is dangling in front of me." In contrast, Participant 1, who did not change, seemed unwilling: "Why did I have to waste my time with a bunch of bozos on a topic I could care less about?"

Certain, ***external capacities*** are also necessary for reorientation. These include sufficient time (Yoon et al., 2007), opportunities to collaborate (Mezirow, 1991; York-Barr et al., 2006), and a supportive context (Seashore-Louis, 1998). *Sufficient time* is needed in which to gain new understandings, to reflect, and to consider alternatives. Collaboration helps the educator clarify understandings, deepens reflection, and reinforces efficacy. A *supportive setting* strengthens efficacy, and promotes reflection and openness.

Both participants of the ES© who changed felt safe. Participant 3 wrote, "As far as meeting the people and being together 'live' I look forward to that." Others who did not change expressed feeling unsafe. Participant 6 explained, "I am still concerned about the coalitions that will form during the class. . . I have seen coalitions work in very negative ways, and I am not looking forward to the first part of the class."

The absence of resolution can create frustration or anger. If a person detects a need for change, but lacks the internal capacity to change, he feels frustrated. This may lead to feelings of anger or depression. Excuses or justifications may be offered to explain why the change was not valid. To provide meaning in the face of anxiety, "we may resort to psychological mechanisms of self-deception" (Richardson, 1990, p. 63). As a result, people hold more tightly to past assumptions, deny that the problem is real, jump to conclusions, or find an issue to distract them (Heifetz, 1994).

However, if external capacities prevent change, the feelings of frustration and anger associated with disequilibrium become amplified. A person blames those factors that make him feel powerless. In order to maintain a feeling of control, it becomes necessary to project one's failure onto something outside oneself, such as a scapegoat (Pfeffer, 1977).

The person who lacks the capacities for reorientation follows the heuristic response, but also experiences feelings of frustration, anger, or sadness. In such instances the person tries to rationalize the heuristic decision *ex post facto*, and may erupt in anger as s/he attempts to justify what feels right but cannot be understood differently based on the mindware s/he possesses. Unable to resolve his conflicts, Participant 6 blamed the course and his instructor: "I have many reservations and still do that this environment will be a successful learning one for me." He concluded, "a lot of tolerance for unacceptable behavior has been taking place."

Phase 3: Resolution

Resolution is ushered in by an "aha" moment (Cavanaugh & McGuire, 1994; Kuhn, 1962). This is an all-at-once occurrence in which one gains new insight (Aziz-Zadeh, Kaplan, & Iacoboni, 2009; Jung-Beeman, et al., 2004; Qui, et al., 2010). Resolution involves a deep, personal change (Quinn, 1996) that is not reversible, because the new meaning perspective is seen as superior to the old. The knowledge, understandings, and memories are reorganized into a new meaning perspective which can be articulated in a way that is fundamentally different from the old one (Mezirow, 1991). The new meaning perspective becomes the new automatic response that successfully guides action and decision making. Resolution results in new-found feelings of confidence and excitement (Mezirow, 1991). Participant 3 explained how his new understanding will influence his own leadership: "I will apply my learnings in real life by being more patient and allowing more time to get to know people before I decide who they are."

CONCLUSIONS

In addition to a model of cognitive change, the study generated eight conclusions. First, the outward indicators (conflict and emotion) of behavior used to select this study's participants *proved to be unreliable predictors* of cognitive change. The assumption that those who showed high conflict and emotion in the chat space were likely to experience cognitive change did not play out in this instance. Participants 1, 2, and 4 were predicted to change, but only participant 2 did. Likewise, participant 3 was not expected to change but did. It may be that the assumptions were faulty or that the sample was too small. It is also likely that participants' public display of conflict and emotion were muted due to the influence of social conventions. Also, conflict in the chat space and ontological conflict may be fundamentally different. Additional research is required to further explore the relationship between participants' visible conflict and cognitive change.

Second, among the *factors influencing change, none appeared as the primary* influence in prompting cognitive change. For example, theorists cite both reflection (York-Barr et al., 2006) and openness (Dewey, 1933) as important factors for change, but among study participants there was no clear pattern between those factors and resulting change. For the two participants who resisted change, one displayed openness

and the other did not. Furthermore, all participants demonstrated times of reflection regardless of whether they experienced cognitive change.

Third, this study *supports the conclusion that there may be an interrelated set of dynamic factors that underpin educator cognitive change*. The two participants who changed (2 & 3) possessed all the factors that positively influence change and showed few of the factors that negatively influence it (see Figure 4, p. 11). Both demonstrated reflection, openness, positive-efficacy, and background knowledge while lacking resistance and negative efficacy. They also met all conditions identified in the educator cognitive change model: 1) detecting a cue; 2) gaining new knowledge; 3) being open and reflective; 4) displaying positive self-efficacy; and 4) having sufficient time, support, and opportunity for collaboration.

Fourth, this study provides a *model for examining educator cognitive change where none currently exists*. The educator cognitive change model proved useful to understand all six participants' experiences during the ES© as recorded in their ten written reflections (responses to instructor prompts). This study reviewed their reflections and the transcripts of three synchronous chat sessions through the lens of the educator cognitive change model. In each case, the model clarified participants' experiences and provided a possible explanation for why some participants underwent cognitive change and others did not.

Fifth, the *model identifies some of the reasons that cognitive change is difficult and provides tangible explanations for the phenomenon*. Operating according to one's existing meaning perspective is efficient and useful. Altering one's prepotent automatic processes is not. Reliance on automatic processes is so strong that every input is shaded or interpreted according to one's existing meaning perspective. This model suggests that even the most receptive educator needs to 1) detect a cue that the existing meaning perspective is insufficient; 2) gain new knowledge; 3) have opportunities to collaborate in a supportive context; and 4) be provided sufficient time if cognitive change is to occur.

Sixth, the *process of educator cognitive change is a function of normal neural processes in conjunction with certain external and internal conditions*. This study establishes resistance as a symptom of underlying conditions rather than an impediment to change; shedding new light on a leader's approach to influencing cognitive change. Resistance results from inadequate cuing, background knowledge, and internal or external capacities. *As a result, the responsibility for change shifts away from the individual educator and onto the leader*.

Seventh, by establishing *resistance as a symptom, this study suggests that influencing educator cognitive change requires more than overcoming resistance; it requires creating a culture that supports both the needed internal and external capacities*. This model assists the educational leader to identify and predict conditions under which educator change is likely to occur. In contrast, policies intended to coerce compliance through either incentives or punitive measures do not support the mental processes of change and are, according to this study, less likely to succeed.

Eighth, a *transdisciplinary approach is useful for providing insight that is not readily apparent through single-disciplinary approaches*. The educational literature enabled the researcher to interpret participants' use of and ontological shifts in power (Brunner, 2002). Neuroscience literature suggested explanations why conflict cues may either lead to self-regulation (De Neys et al., 2008; Egner et al., 2007; Mohanty et al., 2007) or be disregarded (Inzlicht et al., 2009; Westen et al., 2006). Education, neuroscience, and cognitive psychology helped parse sources for disorientation, and identify them as a loss of sense making (Bechara & Damasio, 2005; Lieberman, 2010; Weick, 1993), emotional conflict (Bechara & Demasio, 2005; Mohanty et al., 2007; Rubia et al., 2003), loss of efficacy (Bandura, 1993), and cognitive overload (Bannert, 2002; Kelley & Lavie, 2010; Willingham, 2009).

Significance of the Work

The study has significant implication for educational leadership, educational leadership preparation programs, and for future research.

Educational Leadership

Educational leaders manage change in schools. Successful organizational change results from the collective change of individuals' behaviors (Reeves, 2009). Affecting individual change, therefore, is at the

core of school leadership. By identifying the processes and conditions of educator cognitive change, this model may be useful in two ways. First, the model may provide leaders with a pre-assessment and planning tool for designing educating cognitive change. Second, the model may aid leaders in understanding and interpreting individual cognitive change experiences.

The model can be used by educational leaders to assess an organization's readiness for cognitive change and to plan the necessary conditions for its promotion. Prior to implementing change, the leader should assess whether the environment supports needed internal and external capacities necessary for individual cognitive change. If the change requires a new meaning perspective, the leader must make certain that the difference between the existing concept or practice and the proposed change is clearly cued, and that educators recognize the need for a novel solution. Leaders should conduct an analysis of external capacities to determine whether they are sufficient to support the proposed change. The leader should also enable educator self-efficacy, reflection, and openness by providing the necessary knowledge or skills, time, support, and opportunities for collaboration.

Educational leaders can use the model to diagnose impediments to change and to provide targeted support when individual cognitive change does not occur. The model enables educational leaders to recognize that non-desirable behaviors are symptoms of a flawed educator development process. Frustration, anger, and blaming are normal symptoms of disorientation and unsuccessful reorientation rather than impediments to change. Instead, resistance may signal that the educator development experience did not provide a sufficient cue that change was needed or that supply evidence that a novel solution was required. If participants are unable to make sense of the proposed change, then more knowledge is required. Cognitive overload indicates the need for more time. Emotional stress or loss of efficacy may suggest the need for greater support.

Additionally, the model suggests that complex solutions are needed to address the stubborn problem of educator cognitive change. The literature often highlights educator resistance and the policies, levers, and conditions needed to overcome it. A frequent suggestion is to provide more of some policy, lever, or condition. Successful change involves a complex web of factors that must all occur, some of which may be controlled by policy and others which cannot. There is no single policy, program, or process that can make a significant impact on individual change.

Educational Leadership Preparation Programs

Educational leadership preparation programs often equip candidates to become change leaders. This study has implications for both what is taught about leading change and how it is taught.

Educational leadership preparation programs can use the educator cognitive change model to prepare future leaders to plan for and manage change. Together, the verbal description and the visual representation of the cognitive change model provides a theoretical as well as practical perspective of cognitive change at the individual level. As a theoretical foundation, it serves as a lens through which educational leaders understand and interpret the meaning perspectives of educators. The model also provides guidelines for leaders to plan for and to analyze change.

This model may help educational leadership programs instill leadership behaviors conducive to effecting change within an organization. Program standards typically require candidates to employ behaviors related to collaborative, distributed, and shared leadership. For many, a distributed view of leadership requires a shift in their meaning perspective. As Brunner (2002) noted, educational leaders commonly adopt the language of shared leadership but not the actions. This research suggests that educational leadership preparation programs can utilize this cognitive change model in planning for the necessary leadership meaning perspective change. The anlaysis of the individual cases provides evidence that such a shift may be more likely if the leadership candidates actually experience the differing leadership styles rather than merely discussing them. Furthermore, Experiential Simulations© may be a useful tool for preparing future educational leaders.

Future Research

Since this study provides a model for examining educator cognitive change, researchers interested in studying the phenomenon of cognitive change and developing studies to address the same, now have a framework to guide their work. The model provides a theory with assumptions that can be tested in training programs.

Importantly, this model highlights the intersection of knowledge across various disciplines, suggesting possible means for collaboration. Educators, neuroscientists, and cognitive psychologists might cooperate together to further untangle and identify the factors that encourage or inhibit educator cognitive change. Educators may explore how automatic processes can be actively recruited to frame cognitive change and minimize disorientation. Neuroscience studies can confirm whether the suggested neural processes are involved as indicated by this model. For example, using fMRI neuroscientists can examine neural mechanisms active when educators receive information that is either consistent or inconsistent with their existing meaning perspective. The neural data can be compared with participants' interpretations of the information.

The cognitive change model suggests that a cognitive cue is vital for initiating the change process. Neuroscience studies distinguish between cues caused by conflict (dACC) and by error (rACC). The two participants that changed were cued by error. Are cues caused by errors more likely to spur change than cues caused by conflict?

The applicability of the educator cognitive change model should be further tested. Researchers should gather data from other types of educator development to learn the extent to which the model applies more broadly. In this study, the model was only applied to six cases. Using this model to interpret the cognitive change experiences of more cases will check its broader usefulness. Additionally, researchers can create new programs of educator development based upon this model and test those programs' effectiveness.

The model itself should be tested and refined. Some aspects of the model could not be fully explored. The literature discusses the importance of external capacities like time, collaboration, and support, but the supporting evidence in this study is thin. ES© was not designed to capture those elements. Moreover, time may simply be a function of the other internal and external factors. The time needed for change will vary depending on how long it takes an individual to acquire sufficient knowledge and other capacities. Should these capacities not be available, no time would ever be enough.

Further, it is not known whether all the internal or external capacities needed to support cognitive change are identified. Stanovich and West (2008a) suggest that cognitive decoupling is a necessary internal capacity, but this study lacked the ability to provide evidence in support of their claim. Additional studies can explore how well-correlated the model's identified capacities are with cognitive change.

Limitations

Several limitations to this study should be noted. First, this study is restricted by the researcher's limited understanding of cognitive psychology and neuroscience literature. The researcher's native discipline is education. Using a transdisciplinary approach requires going beyond one's native discipline to bring research from other disciplines to bear upon the problem (Varma et al., 2008). However, this also carries a risk that the researcher has not spent sufficient time immersed in other disciplines to gain insight.

Another limitation is the researcher's own bias. I spent many months preparing for this study by reading theoretical literature and research studies related to the topic. Although every attempt was made to allow the qualitative data to give rise to the findings, the conceptual framework as suggested by the literature likely framed my understanding and influenced my expectations. While trying to prevent the framework from being the funnel into which the data must be poured, it is possible that my analysis is influenced by the expectations of the literature. Future research should be alert for disconfirming data.

This study is only intended to create a transdisciplinary model of educator cognitive change and to apply it using a secondary analysis of data collected in a specific type of educator development using Experiential Simulations (ES©). This setting involves graduate students in educational leadership courses using ES© as a reflective tool. This setting was chosen because of its potential to produce the kind of data necessary to create and apply a transdisciplinary model. Therefore any conclusions only pertain to that type

of educator development. To provide in-depth analysis of data, the study focuses on only those cases that provide some evidence of cognitive change processes. This study is not intended to analyze every instance of educator change that is possible. Due to the unique nature of the setting, results may not be applicable to other types of educator development.

Another limitation is that this study is bounded by the time and parameters of the ES©. All data were gathered during the one-month period of the online portion of the course. Participants were asked to reflect upon—and comment on—only events occurring within the course itself. The researcher was limited to participant responses during this time and about the given topics. Contributing experiences beyond the ES© were unknown unless a participant offered such information. In most cases, participants provided little data regarding either conditions of support or opportunities to discuss issues of power in the real world. So even though support for and collaboration about a change is important external factors indicated by the literature, there was little information on either within the data. In addition, time was limited to the four weeks—preventing continued study of participants for whom change seemed likely.

The study was further limited to the number of cases examined. In order to allow in-depth analysis of their individual experiences, six cases were identified based upon the selection criteria—three most likely and three least likely to experience cognitive change. The selection criteria proved somewhat unreliable. The actual experiences of participant change were inconsistent with the evidence gleaned from the three, four-hour chat transcripts. Other or additional cases may have been more useful.

This study is also limited because the data was gathered ten years before this analysis. The researcher was unable to contact any participants to confirm whether interpretations were correct. The researcher was also unable to conduct follow-up interviews to inquire about the opportunities for collaboration, the support of the work environment, and the influence of time—topics that were not the focus of any reflection questions.

Due to the above limitations the reader is cautioned against generalizing the results to other educator cognitive change situations. More study should be done in other settings to determine the reliability of this model in describing educator cognitive change.

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