NEUROSCIENTIFIC STRATEGIES FOR MANAGING STRESS RELATED TO PERVASIVE CHANGE IN PUBLIC EDUCATION

by

CAMI RAE HAMLIN

A Dissertation Submitted to the Faculty in the Educational Leadership Program of Tift College of Education at Mercer University in Partial Fulfillment of the Requirements for the Degree DOCTOR OF PHILOSOPHY

Atlanta, GA 2017
NEUROSCIENTIFIC STRATEGIES FOR MANAGING STRESS
RELATED TO PERVASIVE CHANGE
IN PUBLIC EDUCATION

by

CAMI RAE HAMLIN

Approved:

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edward L. Bouie, Jr., Ed.D.</td>
<td>Dissertation Committee Chair</td>
<td></td>
</tr>
<tr>
<td>Carl E. Davis, Ed.D.</td>
<td>Dissertation Committee Member</td>
<td></td>
</tr>
<tr>
<td>Pamela A. Larde, Ph.D.</td>
<td>Dissertation Committee Member</td>
<td></td>
</tr>
<tr>
<td>J. Kevin Jenkins, Ed.D.</td>
<td>Chair, Tift College of Education, Educational Leadership</td>
<td></td>
</tr>
<tr>
<td>Jane West, Ed.D.</td>
<td>Director of Doctoral Studies, Tift College of Education</td>
<td></td>
</tr>
<tr>
<td>Keith E. Howard, Ph.D.</td>
<td>Interim Dean of Graduate Studies</td>
<td></td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

Being an educator is hands down one of the most fulfilling and rewarding responsibilities I have undertaken. In the 20 years of being an educator, I have observed, participated in, and probably created more stress then one can imagine, and I have especially tried to remove stress from my colleagues, students, and their families. It is my sincere desire to create learning opportunities filled with enthusiasm and opportunity, appreciation for change, and free from stress. This research endeavor was most definitely a project of my heart and my brain, so it was a natural fit for me to explore the intersection of education and neuroscience.

I have been blessed with wonderful personal, professional, and academic support in completing this research. Carolyn, Glenn, Deborah, Jody, Jayne, and Keaney have provided ongoing words, prayers, faith, rolling pins, grammar, support, encouragement, and all the good stress I can handle in their support of this dissertation for all these years.

Working with Dr. Edward Bouie and Dr. Mary O’Phelan has been a privilege beyond measure, and I want to thank them for their tireless and dedicated work in shepherding me through this process. Their wisdom and willingness to work with me as a guide and mentor have made this experience rich and positive. I have felt respected and supported through every step of the dissertation, and I am grateful.
I would also like to thank the other members of my dissertation committee for their support and guidance: Dr. Elaine Artman, who was positive and encouraging at every turn, Dr. Pamela Larde, who provided invaluable guidance in the qualitative analysis, and Dr. Carl Davis, who supported me along the way. Dr. Paige Tompkins in her wisdom has also advocated for me and stayed the course. Thank you.

I would be remiss not to also thank my Macon Cohort V who unfailingly encouraged me: Dr. Jody Long, Dr. Todd Hurt, Dr. Joseph Richardson, Lisa Rouleau, and Tracey Baham.

I also am grateful to my husband, friends, and colleagues in education who, despite experiencing insurmountable stress both personally and professionally, have agreed to stay the course to pursue the goal of enriching the lives of others. Raleigh, I miss and love you beyond words.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xv</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1. INTRODUCTION TO THE STUDY</td>
<td>1</td>
</tr>
<tr>
<td>Background of the Study</td>
<td>2</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>7</td>
</tr>
<tr>
<td>Status of the Problem</td>
<td>7</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>11</td>
</tr>
<tr>
<td>Research Question</td>
<td>12</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>12</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>15</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>19</td>
</tr>
<tr>
<td>Procedures</td>
<td>21</td>
</tr>
<tr>
<td>Limitations and Delimitations</td>
<td>22</td>
</tr>
<tr>
<td>Definitions of Terms</td>
<td>23</td>
</tr>
<tr>
<td>Summary</td>
<td>24</td>
</tr>
<tr>
<td>2. REVIEW OF RELATED LITERATURE</td>
<td>26</td>
</tr>
<tr>
<td>Neuroscience and the Brain</td>
<td>27</td>
</tr>
<tr>
<td>Brain Structures</td>
<td>27</td>
</tr>
<tr>
<td>Brain Imaging Technologies</td>
<td>28</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging</td>
<td>28</td>
</tr>
<tr>
<td>Computerized Axial Tomography</td>
<td>28</td>
</tr>
<tr>
<td>Electroencephalography</td>
<td>29</td>
</tr>
<tr>
<td>Magnetoencephalography</td>
<td>29</td>
</tr>
<tr>
<td>CHAPTER</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Positron Emission Tomography</td>
<td>29</td>
</tr>
<tr>
<td>Functional Magnetic Resonance Imaging</td>
<td>30</td>
</tr>
<tr>
<td>Functional Magnetic Resonance Spectroscopy</td>
<td>30</td>
</tr>
<tr>
<td>Transcranial Magnetic Stimulation</td>
<td>30</td>
</tr>
<tr>
<td>Functions of the Brain</td>
<td>30</td>
</tr>
<tr>
<td>Unique Features of the Brain</td>
<td>32</td>
</tr>
<tr>
<td>Neurogenesis</td>
<td>33</td>
</tr>
<tr>
<td>Neuroplasticity</td>
<td>34</td>
</tr>
<tr>
<td>Needs of the Brain</td>
<td>35</td>
</tr>
<tr>
<td>Hydration</td>
<td>35</td>
</tr>
<tr>
<td>Sleep</td>
<td>35</td>
</tr>
<tr>
<td>Nutrition</td>
<td>36</td>
</tr>
<tr>
<td>Exercise</td>
<td>36</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>36</td>
</tr>
<tr>
<td>Stress</td>
<td>37</td>
</tr>
<tr>
<td>Characteristics of Brain-Supported Leadership</td>
<td>39</td>
</tr>
<tr>
<td>Safety</td>
<td>39</td>
</tr>
<tr>
<td>Choice</td>
<td>40</td>
</tr>
<tr>
<td>Social Bonding</td>
<td>40</td>
</tr>
<tr>
<td>Stimulation</td>
<td>41</td>
</tr>
<tr>
<td>Feedback</td>
<td>41</td>
</tr>
<tr>
<td>Practice</td>
<td>41</td>
</tr>
<tr>
<td>Theoretical Approaches Related to Brain-Supported Leadership</td>
<td>42</td>
</tr>
<tr>
<td>NeuroLeadership and SCARF</td>
<td>43</td>
</tr>
<tr>
<td>Status</td>
<td>44</td>
</tr>
<tr>
<td>Certainty</td>
<td>44</td>
</tr>
<tr>
<td>Autonomy</td>
<td>44</td>
</tr>
<tr>
<td>Relatedness</td>
<td>44</td>
</tr>
<tr>
<td>Fairness</td>
<td>45</td>
</tr>
<tr>
<td>Leadership Theory</td>
<td>45</td>
</tr>
<tr>
<td>Emotional Intelligence</td>
<td>45</td>
</tr>
<tr>
<td>Emotion Regulation</td>
<td>46</td>
</tr>
<tr>
<td>Social Intelligence</td>
<td>46</td>
</tr>
<tr>
<td>Habits</td>
<td>47</td>
</tr>
<tr>
<td>Neuroscientific-Supported Strategies</td>
<td>49</td>
</tr>
<tr>
<td>Emotional Strategies</td>
<td>49</td>
</tr>
<tr>
<td>Humor</td>
<td>50</td>
</tr>
<tr>
<td>Empathy</td>
<td>50</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental Strategies</td>
<td>51</td>
</tr>
<tr>
<td>Cognitive Therapy</td>
<td>51</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>51</td>
</tr>
<tr>
<td>Compassion Meditation</td>
<td>52</td>
</tr>
<tr>
<td>Visualization Techniques</td>
<td>53</td>
</tr>
<tr>
<td>Physical Strategies</td>
<td>53</td>
</tr>
<tr>
<td>Voluntary Exercise</td>
<td>54</td>
</tr>
<tr>
<td>Nutritional Neurochemistry</td>
<td>54</td>
</tr>
<tr>
<td>Creativity</td>
<td>54</td>
</tr>
<tr>
<td>Social Strategies</td>
<td>55</td>
</tr>
<tr>
<td>Coaching</td>
<td>55</td>
</tr>
<tr>
<td>Play</td>
<td>55</td>
</tr>
<tr>
<td>Summary of Findings and Themes within Reviewed Literature</td>
<td>56</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
<td>58</td>
</tr>
<tr>
<td>Research Design</td>
<td>59</td>
</tr>
<tr>
<td>Population and Sample</td>
<td>60</td>
</tr>
<tr>
<td>Selection and Description of Sample</td>
<td>61</td>
</tr>
<tr>
<td>Participants</td>
<td>61</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>62</td>
</tr>
<tr>
<td>Data Collection</td>
<td>64</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>65</td>
</tr>
<tr>
<td>Summary</td>
<td>67</td>
</tr>
<tr>
<td>4. RESULTS</td>
<td>68</td>
</tr>
<tr>
<td>Delphi Round 1</td>
<td>69</td>
</tr>
<tr>
<td>Question 2</td>
<td>69</td>
</tr>
<tr>
<td>Question 3</td>
<td>70</td>
</tr>
<tr>
<td>Question 4</td>
<td>71</td>
</tr>
<tr>
<td>Question 5</td>
<td>73</td>
</tr>
<tr>
<td>Question 6</td>
<td>74</td>
</tr>
<tr>
<td>Question 7</td>
<td>74</td>
</tr>
<tr>
<td>Question 8</td>
<td>76</td>
</tr>
<tr>
<td>Question 9</td>
<td>78</td>
</tr>
<tr>
<td>Summary of Delphi Round 1</td>
<td>80</td>
</tr>
<tr>
<td>Delphi Round 2</td>
<td>81</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 2 of Delphi Round 2</td>
<td>81</td>
</tr>
<tr>
<td>Summary of Delphi Round 2</td>
<td>83</td>
</tr>
<tr>
<td>Delphi Round 3</td>
<td>84</td>
</tr>
<tr>
<td>Summary</td>
<td>87</td>
</tr>
</tbody>
</table>

5. DISCUSSION, CONCLUSIONS, AND IMPLICATIONS | 89 |

| Summary and Discussion of Major Findings | 91 |
| Benefits of Sleeping | 91 |
| Understanding the Causes and Preventions of Stress | 92 |
| Hands-On Education Strategies | 93 |
| Active Collaborative Learning in Small Groups | 93 |
| Medication-Based Strategies | 94 |
| Limitations | 95 |
| Conclusions | 95 |
| Implications | 96 |
| Recommendations for Future Research | 100 |
| Final Thoughts | 102 |

REFERENCES | 104 |

APPENDICES | 123 |

| A | IRB APPROVAL | 124 |
| B | SURVEY INVITATION | 128 |
| C | PERMISSION TO USE FIGURES | 130 |
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participants’ Roles in Neuroscience</td>
</tr>
<tr>
<td>2</td>
<td>Participants’ Affiliated Organization</td>
</tr>
<tr>
<td>3</td>
<td>Participants’ Neuroscientific Specialty</td>
</tr>
<tr>
<td>4</td>
<td>Participants’ Years of Practice in the Field of Neuroscience</td>
</tr>
<tr>
<td>5</td>
<td>Participants’ Country of Neuroscientific Practice</td>
</tr>
<tr>
<td>6</td>
<td>Participants’ Opinions Regarding the Effectiveness of Incorporating Neuroscientific-Supported Practices in P-16 Education</td>
</tr>
<tr>
<td>7</td>
<td>Participants’ Elaborations Regarding the Effectiveness of Incorporating Neuroscientific-Supported Practices in P-16 Education</td>
</tr>
<tr>
<td>8</td>
<td>Participants’ Delineation of Effective Neuroscientifically Supported Strategies</td>
</tr>
<tr>
<td>9</td>
<td>Participants’ Recommendations for Implementing Effective Neuroscientifically Supported Strategies</td>
</tr>
<tr>
<td>10</td>
<td>Participants’ Ranking of Agreement with Proposed Strategies</td>
</tr>
<tr>
<td>11</td>
<td>Rank Order of Strategies by Mean and Standard Deviation</td>
</tr>
<tr>
<td>12</td>
<td>Final Results of Ranked Strategies</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prefrontal Cortex and Amygdala Response to Stress</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Fisher’s Process of Transition Theory</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>Conceptual Framework of the Study</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Synaptic Density from Birth to 15 years (Neural Pruning)</td>
<td>33</td>
</tr>
</tbody>
</table>
ABSTRACT

CAMI RAE HAMLIN
NEUROSCIENTIFIC STRATEGIES FOR MANAGING STRESS RELATED TO PERVERSIVE CHANGE IN PUBLIC EDUCATION
Under the direction of EDWARD L. BOUIE, JR., Ed.D.

The purpose of this research was to look to neuroscientists for help in identifying strategies that may help bypass the fight-or-flight response of stressed educators undergoing the chronic stress of reform. Educator stress is a pervasive problem equally matched by the level of pervasive attempts of reform that exists in P-16 education. Neuroscience findings that the brain registers change equal to that of threat poses a problem of ongoing inappropriate responses to change, contributing to a crisis of up to a 50% mass exodus of new teachers in some markets.

The study results provided strategies suggested by neuroscientists for educational leaders to implement to help educators reduce stress, stay cognitively engaged, and improve success with pervasive change environments. A panel of expert neuroscientists from the Dana Alliance for Brain Initiatives (DABI) participated in surveys in three rounds of the Delphi method. Twenty-four experts initially responded and collectively identified 16 strategies. Using a 5-point Likert-type rating scale, 12 experts in Round 2 of the Delphi rated their degree of agreement of the appropriateness of each of the
suggested 16 strategies. Using mean and sampling standard deviation, the researcher rank ordered the results of the Round 2 Delphi strategies suggested by DABI members. In Round 3, the experts reviewed the collective contributions for final recommendations of strategies for implementation by educational leaders to reduce stress and increase cognition of their employees when confronted with reform and change in schools, essentially bypassing or inoculating themselves against the reflexive “flight or fight” mode. The 17 experts participating in Round 3 agreed to the use of four strategies: benefits of sleep; understanding the causes and preventions of stress; hands-on strategies; and active, collaborative learning in small groups. One hundred percent disagreed to the use of medication-based strategies. Because half of the experts expressed uncertainty of whether neuroscience could contribute to the field of educational leadership, future recommendations pointed to a need for more empirical research around this infancy partnership.
CHAPTER 1

INTRODUCTION TO THE STUDY

Inherently, education is in a pervasive state of reform, and thus, change is the status quo (Kessinger, 2011; Kotter, 2012). Multiple failed change initiatives result in ineffective organizational learning, leading to reduced capacity of stressed educators (Fullan, 1993, 2001; Harris, 2011; Ingersoll, Merrill, & May, 2014; Kessinger, 2011; McCormick & Barnett, 2011; Richards, 2012; Sass, Seal, & Martin, 2011; Tamir, 2011) in the form of educator turnover, attrition, and migration (Carroll, 2007; Carroll & Foster, 2010; Ingersoll, 2001, 2003; Ingersoll & Merrill, 2010; Ingersoll, Merrill, & Stuckey, 2014; Perda, 2013). Other issues also result, such as absenteeism, burnout, and illness (Elder, Nidich, Moriarty, & Nidich, 2014; McCormick & Barnett, 2011); and possible reinforcement of old patterns, such as preserving the social order and maintaining historical inequities (Fusarelli & Young, 2011; Laguardia & Pearl, 2009; Tamir, 2011). Therefore, the ability to navigate change is a necessary skill for leaders to cultivate (Lindahl, 2010; Pierce, 2006; Reed & Kensler, 2010).

Heifetz (1994) declared that, when change replaces routine, leadership is necessary in times of novel problems. The task of reinventing schools to meet new expectations constitutes what Heifetz (1994) called an “adaptive problem” (p. 94) and “a fuller investigation of the resources of authority is essential” (p. 100), for “a person intent on leading must know the tools at her disposal” (p. 100). School leaders must adapt to
utilizing a plethora of change strategies. In the face of an unstable context of change, Konczak and Molloy (2010) highlighted the necessity of a new leadership development model. According to Lovett (2001), neuroscience could drive educational leadership reform, with leaders using neuroscientific findings to assist in management of the stress of pervasive change environments and to withstand a sustained climate of change in work environments (Ghadiri, Habermacher, & Peters, 2012; Hogan, 2010; Waldman, Balthazard, & Peterson, 2011; Zohar, 1997).

Background of the Study

Reform efforts in public education are an enduring characteristic of the history of public education (Kessinger, 2011). According to Kessinger (2011), seven major reform efforts took place in United States public schools in the last five decades: the National Defense Education Act of 1958, Elementary and Secondary Education Act of 1965, the National Assessment of Educational Progress, A Nation at Risk, America 2000, Goals 2000, and the Elementary and Secondary Education Act of 2001. For as long as public schools have existed, reform efforts have persisted in an effort to change and improve public schools in ever increasing areas such as science (Yager, Ali, & Hacieminoglu, 2010), technology, social responsibility, immigration, diversity, and curriculum in order to produce more effective student citizens capable of competing globally (Banks et al., 2007; Kessinger, 2011). National criticism of public schools in the form of the Cardinal Principles of Secondary Education report of 1918, the 1983 publication of Nation at Risk, and the No Child Left Behind Act of 2001 essentially highlighted the inefficiency of the public schools and raised the levels of resistance (Morrison, 2010). The above reform
efforts are critical to our nation's assessment of America’s position to compete internationally, yet the criticism, framed in response to the fear or threat of the United States losing its edge of global supremacy, results in schools bearing the responsibility of the nation's social, technological, and economic shortcomings (Morrison, 2010). The onslaught of strong emotional reactions to the criticism does little to promote a rational response to the necessary reform.

Despite criticism and resistance, the evolution of public school reformation persists (Kessinger, 2011; Tell, 2009). American public schools continue to educate more students than ever before, yet people’s perceptions of public school systems continue to change radically and negatively (Christensen, 2008). Christensen (2008) contended that the reason for the decline of public approval is essentially due to constant changes in the aim of education. No longer is it the goal of schools to merely graduate students from high school—now the goal is for students to attain college and/or career readiness so that they can contribute to the United States’ globalized economy (Kern, 2011).

Another criticism is the lack of rigor in the P-16 school systems (Darling-Hammond, 2009; Vogel, 2009). As criticism of student achievement in United States public schools continues to increase (Laguardia & Pearl, 2009; Lovett, 2001), leaders at all points along the political spectrum call for action to rigorously prepare students to assist the United States in becoming more globally competitive (Banks et al., 2007; Darling-Hammond, 2009; Hickok, 2006). Researchers argue that a seamless transition from school to college should exist and encourage schools and college leaders to work
together in new ways because diplomas and degrees are not worth as much as in the past (Kirst, 2008; Langenberg, 1997; Schmidt, 2006).

One response to these criticisms, The No Child Left Behind Act of 2001 (NCLB), placed pressure on states’ finances, as well as their achievement status, and caused even greater criticism of United States public schools (Christensen, 2008; Dee & Jacob, 2010) and increased teacher stress (Richards, 2012). Many believe that building teacher capacity and retaining excellent teachers are the answer to student achievement (Charner-Laird, 2006; Darling-Hammond, 2009). At the height of NCLB, more teachers became increasingly educated as they attempted to become even more highly qualified, yet the student achievement results did not increase respectively (Dee & Jacob, 2010).

NCLB united political party members into thinking that perhaps a nationalized standard movement would help increase student achievement (Kern, 2011). States are rank ordered and frequently compared to other states; however, the comparison criteria are not equal because states have traditionally set their own achievement criteria (Bomer & Maloch, 2011; Kern, 2011). This dilemma led to the conversational and practical shift to nationalized standards, or Common Core State Standards, which began several decades ago with the presidential administrations of George H. W. Bush, Bill Clinton, and then George W. Bush (Kern, 2011). Common Core Standards represent the solutions devised by state leaders to address discrepancy among the states and increase student achievement, which come at the expense of teacher accountability (Kern, 2011).

To meet the challenge of preparing more children for college or careers, the Obama administration introduced several reforms for states (U.S. Department of
Education [USDOE], 2011). The Race to the Top initiative provides financial incentives to states (USDOE, 2011). Forty-three states now have flexibility from No Child Left Behind criteria. In exchange for this flexibility, these states have agreed to raise standards, improve accountability, and undertake essential reforms to improve teacher effectiveness (USDOE, 2015).

As national reform continues, and reform efforts filter down to state and local education agencies, improved accountability measures are mandated (USDOE, 2015). The increase in accountability addresses increased assessment measures, a more rigorous curriculum, updated evaluation systems, increased graduation requirements, and teacher burnout (McCormick & Barnett, 2011). Morrison (2010) reported that educators perceive the mandated accountability as time taken away from teaching, doing little to improve the achievement gap. Furthermore, educators take public criticism personally (Morrison, 2010).

Because educators may not recognize or value the differences of the reform goals when the reasons for public education remain the same basically, they resist multiple attempts at public education reform, i.e., standards movement and remediation (Kessinger, 2011). In the instance of leadership, Elmore (2010) asserted that leaders do not have the requisite experience in successful reform for them to succeed at reform and incidentally “reinforce the pathologies of the existing structure” (p. 36.). Rogan, Stäubli, and LeDoux (1997) suggested that repeated experiences of change or fear evoke an adverse association, subsequently hardwired in the amygdala. Multiple studies indicate fear is triggered as the brain is conditioned to respond to change as a threat (Bremner,
2005; Caine & Caine, 2006; Calabrese & Roberts, 2002; Gantt & Agazarian, 2010; Herry, Cioci, & Senn, 2008; Lafferty & Alford, 2010; Perry, 2006; Rock & Schwartz, 2007; Steadman, 2011). A paradox is that repeated change implies repeated failures, resulting in resistance to change, or, at the very least, skepticism of the feasibility of multiple changes (Mason, 2008). Habits of resisting change can then become entrenched in the neurons of the brain (Duhigg, 2012). Veteran educators who have experienced multiple changes have developed neuronal pathways of resistance due to fear and perceived threat.

Educational contexts could elicit ideas used in emergency response fields as to how to incorporate findings from neuroscience to be more proactive in supporting change. Professionals in medical, military, and emergency response fields consistently utilize findings from neuroscience in brain repair practices and therapies to diagnose and treat trauma, illness, injury, stress, and fear in adult learners (Bremner, 2005; LeDoux, 1996; Ross, 2006; Taylor, 2006; Zull, 2006). Examples include nutritional neurochemistry (Hanson, 2009), group therapy (Gantt & Agazarian, 2010; Steadman, 2011), psychotherapy (Cozolino & Sprokay, 2006; Ross, 2006), and coaching (Rock & Page, 2009; Sciarappa & Mason, 2014). In education, school psychologists use findings from cognitive and behavioral sciences to analyze learning processes to diagnose and identify learning problems through quantitative measures, but they are reactive rather than taking a more proactive approach.
Statement of the Problem

Educator stress and its negative byproducts, such as employee turnover and burnout (Ingersoll, 2001, 2003; McCormick & Barnett, 2011), are widespread problems that affect how educators attempt to adapt to the constant changes generated through educational reform efforts. Findings in neuroscience about the brain registering change as threat (Bremner, 2005; Caine & Caine, 2006; Calabrese & Roberts, 2002; Ganttt & Agazarian, 2010; Herry et al., 2008; Lafferty & Alford, 2010; Perry, 2006; Rock & Page, 2009; Rock & Schwartz, 2007; Steadman, 2011) may explain the numerous, inappropriate responses to organizational change (Perry, 2006; Sass et al., 2011). These responses include stress, pessimism, negative associations, problem-solving difficulty, irrational thinking, generalizing, anxiety, and fear (Goleman, 1995; Perry, 2006; Rock, 2009; Rock & Page, 2009). As educators attempt to respond to the pace of changes, and chronically stressed educators continue to respond inappropriately to the persistent state of change in public education (McCormick & Barnett, 2011; Richards, 2012; Sass et al., 2011), neuronal pathways of resistance are strengthened, and resistance to change becomes habit (Duhigg, 2012; Squire, 2009).

Status of the Problem

Educator turnover/attrition, employee absenteeism, and illness are negative byproducts of educator stress. A National Commission on Teaching and America’s Future reported that 7.2 billion dollars per year are expended on teacher attrition, which occurs due to over 44% of new teachers leaving the profession within five years and an estimated 50% of veteran teachers on the verge of retirement (Carroll & Foster, 2010;
Ingersoll et al., 2014; Perda, 2013). This dilemma subsequently causes the “teaching career pipeline to collapse at both ends” (Carroll & Foster, 2010, p. 4). The National Center for Education Statistics (2011) reported teachers and principals leaving the profession in public schools at the rates of 8% and 12% respectively. Seven percent of teachers moved to other schools, and 6% of principals migrated to other schools (NCES, 2011). The School Leaders Network (2014) reported 50% of principals leave the profession before completing their fourth year. Furthermore, increased administrator turnover results in the inability of principals and superintendents to maintain sustainability in a change or see the change to fruition (Strickland-Cohen, McIntosh, & Horner, 2014), as well as increases in teacher turnover, negative effects on student achievement, and resistance to change (Johnson, 2015; Miller, 2013).

In addition to increases in retirement and student enrollment, Ingersoll (2003) found other reasons for the educator shortage, ranging from salaries to personal reasons, which contribute to stress. The teaching shortage problem is also an experience problem (Ingersoll, 2003), causing an instability problem among faculties, especially for hard-to-staff schools (Ingersoll & Merrill, 2010). Instability in the work forces causes job dissatisfaction in the form of stress and burnout, which in turn affects employee performance (Elder et al., 2014). Gantt and Agazarian (2010) contended that this chronic instability and stress, or chronic change, causes neural changes.

Gantt and Agazarian (2010) generated models that describe integrated neural networks, such as the fear system found in a network of neurons in the amygdala, the part of the brain associated with fear. The introduction of change is the juxtaposition from
what an individual expects and what actually occurs (Lafferty & Alford, 2010). This perception of change triggers the orbital frontal cortex, located near the neuronal network in the amygdala related to fear, subsequently triggering a fear response (Bremner, 2005; Caine & Caine, 2006; Gantt & Agazarian, 2010; Herry et al., 2008; Lafferty & Alford, 2010; Perry, 2006). When the amygdala causes metabolic shifts from the prefrontal cortex, which is responsible for cognitive abilities, there is a decrease in executive function (Caine & Caine, 2006; Lafferty & Alford, 2010). Therefore, any trigger of survival mode could result in individuals reacting with fear and reduced understanding (Caine & Caine, 2006; Lafferty & Alford, 2010; Perry, 2006). Figure 1 illustrates the brain’s response to stress.

Emotionally charged and typical responses to the fear or threat of change result in physiological or cognitive changes (Goleman, 2011; Hinton, Miyamoto, & Della-Chiesa, 2008; Saunders, 1999). These changes include survival response (Caine & Caine, 2006); learned helplessness (Peterson, Maier, & Seligman, 1996); fight-or-flight (Perry, 2006); momentary autism (Gladwell, 2005); falling back on old habits (Duhigg, 2012); chronic stress (Richards, 2012); and negative thinking, pessimism, refusal, or inattention (Lafferty & Alford, 2010). Because research estimates that over 70% of all organizational change initiatives fail (Fullan, 1993; Kotter, 1996, 2012; McKinsey Quarterly, 2008; Senge et al., 2000), managing the inevitable decline during the change process is imperative (Kotter, 1996, 2012). In order to facilitate large-scale change, educational leaders need to use strategies that will disengage the fear response and maintain the executive function of the prefrontal cortex (Caine & Caine, 2006; Lafferty & Alford, 2010), thereby limiting the resultant decline and achieving more rapid reform.

Various strategies from neuroscience research that support the brain’s ability to cope with stress are evident by the brain’s recovery from stroke and injury (Bremner, 2005; LeDoux, 1996; Ross, 2006; Snyder, Soumier, Brewer, Pickel, & Cameron, 2011; Taylor, 2006; Zull, 2006). The brain’s quality of plasticity allows it to adapt to new situations (Cozolino & Sprokay, 2006). Evidence supports that mindfulness and meditation develop neural connections (Begley, 2007; Gantt & Agazarian, 2010; Hanson, 2009; Harung, Travis, Blank, & Heaton, 2009; Kezar & Carducci, 2007; Schwartz & Begley, 2002; Shelton & Darling, 2001), which in turn reduce stress (Snyder et al., 2011; Cozolino & Sprokay, 2006). Voluntary exercise or physical activity supports neural
development (neurogenesis) marked by the absence of stress (Begley, 2007; Ratey, 2008; Rock, 2009). Humor and laughter, play, and empathy also have connections to reducing stress and priming the brain for neurogenesis and neuroplasticity (Hanson, 2009; Pink, 2005; Rock, 2009).

Developing skills within one’s emotional intelligence (Cozolino, 2006; Goleman, 2011) and emotion regulation (Cozolino, 2006; Gross, 1998), such as situation selection, situation modification, attention deployment, cognitive change, and response modulation (Gross, 1998; Rock & Page, 2009), supports stress reduction. Evidence of stress decline occurs with the use of collaboration and coaching (Rock & Page, 2009), as well as new habit development (Duhigg, 2012; Rock, 2006). However, given the bureaucratic and time constraints of public education, the researcher explored the emotional, social, behavioral, or physical strategies that neuroscientific researchers suggested would be most effective.

Purpose of the Study

The purpose of this study was to identify the specific strategies or skills supported by neuroscience research that public education leaders could use to introduce and facilitate change in a manner that could significantly increase cognition and reduce the emotional impact of the brain’s automatic stress/fear/threat response to change and educational reform. While a growing body of literature supports the use of neuroscientific strategies in successful brain repair practices (Gantt & Agazarian, 2010; Perry, 2006; Ross, 2006; Sheckley & Bell, 2006; Steadman, 2011), little research has explored the use of these practices in the field of educational leadership. Therefore, this
study draws upon the established research of other fields that use stress inoculation strategies to mitigate how the brain responds to fear and threat as a response to change.

Research Question

The research question that guided this study was as follows: Which neuroscientific strategies do neuroscientific researchers suggest educational leaders use in public schools to manage the stress of persistent change environments that would most effectively allow the brain’s executive function capacity to stay engaged in a sustained climate of change?

Theoretical Framework

Argyris (1977) acknowledged the value of creativity and ingenuity in discovering solutions to problems. Organic institutions take advantage of double-loop learning in that they are constantly exploring new ways to improve their system (Argyris, 1977). For a learning organization, “adaptive learning must be joined by generative learning, learning that enhances our capacity to create” (Senge, 1990, p. 14). Members of an institution who survive in pervasive change environments understand that cognition and emotion are interlinked and play an important role in innovation. “Fundamental shifts in how people think and interact, as well as how they explore new ideas” (Senge et al., 2000, p. 20) are at the heart of a learning organization. Since change environments are the status quo in public education, a leader’s experience with understanding the variety of personal and organizational adaptive response to change is imperative when increasing capacity and facilitating change (Kessinger, 2011; Kotter, 2012).
In order to understand how people respond to change, this study utilized Fisher’s Process of Transition, a change management model initially developed by John M. Fisher in 1999 and later revised in 2012 (Fisher, 2012). Basing his theory on Elisabeth Kubler-Ross’s earlier studies of grief, Fisher identified, described, and diagramed several various negative personal reactions, such as anxiety, fear, threat, denial, guilt, depression, disillusionment, hostility, and anger, as well as positive personal reactions, such as happiness, gradual acceptance, complacency, and moving forward. As illustrated in the diagram displayed as Figure 2, an individual may experience several alternative stages, and the time in the transition differs for individuals based on the variety of prior experiences (Fisher, 2005). Fisher (2012) noted that each individual endures this transitional process in a personal way, and knowing how individuals respond can provide organizations strategies to bring about the change and assist them in the transition.

Fisher’s Process of Transition Theory, also known as Fisher’s Personal Transition Curve, is a theory that recognizes how organizational change influences the emotions of individuals. Fisher (2005) asserted that a change leader must recognize individuals, relationships with others, and the dynamic of time during the change process. A leader should acknowledge the emotional capacity of the individuals, group, and organization, and take steps to strengthen the emotional capacity of the organization by purposefully acknowledging the varied emotional responses to change.

The personal transition curve, as depicted in Figure 2, illustrates how an individual responds with a range of emotions dependent on personal experience and feelings concerning his or her professional and personal lives. An individual can react
negatively, positively, with complacency, or somewhere in between. An individual's journey through the curve is unique, for the time spent in each emotion is different for each individual. A leader should support an individual through the various stages of the curve.

![The Process of Transition](image)


Fisher's Process of Transition also considers the cumulative group dynamics inherent in a change process. The interaction of the individuals’ experiences creates the group dynamic. A group dynamic can move the group toward a positive, negative, or a
neutral response. Therefore, a leader plays an important role in encouraging safe passage through the curve to the other side.

Fisher (2005) also considered the dynamic of time on the interactive emotions of the team involved in change environments. Fisher (2005) believed that the time aspect of change refers to both the acknowledgement of the past, present, and future to the change process, as well as the interval range of emotional responses by the individuals and groups and the time spent in the emotional stage. A leader should acknowledge the amount of change experienced by organizational personnel, the success or failure of the changes, and the time management of the proposed change. The cyclical pattern of emotional responses and their evolving influence over interpersonal relationships impact the success of the change initiatives.

Fisher’s (2005) theory allows for controlling the contagion of stress that is associated with not recognizing the normal emotional responses to change. With acknowledging time, personal, professional, and interpersonal dynamics generated by change, a leader is poised to assist the team with personal and organizational adjustments. A leader can assist the team to think and interact as Senge et al. (2000) promoted when exploring new ideas in the form of change.

Conceptual Framework

This research study explored the intersection of the three areas of neuroscientific strategies, leadership, and education reform initiatives and whether or not the three ideas working in concert could produce transformational change in the public schools. A
synergy exists at the intersection of all three that two of the areas alone do not produce.

*Figure 3* shows the conceptual framework.

![Conceptual Framework Diagram](image)

*Figure 3*. Conceptual framework of the study. Depicted is the unique synergy, resulting as a concerted intersection between neuroscientific strategies, leadership, and education reform, that has the potential to transform change in public schools.

NeuroLeadership, a relatively new theory developed by Rock (2006) to define leadership, merges neuroscientific knowledge with leadership, management, organization education, and development (Rock & Schwartz, 2007). Based on findings from the field of neuroscience, the theory consists of four key domains that include the leader’s ability to solve problems and make decisions, regulate emotions, collaborate, and facilitate change (Rock, 2006). Gordon (2008) asserted that, as it is a new theory, it requires
validation, but it has great promise in its application in the climate of change in education.

Kussrow (2001) maintained that the proliferation of change initiatives magnifies the need for leaders to approach learners in the way they learn neurologically; therefore, a brain-based leadership style is necessary. Kussrow (2001), a process engineer in the restructuring of schools, articulated that neuroscientists’ knowledge of how the brain learns best has direct application to leadership practices at all levels. A transformative leader empowers collaborative efforts in all areas of operation, realizes that it is people who make an organization successful, and gives those people credit for doing the required work to create an effective organization (Collins, 2001; Greenleaf, Spears, & Covey, 2002; Hallinger & Heck, 2010). Leading second-order change (Bass & Avolio, 1990) and transforming performance in educational institutions could be enhanced by knowledge of neuroscience and how the brain chemistry reacts to reform efforts (Goleman, 2011; Goswami, 2008; Heath & Heath, 2010; Medina, 2008; Pillay, 2011; Rock, 2009, 2010; Rock & Page, 2009; Rock & Schwartz, 2007). A brain-based leadership style necessitates an environment characterized by safety, choice, social bonding, stimulation, feedback, and practice (Kussrow, 2001).

A leader who can influence the learning environment to maximize positive outcomes by reducing stress is a leader who may exponentially increase the neuronal growth at the cellular level of the brain, otherwise known as neurogenesis, causing learning to happen and behaviors to change (Kussrow, 2001; Hinton et al., 2008; Madrazo & Motz, 2005; Ross, 2007). Most importantly, Kussrow (2001) noted that,
given the right environment, a brain can physically reorganize itself via its biological capability of neuroplasticity. Using current brain research, Rock and Schwartz (2007) suggested an alternative transformational style rather than humanistic and behavioral approaches to organizational change, which supports Kussrow’s (2001) suggestion that Skinner’s behaviorist approach is drastically outdated and Burns and Stalker’s (1961, 2001) recommendation that a more organic innovative approach to organization is more timely.

For decades, many researchers supported the idea that learners have brain hemisphere dominance in one side or the other and, based on hemisphere dominance, gravitate towards certain professions (Frohlich & Stanko, 2002). Frohlich and Stanko (2002) suggested that an individual can participate in exercises that strengthen both sides of the brain and physically change the brain. Research suggests that organizational leaders who understand neuroscience and the physiology of the brain can use the knowledge to lead in a way that transforms organizations with mindful change (Rock & Schwartz, 2007; Williams, 2010b). Human brains register change as a threat, and the tendency to hold onto old habits for as long as possible creates a resistance that impedes learning (Calabrese & Roberts, 2002; Duhigg, 2012; Lafferty & Alford, 2010; Rock & Schwartz, 2007). An important aspect of brain-based change in the new field of NeuroLeadership is accessing the learner’s emotional capacity as well as interests to maximize learning and create a safe environment (Rock & Schwartz, 2007). The result is the learner feels proud of his/her learning (Madrazo & Motz, 2005) and much more receptive to change (Duhigg, 2012; Rock, 2006).
This inquiry of neuroscientific researchers regarding neuroscientific strategies that leaders can utilize with their faculty and staff to create a welcomed climate of change required a synthesis of theories and concepts. The conceptual framework of NeuroLeadership Theory was integrated with the (a) concepts of neuroplasticity and neurogenesis; (b) emotional intelligence (Goleman, 2011); (c) neuronal practices such as meditation and focused attention (e.g., Gantt & Agazarian, 2010; Harung & Travis, 2012; Harung et al., 2009; Schrag, 2011); (d) stress inoculation strategies (Gladwell, 2005; Meichenbaum, 1985); and (e) habits of change (Duhigg, 2012; Rock, 2006).

**Significance of the Study**

In persistent change environments, as in public education, novel ideas take place at the intersection of art and science (Isaacson, 2011; Kiefer, 2010). If direction for a change environment can be more scientific and more precise, leaders may be able to be more specific and purposeful about changing the patterns of resistance of educators (Rogan et al., 1997). Making the habits of stress inoculation could become a regular daily practice in change environments.

The suggestions provided by neuroscientific research experts could provide educational leaders with a toolbox of neurocognitive strategies that experts agree would reduce chronic stress and threat related to educational reform, facilitate the adoption of change initiatives, and create safe climates of change. Additionally, there could be healthier educators who do not endure consistent stress, work in fear, or experience reduced cognition. Furthermore, costs associated with the negative byproducts of stress, such as the training and support of new teachers and medical costs associated with
chronic stress and teacher turnover and attrition, would be obviated (Carroll, 2007; Ingersoll, 2001, 2003; Ingersoll et al., 2014; Sass et al., 2011).

The field of neuroscience has exploded in the last two decades in the form of increased research funding, the number of neuroscientists, and the proliferation of collaborative and cautionary efforts within education and management (Ansari, Coch, & DeSmedt, 2011; Ashkanasy, Becker, & Waldman, 2014; Goswami, 2008; Healey & Hodgkinson, 2014; Hruby, 2012; Lindebaum & Zundel, 2013). The Society for Neuroscience (2015) recognizes 40,000 members, scientists who promote the study of the brain and nervous system, and publishes a leading peer-reviewed neuroscience journal. Several leading universities, such as Columbia, Harvard, John Hopkins, MIT, and Stanford, have developed integrative programs between education and neuroscience. Leading seminal discoveries in neuroscience, the educational institutions are home to some of the top neuroscience labs in the United States. The Neuroscience and Education Program of the Teachers College of Columbia University (2015) boasted of being the first graduate program in the United States. Stanford’s Bruce McCandliss suggested that Stanford Neurosciences Institute is a great collaboration for the Graduate School of Education to “train the next generation of leaders in educational neuroscience” (McCandliss as cited in Adams, 2014, p. 1). In 2013, The White House (2014) collaborated with educational institutions and announced the Brain Initiative to promote brain research in critical areas. Clearly, there is an emerging trend for the collaboration between neuroscience and education. This presence of the field of neuroeducation requires empirical validation for it to be a viable partnership.
Procedures

In order to identify specific strategies that are appropriate within public schools and assist educators in coping with the brain’s fear response to threat, the researcher employed a research methodology of Delphi to resolve the question addressed by the study. The Delphi method is a communication process whereby experts contribute their opinions regarding an issue, and the researcher aggregates data from the group communication to achieve consensus on the issue (Hsu & Sanford, 2007). To secure expert advice from neuroscientific researchers, the researcher identified experts from the Dana Alliance for Brain Initiatives (DABI) by utilizing a membership list of DABI. Then, in Round 1, the researcher sought open-ended responses to questions from the participants to ascertain the strategies that public education leaders could use to reduce the impact of the fear response resulting from the threat of change inherent in a climate of reform. Following Round 1, the researcher eliminated any repetitions and consolidated the responses into a tool using the open-ended responses from Round 1. In Round 2, using a 5-point Likert type rating scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree), the researcher requested the participants to rate their agreement or disagreement of whether the proposed strategies would disengage the fear response and facilitate cognition in a pervasive change environment. Statistical data analysis of the results using mean and standard deviation focused on those strategies rated with an average of 4 or better that demonstrated agreement on the part of the experts. In preparation for Round 3, the researcher rank ordered those strategies by starting with those strategies with the mean of 5 and ending with those with an average of
4, which demonstrates an agreement of 80% or stronger. If there was a tie with the mean of two strategies, the strategy with the lower standard deviation was used to break the tie, demonstrating less variability and higher consensus for that strategy. The researcher then sent the list of proposed strategies in rank order, along with the mean and standard deviation, to the experts to request agreement or dissension of the results. In Round 3, experts could choose to agree or disagree to the elimination or inclusion of a strategy and report the reason for doing so. After considering responses in Round 3, the researcher shared the results with the panel of experts as a list of identified, sustainable strategies suggested by neuroscientific researchers that educational leaders could use to transform education and allow educators to stay engaged in a sustained climate of change.

Limitations and Delimitations

The scope of this study contained elements beyond the researcher’s control. The researcher realized there might be some difficulty in identifying experts who were aware of the various neurocognitive strategies for reducing fear or stress inoculation techniques, but by choosing an organization of identified leaders and experts in the field of neuroscience, the researcher narrowed this challenge. The researcher made assumptions that neuroscientific researchers from DABI who were familiar with neuroscience would be able to identify the use of stress inoculation techniques to influence reduction in fear response to change and offer suggestions for public education leaders. There was also an assumption that participants would answer honestly and generously when responding to open-ended questions in Round 1, as the researcher would preserve anonymity and confidentiality to avoid groupthink or undue influence from other fellow experts of
DABI. While the population DABI is not anonymous, the participant sample was anonymous. Participants were volunteers who could withdraw from the study at any time and with no consequences. In addition, the body of research exercising caution when integrating neuroscience and education (Hruby, 2012; Varma, McCandliss, & Schwartz, 2008) possibly influenced the responses of the participants; however, the researcher encouraged experts to respond using their scholarship, experience, and research knowledge.

Delimitations are the boundaries the researcher sets for a study. In this study, the researcher chose participants who were neuroscientific researchers identified from DABI, who by their membership promoted brain research and comprehensive dissemination of brain research. The researcher chose this organization precisely because of its expert knowledge in the area of neuroscience and its recognized leadership in the field of neuroscience. The researcher specifically narrowed the options in identifying neuroscientific reasons for the contribution of chronic stress as a characteristic of resistance to change. The researcher did not choose to explore an inclusive view of other reasons for resistance to change as it is beyond the scope of the study.

Definitions of Terms

It is necessary to define several terms to aid in understanding the research. For consistency of interpretation, the following terms are defined:

*NeuroLeadership*, a term coined by author David Rock, is a new field of study that merges neuroscientific knowledge with leadership, management, organization education, and development (Rock, 2006, 2010; Tavis, 2010).
*Neurocognitive*, a term related to the field of cognitive neuroscience, determines how the functions of the brain’s nervous system and mental abilities are related (Purves et al., 2008).

*Neuroscience* is the field of study related to the scientific study of “how the nervous system of humans and other animals develop, how they are organized, and how they function to generate behavior” (Purves et al., 2008, p. 1).

*Stress inoculation* is a strategy that can help provide an individual with cognitive and attitudinal skills one can use to cope with stress (Meichenbaum, 1985).

**Summary**

This chapter identified the problem of educators responding inappropriately to pervasive reform efforts in public education and the possible neurological reasons for so doing. The background and history of the problem demonstrated the barrage of mandated reform efforts and criticism that have plagued public education, as well as the negative byproducts of the rate of failed initiatives. Despite decades of reform efforts and a plethora of change efforts, educator stress continues to reveal itself regardless of the interventions introduced to increase student achievement outcomes or bypass educator attrition, turnover, burnout, and illness. The chapter described the research demonstrating the neuroscientific reasons for resistance to change and its contributions to cognitive reduction and stress, as well as the potential impact of neuroscience to promote change. The status of the problem denotes the importance of acknowledging the advances in neuroscience that could assist educational leaders with the use of a
neuroscientific-supported framework in proactively reducing the impact of the inappropriate reactions that hinder change environments.

The theoretical and conceptual framework of this study expedited the identification of strategies for leaders to promote to help educators embrace change. Fisher’s Process of Transition Theory outlines the emotional adaptations one experiences when transitioning through change and the benefits for leadership in understanding the emotional responses to change for an individual or a group. The conceptual framework depicts the potential that the juxtaposition of leadership, neuroscientific strategies, and education reform initiatives could have for real change. Recent neuroscientific research highlights the benefits of applying neuroscientific findings in educational reform. Evidence also suggests an emerging trend between neuroscience and education that could benefit educational leadership. This chapter also included a discussion of limitations, delimitations, and the use of successive rounds in the form of the Delphi method to ascertain a consensus from expert neuroscientists of DABI in identifying specific neuroscientific strategies educational leaders could use in public schools to manage the stress of persistent change environments. Neuroscientific experts are poised to anticipate future advancements in neuroscience that could enhance educational change, and the results from a Delphi method have the potential to help educational leaders make appropriate plans for the future. Chapter 1 concluded with definitions of terms that are essential to the discussion. Chapter 2 provides a review of theoretical frameworks and related literature pertinent to this study.
CHAPTER 2

REVIEW OF RELATED LITERATURE

The purpose of this study was to identify neurocognitive strategies that experts in neuroscience agree could obviate or alleviate the stress triggered by the fear response related to change that has habitually hindered change environments. The research question was as follows: Which neuroscientific strategies do neuroscientific researchers suggest educational leaders use in public schools to manage the stress of persistent change environments that would most effectively allow the brain’s executive function capacity to stay engaged or in a sustained climate of change?

This chapter reviews literature addressing research and theory related to the brain, including its defining characteristics, structures, technological tools for brain imaging techniques, functions of the brain, unique features such as neuroplasticity and neurogenesis, and the needs of the brain. Following this are descriptions of the characteristics of brain-supported leadership, including theories related to neuroleadership, habits, emotional intelligence, emotion regulation, social intelligence, and neuroscientific strategies. Next is an examination of research related to stress and brain responses to stress. Additionally, this chapter provides a review of research-supported, stress inoculation strategies and career fields that have traditionally used neurocognitive strategies to reduce stress and optimize brain function. The chapter ends with a summary analysis of prominent themes and findings within the reviewed literature.
Neuroscience and the Brain

The brain is the organ that controls thinking, feeling, and the survival response. It weighs about three pounds, and it predominantly consists of water, protein, and fat (Diamond & Hopson, 1998). Physically occupying 2% of an adult body and using 20% of a person's energy to function (D’Arcangelo, 1998), the brain is estimated to have approximately one hundred billion neurons (Begley, 2007; Diamond & Hopson, 1998; Ghadiri, Habermacher, & Peters, 2012) with over 100 trillion connections made uniquely in each individual (Begley, 2007; Sousa, 2006). Neurons, dendrites, and synapses that create neuronal pathways make up the unique cortical mapping for each individual. Developed with experiences of enrichment, these neuronal pathways are pruned when not in use (Begley, 2007).

Brain Structures

The brain has three main parts: the cerebrum, cerebellum, and brain stem. The cerebrum consists of two hemispheres containing four lobes known as the frontal, parietal, temporal, and occipital lobes. Each lobe is responsible for several distinctive functions as well as overlapping in other functional areas (D’Arcangelo, 1998). The frontal lobe's function is to predict results of actions. The parietal lobe's function pertains to sensory integration and in understanding the sense of touch. The temporal lobe function is relative to the hippocampus and amygdala in regards to their role in long-term memory. The occipital lobe contains the visual cortex (D’Arcangelo, 1998).

Neurons and neuronal pathways are located in the cerebral cortex, which covers the four lobes. The cerebellum is responsible for the body moving. The brain stem,
which contains the midbrain, pons, and the medulla, is responsible for the heartbeat and breathing.

Brain Imaging Technologies

Several tools aid neuroscientists in observing the structures and functions of the brain. Until the 1970s, brain study was limited to phrenology, electrical recording techniques, brain injury, and autopsy (Begley, 2007; Purves et al., 2008). The development of computerized tomography provided further knowledge of the brain. The following sections discuss the insights gained from current computerized tomography: (a) Magnetic Resonance Imaging (MRI), (b) Computerized Axial Tomography (CAT), (c) Electroencephalography (EEG), (d) Magnetoencephalography (MEG), (e) Positron Emission Tomography (PET), (f) Functional Magnetic Resonance Imaging (fMRI), (g) Functional Magnetic Resonance Spectroscopy (fMRS), and (h) Transcranial Magnetic Stimulation (TMS).

Magnetic Resonance Imaging (MRI). In the 1980s, a major advancement in brain imagery came in the form of an MRI that uses magnets instead of x-rays to take images with a computer (Purves et al., 2008). An MRI helps to diagnose structural issues (Sousa, 2006). It is the best tool to detect tumors and spinal cord injuries (Sousa, 2006).

Computerized Axial Tomography (CAT or CT). A CAT or CT scan emerged into the field in the 1970's and allowed in-depth examination of brain structure (Purves et al., 2008). A CAT scan can detect brain injury with bleeding, trauma, or tissue tears. It takes a series of x-ray pictures to make an image on the screen to aid in detection of injury or illness (Sousa, 2006).
Electroencephalography (EEG). As early as 1929, an EEG, a series of electrodes placed on the head to record electrical activity, has been used to measure human brain activity (Purves et al., 2008). EEGs make it possible to identify epilepsy or sleep disorders, and, at one time, stroke. CT and MRI technology replaced use of the EEG in some instances, such as stroke identification, although it is still in use (Purves et al., 2008).

Magnetoencephalography (MEG). Magnetoencephalography (MEG) is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents (Sousa, 2006). Magnetic detectors placed on the head detect the speed at which something occurs in the brain (Sousa, 2006). Researchers utilize MEG to identify action in the brain and discern how brain functions result in behavior (Rock & Page, 2009). For example, MEG can identify language processing (Sousa, 2006).

Positron Emission Tomography (PET). Developed in the 1980s, the PET was the first technology developed to detect brain function (Sousa, 2006). It employs a nuclear medical imaging technique to produce a three-dimensional image or picture of functional processes in the body (Sousa, 2006). One major finding using PET was the discovery that optimum levels of adrenalin help the prefrontal cortex, but high levels of adrenaline, like those diagnosed with posttraumatic stress disorder (PTSD), cause the brain to cease operation (Bremner, 2005). Physicians rarely order PET for healthy subjects because it involves the injection of potentially harmful radioactive fluid that subsequently circulates through the brain (Sousa, 2006).
Functional Magnetic Resonance Imaging (fMRI). Utilized since the 1990s, fMRI is a functional neuroimaging procedure using MRI technology to measure brain activity by detecting oxygen and associated changes in blood flow (Sousa, 2006). When an area of the brain is active, it needs more oxygen, glucose, and energy, and an fMRI can detect blood flow activity and the iron in the blood (Sousa, 2006). Because it does not use radiation, the fMRI is much safer than a PET (Sousa, 2006). The fMRI is an important research tool in neuroscience as it measures neural activity and allows researchers to gather various successive images of the same task (Purves et al., 2008). Many major function-specific discoveries have been identified using fMRI.

Functional Magnetic Resonance Spectroscopy (fMRS). In addition to blood flow detection with the MRI technology, fMRS safely measures the spectrum of chemical metabolism in the brain (Sousa, 2006). The results show peaks of brain metabolism. Instead of images, fMRS produces data related to oxygen or chemical levels in brain metabolism (Sousa, 2006).

Transcranial Magnetic Stimulation (TMS). Transcranial Magnetic Stimulation aids in brain cartography. TMS uses a magnetic coil to produce electrical currents to stimulate the brain (Begley, 2007). Subject responses to these currents allow mapping of the motor cortex to determine which parts of the brain control particular functions (Sousa, 2006).

Functions of the Brain

According to Begley (2007), the basis of neuroscience is discovering whether function is localized in the brain. Investigations of exceptions, such as injury, disease, or
exceptional talent, render evidence of the brain’s dynamism (Begley, 2007). These findings reinforce the concept of the brain as a very sophisticated organ. In addition, neuroscience explorations of the brain ascertained the brain hemispheres and structures are responsible for specific functions.

The right hemisphere of the brain analyzes nonverbal communication, communicates emotion, and focuses on visual-spatial and holistic processes (Hanson, 2009; Purves et al., 2008). The left hemisphere produces and understands language and focuses on linguistic and sequential processes (Hanson, 2009; Purves et al., 2008). The right and left hemispheres control the opposite sides of the body, and the corpus callosum, the nerve fibers that join the two hemispheres, serves as communication between the left and right side of the brain (Hanson, 2009; Purves et al., 2008).

Each of the four lobes, frontal, parietal, temporal, and occipital, are responsible for several functions as well as overlap in some functional areas (D'Arcangelo, 1998). The frontal lobe controls over a dozen activities that include attention, behavior, creative thought, some emotion, problem solving, and the sense of smell. The occipital lobe is involved in vision and reading activities. The parietal lobe overlaps with the occipital lobe with some vision and language functions, but also governs sense of touch and proprioception, or response to internal stimuli. The temporal lobe, known as the auditory lobe, is responsible for a small portion of language, speech, behavior, and emotions as well as the processing of music, fear, and sense of identity (Purves et al., 2008).

Other areas of the brain have specific functions also. The cerebellum, located at the back of the brain, is responsible for balance and posture as well as cardiac,
respiratory, and vasomotor centers, which are blood vessels and nerves. The brain stem maintains basic life functions such as respiratory, cardiac, and vasomotor centers. The limbic system, regions that include the amygdala, hippocampus, hypothalamus, and thalamus, controls hormonal and emotional responses (Purves et al., 2008). For the purpose of this research study, the prefrontal cortex (PFC), which is the gray matter layer of the frontal lobe, and the amygdala, which is a gray matter mass associated with emotion in each hemisphere, are key structures. Due to the sophistication of the brain, several functions play an important role in how the brain responds to change.

Unique features of the brain. The brain has unique features that support the promotion of change. Neurons, dendrites, and synapses develop neuronal pathways. A neuron is a cell that transmits and receives electrical signals in the nervous system (Purves et al., 2008), whereas a dendrite is a projection emerging from a neuron that receives a signal or input from another neuron (Begley, 2007; Purves et al., 2008). This occurs at a synapse, which is the connection between a neuron and its target neuron cell (Purves et al., 2008). The brain has the ability to create neuronal pathways based on experience that generates the synaptic density that exists in the brain. As new experiences evolve, so does the number of neuronal pathways. The 100 billion neurons receive input from 10,000 neurons each second (Begley, 2007) which, to put into perspective, has been described as similar to receiving 10,000 phone calls per second. The brain also engages in synaptic or neural pruning to remove unwanted synapses (Begley, 2007) as displayed in Figure 4.

The brain’s complex system of constant change of making neuronal pathways could be the answer to facilitating change in education. Two specific features, neurogenesis and neuroplasticity, could be exploited by innovative leaders to produce the desired change. It is quite remarkable that there is current scientific confirmation of neurogenesis and neuroplasticity to debunk the years of unsupported and incorrect impressions.

Neurogenesis. Purves et al. (2008) defined neurogenesis as the development of the nervous system and the proliferation of new neurons. For over a century, the standard belief was that a brain contained a fixed number of neurons at birth (Begley, 2007). Over
time, the neuroscientific study of rats, primates, and birds provided proof of neurogenesis in nonhumans (Altman, 1962; Begley, 2007). Human neurogenesis was controversial at one time among neuroscientists, with some being quite oppositional to Altman's discovery of it in 1962 (Rakic, 1974, 1985). Results from current mammalian and human studies confirm adult neurogenesis in humans (Bedard & Parent, 2004; Curtis et al., 2007; Eriksson et al., 1998; Gould, 2007; Gould & Gross, 2002; Jin et al., 2006; Opendak & Gould, 2011; 2015). New neurons develop over time due to experience and practice (Opendak & Gould, 2011; 2015; Ross, 2007), and the new neurons reduce stress (Opendak & Gould, 2011; Snyder, Soumier, Brewer, Pickel, & Cameron, 2011). Much of the current research related to neurogenesis is related to memory and learning (Opendak & Gould, 2011, 2015). Eadie, Olson, and Christie (2004) found that with voluntary exercise, there is neurogenesis in human brains. There are indications that it is possible for a leader to craft a rich working environment that will increase neurogenesis and its resulting neuronal pathways to assist changes in attitudes, behaviors, and practices (Hinton, Miyamoto, & Della-Chiesa, 2008; Kussrow, 2001; Madrazo & Motz, 2005; Ross, 2007).

Neuroplasticity. Neuroplasticity, which considers the plastic or malleable nature of the brain to reorganize itself based on experience, is one the characteristics of the brain surmised as early as 1890, but not supported by multiple neuroscientists until a century later in the 1990s (Begley, 2007). Through new experiences, both simple and complex, the brain changes its patterns of neural connectivity (Badenoch, 2008). For decades, scientists believed that neuroplasticity happened only in early childhood. It was around
the turn of the 21st century that multiple studies determined that there was a secondary
timeframe of neuroplasticity around the age of 10, and then even more profound was the
proof of adult neuroplasticity (Begley, 2007). Self-directed neuroplasticity is the concept
that one can use their mind to change their brain, suggesting there is great potential for
creating change (Rock & Schwartz, 2007).

Needs of the Brain

As part of its unique nature, the brain is considered a survival organ, but it needs
water, sleep, nutrition, exercise, and social interaction to optimally work (Medina, 2008).
Failure to meet these needs results in reduced cognition (Medina, 2008; Palmer et al.,
2014). Therefore, it is important for educational leaders to be aware of these needs in
order to support their faculty and staff.

Hydration. Proper hydration of the body assists the brain with its optimal
performance. Malfunction of the hypothalamus, the brain part that controls hunger and
thirst, may result in dehydration (Purves et al., 2008). Dehydration affects the brain
negatively for it results in poor concentration, fatigue, and reduced cognition (Rock &
Page, 2009). Even small amounts of water can improve coherent thinking (Armstrong et
al., 2012).

Sleep. The pons in the brain stem is related to sleep (Purves et al., 2008).
One function of sleep is to replenish blood glycogen (glucose and oxygen) levels (Purves
et al., 2008; Rock, Siegel, Poelmans, & Payne, 2012). Sleep deprivation is detrimental to
the brain and results in loss of processes such as executive function, memory, and logic
(Medina, 2008). Studies show that a short addition to one’s sleep patterns aids in
cognition and emotional control (Ibanez, San Martin, Dufey, Bacquet, & Lopez, 2008; Payne, 2011; Rock et al., 2012; Tassi et al., 2006).

Nutrition. Recent research points to the effect of gastrointestinal hormones on the brain and cognition (Gomez-Pinilla & Tyagi, 2013). Since the brain uses 20% of the body's energy, it follows that specific, nutrient-dense resources provide long-term metabolic use and mental wellness. Gomez-Pinilla and Tyagi (2013) found that dietary docosahexaenoic acid is an Omega-3 fatty acid that supports cognition, leading them to promote the use of nutrient-rich food to aid in energy metabolism and brain support.

Exercise. Exercise brings blood, glucose, and oxygen to the brain to stimulate the protein needed for making neuronal connections and improve the ability to think and solve problems (Medina, 2008). In addition, exercise reduces stress (Ratey, 2008) and increases neurogenesis (Eadie et al., 2004). Integrating exercise leads to reduced health care costs as well as decrease in medical issues (Medina, 2008).

Social interaction. Brains thrive or deteriorate based on the quality of social interaction. Through years of evolution, brain development reflects the importance of social groups (Hanson, 2009). Brains grow and develop through social interaction, dialogue, and reflection (Johnson, 2006). It is through social engagement that humans learn from others; experience exposure to new ideas, experiences, and information and engage in dialogue in order to understand one another and new information (Johnson, 2006). Promising research in the area of mirror neurons suggests that the simple act of observing another human’s actions can produce the same neural connections as when one actually participates (Rizzolatti, Sinigaglia, & Anderson, 2008). Research supports that
reflection creates synaptic and neuronal connections (Johnson, 2006). Zull (2006) and Straumanis (2012) assert that emotional stimulation and connection make the social interaction and learning that much more powerful.

Stress

There is good stress and bad stress, consequently motivating or impairing an individual (McEwen, 2007). Stress is a physiological or behavioral response in the form of an aversive response where there is a loss of control as seen from an observer (Kim & Diamond, 2002; McEwen, 2007; Medina, 2008). The amygdala is the part of the brain where stress response is triggered, and when stress triggers the amygdala, the prefrontal cortex reacts by reducing cognition. According to Bremner (2005), stress inhibits neurogenesis.

During stress, cortisol and adrenaline are released into the bloodstream. Prolonged periods of increased levels of cortisol and adrenaline manifest in unhealthy responses, such as anxiety, depression, sleep problems, memory impairment, and weight gain (McEwen, 2007). When an individual experiences chronic stress and significant amounts of cortisol is released, the surplus of cortisol can actually damage the hippocampus, resulting in reduced memory and learning ability (Bremner, 2005; Rock, 2009). Posttraumatic stress disorder (PTSD) is a diagnosis when there is an extreme reaction to chronic stress that actually causes structural and functional changes in the brain (Bremner, 2005). When there are long, persistent periods of higher levels of cortisol and adrenaline, the amygdala grows in size; conversely, the hippocampus and prefrontal cortex reduce in size (Davidson & McEwen, 2012).
The amygdala contains the fear circuit of the brain, and the prefrontal cortex is where cognition and executive function operate, so biologically fear and stress cause poor cognition or thought processes. Perry (2006) stated, “Fear destroys the capacity to learn” (p. 23). If memory and learning abilities diminish, then it is logical that stress would increase because of this volley. The resulting stress loop (Angier, 2009) is similar to the double-loop learning of reflection and feedback (Argyris, 1977; Blackman, Connelly, & Henderson, 2004) and the habit loop (Duigg, 2012; Squire, 1992). For example, in an environment of pervasive change that creates a climate of chronic stress, a cyclical response of stress that impairs learning and memory develops that in turn reduces capacity and creates more stress, thus beginning the cycle all over again (Sapolsky, 2004).

To desensitize people to stress so that they can think on their feet and help others, stress inoculation has been widely used in crisis response fields. Meichenbaum (1985) developed a behavioristic approach to stress inoculation as a tool to deal with stressful events as well as to learn to prevent future events. Gladwell (2005) reported how police officers receive training in stress inoculation to assist them in responding in an emergency. Gladwell (2005) described some of the behaviors and the cognitive decline during stress and the beneficial effect of repeated training in stress inoculation strategies, such as the type of training Gavin De Becker provides for security guards who protect high profile individuals. Steadman (2011) reported how combat leaders train soldiers to engage the enemy and immunize themselves against fear.
The military, law enforcement, firefighting, and healthcare professions utilize stress inoculation practices as a preventive strategy. Combat leaders and emergency response leaders conduct regular training exercises incorporating simulations to expose and desensitize workers to trauma (Steadman, 2011). If educational leaders can assist educators in responding appropriately to stress related to change, perhaps they can be more open to education’s intense reform efforts. A variety of treatments for stress exists, including group therapy, psychotherapy, coaching, and pharmaceutical options (Begley, 2007; Cozolino & Sprokay, 2006; Gantt & Agazarian, 2010; Rock & Page, 2009; Rock & Schwartz, 2007; Ross, 2006; Steadman, 2011).

Characteristics of Brain-Supported Leadership

The six characteristics of a brain-based leadership style are safety, choice, social bonding, stimulation, feedback, and practice (Kussrow, 2001). These six characteristics should be included when facilitating change in any environment (Kussrow, 2001). The following sections provide a description of each characteristic.

Safety

Kussrow (2001) emphasized the importance for leaders to develop an environment where employees feel safe expressing and contesting ideas and associating with others. Organizations such as NASA are developing leadership programs with opportunities for stretch assignments, designed to challenge comfort zones and promote a sense of safety and risk taking with employees (Williams, 2010a). Caine and Caine (1994, 2006) recommended a climate of minimal threat filled with relaxation for a brain to reorganize itself to learn and embrace new information. When a brain is relaxed and in
a threat-free state, it will learn what it needs to know in order for change to happen (Kussrow, 2001).

Choice

A brain is always looking for the best information to help it survive, so choice allows for that filtering of information (Kussrow, 2001). Learners who have choices are more likely to be open to feedback for improvement (Kussrow, 2001). Without choice, learners feel threatened (Jensen, 1998). Choice helps when an educator can align personal goals with that of the leader’s goals in organizational change (Kussrow, 2001). A learner needs to make sense of personal knowledge and the acquisition of new knowledge, and choice empowers them to synthesize the two sources of information (Kussrow, 2001; Rock & Page, 2009).

Social Bonding

Eisenberger (2011) stated that social bonding, like social interaction, directly contributes to survival. Social bonding occurs when a group of people develops enhanced connections and increased strength through participation in a common cause and social integration. An individual's social awareness and social sensitivity is relative to survival and the avoidance of social pain as experienced by ostracism, rejection, or exclusion (Eisenberger & Lieberman, 2004). To the brain, social acceptance equates with survival, and the many neural circuitries that support social inclusion and bonding are evidence of its importance (Heatherton, 2011). Cacioppo et al. (2002) attributed lack of sleep and reduced cognitive functioning to loneliness. Social bonding increases cognitive function and executive function (Rock & Page, 2009).
Stimulation

A learner's brain needs an abundance of stimulating multisensory opportunities to welcome and experience new ideas and attitudes (Opendak & Gould, 2015). Intellectual stimulation is a characteristic or one of four dimensions of Burns’ (1978) transformational leadership, which is a theory based on inspiring others to change in the best interests of the group (Bass & Avolio, 1994; Opendak & Gould, 2015). Experiencing stimulation leads to innovation and creativity that result in elevated performance (Bass & Avolio, 1994; Opendak & Gould, 2015). An optimal amount of challenging stimulation is necessary to avoid the brain responding with fear and anger when faced with an insurmountable negative challenge that may result in a negative appropriation of the amygdala (Goleman, 1995).

Feedback

Calabrese and Roberts (2002) suggested that feedback allows for gradual and continuous understanding, which ultimately encourages change. When educators truly understand the basis for the reform efforts, they will choose to complete the necessary changes successfully. By giving timely feedback about process improvements critical to brain function, change in behaviors can happen (Calabrese & Roberts, 2002).

Practice

Repeated practice impacts the brain, for it allows the brain to achieve its need for redundancy and elaboration and lighten the cognitive load (Begley, 2007; Ross, 2007). Performance athletes are one example of when, through repetition or through rituals, talents are hardwired into the brain, so less cognitive energy is needed (Rock & Page,
2009). However, oftentimes, people become stuck in their repetition of negative behaviors when too much change happens. Cozolino (2006) recommended offering multiple practice opportunities so people can develop a comfort level and more positive approach, thus overcoming their traditionally negative behavior. Cozolino (2006) added that these opportunities for people to construct their culture socially are preferable to behaviorist models mandating rules and order. Ross (2007) concurred, using the science of the brain in relation to learned and transmitted culture. He contended that a therapeutic environment must be rich with opportunities to change the paradigm of social constructs.

The brain is physically able to change itself when given the opportunity to practice the positive outcomes desired (Kussrow, 2001). Duhigg's (2012) research on habits support this area of practice as one cannot get rid of old habits, but can create new habits with repetition and practice. Therefore, leadership based on brain research requires opportunities for networks of neuron growth in the brain by using a variety of learning strategies and repeated firings of the neurons that comes with practice (Madrazo & Motz, 2005; Williams, 2010b).

Theoretical Approaches Related to Brain-Supported Leadership

With the emergence of a more global perspective, leadership development programs call for a more integrative system of technical and soft skills (Hogan, 2010; Lawrence, 2010; Williams, 2010a), which the U.S. Department of Labor (2011) defined as “applied skills—such as teamwork, decision-making, and communication” (p. 7). Brain-supported practices are emerging in a variety of industries (Hogan, 2010;
Lawrence, 2010; Williams, 2010a). Ethical concerns abound when using neuroscientific findings in education. Hruby (2012) pointed to the need for exercising caution when supporting neuroscience education and its impressive explosion in the past decade. Despite approaching this new frontier with caution, merging the fields of neuroscience and education has limitless potential (Hruby, 2012).

NeuroLeadership and SCARF

NeuroLeadership is a theory developed by Rock (2006) to define leadership based on findings from the neuroscience. It characteristically addresses four key domains, which are the leader's ability to solve problems and make decisions, regulate emotions, collaborate, and facilitate change (Rock, 2006). Reduced stress and highest possible cognition increase a leader’s ability to solve problems effectively (Goleman, 1995).

NeuroLeadership is especially pertinent when implementing change. The literature on leading organizational change supports that the behaviors of leaders can influence how employees respond to change (Furst & Cable, 2008). Recognizing that change is typically a cultural and social phenomenon in organizations, Rock (2008) developed the concept of SCARF to bring awareness of the qualities that the brain is always monitoring when in social situations. SCARF is an acronym that refers to status, certainty, autonomy, relatedness, and fairness (Rock, 2008). Positive or negative interpretations of a social dynamic can be a reward or threat. For example, an evaluation system is particularly stressful and challenges every component of the SCARF model. When an educational leader is introducing or navigating change with a faculty and staff, research supports placing high importance on the qualities of status, certainty, autonomy,
relatedness, and fairness. It is important to create conditions for reward, not threat (Rock, 2008).

Status. Status refers to a feeling of importance one has in relationship to one’s peers (Rock, 2008). Whether it is a colleague or evaluator, feeling valuable to another is important (Rock, 2008). Status is essential when acknowledging one’s contributions to a change environment (Rock, 2008).

Certainty. Certainty refers to knowing what one’s future holds (Rock, 2008). An individual wants to be certain he/she can plan for his/her future and know what to expect. It is the uncertainty of change environments that feels threatening.

Autonomy. Autonomy is related to choice in that an individual wants to be certain they have some control over a situation (Rock, 2008). Leaders and followers value autonomy and seek to move from dependence to autonomy (Harung, Travis, Blank, & Heaton, 2009; Pearson & Moomaw, 2005; Taylor, 2006). When change is mandated, educators often feel threatened when they do not have choice over the method of achieving the desired outcome. If given more autonomy, an educator can take more ownership when contributing to the outcomes. With autonomy, the accountability shifts to oneself.

Relatedness. Relatedness refers to a feeling of security one gets when connected to another individual or a group (Rock, 2008). In an environment of change, the threat comes from not being confident in whom to trust. Humans want to believe confidently that they belong to others in the group, which encompasses social interaction and social bonding (Rock, 2008).
Fairness. Fairness relates to feelings of being treated respectfully and justly by others (Rock, 2008). There is an expectation that there be nonbiased judgment (Rock, 2008). The brain feels threatened if there appears to be less than impartial treatment within the group (Rock, 2008).

Leadership Theory

Emotion has long been deemed an important aspect to learning, and its importance is confirmed by imaging technologies (Felten, Gilchrist, & Darby, 2006; Newman, Guy, & Mastracci, 2009; Sylvester, 1995; Wolfe, 2006). Connecting learning to emotion produces remarkable brain plasticity and exponential growth (Hinton et al., 2008). Newman et al. (2009) used affective leadership theory to explain how important building relationships and connecting with colleagues are to transforming performance. Affective leaders care about people and their emotions and encourage relationships to increase performance change (Newman et al., 2009). Seita and Brendtro (2007) believed that people who make changes do this by feeling connected to those with whom they face challenges. A strong leader celebrates strengths of those genuinely contributing to the success of the organization (Collins, 2001; Scherer, 2006), thereby motivating the organization towards change.

Emotional Intelligence. Multiple theories address the concept of Emotional Intelligence (Sadri, 2012), but Goleman’s (1995) version of Emotional Intelligence (EI) is especially pertinent to the study of emotional reaction to change. The specific components of EI relevant to the topic are empathy, regulation of emotions, and the ability to think when upset (Goleman, 1995). Goleman (1995) coined the term “hijacked
amygdala” (p. 14) to describe the barrage of stressors and an individual’s response to that stress. In 2011, Goleman asserted that learning to cope with stress using principles of neuroscience aids people in being more mindful. He suggested humans enlarge the gap between impulse and action when reacting to stress and focus on training our brain to be more emotionally intelligent, a concept often referred to as emotion regulation.

Emotion regulation. Emotion regulation is the ability to manage emotions, to control affect, or choose an emotional response (Gross, 1998; Rock & Page, 2009). Gross (1998) categorized three strategies of response: naming, reappraisal, and reframing. These three techniques afford insight into a situation in order to better control emotions (Rock & Page, 2009).

Gross (1998) offered strategies to assist individuals before and after the generation of an emotion. The strategies are situation selection, situation modification, attention deployment, and cognitive change (Gross, 1998). To reduce the emotional impact, individuals may choose one of the following to help stabilize emotions: situation selection is a choice of whether to approach or avoid a situation, situation modification is directly modifying a situation, attention deployment changes attentional focus, cognitive change is cognitive transformation of a situation, and response modulation is changing a response (Gross, 1998).

Social Intelligence. Social Intelligence (SI) is a quality that considers both interpersonal and intrapersonal intelligences (Gardner, 1993). SI implies being purposeful and positive about social interactions and bonding, reflecting the fact that the human brain is a social organ that enjoys connecting with other brains (Goleman, 2006).
In educational reform, a fair amount of social intelligence is necessary, for SI is essential to reshaping conflicts (Goleman, 2006) and relationship building. Social intelligence is an empathic concept that a leader should cultivate and inspire among colleagues (Gardner, 1993; Goleman, 2006).

Habits. Graybiel (2008) offered a complete and broad definition of habit learning with the following characteristics: “learned or acquired through experience dependent plasticity, occur repeatedly, performed automatically, involve an ordered and structured sequence, and comprise cognitive and behavioral expressions of routine” (p. 361). As a way for the brain to conserve energy for the survival mechanism, a brain shifts neuronal pathways from the prefrontal cortex to the basal ganglia (Squire, 1992; Yin & Knowlton, 2006). Habit formation, both good and bad, resides in the basal ganglia (Squire, 1992; Yin & Knowlton, 2006). Historically scientists believed that habit formation was the absence of mindfulness, but recent research indicates an intentional feature (Smith & Graybiel, 2014). Research related to habits and the brain have been pervasive, but until recently, not seen as a method to manipulate in support of transformational change (Duhigg, 2012). Researchers are coming closer to understanding the neural circuitry of habitual behavior and how it may lead to direct habit manipulation for making or breaking habits (Graybiel & Smith, 2014; Smith & Graybiel, 2014). Throughout the 1900s, many of the brain discoveries such as synaptic plasticity and cortical remapping, now known as use-dependent cortical reorganization, came about from changing habits of mice and primates through manipulation or stimulation (Begley, 2007). Stressed brains are more susceptible to forming habits (McEwen, 2007; Sapolsky, 2004).
Given there are 100 billion neurons making 10,000 connections or synaptic connections, the brain equates to a huge information storage system in the form of synaptic plasticity. Synaptic plasticity concerns neurons communicating or firing together, which results in increased strength, or not communicating or firing together, which results in decreased strength (Begley, 2007). Simply stated, synaptic plasticity deals with the brain’s absorption of experiences and the resulting changes in structure and function (Opendak & Gould, 2015). It explains why habits such as riding a bike remain in your brain as a synaptic connection, making it possible to be able to ride a bike decades after not doing so (Duhigg, 2012). Habits create changes in the brain, and habits occur because of the changes in the brain resulting from experience (Begley, 2007). The discovery that synaptic plasticity existed in brains well into mature adults was a revelation and foundation for neuroplasticity (Begley, 2007).

Cortical remapping was also a key precursor to neuroplasticity, as it explains why changes to the brain occur when habits change. The more often an activity occurs, the more space in the brain that movement occupies (Begley, 2007). Until the 1980s and 1990s, scientists believed that each part of a brain structure had a fixed function, and that the migration features that research supports today was not possible (Begley, 2007). For example, monkeys with a severed hand nerve lost territory in that area of the brain, but the area of the brain representing the facial sensation created by being brushed by a feather daily grew considerably, similar to the phantom-limb effect for amputees (Begley, 2007). Further evidence exists in the prevalent, successful therapies that encourage cortical remapping in the healing of stroke patients (Begley, 2007; Taub et al., 1993).
Use-dependent cortical reorganization could be the therapy-supported initiative for leaders to understand when introducing reform to faculty and staff (Begley, 2007). It might offset the habits of resistance that seem to be prevalent among educators experiencing multiple failed reform initiatives (Mason, 2008). The integration of synaptic plasticity and cortical remapping in the form of practice, habit facilitation, and experience might possibly enable reorganization of the brain with the outcome of expediting necessary reform (Begley, 2007; Cozolino, 2006; Duhigg, 2012).

Neuroscientific-Supported Strategies

A growing body of research supports the prospects of using neuroscientific strategies to influence change (Duhigg, 2012; Kussrow, 2001; Madrazo & Motz, 2005; Schwartz & Gladding, 2012; Tavis, 2010). One goal for identifying these strategies is their efficacy in reducing danger and boosting reward (Rock, 2008). Another bonus goal is that the use of these strategies enhances SCARF: status, certainty, autonomy, relatedness, and fairness (Rock, 2008).

Emotional Strategies

Zull (2006) contended that emotion is the basis for learning. Since the emotions of fear and threat are emotions directly related to stress, strategies to increase emotional competence are necessary to consider when the goal is to reduce stress (Cozolino, 2006; Goleman, 1995; Zull, 2006). Davidson and Begley (2012) cited strong evidence for changing one’s emotional circuitry with intention. Just as one can get physically stronger, one can get emotionally stronger by practicing positive emotions as demonstrated by fMRI scans of Buddhist monks who engaged in thousands of hours of
compassion meditation (Davidson & Begley, 2012; Lutz, Brefczynski-Lewis, Johnstons, & Davidson, 2008).

Humor. Humor and laughter are interesting phenomena for the brain. The reason that an individual laughs at a joke is that his/her brain already has separate, but related, neural connections to associate the information in a novel way and to respond with laughter (Edwards, 2010; Rock & Page, 2009). An individual who does not find an idea or situation funny may not possess the neural connections to associate or possess an already existing connection to the information (Rock & Page, 2009). Humor is also a way to reduce stress since laughter reduces cortisol and lowers stress hormone levels, as it signals the brain to release dopamine, serotonin, and endorphins, which are neurotransmitters associated with happiness (Fry, 1979).

Empathy. Empathy is awareness of others’ needs and the foundation of any relationship and includes the social and emotional advantages of being compatible (Hanson, 2009). Confirmed by neuroimaging studies of empathy, absorbing another’s emotions by just being with a group of people suffering from distress from an unpredictable change environment can contribute to the stress of the individuals and result in emotional contagion leading to decreased health (Begley, 2007; Buchanan, Bagley, Stansfield, & Preston, 2012; Lutz et al., 2008). Research suggests that exposure and practice in developing a positive, rather than negative, interpersonal understanding can deliberately strengthen successful group dynamics (Buchanan et al., 2012; Hanson, 2009).
Mental Strategies

Mental strategies, also known as cognitive strategies, have been associated with the brain in that research supports how the brain causes the mind to change (Begley, 2007). In the last decade, a shift occurred to an acceptance of dualism or reciprocal relationship of the mind and brain, to include how the mind can also influence the brain (Begley, 2007). Harung and Travis (2012) found a group of successful leaders to have an integrated mind and brain. Mental strategies explore how the mental states and focused attention affect the neuronal circuitry (Begley, 2007).

Cognitive therapy. Rock and Page (2009) defined cognitive therapy as “application” that “focuses on teaching patients how to retrain their thinking patterns” (p. 296). Davidson and Begley (2012) suggested using cognitive therapy as a way to think differently about one’s behavior and reinterpret a situation. According to Begley (2007), cognitive therapy is a successful treatment for obsessive-compulsive disorder (OCD) and depression (Begley, 2007). While psychotherapies have similar outcomes to pharmaceutical options in the short term, psychotherapies like cognitive therapy are more effective over a long timeframe. Cognitive therapies are a top-down hierarchy in how the brain influences behavior (Begley, 2007).

Mindfulness. Mindfulness is a Buddhist construct that intersects with science (Begley, 2007). Mindfulness meditation is an intentional focus on the present with a clear-minded observational perspective and objective viewing of personal emotions and habit loops (Duhigg, 2012; Goleman, 2011; Schwartz & Gladding, 2012; Squire, 1992; 2009). It gained influence with its therapeutic success in treating patients with obsessive-
compulsive disorder (Schwartz & Begley, 2002). Schwartz, a practicing Buddhist and neuropsychologist, and his UCLA partners first used mindfulness-based cognitive training to help OCD patients realize that a defect in brain wiring caused their symptoms, and they could change their responses with the use of mindfulness. The results were a landmark study in what was to become self-directed neuroplasticity (Schwartz & Begley, 2002). Evidence supports mental training leading to physical changes in the brain and increased executive function (Pascal-Leone, Amedi, Fregni, & Merabet, 2005; Schwartz & Begley, 2002). One example of mental training is The David Lynch Foundation (2015) support of schools by incorporating Transcendental Meditation (TM) or Quiet Time to reduce stress and violence. A recent study shows decreased teacher stress and burnout from using TM (Elder, Nidich, Moriarty, & Nidich, 2014).

Compassion meditation. According to Davidson and Begley (2012), compassion meditation is “also known as loving-kindness meditation” (p. 184) that begins with a “focus on those closest to you, wishing that they were free from suffering, and then moving out in an ever expanding radius until the wish encompasses all of mankind” (p. 184.). Research supports that use of compassion meditation results in changes of the brain (Lutz et al., 2008). In a study conducted by Lutz et al. (2008), monitoring of Buddhist monks, experts in compassion meditation, with fMRI technology determined that neural circuitry changed due to participation in compassion meditation and reinforced previous research findings that one can use the brain’s characteristic of neuroplasticity to improve compassion intentionally. Begley (2007) contended that cultivating compassion is a feasible strategy to use in support of change environments.
and that display of compassion or training in compassion meditation results in an interesting phenomenon where an individual approaches a threat, rather than avoiding it. For instance, footage of the Boston Marathon incident revealed individuals running towards the bombing to help victims, an act interpreted by some as heroic and compassionate (Edwards-Levy, 2013).

Visualization techniques. Rock and Page (2009) described visualization as “imagining an experience in detail” (p. 146) and a technique where one must be “correct, precise, and repeated” (p. 147). Athletes, musicians, and job seekers use visualization techniques to assist them in performing better, for example, a piano player is able to practice and perfect a musical piece without ever using a piano (Gladwell, 2008), resulting in an expansion of the motor cortex. The scientific reason for the effectiveness of visualization is that the visual cortex develops the same pathway visualizing as actually performing (Pascal-Leone et al., 2005; Rock & Page, 2009). Another significant benefit of visualization is its ability to aid in resolving fears by visualizing the desired outcomes (Rock & Page, 2009).

Physical Strategies

Physical activity and nutrition are important to increasing cognition (Fede, 2012). Research supports several wellness habits and healthy stress reduction techniques easily incorporated into organizational structures and routines (Begley, 2007; Fede, 2012; Ratey, 2008; Rock & Page, 2009). Aerobic physical activity releases endorphins that elevate relaxation and happiness as well as reduces stress (Ratey, 2008; Rock & Page,
Ratey (2008) emphasized that the same circuits used for moving are used for problem solving.

Voluntary exercise. Voluntary exercise shows promise in the integration of neurogenesis with existing neuronal pathways (Eadie et al., 2004). Research findings involving rats support the absorption of new neurons into existing neuronal pathways in mature adults and hold the most potential for decreasing age-related cognitive decline (Rock et al., 2012). According to Ratey (2008), exercise increases endorphins, while simultaneously reducing cortisol. Exercise engaged in voluntarily provides the most beneficial scenario for the brain to flourish, whereas involuntary or forced exercise induces the stress response (Begley, 2007; Ratey, 2008; Seligman, 2011).

Nutritional neurochemistry. Nutritional neurochemistry involves diet, vitamins, and supplements. Hanson (2009) recommended a daily regime of eating well, limiting sugar, and avoiding food allergens. Also suggested is the ingestion of a daily multi-vitamin, Omega-3 fatty acid, and vitamin E as gamma-tocopherol. Additionally, supplements of serotonin, iron, B-6 vitamin and 5-hydroxytryptophan and tryptophan (HTP) support neurotransmitters (Hanson, 2009).

Creativity. Researchers in some fields refer to creativity as constructivism and explore its role the role of creativity in restructuring the brain (Rock & Page, 2009). Engaging in creative pursuits allows for the novelty of experiences that prime the brain for neuroplasticity, thus garnering support of the role that the arts have on creativity and learning (Glass, Meyer, & Rose, 2013). Researchers in the relatively new field of
neuroaesthetics, which is the creation and appreciation of beauty, explore the creation and appreciation of beauty and their role in the brain (Chatterjee, 2013).

Social Strategies

The social domain includes strategies that exploit the social needs of the brain. Since the brain flourishes within positive social dynamics (Cozolino, 2006; Davidson & McEwen, 2012; Eisenberger, 2011; Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007; Goleman, 2006; Seligman, 2011; Siegel, 2012), practices that consider the social nature of experiences are promising. Social support reduces stress (Eisenberger et al., 2007). Research on mirror neurons and their role in social learning is worthy of consideration (Rizzolatti et al., 2008). The role of social interaction, social bonding, and social intelligence on neuroplasticity is indisputable (Cozolino, 2006; Davidson & McEwen, 2012; Eisenberger, 2011; Goleman, 2006).

Coaching. Brain-based coaching has the potential to empower an educator (Rock & Page, 2009). The social nature of coaching supports direct contribution to social feedback and reflection and the adage of “two brains are better than one.” Rock and Page (2009) maintained that having an objective advocate to demonstrate empathic understanding plays a role in self-improvement. Coaching is a way of facilitating self-directed neuroplasticity (Rock & Schwartz, 2007).

Play. The process of play incorporates many of the characteristics that are healthy for the brain (Rock et al., 2012). Social interaction and bonding, humor, and creativity are just a few of the overlapping benefits of adult play (Brown, 2010; Panksepp & Biven, 2012; Rock et al., 2012). Brown (2010) supported the use of play and its role in
emotional intimacy, healing, and stress relief. Adult play is as important as child’s play for strengthening the brain (Brown, 2010) and can include a variety of options such as organized sports, pottery classes, traveling, and musical experiences.

Summary of Findings and Themes within Reviewed Literature

The review of literature represents key components for facilitating a deeper understanding of the complex workings of the brain and their potential to influence educators in the process of change. The provided history of technological evolutions in brain imaging techniques demonstrates the major advancements in brain research and mapping that continue to progress at a prolific rate allowing the emergent study of neuroscience to explore the matching of the brain's cartography to its functions. A thorough review of the brain and its unique functions and characteristics revealed it is the perfect organ to facilitate change within an organization. The needs of the brain include hydration, nutrition, sleep, exercise, and social interaction, which are instinctive and important for the survival nature of the brain.

Research suggests a variety of neuroscientific experiences and strategies can elicit neurogenesis and neuroplasticity of the brain. Stress and its detrimental effects on the brain as well as techniques to offset stress offer strategies applicable to the working environment. Using the most prolific findings from neuroscience, a review of brain-supported leadership practices, as well as brain-supported theories, indicates promise for addressing change in a positive manner. The brain-based concepts of safety, choice, social bonding, stimulation, feedback, and practice combine nicely with
NeuroLeadership’s SCARF model of status, certainty, autonomy, relatedness, and fairness to create a climate for a healthy and productive brain.

To address the research question of which neuroscientific strategies do neuroscientific researchers suggest educational leaders use in public schools to manage the stress of persistent change environments that would most effectively allow the brain's executive function capacity to stay engaged in a sustained climate of change, this literature reviewed the theories of NeuroLeadership, Emotional Intelligence, Emotion Regulation, and Social Intelligence. Finally, this chapter presented four categories of neuroscientific-supported practices and stress inoculation strategies in the form of emotional, mental, physical, and social descriptions that counter the effects of stress related to the brain’s visceral response to fear. Research indicates it is important to understand the brain and its intricacies in order to support leadership in a pervasive change environment.
CHAPTER 3

METHODOLOGY

This study examined the contributions that experts in neuroscientific research can provide in the field of educational leadership in promoting change and educational reform in educational leadership programs of study. Various research-supported emotional, mental, physical, and social strategies exist that might allow for increasing cognitive function while decreasing stress. The purpose of this study was to elicit expert opinion on using neuroscientific strategies in educational leadership as an emerging field of practice. While there is an abundance of research on strategies that support the reduction of stress, there is little prior research of the use of these strategies in the field of public education leadership.

This study drew upon the established research in the field of neuroscience that uses stress inoculation strategies to mitigate how the brain naturally responds to fear and threat. The researcher extended the focus to determine which of those neuroscientific strategies educational leaders could use in their practice to endure change, cultivate a climate conducive to critical second-order change, and achieve success when implementing change initiatives in educational reform efforts.

The related research question was as follows: Which neuroscientific strategies do neuroscientific researchers suggest educational leaders use in public schools to manage
the stress of persistent change environments that would most effectively allow the brain’s executive function capacity to stay engaged in a sustained climate of change?

Research Design

The research methodology employed to explore the question addressed by the study was the Delphi technique (Linstone, 1978), an adaptation of the Delphi method (Dalkey & Helmer, 1963). The Delphi technique is an appropriate methodology for use in academic research in instances of an existing plethora of research in one area and little or limited application of the research in another area in which the researcher wants to apply it in an original way (Linstone & Turoff, 2002). This mixed methods approach is a way to gather qualitative data in order to later quantify the data for future use (Hall, 2009).

The researcher used the Delphi technique to elicit expert advice regarding the feasibility of using stress reducing strategies to increase cognition and critical thinking so necessary in promoting and sustaining educational reform. Educational leaders should promote critical thinking and cognition, precisely the kind of thinking necessary in the midst of transformational change (Bass & Avolio, 1994). According to Clayton (1997), a diverse and heterogeneous expert panel is important when developing a Delphi study. Additionally the experts should remain anonymous to each other. The anonymous nature of the Delphi method limits bias and avoids expert influence on others or groupthink (Murry & Hammons, 1995). The researcher hoped to obtain knowledge of the most appropriate and effective techniques that neuroscientific research experts agree educational leaders could use to facilitate change in their organizations.
According to Delbecq, Van de Ven, and Gustafson (1975), another benefit of the Delphi technique is the facilitation of a series of repetitive steps or successions of the probe until a researcher reaches a consensual outcome. Through this iterative process, the researcher allows the participants to expand, clarify, or synthesize their suggestions. Furthermore, it enables the sharing of information, elicitation of feedback, refinement of the process, and then revision again until enough reiterations produce the information sought (Delbecq et al., 1975). Powell (2003) recommended experts who are knowledgeable in the topic for the Delphi to be successful in practice-related problems. In this study, the researcher employed three iterations of the inquiry process, referred to as rounds, while questioning experts in neuroscience and education until the team of experts reached consensus regarding the efficacy of the strategies (Dalkey, 1969).

The modified Delphi method research design was appropriate for this study as it served as a group communication tool for gathering experts to contribute to solving a problem (Linstone, 1978). The use of the Delphi method allowed for a cost-effective and efficient method of assembling experts in neuroscience impossible to convene physically and aggregating the opinions of experts to improve the decision-making process (Linstone, 1978). The Delphi method also served to reduce tension that might have existed in face-to-face discussion and eliminated any antagonism between experts (Green, 2014).

Population and Sample

The population of this study was a group of international experts who are knowledgeable in the areas of neuroscientific research. The researcher chose
neuroscientists as the population as they possess knowledge regarding how the brain responds to stimulus. In their role as learners and leaders in brain research, neuroscientists typically promote the educational institutions in which they perform and publish research, and their expert status could help develop ideas for future consideration by educational leaders responsible for educational reform.

Selection and Description of Sample

The Dana Alliance for Brain Initiatives (DABI) is a nonprofit organization comprised of approximately 350 members, nominated and recommended for membership by their neuroscientific peers, who represent various states, countries, and educational institutions. The researcher chose the Dana Alliance for Brain Initiatives (DABI) of the Dana Foundation for the selection of the sample of the population because their membership in the organization is due to their expert status in the field of neuroscience (Dana Alliance, 2015). Initial selection for membership in DABI is dependent on the DABI members’ confirmation and possession of appropriate credentials and membership criteria, such as being a researcher or clinician in neurosciences and willing to promote public awareness of brain research in the form of educational outreach activities (Dana Alliance, 2015).

Participants

Participants were a subset of the DABI neuroscientific research experts who affirmatively responded to the electronic invitation (see Appendix B) and chose to participate in the study. The researcher described the participants’ demographic information, such as gender, years of expertise, institution affiliation, research focus,
profession, institutional role, and country of origin. This information was for summary purposes only, and individuals remained anonymous.

Instrumentation

The Delphi consisted of three rounds of instruments. Each round had its own instrument, iterative in nature and developed from information collected in the previous round. The instruments were designed in order to get the most effective information for possible use in education (Green, 2014).

The Round 1 instrument of Delphi included questions related to demographics of the respondents establishing their expertise, and open-ended questions requesting information regarding strategies suggested by the experts. In the Round 1 of the Delphi, the researcher used Survey Monkey® to provide questions to solicit suggestions from experts in neuroscience regarding strategies to assist leaders in supporting reduction in stress in relationship to change and reform in education.

The open-ended questions for the first round of the Delphi were as follows.

1. What is your role in neuroscience?
2. With what type of organization are you affiliated within neuroscience?
3. What is your specialty within neuroscience?
4. How many years have you been practicing in the field of neuroscience?
5. In which country do you practice neuroscience?
6. Do you believe incorporating neuroscientific-supported practices in P-16 education will be effective in leading change in public education?
7. If so, which neuroscientific-supported strategies or practices would be most effective in reducing stress and increasing cognition for educator leaders promoting change in P-16 education?

8. In the space below, identify and describe with as many details as possible how an educational leader would implement each of the above practices you have suggested.

The researcher eliminated duplicate responses and compiled the responses from open-ended responses in Round 1. Following this, the researcher created a new instrument for Round 2 that provided a condensed list of all the open-ended responses and the number of experts who wrote the responses. Using data from Round 1, the researcher developed a 5-point Likert-type rating scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree) for the experts to rank their degree of agreement with each suggested strategy from the first round and the appropriateness of the strategy for use in public schools. Through Survey Monkey®, the researcher sent the collected and compiled list of strategies from the open-ended responses as an instrument in Round 2 to the experts along with the 5-point Likert-type rating scale to measure the degree of agreement on each strategy suggested.

The Round 3 instrument provided a final ranked list of the strategies, along with their mean and standard deviation, in the form of a list and chart. The Round 3 instrument directed experts to rate their agreement or disagreement for each strategy to be included in the final results. The researcher asked the experts to choose the radio button that expresses agreement or disagreement with each strategy.
Data Collection

The researcher utilized electronic communication with the sample prior to the study in order to make it less time consuming (Green, 2014). The researcher secured electronic mail addresses from the DABI for the experts in the study and contacted the sample via email to request participation in the study. The researcher sent an invitation and informed consent form to the sample of the neuroscientific researchers from DABI to participate in the study and, after explaining the goal of the research, she informed them that agreeing to participate would commit them to all rounds of the Delphi. SurveyMonkey® served as the platform for each electronic and email communication with the experts.

Participant selection relied on the submission of responses to the researcher during the course of three rounds of the Delphi method. The researcher provided reassurances of anonymity to participants prior to their agreement to participate in the study as per Mercer’s Internal Review Board requirements.

The expert participants completed Round 1 in which they answered a number of open-ended questions and offered suggestions that public education leaders could use to aid employees in adapting to the fear response brought on by the threat of change inherent in a climate of reform. In addition, in Round 1 the expert participants provided specific feedback regarding implementation techniques of the recommended strategies or suggestions regarding a combination of some or all of the techniques to influence positive change in education.
In Round 2, the experts rated preliminary agreement on the strategies identified in Round 1 of the Delphi. Data were collected in the form of a Likert-type rating scale of 5 to 1, with 5 denoting the highest agreement of strongly agree. Round 1 data were used in the form of the calculated mean and standard deviation to rank order the suggested strategies from highest expert agreement to lowest expert agreement using the mean and standard deviation.

After collecting Round 2 data, the researcher used the calculated mean and standard deviations of the responses to create Round 3 of the Delphi. Via Survey Monkey® in Round 3, the researcher requested that the experts review the results of Round 2 in the form of the ranked list of strategies and either agree or disagree to the inclusion of the strategy in the results.

Data Analysis

The researcher eliminated duplicate responses from Round 1 and compiled the responses. The researcher analyzed the condensed list of all the open-ended responses and the number of experts who wrote the responses to measure the degree of agreement on each strategy suggested. The experts' rating and preliminary agreement of the strategies noted in the Round 1 of the Delphi were analyzed. After obtaining the Round 2 data, the researcher calculated the mean and standard deviations of the responses. The strategies were then rank-ordered with the highest average of the Likert values, indicating strong agreement about the feasibility of the strategy.

In Round 3, the Likert mean scores and their standard deviation were matched for each suggested strategy. The researcher submitted the resulting scores to the experts to
determine their level of agreement with colleagues’ collective suggestions on the strategies of merit to use in public education to facilitate change.

After Round 2, the researcher prioritized the strategies based on feedback from the experts in order to identify results. Using the mean, the top suggestions for educational leaders to adopt were rank-ordered including the degree of agreement from the third round. The method relied on the expertise of the experts and allowed for a tallying and analysis of the results. At this point, the finalized results of the Delphi were submitted to the experts to determine the recommendations and specific strategies appropriate for implementation in schools and potentially beneficial to educational leaders in the adoption of the practices to influence positive change. Only those strategies receiving a score of 4 or better, demonstrating an 80% agreement or stronger, were included in the final results and recommendations.

Theoretically, the response rate for each round of the Delphi technique is equal, but there was some attrition once the Delphi technique began. Response attrition occurred from 24 respondents in Round 1 to 12 respondents in Round 2 and up to 17 respondents in Round 3. The final data analysis includes the report of attrition.

Hsu and Sanford (2007) suggested several strategies to maximize successive responses from the experts, including the attention to the selection of the expert pool and careful design of the questionnaire documents. The use of web-based software such as Survey Monkey® facilitated the iterative surveys with experts and allowed for a higher rate of completion. The researcher made every effort to secure continuing participation for all rounds of the Delphi.
Summary

The researcher conducted a modified Delphi to attain the consensus of neuroscientific experts regarding the use of neuroscientific strategies to overcome the resistance to change so prevalent in public education. The purposes of this study were to identify neuroscientific strategies, ascertain the implications for neuroscience and educational leadership, and develop ideas for future consideration by leaders responsible for critical reform. In the three rounds of the Delphi method, the researcher transmitted an electronic questionnaire via Survey Monkey® to neuroscientific researchers from DABI for identification of specific strategies that educational leaders could use to transform education and allow educators to stay cognitively engaged in a sustained climate of change. Experts also described how leaders could use the neuroscientific strategy in public education.

Using the results from the open-ended responses, the researcher designed a second round for the experts to rate the degree of agreement using a 5-point Likert type rating. Ratings were statistically analyzed to determine the mean and standard deviation for each suggested strategy. The researcher created a rank-ordered chart of the strategies from a score of 5 to a score of 4, demonstrating an agreement with an 80% or better average. The results, presented in Chapter 4, provide recommendations for educational leaders with possible solutions to prevent future resistance.
CHAPTER 4

RESULTS

The purpose of this study was to identify the specific strategies or skills supported by neuroscience research that public education leaders could use to introduce and facilitate change in a manner that could significantly increase cognition and reduce the emotional impact of the brain’s automatic stress/fear/threat response to change and educational reform. Additional inquiries related to whether the neuroscientists thought there was merit to incorporating neuroscientific strategies P-16 education to lead change effectively, as well as how to implement the recommended strategies in education.

The researcher chose the Delphi method precisely to pool expert opinions and to develop a consensus of whether or not it would be fruitful to explore the connection of neuroscience and education. The perspective from the experts who maintained membership in an international neuroscience group, Dana Alliance for Brain Initiatives (DABI), was unique, for their membership was by nomination for contributions in the field of neuroscience, and the group seeks to educate the public about neuroscientific research. The researcher conducted three rounds of the Delphi to establish consensus on which identified strategies could yield influence by educational leaders on educators. In Round 1, the researcher gathered open-ended responses in which the experts named strategies for increasing cognition for educators experiencing stress. In Round 2, the experts rated their degree of agreement of the suggested strategies from Round 1.
Delphi Round 1

The first question was: Do you agree to participate in the study? While 33 agreed to participate in the survey by answering affirmatively on the first question, not all 33 actually completed the questions beyond the first research question. The respondents were neuroscientists who were members of the Dana Alliance for Brain Initiatives (DABI). Questions 2 through 6 were asked to establish expertise of the participants, and 24 respondents answered these questions. The questions sought to establish information regarding their role, organizational affiliation, specialty, years of practice, and country of practice within the field of neuroscience. The researcher secured the email addresses of the 301 members of DABI by public domain and sent requests via email requesting participation. Questions 7 though 9 focused on suggested strategies. Twenty-four participants responded to Question 7, 22 responded to Question 8, and 19 responded to Question 9.

Question 2: What is your role in neuroscience?

In responding to Question 2, the 24 participants listed a variety of roles; in fact, many reported multiple roles. Thirteen responded with professor, 11 responded with researcher, three were principal investigators, and three reported that they direct labs overseeing undergraduates, graduates, and/or postdocs. Additional respondents denoted that they were faculty, a clinical neurologist, a university administrator, a company owner, and/or an advisor. Table 1 displays the responses to the second question.
Table 1

*Participants’ Roles in Neuroscience*

<table>
<thead>
<tr>
<th>Role</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>13</td>
</tr>
<tr>
<td>Researcher</td>
<td>11</td>
</tr>
<tr>
<td>Principal Investigators</td>
<td>3</td>
</tr>
<tr>
<td>Direct labs overseeing undergraduates, graduates, and/or post doctorates</td>
<td>1</td>
</tr>
<tr>
<td>Faculty</td>
<td>1</td>
</tr>
<tr>
<td>Clinical neurologist</td>
<td>1</td>
</tr>
<tr>
<td>University administrator</td>
<td>1</td>
</tr>
<tr>
<td>Company owner</td>
<td>1</td>
</tr>
<tr>
<td>Advisor</td>
<td>1</td>
</tr>
</tbody>
</table>

Question 3: With what type of organization are you affiliated within neuroscience?

Twenty-four participants responded to the third question. Organizational affiliates included universities and medical schools, as well as research institutions. Six respondents listed multiple organizations. Table 2 lists the organizations delineated by the respondents.
Table 2

**Participants’ Affiliated Organization**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate college</td>
<td>1</td>
</tr>
<tr>
<td>Medical school</td>
<td>2</td>
</tr>
<tr>
<td>University</td>
<td>10</td>
</tr>
<tr>
<td>University/Research institute/Hospital</td>
<td>1</td>
</tr>
<tr>
<td>Academic medical center</td>
<td>1</td>
</tr>
<tr>
<td>State-sponsored medical school and a federal agency that both</td>
<td>1</td>
</tr>
<tr>
<td>sponsors neuroscience research; a member of two professional organizations focused on neuroscience; an editor for 5 scientific journals, all of which focus on neuroscience</td>
<td></td>
</tr>
<tr>
<td>Basic scientific (Society for Neuroscience) and clinical (American Academy of Neurology, American Neurological Association) University medical school</td>
<td>2</td>
</tr>
<tr>
<td>Basic neuroscience department within a medical school</td>
<td>1</td>
</tr>
<tr>
<td>Academic institutions (Emory University Emeritus professor) and VA Medical Center (Deputy Associate Chief of Staff/ Research)</td>
<td>1</td>
</tr>
<tr>
<td>University of California, San Francisco; medical school; Scientific Learning, Inc.; brain training software to help children; Posit Science, Inc.; brain training to help struggling adults and children</td>
<td>1</td>
</tr>
<tr>
<td>NIH, Yale, and 2 private research institutes</td>
<td>1</td>
</tr>
<tr>
<td>Research university</td>
<td>1</td>
</tr>
</tbody>
</table>

Question 4: What is your specialty within neuroscience?

The fourth question solicited participants to relate their neuroscientific specialty. Responses reflected highly diverse specialties within neuroscience. Several related to cognition, others pertained to cellular and molecular neuroscience, and some involved
unique specialties, including neuropsychopharmacology, a specialized study of how drugs affect the brain. Table 3 displays participants’ neuroscientific specialty.

Table 3

Participants’ Neuroscientific Specialty

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neural systems involved in wake-sleep and circadian regulation</td>
<td>1</td>
</tr>
<tr>
<td>Cognitive</td>
<td>2</td>
</tr>
<tr>
<td>Cellular and molecular neuroscience; ion channels; electrical signaling</td>
<td>1</td>
</tr>
<tr>
<td>Socioeconomic disparities in children's neurocognitive development</td>
<td>1</td>
</tr>
<tr>
<td>Cellular 2 and molecular neuroscience</td>
<td>1</td>
</tr>
<tr>
<td>Auditory neuroscience</td>
<td>1</td>
</tr>
<tr>
<td>Synaptic neurophysiology</td>
<td>1</td>
</tr>
<tr>
<td>Neuroendocrinology</td>
<td>1</td>
</tr>
<tr>
<td>Neural development</td>
<td>1</td>
</tr>
<tr>
<td>Neuronal glial physiology and pathophysiology</td>
<td>1</td>
</tr>
<tr>
<td>Neurodegenerative disease; neuroinflammation; neurochemistry of synapses</td>
<td>1</td>
</tr>
<tr>
<td>Pain mechanisms</td>
<td>1</td>
</tr>
<tr>
<td>Visual and oculomotor systems neuroscience</td>
<td>1</td>
</tr>
<tr>
<td>Neuropsychopharmacology</td>
<td>1</td>
</tr>
<tr>
<td>Molecular neurobiology and animal behavior</td>
<td>1</td>
</tr>
<tr>
<td>Memory and cognitive changes with aging</td>
<td>1</td>
</tr>
<tr>
<td>Drug addiction</td>
<td>1</td>
</tr>
<tr>
<td>Integrative neuroscience; learning; brain changes related to mental illness, neurological illness, developmental disorders, aging; training to restore function in struggling individuals</td>
<td>1</td>
</tr>
<tr>
<td>Neurophysiology, sensory systems</td>
<td>1</td>
</tr>
<tr>
<td>Histochemistry: the gain in brain is mainly in the stain</td>
<td>1</td>
</tr>
<tr>
<td>Neuropsychopharmacology</td>
<td>1</td>
</tr>
<tr>
<td>Cognitive neuroscience of attention</td>
<td>1</td>
</tr>
</tbody>
</table>
Question 5: How many years have you been practicing in the field of neuroscience?

Twenty-four participants responded to the fifth research question. The respondents were highly experienced, with years of practice ranging from 17-55 years, which is an average of 33.625 years practicing in the field of neuroscience. Table 4 displays the participants’ responses to number of years of practice in neuroscience.

Table 4

*Participants’ Years of Practice in the Field of Neuroscience*

<table>
<thead>
<tr>
<th>Years in the Field of Neuroscience</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>53</td>
<td>2</td>
</tr>
<tr>
<td>55</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Number of Years: 807

Average Number of Years: 33.625
Question 6: In which country do you practice neuroscience?

Of the Round 1 respondents, 20 worked in the USA, two held employment in the United Kingdom, and two practiced in Canada; Therefore, this was an international group of respondents. Table 5 displays the results of the sixth query,

Table 5

*Participants' Country of Neuroscientific Practice*

<table>
<thead>
<tr>
<th>Country of Neuroscientific Practice</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>20</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
</tr>
</tbody>
</table>

Question 7: Do you think incorporating neuroscientific-supported practices in P-16 education will be effective in leading change in public education?

Only two of the 24 participants answered “no” when responding if they thought P-16 including practices in public education would lead to change. Ten responded “yes”, and 12 indicated they were “not sure”. Table 6 displays the participants’ opinions.

Table 6

*Participants’ Opinions Regarding the Effectiveness of Incorporating Neuroscientific-Supported Practices in P-16 Education*

<table>
<thead>
<tr>
<th>Effectiveness of Incorporating Neuroscientific-Supported Practices in P-16 Education</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion</td>
<td>Not Sure</td>
</tr>
<tr>
<td>Number of Responses</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 7 displays elaborations of the participants’ opinions regarding the effectiveness of incorporating neuroscientific-supported practices in P-16 education.

Table 7

*Participants’ Elaborations Regarding the Effectiveness of Incorporating Neuroscientific-Supported Practices in P-16 Education*

<table>
<thead>
<tr>
<th>Participants’ Elaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Not enough evidence to answer</td>
</tr>
<tr>
<td>• Maybe. When theory meets reality, things can fail. Not all scientific publications are correct. “Leading change in public education” could mean leading change in a negative way. It is a vague statement. Anything can lead to change.</td>
</tr>
<tr>
<td>• Depends on the practice. Not yet sufficient evidence to be certain of this.</td>
</tr>
<tr>
<td>• Perhaps</td>
</tr>
<tr>
<td>• It might be</td>
</tr>
<tr>
<td>• No, no real evidence in the research to support such strategy.</td>
</tr>
<tr>
<td>• I am not sure what you mean by neuroscientific-supported practices. If you mean 'brain games' the answer is no. If you mean commonsense things like letting adolescents get enough sleep, and using frequent returns to topics to facilitate learning the answer is yes.</td>
</tr>
<tr>
<td>• Possibly; it depends like always on the quality of the program and the teachers</td>
</tr>
<tr>
<td>• It’s going to happen, for two reasons. 1) We MUST help strengthen the NEUROLOGICAL resources in children who have a lousy or abusive or high-stress childhood. We now focus too strongly on 'content' when we should have more focus on 'brain function' and 'brain power'. 2) EVERY kid would be advantaged by having a brain that operated with higher efficiency and greater powers.</td>
</tr>
<tr>
<td>• Depends on the knowledge of those who do the teaching.</td>
</tr>
<tr>
<td>• Unsere; depends on mode of implementation</td>
</tr>
<tr>
<td>• Somewhat</td>
</tr>
</tbody>
</table>
For the Not Sure category, responses included “not enough evidence”, “perhaps”, “maybe”, and “possibly”. Many responses considered effectiveness would depend on various factors. Even among the cellular and molecular neuroscientists, there was a difference of opinion about whether incorporating neuroscientific-supported practices in P-16 education will be effective in leading change in public education.

Question 8: If so, which neuroscientifically supported strategies or practices would be most effective in reducing stress and increasing cognition for educator leaders promoting change in P-16 education?

For the eighth research question, only 22 participants responded. Of those 22 responses, two were “n/a”, one referenced a prior answer for Question 7, one answer was “none”, and one answer was “no idea”. Table 8 displays responses of greater depth.
Table 8

*Participants’ Delineation of Effective Neuroscientifically Supported Strategies*

<table>
<thead>
<tr>
<th>Effective Neuroscientifically Supported Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• I am not sure that there is scientific evidence that supports any such approach.</td>
</tr>
<tr>
<td>• I think jury is out on whether any of this is effective.</td>
</tr>
<tr>
<td>• 1. Forbid the use of Facebook and other social media in class rooms; it is known to distract students around the person doing so. 2. Young people with developing brains benefit from sleeping, whereas many schools start early in the morning (e.g. 8 AM). Let young people sleep in. 3. Apply Spaced Learning techniques. Cramming before exams is detrimental for learning.</td>
</tr>
<tr>
<td>• I am not aware of the possibilities as this is far outside the scope of my research area.</td>
</tr>
<tr>
<td>• Understanding of causes and prevention</td>
</tr>
<tr>
<td>• This is not my specialty. But I find that familiarity with a stress-inducing stimulus usually lessens its effects.</td>
</tr>
<tr>
<td>• I don’t think there are neuroscientifically supported strategies for educators themselves.</td>
</tr>
<tr>
<td>• Meditation</td>
</tr>
<tr>
<td>• I don’t have anything specific, but will say that what is done needs to be supported by vetted scientific evidence.</td>
</tr>
<tr>
<td>• Using visual mapping (often called mind mapping) to lay out ideas, communicate, brainstorm, plan, etc.</td>
</tr>
<tr>
<td>• A variety of practices. An approach similar to cognitive behavioral therapy would be interesting to consider.</td>
</tr>
<tr>
<td>• There are forms of computerized brain training that are HIGHLY effective. They’re MUCH easier and less expensive to administer (and just as effective) than are meditation or medication based strategies.</td>
</tr>
<tr>
<td>• Active, collaborative learning in small groups in place of impersonal large lectures</td>
</tr>
<tr>
<td>• I have limited knowledge of education strategies; my guess would be hands-on.</td>
</tr>
<tr>
<td>• Unsure—yoga; mindfulness</td>
</tr>
<tr>
<td>• Mindfulness meditation; relaxation training</td>
</tr>
</tbody>
</table>
Question 9: In the space below, identify and describe with as many details as possible how an educational leader would implement each of the above practices you have suggested.

Nineteen participants responded to Question 9 regarding the implementation of neuroscientific strategies to support cognition and reduce stress. Eight participants failed to detail implementation as prompted by the research query. Instead, they answered, “not sure”, “n/a”, “no idea”, “I don’t think there are any”, “I suggested none”, “I don’t think there are any”, “do not see the need”, or “too complicated to answer (accompanied by a suggestion to call and discuss)”. Table 9 displays only actual suggestions for implementation.
Table 9

Participants’ Recommendations for Implementing Effective Neuroscientifically Supported Strategies

<table>
<thead>
<tr>
<th>Implementing Effective Neuroscientifically Supported Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• First, he or she would have to find a theoretical one, and then test to see if it is valid.</td>
</tr>
<tr>
<td>• 1. Educate students about the “second-hand-smoking” negative effects of distractions in a classroom environment. 2. Compare performance in schools that start late compared to those that start early. Educate educational leaders about the outcome. Make schools start later in the day. 3. Teach students about Spaced Learning versus Massed Learning. The former is way more efficacious and helps with retention.</td>
</tr>
<tr>
<td>• Public writing and speaking</td>
</tr>
<tr>
<td>• Again, not my specialty. However, I feel educators might benefit from drills that involve role-playing exercises in a safe environment.</td>
</tr>
<tr>
<td>• Read the scientific literature, consult with experts, go for training with experts, and then implement them in the classroom.</td>
</tr>
<tr>
<td>• Purchase one of the very good Mind Mapping software programs available for laptops, tablets, and smartphones.</td>
</tr>
<tr>
<td>• This would have to be discussed with experts in stress reduction along with experts in education.</td>
</tr>
<tr>
<td>• An academic leader should organize a “coalition of the willing” among faculty members, those who are willing to learn and implement the new strategies of active learning. Once others see how much better the outcomes are with that approach, many more will want to get involved.</td>
</tr>
<tr>
<td>• Unsure; would have to spend much time thinking about, but leader should be servant as well and set the example.</td>
</tr>
<tr>
<td>• Obtain mindfulness manual. Institute training as part of classroom work.</td>
</tr>
</tbody>
</table>
Following the nine questions, the researcher asked participants to provide their email address if they agreed to participate in subsequent rounds. Ten participants provided their email addresses, whereas others responded to my email with their agreement. The researcher sent invitations to all members of DABI with known email addresses with the exception of those requesting removal of their emails from the study.

Summary of Delphi Round 1

In Round 1, the researcher gathered information regarding the participating neuroscientists’ area of expertise and identified their suggestions of strategies to benefit educators in pervasive climates of change. Of the 301 neuroscientists who were invited by email, only 24 of 301 (8%) responded to establish their expertise and give their opinion as to whether using neuroscientifically supported practices would be effective in leading change in P-16 education. However, participation declined in the final two open-ended questions when only 22 and 19 (7.3% and 6.3%) responded when asked to identify the specific strategies and describe implementation of the strategies. Despite what appears to be a low response rate, the number of respondents is appropriate for a Delphi study (Delbecq, Van de Ven, & Gustafson, 1975).

The researcher exported Round 1 responses from the online survey tool into an Excel document. The first five questions were analyzed for demographic identification of expert status. Three questions specifically related to strategy identification and use, which the researcher analyzed to determine the meaning of each response. While there was some affirmation to the use of neuroscience in education with 10 of the 24 (41.6%) who agreed, there was a slightly larger ambiguous response with 50% of the respondents
who were unsure about the possibility, and only two respondents who replied negatively. The researcher then created a list of the respondents’ suggestions for possible neuroscientifically supported strategies or practices that would be most effective in reducing stress and increasing cognition for educator leaders promoting change in P-16 education. After combining similar strategies, the researcher constructed responses into a survey of consolidated strategies. The neuroscientists identified 16 practices for consideration in Round 2.

Delphi Round 2

The researcher extracted 22 responses from Round 1, Question 8, then consolidated similar answers and combined repetitions, culminating in a list of 16 strategies for the Round 2 survey requesting the experts to rate their agreement with the appropriateness or efficacy of each neuroscientifically supported strategy for reducing stress and increasing cognition. The researcher sent emails to the participating neuroscientists (N = 24), requesting their continuing participation in Round 2. Twenty-one indicated they would continue to participate.

Question 2 of Delphi Round 2

In Round 2, participants ranked their degree of agreement of the appropriateness or efficacy of each strategy suggested by neuroscience experts for reducing stress related to change and increasing cognition with public school educators. This involved the use of a 5-point Likert-type rating scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Table 10 displays the 16 strategies and the degree of agreement that the 12 of the 21 respondents rated.
Table 10

Participants’ Ranking of Agreement with Proposed Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>N</th>
<th>( \bar{x} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Meditation</td>
<td>8.33%</td>
<td>8.33%</td>
<td>16.67%</td>
<td>50.00%</td>
<td>16.67%</td>
<td>12</td>
<td>3.58</td>
</tr>
<tr>
<td>2. Benefits from sleeping</td>
<td>8.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.67%</td>
<td>75.00%</td>
<td>12</td>
<td>4.50</td>
</tr>
<tr>
<td>3. Starting school later in the morning</td>
<td>8.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>58.33%</td>
<td>12</td>
<td>4.33</td>
</tr>
<tr>
<td>4. Apply spaced learning techniques.</td>
<td>0.00%</td>
<td>0.00%</td>
<td>58.33%</td>
<td>25.00%</td>
<td>16.67%</td>
<td>12</td>
<td>3.58</td>
</tr>
<tr>
<td>5. Understanding the causes and prevention of stress</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>58.33%</td>
<td>41.67%</td>
<td>12</td>
<td>4.42</td>
</tr>
<tr>
<td>6. Familiarity with a stress-inducing stimulus</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>50.00%</td>
<td>25.00%</td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td>7. Forbid the use of Facebook and other social media</td>
<td>0.00%</td>
<td>50.00%</td>
<td>41.67%</td>
<td>8.33%</td>
<td>0.00%</td>
<td>12</td>
<td>2.58</td>
</tr>
<tr>
<td>8. Using visual mapping (often called mind mapping)</td>
<td>16.67%</td>
<td>0.00%</td>
<td>66.67%</td>
<td>8.33%</td>
<td>8.33%</td>
<td>12</td>
<td>2.92</td>
</tr>
<tr>
<td>9. An approach similar to cognitive behavioral therapy</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>58.33%</td>
<td>16.67%</td>
<td>12</td>
<td>3.92</td>
</tr>
</tbody>
</table>
Table 10 (continued)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>N</th>
<th>( \bar{x} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Forms of computerized brain training</td>
<td>25.00%</td>
<td>25.00%</td>
<td>8.33%</td>
<td>33.33%</td>
<td>8.33%</td>
<td>12</td>
<td>2.75</td>
</tr>
<tr>
<td>11. Medication based strategies</td>
<td>50.00%</td>
<td>16.67%</td>
<td>25.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>12</td>
<td>2.00</td>
</tr>
<tr>
<td>12. Active, collaborative learning in small groups</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>41.67%</td>
<td>33.33%</td>
<td>12</td>
<td>4.08</td>
</tr>
<tr>
<td>13. Hands-on education strategies</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.67%</td>
<td>50.00%</td>
<td>33.33%</td>
<td>12</td>
<td>4.17</td>
</tr>
<tr>
<td>14. Yoga</td>
<td>8.33%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>58.33%</td>
<td>0.00%</td>
<td>12</td>
<td>3.42</td>
</tr>
<tr>
<td>15. Mindfulness</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>50.00%</td>
<td>25.00%</td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td>16. Relaxation training</td>
<td>8.33%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>50.00%</td>
<td>16.67%</td>
<td>12</td>
<td>3.67</td>
</tr>
</tbody>
</table>

Summary of Delphi Round 2

The researcher presented the 16 practices identified from Round 1 (see table 10) to the Round 2 participants \( (N = 21) \) for rating. The experts were asked to rate their agreement on a scale of 5 to 1, with 5 denoting the strongest agreement, in the form of Likert-type rating scale. Nine respondents exited the survey after responding to the agreement to participate. Only 12 respondents, which was a 50% response rate, of the original 24 respondents in Round 1 rated all 16 strategies.
In order of highest agreement, seven strategies received the highest rate of agreement with an average of 4 or more: (1) benefits of sleeping (4.50); (2) understanding the causes and prevention of stress (4.42); (3) starting school later in the morning (4.33); (4) hands-on education strategies (4.17); (5) active collaborative learning in small groups (4.08); (6) familiarity with a stress-induction formula (4.0); and (7) mindfulness (4.0). Nine strategies, listed in order of highest disagreement, received an agreement of less than four: (1) medication-based strategies (2.0); (2) forbid use of Facebook and social media (2.58); (3) forms of computerized brain training (2.75); (4) using visual mapping (often called mind mapping) (2.92); (5) Yoga (3.42); (6) apply spaced learning techniques (3.58); (7) meditation (3.58); (8) relaxation training (3.67); and (9) an approach similar to cognitive behavioral therapy (3.92). Understanding the causes and prevention of stress was the only strategy that all experts rated with agreement and strong agreement with no neutrality or disagreement.

Delphi Round 3

Round 3 offered the participating experts (N = 17) one last chance to review their colleagues’ previous responses as well as to collectively contribute their expertise as to the final recommendations of suggested strategy use made to educational leaders. The researcher used Round 2 data in the form of the calculated mean and standard deviation to rank order the 16 suggested strategies from highest expert agreement to lowest expert agreement using the mean and standard deviation. Where there was a tie with the mean, the standard deviation was used to rank order, and where the standard deviation was also a tie, the strategies were ranked alphabetically. Table 11 displays the rank order results.
Table 11

*Rank Order of Strategies by Mean and Standard Deviation*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Agree (n)</th>
<th>Disagree (n)</th>
<th>N</th>
<th>(\bar{x})</th>
<th>(M (SD))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits from sleeping</td>
<td>100% (16)</td>
<td>0.00% (0)</td>
<td>16</td>
<td>1.00</td>
<td>4.5 (1.12)</td>
</tr>
<tr>
<td>Understanding the causes and prevention of stress</td>
<td>94.2% (16)</td>
<td>5.88% (1)</td>
<td>17</td>
<td>1.06</td>
<td>4.42 (49)</td>
</tr>
<tr>
<td>Starting school later in the morning</td>
<td>70.59% (12)</td>
<td>29.41% (5)</td>
<td>17</td>
<td>1.29</td>
<td>4.33 (1.11)</td>
</tr>
<tr>
<td>Hands-on education strategies</td>
<td>93.33% (14)</td>
<td>6.67% (1)</td>
<td>15</td>
<td>1.07</td>
<td>4.17 (0.69)</td>
</tr>
<tr>
<td>Active collaborative learning in small groups</td>
<td>81.25% (13)</td>
<td>18.75% (3)</td>
<td>16</td>
<td>1.19</td>
<td>4.8 (0.76)</td>
</tr>
<tr>
<td>Familiarity with a stress-inducing stimulus</td>
<td>68.75% (11)</td>
<td>31.25% (5)</td>
<td>16</td>
<td>1.31</td>
<td>4.0 (0.71)</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>56.25% (9)</td>
<td>43.75% (7)</td>
<td>16</td>
<td>1.44</td>
<td>4.0 (0.71)</td>
</tr>
<tr>
<td>An approach similar to cognitive behavior therapy</td>
<td>57.14% (8)</td>
<td>42.86% (6)</td>
<td>14</td>
<td>1.43</td>
<td>3.92 (0.64)</td>
</tr>
<tr>
<td>Relaxation training</td>
<td>78.57% (11)</td>
<td>21.43% (3)</td>
<td>14</td>
<td>1.21</td>
<td>3.67 (1.03)</td>
</tr>
<tr>
<td>Apply spaced learning techniques</td>
<td>50.00% (6)</td>
<td>50.00% (6)</td>
<td>12</td>
<td>1.50</td>
<td>3.58 (0.87)</td>
</tr>
<tr>
<td>Meditation</td>
<td>35.71% (5)</td>
<td>64.29% (9)</td>
<td>14</td>
<td>1.64</td>
<td>3.58 (1.11)</td>
</tr>
<tr>
<td>Yoga</td>
<td>42.86% (6)</td>
<td>57.14% (8)</td>
<td>14</td>
<td>1.57</td>
<td>3.42 (0.86)</td>
</tr>
<tr>
<td>Using visual mapping</td>
<td>46.15% (6)</td>
<td>53.85% (7)</td>
<td>13</td>
<td>1.54</td>
<td>2.92 (1.04)</td>
</tr>
<tr>
<td>Forms of computerized brain training</td>
<td>16.67% (2)</td>
<td>83.33% (10)</td>
<td>12</td>
<td>1.83</td>
<td>2.75 (1.36)</td>
</tr>
<tr>
<td>Forbid the use of Facebook and other social media</td>
<td>50.00% (7)</td>
<td>50.00% (7)</td>
<td>14</td>
<td>1.50</td>
<td>2.58 (0.64)</td>
</tr>
<tr>
<td>Medication-based strategies</td>
<td>0.00% (0)</td>
<td>100% (12)</td>
<td>12</td>
<td>2.00</td>
<td>2.0 (1.15)</td>
</tr>
</tbody>
</table>
The neuroscientists were asked to solicit one final opinion as to either agreement or disagreement as to whether the strategies should be included in the suggestions to educational leaders. Table 12 lists the results of Round 3. The strategies are rank ordered by percentage of agreement.

Table 12

*Final Results of Ranked Strategies*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Agreement</th>
<th>Disagreement</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits from sleeping</td>
<td>100.00%</td>
<td>0.00%</td>
<td>16</td>
</tr>
<tr>
<td>Understanding the causes and prevention of stress</td>
<td>94.12%</td>
<td>5.88%</td>
<td>17</td>
</tr>
<tr>
<td>Hands on education strategies</td>
<td>93.33%</td>
<td>6.67%</td>
<td>15</td>
</tr>
<tr>
<td>Active collaborative learning in small groups</td>
<td>81.25%</td>
<td>18.75%</td>
<td>16</td>
</tr>
<tr>
<td>Relaxation training</td>
<td>78.57%</td>
<td>21.43%</td>
<td>14</td>
</tr>
<tr>
<td>Starting school later in the morning</td>
<td>70.59%</td>
<td>29.41%</td>
<td>17</td>
</tr>
<tr>
<td>Familiarity with stress inducing stimulus</td>
<td>68.75%</td>
<td>31.25%</td>
<td>16</td>
</tr>
<tr>
<td>An approach similar to cognitive behavioral therapy</td>
<td>57.14%</td>
<td>42.86%</td>
<td>14</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>56.25%</td>
<td>43.75%</td>
<td>16</td>
</tr>
<tr>
<td>Apply spaced learning techniques</td>
<td>50.00%</td>
<td>50.00%</td>
<td>12</td>
</tr>
<tr>
<td>Forbid the use of Facebook and other social media</td>
<td>50.00%</td>
<td>50.00%</td>
<td>14</td>
</tr>
<tr>
<td>Use visual mapping</td>
<td>46.15%</td>
<td>53.85%</td>
<td>13</td>
</tr>
<tr>
<td>Yoga</td>
<td>42.86%</td>
<td>57.14%</td>
<td>14</td>
</tr>
<tr>
<td>Meditation</td>
<td>35.71%</td>
<td>64.29%</td>
<td>14</td>
</tr>
<tr>
<td>Forms of computerized brain training</td>
<td>16.67%</td>
<td>83.33%</td>
<td>12</td>
</tr>
<tr>
<td>Medication-based strategies</td>
<td>0.00%</td>
<td>100.00%</td>
<td>12</td>
</tr>
</tbody>
</table>
As delineated by Table 12, only one strategy, benefits of sleep, received 100% agreement of inclusion in the results to educational leaders. Four strategies (25% of the strategies) received agreement of 80% or higher. Eight strategies (50% of the strategies) received agreement of higher than 50% or more agreement than disagreement. Two strategies received equal agreement and disagreement, and six strategies received more disagreement than agreement. Only one strategy, medication-based strategies, received 100% disagreement.

Summary

This chapter presented the results of the Delphi study. The researcher utilized the Delphi method to develop consensus of the strategies that neuroscientists suggested educational leaders could use to reduce stress for educators related to pervasive change environments in public education. Besides a consensus of a list of strategies, the study also denoted the degree of agreement for use of the strategies.

The researcher selected the neuroscientists invited to participate in this study from the list of 350 members of the Dana Alliance for Brain Initiatives (DABI). The researcher secured 301 email addresses from the list of 350 members and invited these members to participate in a survey to suggest neuroscientific-supported strategies that, if used by educational leaders with educators, could increase cognition while undergoing the stress related to pervasive change environments. Round 1 responses were analyzed from 24 respondents, and a list of 16 strategies were presented in Round 2 for neuroscientists to rate agreement using a 5-point Likert-type rating scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The researcher
analyzed the resulting 12 responses in Round 2 for mean, standard deviation, degree of agreement, and the percentage of respondents who agreed or strongly agreed to the use of the strategies. The strategies were then rank ordered by mean and agreement and sent to the neuroscientists for a final Round 3. The standard deviation served to rank order tied responses; in instances of a tied mean and standard deviation, ranking was alphabetical.

In Round 3, the 17 experts were asked to agree or disagree with the suggested the strategies for educational leaders to use in managing stress in pervasive change environments responded with agreement. Four strategies had more than 80% agreement for use by educational leaders as compared to seven strategies having a mean of 4.0 or higher in Round 2, demonstrating higher consensus. Chapter 5 provides a summary and discussion of the major findings, presents the conclusions and implications, and offers recommendations for future research.
Stress is an identified reason for educators leaving the profession in large numbers (Elder, Nidich, Moriarty, & Nidich, 2014; Fullan, 1993, 2001; Harris, 2011; Ingersoll, Merrill, & May, 2014; Kessinger, 2011; McCormick & Barnett, 2011; Richards, 2012; Sass, Seal, & Martin, 2011; Tamir, 2011). Recent estimates of new teacher attrition are that 44% of new teachers are leaving the profession within five years (Perda, 2013), up 50% in two decades, and it is costing billions of dollars annually (Carroll & Foster, 2010; Ingersoll, Merrill, & Stuckey, 2014; Perda, 2013). Stress actually changes the brain by reducing neurons, reducing the size of the prefrontal cortex, and increasing the size of the amygdala, essentially reducing cognition and increasing fear. When under stress, the brain resorts to habit making to conserve energy. Educators in chronic stress actually create habits of resistance and habits of maintaining the status quo. Stress is a byproduct of the biological response to change.

Findings in neuroscience report that the brain responds to change just as it does to threat, which increases the stress response and decreases cognition (Bremner, 2005; Caine & Caine, 2006; Calabrese & Roberts, 2002; Gantt & Agazarian, 2010; Herry, Cioci, & Senn, 2008; Lafferty & Alford, 2010; Perry, 2006; Rock & Page, 2009; Rock & Schwartz, 2007; Steadman, 2011). Education is in a constant state of change due to increased criticism, changes on the global industry scene, and increased pressure to
produce results (Banks et al., 2007; Kessinger, 2011). Furthermore, the fact that almost half of all new teachers leave the profession within five years provides ongoing challenges to educational leaders’ abilities to develop cohesive faculties and staffs. The irony of education being in a constant state of change is that most schools look the same from an observer’s point of view, which perceives the model of a teacher delivering information to students. Despite the plethora of changes introduced to education, educators assimilate the new information in old ways of habits, thus leaving the environment unchanged with no new results.

Pairing the stress response triggered by the plethora of changes occurring in education to the findings in neuroscience that people respond to change just as they do to threat results in reduced cognition and increased stress, both of which are detrimental to educators in the midst of change and the educational leaders responsible for creating a climate of results. This study sought to identify neuroscientific strategies for improving cognition while undergoing change-induced stress for educational leaders in pervasive change environments to utilize in support of their colleagues through the change process. Leading systemic change in an era of unrelenting demand for educational improvement may be dependent on a leader’s ability to create change environments that are conducive to embracing change and free of stress, fear, and threat. Embracing aspects of neuroscience to create a safe climate where educators are empowered to be innovative, inventive, and novel in their approaches to improving education for learners requires increased cognition and may result in a collective effort for quantum leaps of change (Lovett, 2001).
Summary and Discussion of Major Findings

When asked to suggest strategies that could bypass the fight-or-flight stress response so that the cognition would stay intact to accommodate the pervasive change environments of public education, experts collectively identified 16 strategies. After three rounds of Delphi, the experts arrived at a consensus by narrowing the options to four strategies that had a high rate of agreement for assisting educators to reduce stress and maintain cognition. The four strategies suggested were benefits of sleeping, understanding the causes and prevention of stress, hands on education strategies, and active collaborative learning in small groups. The strategy that all of the experts disagreed with unanimously was the use of medication-based strategies.

Benefits of Sleeping

One hundred percent of the 16 respondents rated benefits of sleeping as an important strategy for educational leaders to include in their repertoire of suggestions to educators. The expert who suggested this strategy referred to children and not adults, but the body of research supports that the brains of adolescents and adults require sleep, although perhaps different amounts for different people, for proper brain function. This finding is consistent with the review of literature, since sleep is a required component of brain optimization related to the brain being a survival organ (Medina, 2008). Further, reduced cognition is the result of the brain not getting its required sleep (Medina, 2008; Palmer et al., 2014). When deprived of sleep, an individual experiences a loss of executive function, memory, and logic (Medina, 2008). Gains in sleep result in improved emotional control and cognition (Ibanez, San Martin, Dufey, Bacquet, & Lopez, 2008;
Payne, 2011; Rock, Siegel, Poelmans, & Payne, 2012; Tassi et al., 2006). Research also supports that stress results in sleep problems (McEwen, 2007) and the evidence of a stress loop related to sleeping patterns in that stress causes lack of sleep, which results in cognition issues, and lack of sleep causes reduction in cognition, which can cause stress (Angier, 2009). Sleep also serves as replenishment of blood glucose and blood oxygen levels (Purves et al., 2008; Rock et al., 2012).

Understanding the Causes and Preventions of Stress

Sixteen out of seventeen respondents agreed with rating the importance of understanding the causes and preventions of stress, thus resulting in a 94.12% rate of agreement for this strategy. The literature supports how stress affects biological responses: stressed brains are more vulnerable to making habits (Duhigg, 2012) because habits save energy and stressed brains do not have as much glycogen for energy. Causes of stress vary among individuals, for what may be stressful to one may not be stressful to another (Medina, 2008). Stress responses vary behaviorally and physiologically, depending on the stressor and the individual experiencing the stress, and typically result in a negative response and an avoidance or reduction of the stressor (Kim & Diamond, 2002; McEwen, 2007; Medina, 2008).

The experts suggested public speaking and writing as a suggestion for implementation. Research highlights many emotional, mental, physical, and social preventions of stress, such as play, voluntary exercise, humor, and sleep. The research also suggests repeated exposure to the stressor to lessen the stress response.
Hands-On Education Strategies

Fourteen expert respondents (93.3%) demonstrated agreement for the use of hands-on strategies to promote change in education. The expert suggested “drills that involve role playing in a safe environment” for implementation and incorporation of physical involvement. While the review of literature does not specify the exact language of hands-on strategies, the use of play to counteract stress is suggested (Rock et al., 2012). Brown (2010) stated that adult play strengthens the brain and results in neurogenesis. Creativity is an outcome of play, and physically getting your hands involved in the process facilitates understanding (Brown, 2010; Panksepp & Biven, 2012; Rock et al., 2012).

An additional benefit of hands-on strategies is the idea of sensory integration as supported by research. Opendak and Gould (2015) promoted the use of multisensory activities for a brain to welcome new ideas. There is also a suggestion that stimulation is necessary to avoid the amygdala being “hijacked” (Goleman, 1995, p. 14) because of a negatively perceived experience (Bass & Avolio, 1994; Opendak & Gould, 2015). As another example of hands-on learning, Senge (1990) recommended adaptive learning joined with generative learning to facilitate individual creativity.

Active Collaborative Learning in Small Groups

Thirteen out of sixteen respondents (81.25%) agreed that active collaborative learning in small groups could be a strategy to bypass stress to promote change. When asked to describe the implementation of the neuroscientifically supported practice of active collaborative learning in small groups, the expert wrote,
An academic leader should organize a “coalition of the willing” among faculty members, those who are willing to learn and implement the new strategies of active learning. Once others see how much better the outcomes are with that approach, many more will want to get involved.

Research documents the social requirements of the brain as extremely beneficial to the brain’s ability to create neuronal pathways (Heatherton, 2011). Social bonding is necessary for brain optimization (Cacioppo, 2002; Eisenberger, 2011; Kussrow, 2001; Rock & Page, 2009). Positive social interaction and bonding improve cognitive and executive functions (Rock & Page, 2009). Social benefits to the brain include survival, neurogenesis, neuroplasticity, and stress reduction (Eisenberger, 2011; Gardner, 2003; Goleman, 2006; Hanson, 2009; Medina, 2008; Rock, 2008; Rock & Page, 2009).

Medication-Based Strategies

Twelve expert respondents were in total disagreement in using medication-based strategies. This major finding warrants further exploration. The literature review supported a more holistic approach of using nutritional supplements, also referred to as neurochemistry (Hanson, 2009). The research does mention the costs associated with medication-based strategies in relationship to the medical costs, insurance costs, and absenteeism associated with teacher burnout and attrition. More research to determine how medication-based strategies are harmful to the brain’s ability to cope with stress is necessary.
Limitations

Some of the suggestions by the experts related to student learning and cognition, as well as teacher instructional practices that potentially influence cognition. This might indicate a misunderstanding of what the research sought to discover and/or signify that the experts possessed limited familiarity with current school reform efforts and how those efforts result in a climate of almost continuous change. Perhaps if the experts had a better understanding of this, the responses might have been different. However current brain research is clear on the findings of how change/fear/threat affects all brains biologically, adolescent or adult, in the same way, and whether or not the stimulus is a tiger, snake, evaluation system, school reform, or an alarm, and that is to engage the fight-or-flight response. How the brain does differ is the snake that causes alarm in one individual may evoke curiosity in another. Skydiving may be stressful to one individual and may not be stressful to another. Some educators may welcome school reform, and others dread or deny it. However, for this research, the researcher requested strategies to bypass stress and increase cognition for educational leaders to lead with educators involved in pervasive change; the replies about student learning and cognition by some of the experts are evidence that they misunderstood the request. Future research could identify experts familiar with school reform efforts that result in continuous change environments.

Conclusions

This Delphi study was used to determine if experts had neuroscientific research-supported suggestions that public education leaders could use to introduce and facilitate
change in a manner that could significantly increase cognition and reduce the emotional impact of the brain’s automatic stress/fear/threat response to change and educational reform. The panel of experts identified the four strategies that met the prescribed threshold of 80% or better indicating strong agreement: knowing the benefits of sleeping, understanding the causes and preventions of stress, using hands-on education strategies, and implementing active collaborative learning in small groups. The findings were consistent with neuroscience research related to the needs of the brain as a survival organ and ways to obviate stress in general. When asked whether the experts thought that incorporating neuroscientific-supported practices in P-16 education would be effective in leading change in public education, 50% of the experts responded with being unsure, and roughly 42% responded affirmatively. Continued research is necessary.

Implications

For educational leaders, the findings of this study indicate a return to a more organic approach to leading change. Neuroscientists did not suggest any expensive or exclusive strategies, but rather strategies that are simple, cost-effective, readily available, and user-friendly. The findings are consistent with the theoretical framework of Fisher’s Process of Transition, which recognizes how organizational change and emotions are interlinked and supports a leader’s focus on strengthening the emotional capacity of individuals and groups of colleagues (Fisher, 2012). Garnering the synergy suggested by the conceptual framework for leaders using neuroscientific-supported strategies to promote change, educational leaders could implement the identified strategies immediately with relatively very little studying and preparation.
In order to use the suggestions from neuroscientists for educational leaders to understand clearly the causes of stress and how to prevent stress, leaders need to understand the negative and positive effects of stress, the biological responses of stress, the reasons for prevention, and how change invokes stress. Recognizing stress as an emotion with its variety of levels of stress is connected to Fisher’s Process of Transition (Fisher, 2012). It also requires educational leaders to understand how stress interferes with productivity and inhibits change so that they must be ever evolving into recognizing the symptoms of stress and what stress looks like from their colleagues. Educational leaders should use the research that contends that stressed brains are more likely to make habits to understand how difficult it is for educators to let go of habits and to better understand why their resistance appears to innate. Using the knowledge of habits could shift the paradigm and potentially make the habits of stress inoculation, retention, and innovation as the new norm, essentially changing the patterns of resistance of educators (Duhigg, 2012; Mason, 2008; Rogan, Staubli, & LeDoux, 1997).

Another major implication for educational leaders and educators is the understanding that sleep is a necessary component for a successful stress-free existence. Imagine educational leaders encouraging their colleagues to sleep and creating the climate for making it happen by reducing their workload. Educational leaders and their educator colleagues would know that the lack of sleep is actually causing them more stress, less productivity, and reduced cognitive engagement. In addition, they would understand that their leadership has created a better opportunity for them to engage in
healthier sleep habits. More productive sleep habits could mean increased opportunities for enhanced cognitive creativity.

The implications for educational leaders for using hand-on strategies to introduce and promote change to educators serve several purposes. Educators need to understand organically the change in order to facilitate learning. The more one plays or conceptualizes an idea, theory, initiative, or a task, the more likely an educator will be able to understand and master the concept. The sensory experience of hands-on strategies also serves to connect the ideas to the learners’ brains neuronally and allows prohibits the negative perception of change that the amygdala automatically attempts to attribute (Bass & Avolio, 1994; Goleman, 1995; Opendak & Gould, 2015).

The implication for educational learners to use active collaborative learning in small groups to facilitate change is the concept of safety in numbers. In this case, it refers to the emotional safety provided by small groups of collaborators. When an educational leader understands the brain’s need for social bonding, emotional connection, and creating meaning with others, collaborative leadership has the potential for actualization (Hallinger & Heck, 2010). Working collaboratively in small groups also supports NeuroLeadership founder, Rock’s (2008) SCARF model of status, certainty, autonomy, relatedness, and fairness and how a leader’s understanding of the brain’s need for these concepts can influence change. Fisher’s Process of Transition acknowledges how the cumulative effects of each individual makes up the group dynamic and that a group relying on the group capacity can accelerate change (Fisher, 2012).
There are implications for lawmakers, educational reformers, and for educational leaders at the state, district, and school level as to the futility of continuing to add change initiatives without taking away any. The tendency in public education is to do more to get more, but what if the paradigm is to do more with less? Because educators would benefit from more sleep and stress impacts their productivity, perhaps reducing the number of change initiatives would allow for a narrower focus. This could reduce the number of exiting teachers, who report burnout, low pay, lack of resources, and stress related to change as reasons for leaving the profession. In addition, the drastic reduction of costs associated with failed change initiatives would serve to fund more hands-on materials for ongoing learning. Imagine innovative competitions where educators work with students to work on real-world problem solving to solve challenges from industry, rather than working on problems already solved.

There are also implications related to the infancy of neuroscience and education. That fact that half of the expert respondents were unsure as to the viability of the marriage between neuroscience and education indicates the need for more research by both educators and neuroscientists. Ideally, they would create opportunities to engage collaboratively in research. Empirical research for neuroscientists and educators needs to be a viable partnership.

Educational leaders need to understand that neuroscience research focuses on the neurogenesis and neuroplasticity of the brain and the benefits for adults, as well as children. In fact, adults are more at risk of resorting to habits during stressful periods, which is in direct contradiction to neurogenesis. Stress reduces neurons and inhibits
neurogenesis (Bremner, 2005). More neurons reduce stress (Opendak & Gould, 2011; Snyder, Soumier, Brewer, Pickel, & Cameron, 2011). Therefore, focus on creating situations for more creativity and innovativeness will result in neurogenesis and, consequently, reduced stress. If there is a collaborative focus on creativity and ingenuity, and embracing change is the goal for educators, then educational leaders need to be the model they want their educators to be.

Educational leader and teacher preparation programs, recruitment for education programs, and recruitment and retention strategies for the education profession should focus on attracting individuals who thrive under what may be stressful to some, understand stress and cognition biologically, engage as active learners who like to work in groups, embrace change as the status quo, and conduct action research.

Recommendations for Future Research

This study integrated the fields of study specifically related to the brain’s response to change and stress as a threat and how it may contribute to inhibiting transformational change in education. Further research is necessary to clarify this phenomenon. There are numerous possibilities for research in the areas of neuroscience and education:

- Repeat the study surveying neuroscientists actively engaged in neuroscience research who are relatively newer experts and more prone to exposure to more current research techniques.
- Repeat the study and specifically identify neuroscientists who are familiar with the stress response related to change.
• Repeat the study and survey only cognitive neuroscientists who study how neural systems make up cognition. Cognitive neuroscientists are a narrower field of neuroscientists who may be familiar with cognitive decline under stress.

• Additional research could interview educators who have been successful in responding to change to identify the strategies they used to keep stress at bay.

• Survey the sleep habits of successful educational leaders of schools with desired results.

• Survey those educators who exit the profession due to stress to determine if they have used medication-based strategies in previous years in hopes of alleviating stress.

• It would be interesting to survey those teachers who remain in the profession to determine what percentage of educators are utilizing medication-based strategies to deal with stress and to study the correlation of schools and their achievement success.

• Survey educational leaders who are successful in spite of stress factors (e.g., poverty, at risk student populations, change) to determine the strategies they use to create a stress-free climate.

• Educational leaders and neuroscientists should engage in collaborative action research around the findings and their possible contributions to promoting change.
Final Thoughts

New teachers leaving the profession at rates of almost 50% within their first five years costs the taxpayers billions of dollars each year (Ingersoll et al., 2014; Perda, 2013). It is hard to imagine that the status quo of education system can remain intact for too much longer if it is not producing the necessary number of graduates and workers who are capable of working in a global knowledge economy. Additionally, the research questions the educational system’s focus on competitive individual standardized learning, when not only brain health, but also industry, values creative ingenuity and teamwork over the individual. Imagine a school where an observer looks into a room and cannot distinguish the educator from the learner because small groups of people blissfully engage in hands-on activities as they discover new knowledge together fill the room. In this new knowledge economy, the educational leaders understand that the work of school happens at school and that the long hours of working into the night to meet the excessive educational requirements serve only to reduce neurons, create habitual practices of resistance, inhibit growth, and stifle change. Educational leaders promote the benefits of sleeping and understand the causes and prevention of stress, as evidenced by a climate of play, creativity, and innovation in real world, generative learning. The promotion of this vision and the transformation of what learning looks like by educational leaders will result on the realization of the capacity for the brain to learn in innovative ways. Costs (health costs, training) associated with attrition and stressed educators could be reduced (Opendak & Gould, 2011; Snyder et al., 2011).
There are many implications for more research in the area of neuroscience and education. The field of neuroscience has increased dramatically in recent decades and the Society of Neuroscience has more than 38,000 members. Education departments have created degrees incorporating neuroscience. Clearly there is a movement towards this emerging partnership of neuroscience and education (Ansari, Coch, & DeSmedt, 2011; Ashkanasy, Becker, & Waldman, 2014; Goswami, 2008; Healey & Hodgkinson, 2014; Hruby, 2012; Lindebaum & Zundel, 2013). After all, what is education about but optimizing the brain and its learning potential? The scientists who study the phenomena of brain optimization are neuroscientists. It seems an obvious enterprise, yet there exists caution as much as promotion of their joint enterprise.

With increased pressure on educational institutions to promote effective learning, increase retention, and reduce attrition, it is in school leaders’ best interests to create a climate of reduced stress for teachers. Extending the service of teachers, creating a climate of stress tolerance, and reducing the costs associated with attrition and the negative health effects and medical costs of stress could transform education.
REFERENCES


APPENDICES
APPENDIX A

IRB APPROVAL
03-Jan-2016

Ms. Cami Rae Hamlin
Mercer University
Tift College of Education
1501 Mercer University Drive
Macon, GA 31207-0001

RE: Neuroscientific Strategies For Managing Stress Related To Pervasive Change in Public Education : A Delphi Study (H1532341)

Dear Ms. Hamlin:

Your application entitled: Neuroscientific Strategies For Managing Stress Related To Pervasive Change in Public Education : A Delphi Study (H1532341) was reviewed by this institutional review board for human subjects research in accordance with Federal regulations 45 CFR 46.110(b) and 45 CFR 46.110(e) (for expedited review) and was approved under Category 7 per 45 FR 60944.

Your application was approved for one year of study on 03 Jan 2016. The protocol expires 04 Jan 2017. If the study continues beyond one year, it must be re-evaluated by the IRB Committee.

Item(s) Approved:
New application online surveys

Please complete the survey for the IRB and the Office of Research Compliance. To access the survey, click on the following link: https://www.surveymonkey.com/K2CCTR

Respectfully,

Ave Chambaliz-Richardson, M.ED., CHI, CCM
Member
Institutional Review Board
Mercer University IRB & Office of Research Compliance
Phone (478) 301-4101
Fax (478) 301-2329
ORC_Mercer@Mercer.Ed

1400 Coleman Ave • Macon, Georgia 31207 • (478) 301-4101 • FAX (478) 301-2329
26-Feb-2016

Mr. Carl Rae Harlin
Mercer University
1501 Mercer University Drive
Macon, GA 31207-0001

Ref: Neuroscientific Strategies For Managing Stress Related To Parvasive Change In Public Education: A Delphi Study (H1512341)

Dear Mr. Harlin,

I am in receipt of a modification submitted, to the above protocol (H1512341).

On 26-Feb-2016, reviewed and approved the Addendum on behalf of Mercer University's Institutional Review Board for Human Subjects Research in accordance with Federal Regulations 451112 and 451115(a) categories(4) for expedited review.

Change Approved:
Modification: Significant Change - Round 2 Survey with Likert-Type Responses based upon Round 1 Open Ended Responses

NARRATIVE: Round 2 Survey with Likert-Type Responses based upon Round 1 Open Ended Responses; in Round 2 the researcher will solicit the experts’ rating and preliminary agreement of the strategies noted in Round 1 of the Delphi. The researcher will collect data in the form of a Likert-type rating scale on a scale of 5 to 1, with 5 denoting the highest agreement of strongly agree.

NOTE: The approval date of this modification does not change the annual renewal date of your protocol.

Please complete the survey for the IRB and the Office of Research Compliance. To access the survey, click on the following link: http://www.zoomerang.com/Survey/ra-LS4G1C6D24541.

It has been a pleasure to work with you and much success with your project! If you need any further assistance, please feel free to contact our office.

"Mercer University has adopted and agrees to conduct its clinical research studies in accordance with the International Conference on Harmonization's (ICH) Guidelines for Good Clinical Practice."

Mercer University IRB & Office of Research Compliance
Phone (478) 301-4101
Fax (478) 301-2329
ORC_Research@Mercer.Edu

Respectfully,

[Signature]

Ava Chambers-Richardson, M.Ed., COP, CIM
Member
Institutional Review Board
30-Mar-2016

Ms. Carrie Hamlin
Mercer University
1501 Mercer University Drive
Macon, GA 31207-0001

RE: Neurocognitive Strategies For Managing Stress Related To Pervasive Change in Public Education: A Depth Study (H1512341)

Dear Ms. Hamlin:

I am in receipt of a modification submitted to the above protocol (H1512341).

On 3/30/2016, I reviewed and approved the Addendum on behalf of Mercer University’s Institutional Review Board for Human Subjects Research in accordance with Federal Regulations 45.110 and 45.111(a)(1)(ii) and (iii), permitted changes for review.

Changes approved:

Modification - Significant Change: Round 3 Survey with Agree/Disagree Responses based upon Round 1 Responses/Results with Mean and Sampling Standard Deviation

NARRATIVE

In the final round below, strategies suggested by DASH members are ranked by mean and include sampling standard deviation. This final round is a chance for the experts to review the collective contributions and to have one last chance to agree or disagree to the inclusion of the strategies as recommendations to educational leaders in helping educators to reduce stress and increase their cognition when confronted with any type of change in schools, essentially bypassing or inculcating themselves against the reflexive “fight or flight” mode. Please offer your expertise in rating your agreement or disagreement of whether each strategy should be included in the suggestions made to educational leaders.

NOTE: The approval date of this modification does not change the annual renewal date of your protocol.

Please complete the survey for the IRB and the Office of Research Compliance. To access the survey, click on the following link: http://www.zoomerang.com/Survey?c=WERPDURKQG

It has been a pleasure to work with you and much success with your project! If you need any further assistance, please feel free to contact our office.

“Mercer University has adopted and agrees to conduct its clinical research studies in accordance with the International Conference on Harmonization’s (ICH) Guidelines for Good Clinical Practice.”

Mercer University IRB & Office of Research Compliance
Phone (478) 301-4101
Fax (478) 301-2329
ORC_Research@Mercer.edu

Respectfully,

[Signature]

Ava Chambers-Richardson, M.Ed., CIP, CIM
APPENDIX B

SURVEY INVITATION
Dear Respondent,

My name is Cami Rae Hamlin. I am a doctoral candidate at Mercer University in the Educational Leadership Program. I am conducting a research study designed to identify the specific strategies or skills supported by neuroscience research that public education leaders could use to introduce and facilitate change in a manner that could significantly increase cognition and reduce the emotional impact of the brain’s automatic stress/fear/threat response to change and educational reform. It is being conducted in support of the degree requirements for a PhD and is entitled Neuroscientific Strategies for Managing Stress Related to Pervasive Change in Public Education: A Delphi Study. I am emailing to ask if you would like to participate by completing a survey for this research project. Mercer University’s IRB requires investigators to provide informed consent to the research participants.

If you would be interested in taking this survey, please click on this link and provide your consent to take the survey: (https://www.surveymonkey.com/r/CNH9V8R).

If you have any questions about the study contact the investigator (Cami Rae Hamlin, cami.rae.hamlin@live.mercer.edu).

Mercer University’s Institutional Review Board (IRB) reviewed study #H1512341) and approved it on (05-Jan-2016).

Questions about your rights as a research participant:
If you have questions about your rights or are dissatisfied at any time with any part of this study, you can contact, anonymously if you wish, the Institutional Review Board by phone at (478) 301-4101 or email at ORC_Research@Mercer.edu.

Thank you in advance for your time and participation!
For Figure 1

On 7/14/2013 10:10 AM, camihamlin@aol.com wrote:

Dr. Travis,

I hope this request finds you well. I am writing to you to request permission to use an image in my dissertation presentation. The image relates to the effects of stress on executive function and is attached. I would be most appreciative if permission could be granted. If you need further information please don't hesitate to ask.

Kindest regards,

Cami Hamlin

From: Fred Travis <ftravis@mum.edu>

To: camihamlin <camihamlin@aol.com>

Sent: Sun, Jul 14, 2013 12:08 pm

Subject: Re: Use of Image Permission

Yes, Cami, you may use this. Thank you for asking

Fred
For *Figure 2*

From: camihamlin@aol.com

Sent: 26 May 2017 23:40

To: john.m.fisher@c2d.co.uk

Subject: Fisher's Process of Transition

Mr. Fisher, May I have permission to use your diagram in my dissertation?

Kindest regards, Cami Hamlin

From: "John M Fisher" <john.m.fisher@blueyonder.co.uk>

Date: May 27, 2017 at 12:34:24 PM EDT

To: <camihamlin@aol.com>

Subject: RE: Fisher's Process of Transition

Cami, of course you have my permission to use my diagram in your dissertation J

Out of curiosity, what is your dissertation about and how are you using it?

Thanks

john

John M Fisher

C Psychol, AFBPsS, PMABP, MSc., FITOL

07980743613
For Figure 4

Resent-From: <Cami.Rae.Hamlin@live.mercer.edu>

From: Bill Breitsprecher <webmaster@clubtnt.org>

Date: May 28, 2017 at 11:53:50 AM EDT

To: <Cami.Rae.Hamlin@live.mercer.edu>

Subject: Thank you for professional courtesy

Reply-To: <webmaster@clubtnt.org>

I appreciate that you felt it important enough to as -- sure -- please use as you need to. There is a need to educate and inform people about these issues -- thanks