Revolutionary Education: A Modern Synthesis of John Dewey's Evolutionary Philosophy and Educational Theory

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“REVOLUTIONARY EDUCATION: A MODERN SYNTHESIS OF JOHN DEWEY’S EVOLUTIONARY PHILOSOPHY AND EDUCATIONAL THEORY,” a Doctoral research project prepared by W. JASON NEIDERMEYER in partial fulfillment of the requirements for the Doctor of Education degree in the Educational Foundations and Leadership Department.

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Abstract

John Dewey was one of the first philosophers who intentionally used the principles of evolution to produce his perspective. He was also the foremost educational theorist of a generation. In both fields, he was a pragmatist, and he sought to lay waste to the dualisms that prevented progress. It is therefore ironic that he erected an artificial wall between the evolutionary thought that pervaded his writings on philosophy, psychology, and even art, and his works on education. I argue in this dissertation that the true power of Dewey would come through the synthesis of his evolutionary and educational thoughts.

Using Dewey’s works and the trajectory of his career as a template, I identify three key problems in education that Dewey needed to solve for his vision of education to align with his evolutionary philosophy. The first problem is that of the separation between subject and method, the second is from where education’s direction should derive, and the third seeks to achieve balance between the concrete and abstract knowledge that is taught in the classroom. Following Dewey’s model of using various disciplines to inform his reasoning, I draw upon research in fields that include cognitive ethology, neuroscience, anthropology, and archaeology in my quest solve Dewey’s aforementioned problems.

In the dissertation’s final chapter, I conclude that the vehicle for the success of Dewey’s evolutionary educational philosophy will be a classroom suffused with art and science, or more broadly, invention and inquiry. This conclusion aligns with some of the recent movements in education, and that provides me with hope. It is time for John Dewey to be revisited. We need the change in education to be not just about a revolution, but also about evolution.
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Completing this dissertation has been a labor of love (though there were constant reminders of the thin line that separates love from hate). Were it not for the people that kept pushing me forward through their encouragement, their guidance, or their overt and covert reminding me of what is important, the work would not be what it is. Therefore, I would like to thank each of my committee members who together helped usher me through to the stage of completion. David Barash, thank you for joining my committee on a lark by answering the unsolicited query of blindly ambitious graduate student. Your capacity to synthesize work from various fields using evolution embodies everything that I have tried to do in this work. I think John Dewey would have appreciated you. Gary Tiffin, you have been my guide through the entire George Fox program. You were the one who willingly took an agnostic under your wing and helped me feel embraced by the school in a way that I would have never predicted and I am happy that you have been there to help see me through to the end of my time at George Fox. I anticipate looking to you as a mentor for the rest of my life. And Ken Badley, I would like to thank you for being my chair. Without you, though I am certain this dissertation would have been written, it would not be well-written (or is that written well?). You have helped me to a greater understanding of good writing, and I hope this final product is representative of my growth.

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teacher proud with whatever you choose to do with your life. Luke Neff also deserves mention, because, in addition to being a fellow Burgerville fiend, it was his brief comments on the final chapter that helped me conclude the dissertation the way I wanted it to be concluded. And it would of course be wrong not to mention my cohort, “The Collective” in an Acknowledgements section. It is interesting that such a random collection of individuals with nothing in common except for a desire to improve education could have had so much fun learning statistics for three consecutive summers. Perhaps, as we all learned in that first interview, there is more power in the cohort model than we ever could have imagined.

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To my family,

Thank you for helping me remember what is important
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Chapter One:

Why Dewey? Why Now?

Depending on their vantage points, people thought of John Dewey as a philosopher, a pedagogical ideologue, or the creator of a system for organizing library books. However, he was much more than that. He was a teacher and a political theorist, a philanthropist and an art critic, a naturalist and a leader of the progressive movement. That he came to be considered a pragmatist may have seemed preordained by the sheer multiplicity of his roles, but it was hardly by Dewey’s own calculations. He sought answers to his questions through whatever means showed the most promise (Dalton, 2002). His inquiries centered on the premise: how does experience influence human existence? With this question in mind, the goal of his inquiries became to determine what could be done to improve the experience of experience.

Dewey was, therefore, a humanist. However, he did not evince the spiritual humanism of pre-colonial Europe that would manifest itself as justifiable imperialism (Crosby, 2004; Webb, 2006). Nor was he an advocate for the sort of secular humanism that perpetuated the precept of Social Darwinism (James Campbell, 1995). The rigid dualisms in academia rankled him. For Dewey objects, ideas, or experiences had no meaning in the absence of context. To Dewey (1958), these false dichotomies, while constructed to bring greater understanding to critical concepts, were in reality employed by “… those who enjoy a privileged status, whether as philosophers, as saints or scholars, and who wish to justify their special status” (p. 106). Such an act grants a greater sense of control to those in power, and erstwhile humanists of either sort, therefore, effectively could wield the dualisms. Rather, Dewey was a humanist because he sought to understand humanity so he could care for it, with the hope of facilitating growth in all individuals and all societies. Dewey, despite forays into what others considered unrelated topics
(Dewey, 1929, 1980, 1997a), would return to the two that served to connect all subjects: evolution and education.

Jerome Popp (2007), a Dewey scholar, labeled Dewey as *Evolution’s First Philosopher*. Dewey was among the first thinkers who sought to bring evolution to bear in fields outside of biology. Through his works, he used evolution to understand the problems presented not only in philosophy but also in areas as diverse as individual and social psychology (Dewey, 1929, 1958) and art (Dewey, 1980). Dewey (1966) built these intellectual bridges because, as he noted in *Democracy and Education*:

No one who has realized the full force of the facts of the connection of knowing with the nervous system and of the nervous system with the readjusting of activity continuously to meet new conditions, will doubt that knowing has something to do with reorganizing activity, instead of being isolated from all activity, complete on its own account … The development of biology clinches this lesson, with its discovery of evolution. For the philosophic significance of the doctrine of evolution lies precisely in its emphasis upon continuity of simpler and more complex organisms until we reach man. The development of organic forms begins with structures where the adjustment of environment and organism is obvious, and where anything which can be called a mind is at a minimum. As activity becomes more complex, coordinating a greater number of factors in space and time, intelligence plays a more and more marked role … For the doctrine of organic development means that the living creature is a part of the world, sharing its vicissitudes and fortunes, and making itself secure in its precarious dependence only as it intellectually identifies itself with the things about it, and, forecasting the future consequences of what is going on, shapes its own activities accordingly. (pp. 337-338)
Even as he concluded that evolution bound organisms, thoughts, and activities, Dewey did not attempt to make the connection between education and evolution. This conclusion may have arisen from his concern that the public had demonstrated an aversion to evolutionary thought (Popp, 2007) or resulted from his desire to have credible scientific evidence before making any sort of grand claim (Dalton, 2002). What is known, according to Popp (1999), is that “after more than thirty years in philosophy of education … I cannot remember one discussion of Darwin’s influence [on it]” (pp. 90-91). Dewey separately embraced evolution and education, but for whatever reason, he was not comfortable linking them. This artificial boundary did not, however, prevent him from coming to the brink of doing so.

Dewey closely studied decades of research on infant and children ontogeny hoping to merge these discoveries with those of psychology, anthropology, evolutionary biology, and the developing field of neuroscience. He sought to bring greater understanding to the vagaries of human behavior (Dalton, 2002; Dewey, 1929). Unlike his contemporaries, he realized that as much as he and everyone else were products of social circumstance, he was also a product of his biological inheritance (Dewey, 2008). He repeatedly pined for what would today be termed cognitive ethology, cognitive neuroscience, and evolutionary psychology (Dewey, 1929, 1958). Given the science that was available at the time, Dewey instead utilized information gleaned from what would be considered by today’s standards crude experiments to provide insight into human social behavior (Dalton, 2002).

Dewey thought human activity was the result of biological impulses expressed within the socially experienced cultural framework and that repeated interactions of the two realms produced habits. He (1929) determined that the institutions of society should ensure that those socially acceptable habits continued to be adaptive. His observations as a scientist, however,
demonstrated that natural impulses existed at the group, individual, and internal levels, often manifesting as a series of conflicts both among and within levels (Dalton, 2002). These conflicts meant that a shift in environmental conditions necessitated a change in both inter and intra-generational habits (Dewey, 1929).

This mindset is at odds with an individual’s desire to control his or her environment to ensure the adaptive value of his or her established behaviors. Dewey (1929) recognized this and observed that it is:

… not the nation but its customs that get old. Its institutions petrify into rigidity; there is social arterial sclerosis. Then some people not overburdened with elaborate and stiff habits take up and carry on the moving process of life. The stock of fresh peoples is, however, approaching exhaustion. It is not safe to rely upon this expensive method of renewing civilization. We need to discover how to rejuvenate from within. (p. 102)

Dewey saw this rejuvenation coming from the schools. However, because of his experience with the progressive political movement, he determined that the system was one in which “schooling has been largely utilized as a convenient tool of the existing nationalistic and economic regimes” (Dewey, 1929, p. 127). Under the influence of politics, Dewey thought that “education becomes the art of taking advantage of the helplessness of the young; the forming of habits becomes a guarantee for the maintenance of hedges of custom” (Dewey, 1929, p. 64). Through the utilization of culture to direct basal instincts, society became self-perpetuating in spite of shifting environmental conditions. The institution of education was using evolutionarily derived biological capacities with habitual constructs to prevent cultural evolution.

Dewey, a lifelong educator, wanted and expected something different from the schools. He sought to let students test the veracity of their existing habits for the release of biological
impulses in the social conditions that were presented. This practice would allow individuals and society to determine the necessity for developing new behaviors and would help perpetuate a culture that was authentic for individuals and intergenerational groups.

Education, therefore, provided a societal structure that could be designed for the production of meaningful experiences. However, an understanding was required of how humans perceive the world. Educational institutions would seem the ideal place from which to launch a biological investigation of how information and skills are transmitted. However, for Dewey, his philosophical investigations into experience played a critical part. For him, experience lay at the interface between existence and consciousness, objects and aims, and beginnings and ends; all were nothing more than boundaries assigned by the mind. The more an individual could do to connect experiences, the closer the composite of experiences came to embody an individual’s existence. The ideal institution, therefore, would allow individuals to learn from experience, which for Dewey (1966) meant that the learner is able:

“… to make a backward and forward connection between what we do to things and what we enjoy or suffer from things in consequence. Under such conditions, doing becomes trying; an experiment with the world to find out what it is like; the undergoing becomes instruction—[a] discovery of the connection of things.” (p. 164)

To him, experiences gave context and meaning to knowledge of all regardless of age, and the school and the teacher should provide them (Dewey, 1956a).

An education that focused on experiences would transcend the mind/body dualism that was the prevailing wisdom of the academicians of his day. This refocus would allow education to tackle other pedagogically important false dichotomies through biologically impelled but culturally mediated complete acts of thought (Dewey, 1997a). It would occur through the use of
what some Dewey scholars have called the pragmatic triangle, whereby an understanding of the social context (democracy) and the pedagogical means (experience and thought) would produce the desired end (education) (Popp, 1999).

For Dewey, if education were to be considered the end, it would also be the means. Because he refused to grant to any subject that it was the end, education could be viewed instead as a means to achieving meaning; a meaning that would likely change through experiencing more education. This recognition runs parallel to the process of evolution; there is no end to it either. Both of them, therefore, can be viewed in similar lights; they can serve as metaphors for each other (e.g. education can bring personal evolution).

Several researchers attempted to make the connection, but they have either fallen into the epistemological traps that Dewey himself loathed or that he had fallen into himself. In Naturalizing the Philosophy of Education: John Dewey in the Postanalytic Period, Jerome Popp (1999) brought all manner of philosophical thought to bear on the question. He included the evolutionary philosopher he presents as Dewey’s contemporary parallel in Evolution’s First Philosopher, Daniel Dennett, but beyond that inclusion, there is little science mentioned in the text. Such an omission may be because Popp’s (1998) previous work, Cognitive Science and the Philosophy of Education, was devoted to bridging the gap between classic educational philosophy and contemporary cognitive neuroscience. The work, however, was done at a time when cognitive neuroscience was in its infancy. Subsequent researchers have taken up the brain-based education mantle, taking it in so many directions that developmental neuroscientist John Bruer put the brakes on some of the most ambitious claims of this emerging educational sub-field/business venture (Bruer, 2008). His concern mimics that of Dewey (1939), who wrote:
… the final reality of educational science is not found in books, nor in experimental laboratories, nor in the class-rooms where it is taught, but in the minds of those engaged in directing educational activities. Results may be scientific, short of their operative presence in the attitudes and habits of observation, judgment and planning of those engaged in the educative act. But they are not educational science short of this point. They are psychology, sociology, statistics [and] … We must distinguish between the sources of educational science and scientific content … Enlightenment, clarity and progress can come about only as we remember that such [scientific] results are sources to be used, through the medium of the minds of educators, to make educational functions more intelligent. (p. 639)

In light of his frustration with the lack of triangulation between the learning sciences and the feeling of the classroom, Dewey would have appreciated the recent attempts to construct an evolutionary educational psychology (Carlson & Levin, 2007; Geary, 2007). However, he would not have found a satisfactory inclusion of the key sociological and philosophical issues that he knew complicated education as a subject for scientific investigation (Dewey, 1939).

Kieran Egan, an educational theorist, ambitiously has tried to generate the kind of synthesis of neuroscience, pedagogy, psychology, philosophy, sociology, and anthropology that Dewey might have sought were he alive today. Egan has, however, attempted to distance himself from John Dewey (Egan, 1997, 2002, 2008). This distancing may be a product of his own misinterpretation of Dewey as an advocate for a boiler-plate progressive student-directed education or his wanting to distance himself from an oft-misinterpreted educational theorist in hopes of carving out his own niche or for some other reason. That is for him to answer.
Unfortunately, in his attempt to create a comprehensive—and therefore evolutionary—
theory of education, Egan has fallen into the same trap as Dewey. In his last major work, Dewey
(2008) concluded that:

Intellectual operations are foreshadowed in behavior of the biological kind, and the latter
prepares the way for the former. But to foreshadow is not to exemplify and to prepare is
not to fulfill. Any theory that rests upon a naturalistic postulate must face the problem of
the extraordinary differences that mark off the activities and achievements of human
beings from those of other biological forms. (p. 49)

Dewey’s caution about minding the differences between humans and other animals was
presumably taken to heart by subsequent theorists. This includes Egan, who claims that his plan
for an educational system that develops cognitive tools is evolutionary, even though it is based
on research limited to humans. Dewey made this same separation between humans and animals
when presenting his thoughts on education, though he had drawn the conclusion that continuity
exists between humans and all other animals in other works (Dewey, 1958, 2008). Perhaps given
the chance, Dewey would have sought to incorporate studies that included both ancestral species
and those with similar learning capacities and social tendencies. Today, this aim is possible. It
was near the end of his career that Dewey (2008) wrote, “To speak, to read, to exercise any art,
industrial, fine or political, are instances of modifications wrought within the biological organism
by the cultural environment” (p. 49). Contemporary neuroscientists are now testing this
consideration in a manner that can provide the critical pieces of the puzzle that connect evolution
and education.
Statement of the Problem

Throughout his career, John Dewey emphasized the importance of context to experience. If this same premise is used to evaluate the conditions that affected Dewey’s own development as a social theorist, a parallel can be drawn with the present state of American society. His philosophical maturation occurred during a half century that witnessed the rise of three political systems (capitalism, communism, and totalitarianism), two world wars, and one global economic collapse (the Great Depression). In a classic instance of history repeating itself, the past three decades have witnessed technological innovation that expanded the marketplace for capitalism (Ritzer, 2010; Ritzer & Jurgenson, 2010). China, a communist state, has arisen as the U.S.’s chief economic rival (Ikenberry, 2008). Totalitarian regimes have given rise to wars across the globe, including two where the U.S. was one of the principal participants (Little, 2008). A global economic collapse, referred to as The Great Recession, occurred and put millions of people into some form of financial distress (Grusky, Western, & Wimer, 2011).

Dewey’s prescriptions for education could have been the response of an evolutionarily inclined philosopher to a change in environmental conditions similar to those of today. It is therefore possible that what he thought would be socially adaptive then might be adaptive today. Given the present fervor to restructure schools (Ravitch, 2011; Ripley, 2013), but with the absence of a truly comprehensive approach to change (Tucker, 2011, 2012), the amelioration of Dewey’s final dualism may provide a prescription for American education. Therefore, the aim of this dissertation is to use contemporary research to create a formal synthesis of Dewey’s evolutionary and educational thought in order to bring true learning experiences to students.

Research Questions

To achieve a 21st century synthesis of Dewey, I must seek the answer to four questions:
1. If Dewey’s educational philosophy was a sort of social adaptation to present environmental conditions, why was it not readily accepted and implemented at its inception?

2. What were the key dualisms that he sought to address both through education and through evolutionary thought?

3. How does contemporary cross-disciplinary research substantiate Dewey’s proposed amelioration of those dualisms?

4. What must transpire in a classroom for Dewey’s vision to become fully realized?

**Chapter Structure**

I address these questions in subsequent chapters. I address research question number 1 in Chapter Two through a comprehensive analysis of the cultural conditions and their biological underpinnings that prevented Dewey’s vision of education from becoming the prevailing model for American schools. Research question number 2 is answered in Chapter Three, where I examine four dualisms as having significant overlap between Dewey’s major works on education and his works grounded in evolution. The answer to research question number 3 spreads across Chapters Four through Six, with each addressing its own false dichotomy by drawing connections between Dewey’s works and relevant contemporary research. In Chapter Four, this entails addressing the gap that exists for teachers between subject and method, while Chapter Five identifies from where or whom the direction of education should derive. Chapter Six not only ameliorates Dewey’s concrete/abstract and mind/body dualisms but also secures the connection between the two. Chapter Seven concludes the work by answering the final research question through its provision of an evolutionarily updated prescription for education that truly can be called Deweyan.
Chapter Two:

Destined to Lose?

It seems that for many in education, the imprint of Dewey and his philosophy is indelible (Egan, 1997, 2002; Gutek, 2004; Noddings, 2010; Webb, 2006). From the organization of school libraries to the expectation that teachers use differentiated instruction, many of his individual ideas appear to be alive and well. Yet, Dewey himself would be frustrated with the isolated implementation and institutionalization of particular practices, for he thought that every act and experience made sense only when placed in a context. Similar to an organism that has evolved in response to particular pressures, when removed from its native environment and ecology, the organism’s behaviors that were adaptive in one setting can be maladaptive in another. So many of Dewey’s ideas were removed from the educational ecology to which they were adapted—his comprehensive philosophy of education—it is no wonder some blame him for the failures of American education (Egan, 2002; Hirsch, 1988). But why were they removed? What was it about Dewey’s emphasis on the importance of experience in education that destined his philosophy for failure?

Destined for Success … and Failure

By the time he was born, Dewey’s synthetic view of thinking had already been marginalized due to discoveries made during the European enlightenment. Prior to this period, much of knowledge had been cloaked in mysticism and narratives, a byproduct of the Socratic age (Hall, 2010). The emergence of the scientific method, which Dewey would come to appreciate and deploy, meant that true knowledge was acquired through experimentation (Dewey, 1958, 1966, 2008). This shift led to many of humanity’s greatest discoveries: the existence of gravity, the orbit of the earth around the sun, the theory of natural selection.
However, because this shift required a focus on testable minutiae, a move to a decidedly reductionist view of the world was necessitated. Consequently naturalists and philosophers were reclassified as practitioners in particular fields and sub-fields defined by their discovered phenomena (Foucault, 1973). Fueled by the natural need to classify (Gazzaniga, 2008), and having been given new vehicles in the form of the printing press and Linnaeus’ system of classification (Foucault, 1973), the subdivision of the world began in earnest for professional scientists and artisan naturalists (Jardine, Secord, & Spary, 1996). This trend began in Europe and soon spanned the globe.

On the other side of the Atlantic, a different system of thought existed. Holistic and ecological in nature, many Native Americans thrived in and coexisted with their environments, due to centuries of refinement of their communal knowledge (Webb, 2006). Isolated from the cultural crossroads of Europe, the perceived wisdom of the Native Americans mirrored the discoveries of Socrates (Hall, 2010) and was transmitted through the same oral tradition (Ong, 1982; Reagan, 2005; Wolf, 2008). Unfortunately for the Native Americans, they seemed as destined to lose the battle against the advance of written language as Socrates and for the same reasons. The human brain classifies, categorizes, and labels (Gazzaniga, 2008). Language, particularly written language, provides an outlet for these abilities, thus allowing for cultural transmission not only through space but also through time (Wolf, 2008). Although the human brain is not wired for reading, particular cortical regions can be conveniently co-opted, as in the case of the neural modules for face recognition being appropriated for letter recognition (Cantlon, Pinel, Dehaene, & Pelphrey, 2011). This capability allows for the neurological development of a reading culture (Dehaene, 2009).
Even as Socrates and the Native Americans were losing their battles against the development of the reading mind, a neuroscientific advocacy for their philosophies of transmission did not exist. As recognized by Dewey (1980) and demonstrated by art and artifacts for more than 40,000 years (Henshilwood & d'Errico, 2011), humans possess a natural tendency to think symbolically. Dewey wrote, “… art is the living and concrete proof that man is capable of restoring consciously, and thus on the plane of meaning, the union of sense, need, impulse and action characteristic of the live creature” (Dewey, 1980, p. 25). For Dewey, art was representative of a life that was being lived. Gregory Bateson, philosopher and anthropologist, went a step further, suggesting that because “… consciousness … must always be limited to a small fraction of mental process[es],” it is art rather than language that allows for “… a message about the interface between [the] conscious and unconscious” (Bateson, 2000, p. 136-138). Both philosophers hint at the existence of the interpreter cognitive neuroscientists think the human brain possesses (Gazzaniga, 2008). This critical piece of cognitive architecture transforms sensory inputs into the kind of meaningful experiences Dewey considered the basis for human thought. The innate desire for making meaning explains why, in the absence of direct experiences, humans often learn from the experiences of others shared through stories (Gottschall, 2012; Ong, 1982). Whether the power of the narrative lies in a story’s capacity to activate a listener’s mirror neurons (Gazzaniga, 2008) or feeds the listener’s desire for authenticity (Niedermeyer, 2012; Sparrowe, 2005), the oral tradition of cultural transmission apparently feeds the human desire for synthesis.

Both traditions are on equal but opposed footing with regard to their neural underpinnings and overarching purposes. The former makes meaning by classifying and the latter by synthesizing. Perhaps the pragmatic middle ground Dewey (1963) so desperately sought
late in his career should have manifested itself before he was born. However, more was working against Dewey’s ideas than brain areas activated by classification and writing systems. He was pushing against the prevailing culture of the United States that had been perpetuated by the very system he was so desperate to change. He failed to realize how deeply rooted Americans were in their culture and, therefore, why it would be so difficult to change, even if he were correct about how people generate thoughts.

**Culture vs. Thought**

Prior to the establishment of the colonies in the new world, a developing sense of nationalism existed within the European states. Much of this nationalism may have been a response to the movement toward capitalism during the Renaissance (McGovern, 1970), largely perpetuated by nation-states to prevent diffuse networks of individual trade-partners from weakening the central authority of the government (Mann, 1995). Nationalism also may be attributable to the Protestant Reformation (Gonzalez, 2010). By solidifying the differences that existed between groups, this religious movement activated the more basal root of nationalism, tribalism (Ridley, 1996; E. O. Wilson, 2012).

Bound not by borders nor by the sovereign status of a monarch but by instructions cast by a higher power, people were brought together by the church (D. S. Wilson, 2008). Because of the geographic limitations of any given church, various sects developed, each with their own tenets of behavior tailored to their localized socio-political and natural environments (D. S. Wilson, 2003). Seeing such organization as a threat to its sovereignty, many governments nationalized religion in a fashion that appealed to the majority of their citizens to consolidate their economic and political power with dominion over their citizens’ religious affiliation (Israel, 1966; Sahlins, 1994). In England, this meant bringing Protestants and Catholics into the fold under the auspices
of the Anglican Church. The inconsistency of values and practices associated with the shifting whims of the monarch meant that different sects and affiliations could become marginalized during different time periods (J. D. Clark, 1997, 2000). Therefore, when the new world offered the promise of religious freedom, many saw the ships headed across the Atlantic as too great an opportunity to ignore (Conforti, 2001).

Given the opportunity to perpetuate their own religions and cultures, the colonists developed education systems and practices built with that goal in mind. Using their bible as the primary text, lessons were prepared to disseminate values. Recitation and memorization prevented teachers and students from acquiring anything other than the literal meaning of the material. Therefore, through their pedagogical practices, the primarily Protestant colonists were able to propagate their culture (Kaestle, 1983; Webb, 2006).

The stifling of original thought, which Dewey would abhor in a classroom, is not always undesirable. Allowing for decisions to be made by simply mirroring the actions of others is deployed by many social species (Ridley, 1996; E. O. Wilson, 1975), at times providing the greatest possible solution for any given individual (Ridley, 1993). At other times, the conscious act of weighing options is circumvented by previously developed heuristics and allows for decisions to be made rapidly when the perceived stakes are high (Todd, 2000). Both of these processes, whether derived socially or individually, ensure the survival of individuals and their genes, thereby perpetuating their ideas and thoughts as well. These two processes most frequently are utilized when individuals are under stress, because changing cultural practices in known environmental conditions can be catastrophic (Diamond, 2005).

When viewed through this lens, it becomes almost ironic that one of the more famous examples of the failed integration of a cultural practice involved Europeans ignoring the wisdom
of Native Americans. Europeans grew and consumed domesticated corn—which they learned from the Native Americans—without soaking it in lye, known as nixtamalization, to produce hominy. This resulted in an outbreak of pellagra (Queller, 2012). Had this Native American practice not been ignored, Europeans would have been able to receive corn’s nutritional benefits, such as niacin, that the nixtamalization allowed. Similarly, the integration of the Native American view of education with that of the Protestants would have produced something akin to Dewey’s own pragmatic view of education. However, the tribal tendency toward xenophobia prevailed (Queller, 2012; Ridley, 1996; E.O. Wilson, 2012) and the traditions of American education had begun.

The cultural traditionalism started at the beginning of the agricultural age (Toffler, 1980) and continued through the industrial and digital revolutions. Educational traditionalists ignored Dewey’s philosophical predecessors Rousseau, Pestalozzi, Herbart, and Spencer (Noddings, 2010; Piaget, 1970) and his system-level thinking successors such as Gregory Bateson (1979) and Buckminster Fuller (1979). Stressing knowledge integration through his “ecology of mind” analogy, Bateson spearheaded the philosophical wing of the cybernetics movement of the late 1960s and early 1970s (Bateson & Bateson, 2000). Fuller (1979), meanwhile, worked on the technological side of the movement. Both discovered with frustration that the most gifted people were channeled into roles as specialists. This direction perpetuated the prevailing philosophy of compartmentalization that prevented the synthetic, system-level thought necessary to move the nation forward.

Unfortunately for these philosophers, the development of their theories happened during times of social upheaval. For Dewey, this came when the progressive movement turned into the roaring 1920s and eventually the Great Depression, whereas for Bateson and Fuller it came
during the social unrest and civil rights movement of the 1960s (Webb, 2006). These upheavals prevented their theories from being adopted by anyone other than already marginalized groups in a society swinging back toward traditionalism (Bateson, 2002). Rather, as Dewey observed (1963), portions of theories were assimilated, modified, and codified to fit within existing philosophical frameworks, ensuring that even the most synthetic of his ideas were to be presented in the most segmented of ways. These ideas came to be a part of the standardized curriculum and methodology and ensured that they would be presented in the most traditional (i.e. teacher-centered) of fashions. The root goal of the newly incorporated curriculum and methods utilized by teachers might have been to facilitate cultural and social equality. Through the sanitizing effect of traditionalism, the same sub-groups that had been marginalized continued to be so (Bruner, 1990). As Dewey (1956a, 1963, 1980) might lament, such practices minimized any experiences the child might use to contextualize information and build meaning because they may have derived from their unassimilated, and, therefore, tribally different, cultural practices (Bruner, 1990). Dewey would have found this maddening because he thought students’ experiences and teachers’ knowledge of those experiences should serve as the basis of education.

**Knowledge from Experience**

Though Dewey bore witness to the beginning of nationally standardized tests (Webb, 2006), he would have found appalling the degree to which students are objectified in contemporary education (Ravitch, 2011). Educators took cues from the drive for rationality, calculability, and efficiency that characterized the business community since Taylor’s development of his rules of scientific management (Ritzer, 2010) and the military for several centuries before that (Foucault, 1977; Noddings, 2010). In the 100 years since Dewey’s first publication, schools continued to act as the perpetuators of prevailing culture (Spring, 2001) and
as filters for higher education (Webb, 2006). They did so not by teaching students to think but by training them to pass a test (Ravitch, 2011). This approach would have been an even greater affront to Dewey, because for him, knowledge was a direct correlate of lived experience.

But how, in the midst of so much progressive fervor at the turn of the century, did he come to lose this battle, too? To utilize a child’s experience, a teacher must have knowledge of the child (Dewey, 1956a; Noddings, 2003, 2010). In the smaller communities of the pre-industrial age, a teacher may have been knowledgeable about his or her students because they were within the natural scope of known individuals (Dunbar, 1993). Urbanization occurred in conjunction with the industrial revolution, and the exponential growth in the community size prevented such a close student-teacher relationship. Perhaps Dewey’s own experiences in his experimental school inspired his progressive take on the teacher-student relationship or perhaps he possessed a keen capacity to identify the natural means by which students determine who they are going to follow (Niedermeyer, 2012). In either case, the emphasis Dewey placed on a teacher’s need to know his or her students ran counter to the direction education was headed in an industrializing nation.

Unfortunately for Dewey, other aspects of the Progressive agenda proved to be more pressing, including the need for students in poverty to be kept healthy, and to be able to attend schools, regardless of quality (Webb, 2006). A second phase of implementation of Progressive ideas may not have been a problem had progress been allowed to continue. However, the interruption caused by World War I compounded the amorphism of the Progressive agenda (Filene, 1970). Also, the haphazard implementation of Dewey’s ideas caused the educational movement’s momentum to be arrested (Dewey, 1963). A resumption of the movement may have been possible in light of the increasing economic prospects across the nation, but the national
pre-occupation with prohibition followed by the Great Depression ensured it did not (Flanagan, 2007). Instead, many teachers were laid off, and class sizes increased dramatically (Webb 2006). Consequently, teachers were unable to identify and utilize the relevant experiences of individual students.

Less than a decade later, following the full implementation of New Deal programs and the economic recovery spurred by World War II, suddenly a great need existed for new teachers and the financial resources to pay for them. Unfortunately, not enough qualified individuals were available to hire, so states granted emergency licenses to unemployed adults (Webb, 2006). Such haphazard hiring practices placed undue stress on teachers, ensuring that they were going to act only in ways that were familiar to them (Todd, 2000), probably in the modes and with the affect of their own teachers (Timmerman, 2009). Teachers continued to disseminate information in a fashion that was not engaging to students (Shernoff, Csikszentmihalyi, Shneider, & Shernoff, 2003), with an emphasis on perpetuating the prevailing culture (Spring, 2001). In this system, some philosophers considered the primary role of the teacher to be babysitting (Fuller, 1979).

With the economy prospering for the next three decades (Denison, 1985), Dewey might have had the expectation that the quality of education might improve as the financial situation encouraged more students to become teachers. The federal government prevented such a movement by becoming active participants in educational reform (Hargreaves, 2008). This appropriation began with the New Deal (Webb, 2006) and included the national focus on defeating communism (Walker, 2011). This focus enabled the federal government to perpetuate a fear of progressivism by linking it to communism (Foster, 2000; Griffith, 1987). This association leant added weight to the sort of top-down educational reform that began (and continues) to characterize American education (Hargreaves, 2008).
Developing Schools for Developing Minds

The drive for heavy-handed, top-down educational standardization that prevents a teacher from utilizing student experiences in the method advocated by Dewey can be traced to an earlier era: the dissolution of the popular apprenticeship system in colonial America. Originally, apprentices were placed in the care of masters who were in turn charged with educating the youth (Webb, 2006). Such a system provided the kind of experience that generated the foundation Dewey (1997a) saw as necessary for thought. The system also ensured that the teacher knew upon what experiences they could build. The children’s proximity helped ensure that masters knew their apprentices, which allowed them to develop a more pragmatic, and, therefore, Deweyan, view of their students based on their knowledge of those individuals’ experiences and cultures (Bruner, 1990). This recognition could explain why roles of master and apprentice have been identified as one of the primary modes for the social transmission of information for pre-agricultural societies (Hewlett, Fouts, Boyette, & Hewlett, 2011; Lancy, 2008; Lancy, Bock, & Gaskins, 2010; Sterelny, 2007) and non-human primates (Matsuzawa et al., 2001). It also explains why in early adolescence individuals tend to seek mentors (Egan, 1997; F. R. Wilson, 1999). Public perception of such a system, however, held that the dissemination of certain culturally important skills could not be ensured, thereby precipitating the movement to enroll all students in common schools (Webb, 2006).

With the movement toward common schools, there became a common direction for students: standardized preparation based on age and socio-economic class. Dewey (1956a, 1966) also sought direction for students. However, Dewey’s goal was growth in the students facilitated by a teacher knowledgeable about the student, both as an individual and as a developing member of the human species. Many of Dewey’s generalized notions about cognitive development were
supported through the experiments of educational psychologists who were both contemporaries and successors (Bruner, 1960, 1990; Montessori, 1972, 2004; Piaget, 1964; Vygotsky, 1978, 1986). However a steadfast adherence to the centuries’ old, singular mode of teacher-centered transmission was indicative of the cultural inertia against which he and his adherents were pushing.

This ideological battle was put on stark display with regard to the prospective implementation of Dewey’s (1997a) notion that meaning is developed by working from small, individual events and experiences through to the development of generalized rules, a perspective echoed by the constructivist movement more than half a century later (Jonassen, 1991). For a methodology that facilitates this sort of thought to be enacted in a classroom, there must be a significant amount of trust in the teacher’s abilities. Whether one evaluates the quality of teacher preparation (Angus, 2001) or the perceived class of those in the teaching profession (Butts & Cremin, 1953), from the beginning of formalized education in America, the single word used to describe either would be the same: low (Webb, 2006). That both of these would continue to be true both to and through Dewey’s time is indicative of the aforementioned traditionalism (Toffler, 1980) that has predominated in American culture throughout its existence.

As the industrial movement moved toward hyper-rationality (Ritzer, 2010), teachers became trainers tasked with disseminating standardized skills, information, and most importantly, cultural norms (Spring, 2001; Webb, 2006). An effort such as this ensured that educators could claim that reforms were being made such as higher standards for teachers and students with more rigorous evaluations of both (Ravitch, 2011). The virtues and ideals of obedience, patriotism and a uniform national character remained the same (Webb, 2006, p. 151).
With a continual educational crisis since state and federal governments began to serve as the administrators of education, a reform undercurrent has been associated with public schools (Webb, 2006). In spite of the crises and changes, student performance has remained static (Berliner & Biddle, 1995; Ravitch, 2011), suggesting something needs to change. And what need to be reformed are the prevailing practices of teaching. In spite off all that was written by his predecessors, Dewey, and his psychological and philosophical successors, little has changed in most classrooms. Indeed, some educators attempted to bring these new discoveries to the classroom. However, the schools poorly incorporated these new ideas. Among the most notable of missteps happened with regard to Herbart’s revolutionary methodology. His practice of grounding new lessons in students’ prior knowledge before attempting to apply the ideas in different situations was, unfortunately, implemented in an almost mechanistic fashion (Connell, 1980; Webb, 2006), which prevented the responsiveness to student experience necessary for its success. Dewey’s methods were misapplied, leading to him write a book, *Experience and Education* (1963), to decry the poor implementation of his prescribed ideologies and re-explain what being pragmatic means. Bruner’s development of his constructivist methodology (Bruner, 1960) led to student-centered classrooms of discovery that afforded little learning and lots of chaos (Kirschner, Sweller, & Clark, 2006). Every effort at psychological-based comprehensive reform seems to have failed. But why have they failed?

As mentioned previously, prior to the enlightenment, society considered the great thinkers to be those who had a comprehensive view of the world. This status was granted to philosophers in spite of the lack of inquiry into the natural or social aspects of life (Hall, 2010). Upon the development of new scientific methods, however, the great thinkers found themselves predisposed to specialization. The subsequent explosion of available knowledge to any layperson
precipitated a need for categorization and compartmentalization, with both becoming standardized (Foucault, 1973). The perception of specialists as generators of knowledge and citizens to be users of knowledge (Fuller, 1979) led to the perception of teachers as dispensers of knowledge to students; it was their job to accept it. This flew in the face of how Dewey, psychologists (Bruner, 1990; Piaget, 1964, 1970; Vygotsky, 1978, 1986), and cognitive neuroscientists (Gazzaniga, 2008; Hall, 2010) perceive human learning to work. However, this perception became the cultural norm and expectation and continued to guide pedagogical practice. This recognition, paired with the traditionalism born of humanity’s innate tendency toward tribalism (Ridley, 1996; E.O. Wilson, 2012), is the likely explanation for why the movement toward cultural literacy (Hirsch, 1988) was among the most successful in American education (Ravitch, 2011; Webb, 2006).

After the *A Nation at Risk* report, E.D. Hirsch (1988) presented his reform effort as a response to an educational system that had over-emphasized experiences because it had too closely adhered to Dewey’s principles. Rather, it was “... only by piling up specific, communally shared information [that] children learn to participate in complex cooperative activities with other members of their community” (Hirsch, 1988, p. xv). Dewey (1916, 1956a, 1956b, 1966, 1997a) advocated a process where students would act in concert with knowledgeable adults. Hirsch misrepresented Dewey’s idea of directed experience and went against what the anthropological literature demonstrates are successful patterns of social transmission (Hewlett, et al., 2011; Lancy, 2008; Lancy, et al., 2010). This misinterpretation would bother Dewey less than something else the reform movement omitted. Education and the goal of cultural literacy emphasized knowledge accumulation and failed to achieve reflection, what Dewey considered crucial to successful thought.
A Reflection of Values

For Dewey, a completed thought required one to reflect on an experience. In many instances, this can be achieved linguistically, utilizing the avenues of speech or writing. At other times, however, reflection must be achieved through other media. These other media—be they music or dance, painting or sculpture—are most often assigned a more abstract term: art. Yet, for Dewey, art was decidedly concrete. He had determined that it is the “... degree of completeness of living in the experience of making and of perceiving that makes the difference between what is fine or esthetic in art and what is not” (Dewey, 1980, p. 26). Unfortunately, the famed Gilded Age through which Dewey lived in the United States brought with it a stratification of society and a de facto appropriation of the fine arts by the new aristocracy (N. Harris, 1962). Art came to be something that could only be accessed by money, in spite of its existence in humans long before the development of currency (Davies, 1994; Henshilwood & d'Errico, 2011; Henshilwood & Marean, 2003; Ridley, 2010). The limited accessibility meant the outlets for observing others’ reflections were directly tied to one’s finances. This cultural development bled into the schools, which in Dewey’s time began to cut funding for art (Dewey, 1966), a trend that would continue into the 21st century (Ravitch, 2011; Webb, 2006). This decision limited the means by which students could complete their own thoughts and develop meaning for their experiences through reflection.

The limitation of art as a venue for classroom learning may have restricted the learning opportunities and the associated upward mobility for lower-class students. The effects could have been mitigated had another experiential and reflective outlet existed for them. For a time, vocational education was an option (Webb, 2006). By providing students with coursework that had concrete outcomes, they were not only producing artifacts for evaluation but also avenues
for reflection (Crawford, 2009). In these classes, students were asked to manifest their ideas not through the abstraction of language but through tangible constructions made by their hands with the help of tools, an act that had helped bring on the dawn of humanity (F. R. Wilson, 1999). When students work at a job or engage in curriculum that most closely resembles a job, that they feel most valued (Csikszentmihalyi & Schneider, 2001). Given its association with a particular societal caste, vocational education came to be seen as a conduit for the perpetuation of the social strata and not as an elevator out of it. Even as Dewey and his contemporaries observed significant progress, the perception of social equality was not generated until there was an elevation in educational standards and an increase in curricular standardization. So, while the former led to better living conditions for students, the latter eliminated the perception tracking of students based on social class, ensuring that all students would have access to the exact same material (Webb, 2006). In echoing the argument that had been made nearly a century before against the apprenticeship system, educational reformers were ensuring that the most critical component for reflection and learning—the emotional connection to individual experience (Dewey, 1997a; Hall, 2010)—was going to be eliminated from the classroom.

The Great Depression and two World Wars kept the movement towards standards and standardization alive for more than two decades before it finally reached a crossroads in the 1950s (Webb, 2006). The need for more teachers in the wake of the emerging economic stability and the growing concern about the communist threat precipitated this crossroad. Society’s expectation was that students would be better prepared to ensure America’s international primacy. But with no reliable metrics for measuring student achievement, educational administrators formed an informal commission in 1948 to identify how such tools might be produced. Initially meeting at the American Psychological Association Convention, a group of
college examiners began what would become an annual collaboration to classify educational objectives. This process culminated in the production of the *Taxonomy of Educational Objectives* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), colloquially known today as Bloom’s Taxonomy.

The examiners principally developed the book to provide organizational tools for test writers with the understanding that “it is rather difficult to classify educational test items as abilities or skills without a full knowledge of the student” leading to the “… omission in the taxonomy …” of skills and abilities (Bloom, et al., 1956, p. 39). Developers of educational objectives used the book as the framework for a half century of teachers (Krathwohl, 2002). This occurred, in spite of the commission’s own recognition that “… intellectual abilities and skills … are more widely applicable than knowledge … [and] by definition we would [therefore] select intellectual abilities and skills as having greater transfer value” (Bloom, et al., 1956, p. 42). The adaptation can be explained by viewing education as a sort of control mode that allows the existing power structure to stay in place (Foucault, 1977) and the prevailing culture to be perpetuated (Spring, 2001). The committee saw that it was “… very clear that in the middle of the 20th century we find ourselves in a rapidly changing and unpredictable culture …” that required “… the development of generalized ways of attacking problems and on knowledge that can be applied to a wide range of new situations” (Bloom, et al., 1956, p. 40). Hypocritically, the committee also determined that “… it is possible to predict in advance both the kinds of problems individuals will encounter and the solutions,” allowing educators to predetermine their students entire course of action (Bloom, et al., 1956, p. 40). With such practices, as Dewey (1956a) lamented early in his career, students did not need to reflect on the knowledge they were receiving; the curriculum designers did this reflection for them in advance.
Doomed from the Beginning

Following the Bloom report and the subsequent development of standardized tests, classrooms were bereft of reflective or dynamic learning. This void could be seen in the educational reforms precipitated by the fear generated by Sputnik, the *A Nation at Risk* report, and the *No Child Left Behind* Act (Ravitch, 2011; Webb, 2006). An increasing number of standards meant a need existed for increased knowledge and to expand the vocabulary necessary to achieve cultural literacy. An accumulation of facts and cultural conceptions would likely stifle the varied interpretations of texts based on individual experiences. The movement’s founder would not be troubled because he thought the author was the only one who could apply meaning to any literary work (Hirsch, 1967, 1976). This assumption meant that the capacities of analysis, synthesis, and evaluation that comprised the upper echelons of Bloom’s Taxonomy, (Bloom, et al., 1956), were no longer necessary. Perhaps they never were.

American education may owe to the Puritans “most that was of value for our educational development” (Cubberley, 1934). This value produced the principle literacy goals of ensuring that students would know the scripture to avoid that Old Deluder Satan and propagate Protestant principles and morals (Tyack, 1967; Webb, 2006). Perhaps schools never were created to help students learn, as Dewey hoped, by utilizing how we think. Maybe they existed only to “maintain order” (Webb, 2006, p. 107), because, in the minds of the founding fathers, “... conformity [was] the price of liberty” (Tyack, 1967, p. 84-85). Then Dewey, in spite of his awareness and insight into what it meant to be human and how the human mind works, was destined for failure more than two centuries before he was even born. His failure also may mean that the suppression of his ideals was primarily the product of culture, and culture can evolve.
For Dewey, the vast majority of culture was the product of habits of thought transmitted from one generation to the next through biologically impelled mechanisms. Much of America’s prevailing culture was the product of the classificatory dichotomies set up as a part of the emergence of scientific thought. Dewey (2008) thought this process was both innate and learned. He appreciated the scientific process by which many of the dichotomies were produced to change culture. However, Dewey recognized that the dualisms upon which it was erected needed to be overcome. Having determined that education is the primary conduit by which cultural transmission occurs, for Dewey to succeed, the false dichotomies that stood as obstructions to cultural progress must be identified before they can be fixed. That is the aim of the next chapter.
Dewey recognized that, in his insistence that experience be the basis for education, a potential pitfall existed. He was concerned that if generated experiences are taken to be nothing more than the desired end, they “... may be so disconnected from one another that, while each is agreeable or even exciting in itself, they are not linked cumulatively to one another” (Dewey, 1963, p. 26). Such a recognition puts the onus on the teacher to navigate a series of the philosophical dichotomies to produce that which was cherished—growth in the individual, the community, and the world of the sort that comes only from experience. Dewey abhorred these philosophical dichotomies. The titles of his books and chapters provide insight into the dichotomies he was most concerned with ameliorating. He often demonstrated his desire to do so through his use of the inclusive word “and” as opposed to the exclusive “versus.” Although he would likely argue that his ideas never came to true completion before his death, his continual remonstrations and revisions of his own works both publicly and privately are a testament to this desire (Dalton, 2002). Viewing these dichotomies as patterns of temporal and spatial movements of thought illustrates Dewey’s philosophical and pedagogical evolution.

**Dewey’s Dualisms**

**Subjected Methodology.** Early in his career when he was most intensely focused on changing education, Dewey’s concerns centered on the teacher-student relationship. This focus culminated in *The Child and the Curriculum* followed by consecutive chapters in *Democracy and Education* entitled “The Nature of Method” and “The Nature of Subject Matter.” This line of thought demonstrated his concern that education seemed to lie at the interface between a developing industrial society’s understanding of how students learn and what it is they need to
know. Dewey saw first hand that children seem to learn best when engaged in activities that to all the world was nothing more than play (1956a, 1956b, 1962). He was aware that the exponential increase in available and potentially necessary knowledge perpetuated a pedagogical proclivity for direct instruction. The nearly universal adoption of the latter method was understandable not only in light of the perceived breadth of information needed to succeed as an adult in a society but also because of the way schools were designed.

Dewey thought schools created artificial conditions that were not conducive to the natural patterns by which people learn. He thought this because schools were constructed and constituted in fashions that created arbitrary assemblages of individuals with the extrinsic expectation of acquiring information related to a particular field of study. Teachers, therefore, had to rely on general methods that come from educational authorities to use in all situations and with all children or trust the route by which they came to understand the subject (Dewey, 1956a, 1966). In the case of the former, while utilizing the discoveries of one’s pedagogical predecessor’s may at its surface be desirable, Dewey identifies that “... there is always a danger that these methods will become mechanized and rigid, mastering an agent instead of being powers at command for his own ends” (Dewey, 1966, p. 170). Such practices often over-emphasize particular sense stimuli to the exclusion of others (Dewey, 1956a) and are more likely to blossom in situations whereby the desire is for “speedy, accurately measurable, correct results” (Dewey, 1966, p. 175). In opposition to such generalized methodology is one that is specific not only to the subject matter but also to the instructor himself. In such a case:

Even the most scientific matter, arranged in most logical fashion, loses this quality, when presented in external, ready-made fashion, by the time it gets to the child. It has to undergo some modification in order to shut out some phases too hard to grasp, and to
reduce some of the attendant difficulties. What happens? Those things which are most significant to the scientific man, and most valuable in the logic of actual inquiry and classification, drop out. The really thought provoking character is obscured, and the organizing function disappears. Or as we commonly say, the child’s reasoning powers, the faculty of abstraction and generalization, are not adequately developed. So the subject matter is evacuated of its logical value, and, though it is what it is only from the logical standpoint, is presented as stuff only for “memory.” (Dewey, 1956a, p. 26)

The product of either extreme, therefore, is an expectation that students will accumulate a quantity of knowledge that is commensurate with the quantity of their intellect. Such a goal produces a clearly delineated end of learning not just to learn but also to demonstrate its transpiration via an objective standardized test (Dewey, 1966). The result is to produce the kind of education described in the previous chapter.

Education practices that focus on either method or subject place them in diametric opposition to Dewey’s espousal that all knowledge is subjective and experiential. He felt, therefore, that the means and ends of education merge into the single aim of growth through the acquisition of useful experiences. Growth in students suggests an increased ability to respond effectively to novel challenges, so the job of the teacher is to fashion conditions that challenge students. Such a practice requires a fusion of subject and method (Dewey, 1966) as it forces students to deploy their existing habits in an unfamiliar circumstance or to develop new behaviors (Dewey, 1929). The result is both an experience and a reflection with the promise of eliciting both empirical (i.e. concrete) and scientific (i.e. abstracted) thought.

**Origin of Direction.** For an educator in a system devised by Dewey, the primary aim is to identify the direction that is to guide the students and how it is to be determined. Dewey’s
second major work on education, *The School and Society*, shows the beginning of his investigation and is continued in *Democracy and Education* in the chapters “Education as Conservative and Progressive,” “Interest and Discipline,” and “Play and Work in the Curriculum.” Even though he had not concluded his investigation into the direction taken in education, Dewey (1929) began to investigate this question in a larger context with his work on social psychology, *Human Nature and Conduct*. As Dewey (1966) saw it, in his time:

> The “course of study” consist[ed] largely of information distributed into various branches of study, each study being subdivided into lessons presenting in serial cutoff portions of the total store. In the seventeenth century, the store was still small enough so that men set up the ideal of a complete mastery of it. It is now so bulky that the impossibility of any one man’s coming into possession of it all is obvious. But the educational ideal has not been much affected. (p. 187)

Dewey recognized that the finite amount of available knowledge paired with the limited access most students had to books once dictated that school should be strictly for book-learning. However, with the advent of the printing press, student access increased to books and other sources of information, much in the same exponential fashion as the amount of information did. To retain the same methods, albeit in a very different environment, was representative of a different dictate of society—the desire for the conservation of customs. Such a system would come to value docile plasticity, appreciating not those students who have something to say of their own creation but those who know what they are supposed to say when asked (Dewey, 1929). The production of young citizens well versed in such capacities after a few years of schooling would serve to perpetuate a society and its structures that have been hundreds of years in the making (Dewey, 1956b).
Conversely, progressive education emphasizes the capacity of malleable minds to effect environmental change (Dewey, 1929), allowing the minds to be prospective as opposed to retrospective (Dewey, 1963, p. 79). Any individual seeking to change the environment is apt to do so in his/her own behalf (Dewey, 1929, 1958, 2008). True progressive education might then be viewed as acting at the whims of the student. With articulated whims being outward manifestations of intrinsic motivation, it may seem no purpose to the activity exists other than the act of engaging in it for engagement’s sake. For the individual actor, however, the goal may be the experience itself, which is the primary unit of individual growth (Dewey, 1963).

A singular emphasis on the former (conservative) or the latter (progressive), however, denies the student of a complete and transferable education. The conservative emphasis is likely to produce classrooms where the students talk of work while those in a progressive class talk of play. For most students, outside of the artificial school constructs, the two are suffused with the same meaning. Possessing the natural impulse to help by mimicking the actions of adults, work and play come to exist on a single continuum. The temporal and spatial immediacy of the desired outcome determines the activity’s placement (Dewey, 1966). Experiences where success is observed immediately are more likely to be termed play whereas those with a greater lag before such a determination may be identified as work, even though both are engaging, if not outright fun. When purpose is removed from an activity, however, the continuum becomes another of Dewey’s dualisms, identified either as drudgery or fooling around (Dewey, 1966).

A teacher’s is job to ensure both are avoided, as neither is likely to lead to growth. The perceived need for what both purportedly produce in the student, discipline (via drudgery) and interest (via fooling around), can lead to the selection of methods and subjects that serve either
end. Dewey noted that historically, when a teacher invoked discipline as the purpose for an activity:

… it has screened and protected traditional studies and methods of teaching from intelligent criticism and needed revisions. To say that they are “disciplinary” has safeguarded them from all inquiry. It has not been enough to show that they were of no use in life or that they did not really contribute to the cultivation of the self. That they were “disciplinary” stifled every question, subdued every doubt, and removed the subject from the realm of rational discussion. By its nature, the allegation could not be checked up. Even when discipline did not accrue as matter of fact, when the pupil even grew in laxity of application and lost power of intelligent self-direction, the fault lay with him, not with the study or methods of teaching. (Dewey, 1966, p. 133)

Educators were allowed to maintain that discipline could be a desired end. Consequently, they erred in either of two or both directions. The discipline could be too abstract in that it did not produce a skill that was transferable in any meaningful sense to a particular endeavor. On the other hand, discipline may be too concrete and produces a tactic that is only functional in a very specific setting. Conversely, an over emphasis on student interest may be equally ineffective and produce undesirable consequences. By catering only to that which is agreeable for an individual, a teacher is likely to reinforce obstinate stubbornness, producing “… persons [that] are naturally diverted from a proposed course of action by unusual, unforeseen obstacles, or by presentation of inducements to an action that is directly more agreeable” (Dewey, 1966, p. 129). Therefore, students who were products of the latter emphasis were likely to lack the discipline necessary to apply effort to anything that was not agreeable and easy. Those who were products of the former
would only be able to apply effort in highly specific, mechanized endeavors that were of little interest.

For Dewey, the prescribed synthesis is one whereby the students supply the interest and discipline but the teacher dictates the direction, or more specifically, the conditions. By positioning the teacher as a de facto environmental engineer, Dewey (1956a, 1956b, 1966) asks the educator to know the student as both a person and a learner. A teacher can work from a position of understanding the students’ background experiences, developed habits, and the quality of their intellect. A competent educator should be able to craft circumstances that challenge the students to generate authentic solutions to problems that are bound as tightly to the reality outside the classroom as possible (Dewey, 1966). By invoking issues affecting the local community, students may feel they are working toward something tangible (Dewey, 1956a, 1956b). This approach provides the potential for motivation to delay the gratification of success (Dewey, 1966). Teachers can create circumstances that elicit an internal reference to previously acquired experiences, habits, and knowledge to provide direction and generate thought, helping students achieve originality in their solutions to the presented problems. As a result, the teacher could have pupils who feel less like laborers toiling away toward some end dictated by their financial overlord and more like artists whose works are the embodiment of all that they know and can do (Dewey, 1929, 1980).

Types and Sources of Knowledge. The aim of Dewey’s educational process is to make students feel they are artists in charge of crafting their existence. The difficulty comes in identifying the types of knowledge needed to facilitate the requisite experiences and reflections. Dewey wrote in, “Concrete and Abstract Thinking” and “Empirical and Scientific Thinking,” in How We Think and in chapters in Democracy and Education entitled “Labor and Leisure” and
“Intellectual and Practical Studies,” that knowledge classically has been broken into that which can only be exhibited externally and that which must be processed internally. Prior to the advent of the printing press, most people’s exposure to books was limited to school. Consequently, education had to deal with intellectual study. Because most people who attended school beyond the primary grades were destined for society’s upper crust, schooling should be focused on that which might be engaged in for “leisure.” But, as Dewey (1966) noted:

On the other hand, certain concessions have been made to the masses who must engage in getting a livelihood and to the increased role of economic activities in modern life. These concessions are exhibited in special schools and courses for the professions, for engineering, for manual training and commerce, in vocational and prevocational courses; and in the spirit in which certain elementary subjects, like the three R’s, are taught. The result is a system in which both “cultural” and “utilitarian” subjects exist in an inorganic composite where the former are not by dominant purpose socially serviceable and the latter not liberative of imagination or thinking power. (p. 257)

As Dewey observed, educational philosophers dating back to Aristotle claimed an either/or aspect existed as to what sorts of knowledge are to be taught in a given forum. The two types of knowledge were considered mutually exclusive both socially and psychologically for centuries before Dewey’s birth (Dewey, 1929, 1958, 1966).

Dewey’s perception, however, was of the interactive and synthetic nature of the different knowledge forms. Dewey identified that it was from the artists and artisans that scientists and philosophers derive their ideas and get the practical evaluation of their theories. He recognized that ideas created without reference to concrete application was a solipsistic and meaningless pursuit (Dewey, 1958). He also observed society’s cultural limitations without scientific testing
or philosophical insights, whereby the empirical discoveries in the absence of controlled
evaluation lead to unfounded mythologizing (Dewey, 1966, p. 264). For Dewey (1997a), the two
worked together as a part of an imperfect feedback loop, with observations made as a part of
daily acts of life serving as the impetus for reflective testing, followed by the application and
subsequent evaluation of modified practices. The loop was imperfect not because it was
consistently imbalanced in favor of one thought form but because it was consistently inconsistent
in its manifestations. At times observation would beget reflection. However, at times
observations would lead to more observations, or reflection would facilitate further reflection. It
was dependent completely on the ambient conditions. The teacher and the student could dictate
those conditions, at least in part.

The conditions that could not be dictated by the active participants in the educational
dyad were dictated by nature and this presented a much greater philosophical challenge. To
abstract meaning from individual experience in a universal form that allowed it to be applicable
in future concrete circumstances, the mind/body dualism had to be ameliorated. This dichotomy,
entrenched in philosophical thought since its inception by Descartes, warranted the devotion of
the latter stages of Dewey’s career to proving this separation false. Though he touched on the
matter in his books on education, much more time was spent on the issue in his aforementioned
two works in psychology and the book in which he sought to naturalize philosophy, *Experience

Dewey was well versed in Hegel’s notion of dialectics. He began to question his almost
dogmatic adherence to the tenets of *Naturphilosophie* when he realized that his philosophical
mentor failed to provide a natural psychological process that brought about individual
consciousness (Dalton, 2002). Early in his career, Dewey investigated the evolutionary process
and Darwin’s effect on philosophy. This research led to the production of decidedly cogent arguments for the inclusion and interaction of knowledge derived from both culture and nature in philosophical (Dewey, 1997b) and educational settings (Dewey, 1966). But it was not until his writing of *Human Conduct and Nature* that he overtly stated that the experience he championed as the unit of learning is attained through the release of natural impulse through socially transmitted habits (Dewey, 1929). For him this meant that human behavior and thought was not the product of both nature and culture but the product of nature interacting with culture.

Dewey’s knowledge of evolution led him to the conclusion that any organism with a body (i.e. a nature) that interacted socially (i.e. with the potential for culture) had a mind. Empirical philosophers would therefore emphasize the final, finished, and sensorially observable objects—the knowledge of the body. That emphasis would result in missing the connections produced by scientifically established relationships that would otherwise go unrecognized, because those were generated by the mind. Conversely, to focus only on the quantitative “...purely unitary physical element would have no efficacy; it could not act or be acted upon” (Dewey, 1958, p. 145), because it ignored the necessity of the body to the mind. For Dewey, this meant some sort of pragmatic fusion must exist between the two, because:

If we conceive of the world of immediately apparent things as an emergence of peaks of mountains which are submerged except as to their peaks or endings, and as a world of initial climbings whose subsequent career emerges about the surface only and here and there by fits and starts; and if we give attention to the fact that any ability of control whatever depends upon ability to unite these disparate appearances into a serial history, and then give due attention to the fact that connection into a consecutive history can be effected only by means of a scheme of constant relationships (a condition met by the
mathematical-logical-mechanical objects of physics), we shall have no difficulty in seeing why it is that the immediate things from which we start lead themselves to interpretation as signs or appearances of the objects of physics; while we also recognize that it is only with respect to the function of instituting connection that the objects of physics can be said to be more “real.” In the total situation in which they function, they are means to weaving together otherwise disconnected beginnings and endings into a consecutive history. Underlying “reality” and surface “appearance” in this connection have a meaning fixed by the function of inquiry, not an intrinsic metaphysical meaning. (Dewey, 1958, p. 139)

Dewey (1958) had come to recognize that science and philosophy, existing only in the abstractions of the mind, are practically meaningless, whereas concrete bodily experiences without reflective inquiry are the road to blathering mysticism. Neither process nor entity can achieve full functionality without the other.

**Naturalized Education**

Having in his own estimation succeeded in the fusion of philosophically false dichotomies—even if had not completely satisfied his critics (Dalton, 2002)—Dewey seemingly felt emboldened to investigate modes of experiencing. With his work, *Art as Experience*, Dewey examined how the process of engaging with art both in its production and observation modified past experiences and generated new ones. This sits in opposition to his publication of *Logic: The Theory of Inquiry*. In this book he sought to establish that, because the capacity for reason does not emerge from nothing, a scientifically observable and verifiable explanation existed for how the human mind uses experience to generate thought (Dewey, 2008). Were these written by anyone else, these works might be interpreted as the product of an unfocused investigator. But
for Dewey, they represented his attempt to use evolution to naturalize two of humanity’s greatest achievements, art and science.

In the small volume *Experience and Education* published the same year as *Logic*, Dewey (1963) attempted to bring greater clarity to the underpinnings of his educational philosophy. For more than a quarter of a century, Dewey witnessed his prescriptions for education misinterpreted and misapplied in ways that perpetuated a misguided system. His frustration with the turn education had taken mirrored the frustration he had with the restrictive definition of art and the misunderstanding of science he attempted to overturn in the aforementioned works. With his writing of *Experience and Education*, Dewey thought he could clarify the final reconciliation he had sought since the beginning of his career between teaching methodology and the processes of learning (Dewey, 1956a). Dewey (1966) recognized the challenge he posed for the school system and stated:

> A reorganization of education so that learning takes place in connection with the intelligent carrying forward of purposeful activities is a slow work. It can only be accomplished piecemeal, a step at a time. But this is not a reason for nominally accepting one educational philosophy and accommodating ourselves in practice to another. It is a challenge to undertake the task of reorganization courageously and to keep at it persistently. (p. 137)

The reorganization to which Dewey alludes would certainly incorporate his findings with regard to art and science, and given the scope of his investigations, he could be forgiven if he prematurely thought that he had successfully justified his prescriptions for education. His was a 50-year career incorporating knowledge acquired through the integration of academic fields ranging from art critique to theoretical physics, from developmental psychology to political
philosophy. He was as accomplished an American thinker as has ever existed, and in my estimation, he has earned the title of polymath several times over. Yet his critics, particularly those in education, thought he never defended successfully his melded dualisms. I believe this was because he never brought evolutionarily relevant fields to bear on the aforementioned great dichotomies of education: subject/method, the origin of direction, and concrete/abstract. I address this oversight in the next three chapters, with each devoted to using evolution to bridge one of the artificial gaps that produced the dualisms Dewey identified.
Chapter Four: Subjected Methodology

As I suggested in Chapters One and Three, Dewey insisted on the amelioration of what he saw as the false dichotomies of education. However, as noted in Chapter Two, it was to little avail. The first dualism he sought to address was in many ways the most rudimentary one for the teacher—the apparent battle between method and subject. In his early treatise on the matter, The Child and the Curriculum, Dewey (1956a) identified two schools of thought. The first focused not on the student but on the subject. He noted that the teacher’s job is to:

… ignore and minimize the child’s individual peculiarities, whims, and experiences. They are what we need to get away from. They are to be obscured or eliminated. As educators our work is precisely to substitute for these superficial and casual affairs stable and well-ordered realities; and these are found in studies and lesson … Let the child proceed step by step to master each one of these separate parts, and at last he will have covered the entire ground. (p. 8)

To teachers of this ilk, children are nothing more than embodied immaturity, and, therefore, the teacher’s job is to bring about mature understanding commensurate with the knowledge available in the selected text. The child who exhibits docile plasticity (Dewey, 1929) is one thought to be amenable to instruction and, therefore, the one who has the opportunity to achieve mature adulthood (Dewey, 1956a).

Opposing this viewpoint is one that envisions children as the centerpiece. For educators who favor this perspective, the child dictates the curriculum with the most amenable method dictating the progression of the lesson. Dewey (1956a) suggests that for such a philosophy:
Subject matter is but spiritual food, possible nutritive material. It cannot digest itself; it cannot of its own accord turn into a bone and muscle and blood. The source of whatever is dead, mechanical, and formal in schools is found precisely in the subordination of the life and experience of the child to the curriculum. It is because of this that “study” has become a synonym for what is irksome, and a lesson identical with a task. (p. 9)

Those ascribing to this philosophy embrace the individualization of education, ceding complete curricular control to the child in exchange for forging desired experiences.

The widely held perception was that Dewey was in the latter camp (Gutek, 2004), probably because he spent the better part of his career battling the former (as outlined in Chapter Three) and because he mercilessly criticized such a philosophy. To him, when a subject-based curriculum was education’s aim, information acquisition was:

… treated as an end itself [and] the goal becomes to heap it up and display it when called for. This static, cold-storage ideal of knowledge is inimical to educative development. It not only lets occasions for thinking go unused, but it swamps thinking. No one could construct a house on ground cluttered with miscellaneous junk. Pupils who have stored their “minds” with all kinds of material which they have never put to intellectual uses are sure to be hampered when they try to think. They have no practice in selecting what is appropriate, and no criterion to go by; everything is on the same dead static level.

(Dewey, 1966, p. 158)

Even as he attempted to lay waste to the prevailing pedagogical philosophy, he criticized practices that focused on the child’s own machinations. Given the reins of their own education, people—children or adults—are more inclined to do what is pleasurable than what is not
(Dewey, 1956a). Therefore, they are likely to select desirable experiences. Dewey (1963) determined that the problem with this is that:

An experience may be immediately enjoyable and yet promote formation of a slack and careless attitude; this attitude then operates to modify the quality of subsequent experiences so as to prevent a person from getting out of them what they have to give … Energy is then dissipated and a person becomes scatter-brained. Each experience may be lively, vivid, and “interesting,” and yet their disconnectedness may artificially generate dispersive, disintegrated, centrifugal habits. The consequence of formation of such habits is inability to control future experiences. (p. 26)

Without the direction provided by the logical subject presentation, students apparently become lost in the Bacchanalia of experiencing pleasure without having developed any meaning for experiences.

Dewey thought that the focus of primary education should be the growth of children into themselves, their culture, and their environment. From his perspective, knowledge acquisition was less important than the ability to discern the contexts in which knowledge might be used. For Dewey, this is where method meets subject. He thought students should acquire knowledge in a fashion that makes it readily transferable and that this interface creates a relationship where “… method means that arrangement of subject matter which makes it most effective in use” (Dewey, 1966, p. 165). As written, Dewey’s statement seems to have him purporting the primacy of subject matter (Rury, 2012). Such an interpretation explains the repeated invocation of his cherished idea of student growth by reformers preferring standardized tests (Baker et al., 2010; Betebenner, 2009; Ladd & Lauen, 2010), even as he steadfastly spoke out against the practice (Dewey, 1983; Garrison, 2012). Dewey (1929, 1966, 1997a) maintained throughout his career
that a child or adult who is not culturally indoctrinated does not classify knowledge by subject, but by its ability to achieve a desired end. This idea is more in line with those who emphasize methodology as the foundation for instruction. How does Dewey reconcile this almost hypocritical dichotomy?

**Types of Knowledge and Means of Transmission**

Rather than separating subjects based on the culturally defined disciplines established in the 17th century (Dewey, 1966; Foucault, 1973), Dewey (1997a) divided them into three categories based on the type of knowledge being acquired: those principally involved with the skills development, those concerned with the knowledge acquisition, and those concerned with abstract reasoning (p. 50). Due to the unique nature of abstraction and its dichotomous relationship to experience, the abstract/concrete dualism received significant treatment by Dewey throughout his career and will be dealt with at length in Chapter Six of this manuscript. The other two forms of knowledge, however, have continued to be inextricably bound to each other by his successors and they have been investigated by researchers in the cognitive fields that emerged in the years since Dewey’s passing.

Dewey committed a significant portion of his post-retirement career to support Myrtle McGraw’s work in what today is considered cognitive neuroscience (Dalton, 2002). Dewey was at the vanguard of the movement that would soon captivate psychologists and neuroscientists (Bruner, 1990). As he showed in *How We Think* (Dewey, 1997a), something distinct and different occurs when a person learns processes versus information. What he did not know was that the process can be traced back to the brain regions involved. While he knew based on his knowledge of McGraw’s *Neurobehavioral Theory of the Development of Consciousness* (Dalton, 2002) that learning skills affected electrical signals in the brain, Dewey would not have been able
to identify as today’s neuroscientists can that much of skills learning—also known as procedural knowledge—is located in the basal ganglia. The second type of knowledge, an assimilation of information termed declarative knowledge, principally involves the hippocampus (Blakemore & Frith, 2005; Bransford & Brown, 2000; LeDoux, 1996). Dewey would have appreciated that both of these brain regions are bound to language (Knecht, 2004; Ullman, 2006). He also would feel validated to know that an ability whose principle purpose he thought was to influence the social activity of others (Dewey, 1997, p. 179) is supported by those researching the use of vocalizations and signals in animals (Dawkins & Krebs, 1978, 1979; Krebs & Dawkins, 1984; Seyfarth & Cheney, 2010) and those researching different human languages (Calude & Pagel, 2011). For the theorist, as Dewey (1929) saw it, “… the problem of social psychology is not how either individual or collective mind forms social groups and customs, but how different customs, established interacting arrangements, form and nurture different minds” (p. 63). Although he was not speaking about education, the problem evinces a need to understand the social and cultural transmission patterns of humans. Were Dewey speaking to a group of educators, he would refer to this process as a study of pedagogical methods.

That Dewey was so interested in this field demonstrates his prescience. In most societies, little information is transmitted through overt teaching in a classroom setting (Hewlett, et al., 2011; Lancy, 2008; Lancy, et al., 2010). Instead, it occurs as a part of everyday experiences. This knowledge lends further credence to Dewey’s repeated refrains (1966; 1956a; 1963; 1997a) about the artificiality of the classroom as a place of learning and gives justification for his academic interest in the origins of behaviors. He was frustrated with his contemporaries’ focus on linguistic methods of studying psychology (Dalton, 2002), because in his estimation:
… words do not express elements or forces which are psychic or mental in their first intention. They denote *ways of behavior*. These ways of behaving involve interaction, that is to say, and prior groupings. And to understand the existence of organized ways or habits we surely need to go to physics, chemistry and physiology rather than to psychology. (Dewey, 1929, p. 62)

Dewey was frustrated with the turn psychology had taken under the direction of Freud and Jung (Dalton, 2002). This turn led him to seek answers about human behavior patterns through an interdisciplinary approach that became a hallmark of his work (James Campbell, 1995; Dalton, 2002; Dewey, 2008; Popp, 1999). However, Dewey’s use of physics and chemistry to inform his philosophical investigations was more a product of the access he had to those fields—his daughter worked with the eminent physicist Neils Bohr (Dalton, 2002)—than it was due a steadfast belief that these sciences would provide direct insight into human development. He would have much preferred to ground his thinking in the tenets of evolutionary biology (Dewey, 1916). Unfortunately for Dewey, there was little understanding of and much consternation about Darwinian theory among his peers and laypersons. If he outwardly embraced evolutionary thought any more than he already had, he would have been right to expect an adverse response from the public (Popp, 2007).

Despite his trepidation to question the veracity of specific philosophers’ and psychologists’ claims (Dalton, 2002), Dewey (1997b) established that, in his estimation, “… doubtless the greatest dissolvent in contemporary thought of old questions, the greatest precipitant of new methods, new intentions, new problems, is the one effected by the scientific revolution that found its climax in the ‘Origin of Species’” (p. 19). In practice, for him this meant that:
The significance of the evolutionary method in biology and social history is that every distinct organ, structure, or formation, every grouping of cells or elements, is to be treated as an instrument of adjustment or adaptation to a particular environing situation. Its meaning, its character, its force, is known when, and only when, it is considered as an arrangement for meeting the conditions involved in a specific situation. (Dewey, 1916, p. 93)

This interpretation extended Darwinian theory beyond the more widely accepted application to physiological adaptations and into behavior in a way that served as a harbinger of the socio-biological revolution that began in the 1970s (E. O. Wilson, 1975).

As sociobiology evolved and grew, it began to shape other fields, and it inspired the development of evolutionary psychology. In these new fields, one of the key principles was the understanding that the human organism developed, as all organisms did, in an environment of evolutionary adaptiveness (EEA) (Tooby & Cosmides, 1990). Some debated as to how the EEAs were constituted (Laland, Odling-Smee, & Feldman, 2000; Ridley, 1993). However, it is widely accepted that humans’ EEAs precipitated the development of the modern human brain (Tooby & Cosmides, 2007) and modern human behavior (Symons, 1995). Humans now exist primarily in environmental conditions that differ significantly from their original EEA. This condition suggests that the innate habits used for the expression of biological impulses that Dewey (1929) described are ecologically no longer rational (Cosmides & Tooby, 1994). Dewey (1929) wrote:

> Every habit incorporates within itself some part of the objective environment, and no habit and no amount of habits can incorporate the entire environment within itself or themselves. There will always be disparity between them and the results actually attained. Hence the work of intelligence in observing consequences and in revising and readjusting
habits, even the best of good habits can never be forgone. Consequences reveal unexpected potentialities in our habits whenever these habits are exercised in a different environment from that in which they were formed. (p. 51)

Many human habits are natural instincts generated for success in an EEA that was highly variable (Potts & Clark, 1996; Richerson & Boyd, 2000). The environment (i.e. the school) developed for the express purpose of activating, refining, and creating new habits is static and artificial. Dewey would ask, what are the natural transmission patterns that have evolved for the two distinct types of knowledge identified by cognitive scientists, procedural, and declarative?

**Animal Models?**

Modern hunter-gatherer societies may provide a rough approximation of humans’ original EEA (D. S. Wilson, Timmel, & Miller, 2004). Some consider these societies the most fertile ground for evaluating the manner in which human education most naturally transpires (Gray, 2011; Muller, 2010). However, the emphasis on cultural rigidity in both hunter-gatherer (Lancy, 2008; Lancy, et al., 2010) and other indigenous non-Western societies (Reagan, 2005) potentially perturbs the natural selection of transmission patterns for procedural and declarative knowledge. The alternative means using non-human animals (henceforth referred to as animals). Instead of using other species as the initial filter, we may discover the methods by which skills and information are transmitted in the absence of the cultural intricacies that are hallmarks of humanity (Pagel, 2012).

Caro and Hauser’s (1992) initial investigation into purposeful social transmission in animals led to a definition of teaching. Their definition states that a teacher modifies his or her behavior only in the presence of a pupil, incurs some cost or no immediate benefit, and allows pupils to acquire knowledge or skills more rapidly than they would on their own. The
investigation identified what they considered two generalized teaching methodologies deployed in animals. The first is opportunity teaching, defined as a situation where the “… teacher puts [the] pupil in a situation conducive to learning a new skill or acquiring knowledge” (p. 166). The second methodology is when the teacher “… directly alters the behavior of [the] pupil by encouragement or punishment” (p. 167). Neither method necessarily involves taking the perspective of others that often is associated with the natural human inclination toward the pedagogical method of active teaching (Csibra & Gergely, 2011). However, in a subsequent review of teaching in non-human animals, Thornton and Raihani (2008) established that “… many forms of human tuition do not require teachers to impute mental states to pupils” (p. 1824).

This update to Caro and Hauser’s (1992) landmark paper removed the burden of intentionality when evaluating effective patterns of social transmission. The paper instead placed the burden on the facilitation of learning (Thornton & Raihani, 2008). The shift of focus from the teacher’s actions to the learner’s actions precipitated a classification of instructional techniques based on the type of knowledge being transmitted. The two types are progressive teaching for the transmission of procedural knowledge and fixed teaching for the transmission of declarative knowledge (Thornton & Raihani, 2008). These types mirror the separation made by cognitive neuroscientists and Dewey. Because Dewey wanted to ground our understanding in evolutionary theory, the net that is cast cannot be too wide. Instead, how the animals are selected for juxtaposition with the more innate patterns of human transmission (Skerry, Lambert, Powell, & McAuliffe, 2013) must be given careful consideration using evolutionary principles as the filter.

Such an endeavor inevitably leads to using primates, the order of which humans are a part and with which humans share most, if not all, of their brain regions and much of the same cognitive architecture (Gazzaniga, 2008). It should also lead us to investigate the EEA of the first
cognitively modern humans and the assumption that it is best approximated by hunter-gatherers. The hunting component of the first modern humans’ lives largely was engaged in by groups to take down large prey (Pagel, 2012), a practice mirrored by a variety of large-brained social carnivores (King, 1980; Schaller & Lowther, 1969). The gathering aspect of humans focuses on foraging for a wide variety of food items, some of which are difficult to access or are toxic. Successful consumption requires both correct identification and handling techniques (Zarger, 2010), a practice used by other generalist species (Ossi-Lupo, 2010). Finally, the pair-bonding that takes place between human mothers and offspring (Hrdy, 2009) and couples (Gavrilets, 2012; Ridley, 1993) is exhibited by other animals that possess temporally extended social connections. This unique social behavior allows for the transmission of skills and information (de Waal, 2009; Marzluff, 2013). Through this approach, my investigation takes advantage of the sort of experimentation Dewey saw as so critical to the advancement of knowledge (Dalton, 2002; Dewey, 1958, 1997b) and the contextual behavior evaluation that is necessary to get beyond the rampant behaviorism that emerged late in Dewey’s career (Hickman & Alexander, 2009; Popp, 1998).

**Primates and Mimicry**

Over the past several decades, significant debate has occurred over whether animals possess culture. Much of it centers on varied definitions of culture, for few question whether animals learn behaviors from others (Thornton & Clutton-Brock, 2011; van Schaik & Burkhart, 2011; Whiten, 2011) or that different communities possess unique behaviors that are transmitted from one generation to the next (Whiten & van Schaik, 2007). The exhibition of these sorts of behaviors and customs has been most readily observed in our closest living ancestor, the chimpanzee (Whiten, 2011). An increase in brain size was correlated with an increased capacity
for social learning (van Schaik & Burkhart, 2011), and both humans and chimpanzees possess some of the largest brain-size-to-body ratios among all animals. Both are primates and great apes and therefore possess similar neural architecture (Gazzaniga, 2008). The homologous structures in the brains of primates extend into even the most specialized regions associated with the language development (e.g. Broca’s and Wernicke’s areas) in both chimps (Gannon, Holloway, Broadfield, & Braun, 1998; Scocter et al., 2010; Taglialatela, Russell, Schaeffer, & Hopkins, 2008) and macaques (Gil-da-Costa et al., 2006). These similarities suggest that chimpanzees and, to a lesser degree, other primates might provide us with significant insight into not only how humans learn, but also how knowledge is best transmitted in the social manner Dewey (1966) championed.

Almost two decades ago, monkeys and apes were shown to possess mirror neurons (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996), which are cells that fire not only when one is performing a task, but also when one is watching it be performed (de Waal, 2009). Prior to this discovery, the hypothesis was that the act of watching facilitates skill learning in primates (Tomasello, Davis-Dasilva, Camak, & Bard, 1987; Tomasello, Kruger, & Ratner, 1993). A similar assumption was made about humans thanks to anthropologists’ identification of the cross-cultural practice of learning through observation (Gaskins & Paradise, 2010). The discovery of mirror neurons enabled researchers to link this previous work directly to brain architecture that was shared between humans and other primates (De Waal, 2009; Gazzaniga, 2008).

That observation accelerates skill acquisition suggests that procedural learning occurs through that mode of transmission. However, the studies failed to determine whether learning through mimicry could perpetuate the kind of cultural differences that observational studies
suggest exist between chimpanzee troops in the wild (Nakamura & Uehara, 2004). Experimental evidence, however, demonstrates that social customs such as hand-clasp grooming (Bonnie & de Waal, 2006) and skills such as tool use (Whiten, Horner, & de Waal, 2005) can be learned, transmitted, and remain unique among different chimp cultures (Whiten, Schick, & Toth, 2009). The process is similar to what has been called in humans vicarious reinforcement (Bandura, 1977; Gaskins & Paradise, 2010).

Without the intentionality outlined in the previous section, the successful transfer of skills probably is attributable in primates to their unique capacity to imitate. The learner’s selection of the model individual is the product of unlearned habits that Dewey (1929) ascribed to humans. In master-and-apprentice learning (Matsuzawa, et al., 2001), naïve chimpanzees in the wild follow and mimic the behavior of experienced and successful individuals (Horner, Proctor, Bonnie, Whiten, & de Waal, 2010). This practice is most readily utilized when learning to use tools while foraging (Whiten, 2011). Such individuals acquire a deferential followership not only because they are dominant, but also because they are considered prestigious (Henrich & Gil-White, 2001). This innate desire to follow those who are successful mirrors the way in which apprenticeship pairings are created both formally (Lancy, 2008; Reagan, 2005) and informally in humans (Crawford, 2009; F. R. Wilson, 1999; Wolseth, 2010). In both humans (Lancy & Grove, 2010) and other primates (Boesch, 1991), often the selected master achieves a prestigious position not because of his or her ability in relation to others in the group, but because a close bond puts the learner in close proximity to a more experienced individual. (Refer to the section on pair-bonding in this chapter for more information.)

The apprenticeship mode of cultural transfer in many ways mimics the way non-literate societies transmit information, whereby learning occurs in virtual silence through the sort of
unintentional demonstration associated with imitation (Tehrani & Riede, 2008). Apprenticeship was identified as critical to success in not only non-literate societies (Lave, 1977), but also as an important mode of transmission used in many literate non-Western societies (Reagan, 2005). Recently, apprenticeship has even been deployed in technologically driven Western first-world countries to facilitate more rapid learning (Harhoff & Kane, 1997; Heyes, 2013).

In spite of similarities, non-human primate social transmission differs in several ways from that of humans. Humans’ use of language and its potential influence on social transmission (Csibra & Gergely, 2011) may be what facilitates the use of teaching and the activation of mimicry (Hewlett, et al., 2011). However, because in many human cultures the primary linguistic contribution of the master to the apprentice’s learning comes in the form of verbal abuse (Lancy, 2008), it may be imitation instead of language that contributes to the successful transmission of procedural learning. This tendency toward exact behavioral replication stands in opposition to other primate species. Other primates are more apt to emulate, which is defined as attempting to achieve the same results regardless of method (Whiten, 2011). The difference in copying behavior may be attributable to the difference in cause-and-effect reasoning between the species (Csibra & Gergely, 2011; Pagel, 2012), for as Dewey (1966) saw it, a child may:

… note how the other person catches and holds [a] ball in order to improve his own acts. He imitates the means of doing, not the end or thing to be done … as a matter of fact, imitation of ends, as distinct from imitation of means which help to reach ends, is a superficial and transitory affair … [that] idiots are especially apt at … When we find children engaging in this sort of mimicry, instead of encouraging them … we are more likely to rebuke them as apes. (p. 35)
The dichotomy between the imitation of means and ends Dewey presents is not so much a product of species-level differences as a difference in the task complexity engaged in by the two species. Consequently, in chimps and humans, a greater number of steps before successful completion of a procedure are more likely to produce imitation than emulation (Whiten, 2011). The apparent complexity of human tasks may come from the human capacity to ratchet or layer on improvements to previously established sequences of behavior (Whiten, 2011). Depending on the structure of a given society, ratcheting may or may not be encouraged (Crown, 2010), but the ability to modify the achievements of predecessors has contributed to the advancement of the human species (Ridley, 2010). Additionally, because of the difference in task complexity between humans and other primates, some research suggests humans are given to over-imitation—copying convoluted sets of behavior—that could be bypassed to achieve the same ends while saving time and energy (Lyons, Damrosch, Lin, Macris, & Keil, 2011). Dewey (1929, 1966, 1997a) would think a reflective evaluation of means and ends would prevent over-imitation from transpiring altogether.

An alternative explanation, however, may be that human societies are more apt to utilize arbitrary behaviors to cement the identity of individuals who are a part of the group (Pagel, 2012; Whiten, 2011; Wilson, 2007). This act ensures the survival of the prevailing culture (Reagan, 2005; D. S. Wilson, 2003), a goal that Dewey (1929, 1966, 1958) believed benefited people in positions of power. This innate desire to transmit not just meaningful procedures, but also the arbitrary behavioral edifices of culture is typical of primates. The differences in the structures of human and non-human primate society may perpetuate the use of different social transmission methods for some of the culture’s most critical skills. Therefore, an investigation is needed on a
group of species whose similarity in EEA produce societies more analogous to those of humans (Thompson, 1975).

**Social Carnivores and Group Coordination**

Dewey (1929) concluded in his work on social psychology, *Human Nature and Conduct*, that culturally established habits are the product of biological impulse mediated by social interaction. Since Dewey (1963) thought “… education [to be] essentially a social process … realized in the degree in which individuals form a community group” (p. 58), he would think that the way in which a social group is organized would have significant bearing on how cultural transmission transpires. It has been demonstrated that an animals’ social organization is a byproduct of its diet (King, 1980; Thompson, 1975). Therefore, an analysis of dietary difference provides insight into how other aspects of a society function. Contemporary hunter-gatherer societies consume significant quantities of meat (Cordain et al., 2000) primarily from species larger than themselves (King, 1980). This pattern is similar to that of ancestral hominids (MacDonald, 2010), but differs significantly from non-human primates that consume little meat (Stanford, 1995). Therefore, the organization of human cultures mirrors more closely that of the social carnivores for whom the consumption of large mammals is a characteristic shared with humans (King, 1980; Schaller & Lowther, 1969; Thompson, 1975).

Pursuing and bringing down prey much larger than the individual predator requires organization by the predatory group, which in turn requires the predator to attend to other members’ behavior (Drea & Carter, 2009). This action is a necessity shared by teams of human hunters (MacDonald, 2010). Significant coordination of behaviors has been observed in terrestrial (Bednarz, 1988; Creel & Creel, 1995; Stander, 1992b) and aquatic social carnivores (Ramp, Hagen, Palsboll, Berube, & Sears, 2010; Rendell & Whitehead, 2001). Documented
cases show the kind of synchronous causal behavior (Visser et al., 2008) rarely observed in non-human primates. Research also shows in-group role specialization (Gazda, Connor, Edgar, & Cox, 2005; Sharpe, 2001; Stander, 1992a) that has not been documented in non-human primates (Drea & Carter, 2009). This specialization primarily was thought to be unique to humans (Pagel, 2012), effectively creating behavioral niches within a one-species community. Although human roles are more complex (Pagel, 2012), the interactions with prey and each other in many social carnivore species provide a unique environment for learning not only skills (i.e. procedural knowledge) from each other, but also for learning how to coordinate one’s behavior in a group. This capacity is critical to the success of the human lineage (MacDonald, 2010; van Schaik & Burkart, 2011). Dewey was acutely aware of the need to be cognizant of others’ behaviors when engaging in purposeful action in a social setting. He thought that students need “… more opportunity for conjoint activities in which those instructed take part, so that they may acquire a social sense of their own powers” (Dewey, 1966, p. 40). By engaging in group activities, students have the opportunity to not only grow inwardly through acquiring new knowledge and skills, but also grow outwardly to find their place in the group.

Unfortunately, little experimental research has been done with social carnivores on the coordination of behavior and its relationship to learning. However, Drea and Carter’s (2009) work with hyenas demonstrates that experienced individuals modify their behavior in the presence of naïve individuals to promote group success. These individuals do it in a way that allows for learning to occur. However, they do not achieve what Caro and Hauser (1992) consider opportunity teaching in that the group dictates the goal based on the group’s immediate needs and not the needs of a naïve individual. For the hyenas, their group-oriented behavior included acting contrary to their position of dominance. This self-handicapping has been
observed in other carnivore species and humans. Recently, researchers have concluded that the function of this behavior is to promote interaction (Bekoff, 2001; S.L. Brown & Vaughan, 2009). Anthropologists have observed people in indigenous societies self-handicapping to perpetuate juvenile contribution to both the hunt (MacDonald, 2010) and craftsmanship (Crown, 2010). In humans, this requires that adults provide tools and supplies (Lancy, et al., 2010). This behavior is similar to social canids, who are more apt to share objects that are the focus of play bouts than those who were members of an asocial species (Biben, 1982).

With adults of various human cultures using some of their society’s limited resources to facilitate learning in children, the act of self-handicapping to promote learning is approaching cultural universality (Crown, 2010; MacDonald, 2010). This behavior represents the investment identified by Caro and Hauser (1992) and Thornton and Raihani (2008) necessary to be defined as teaching. Among other social carnivores, however, learning takes place because engaging in the hunt is participatory and experiential (Thornton & Raihani, 2008). This participation immediately benefits the group to prevent it from achieving Caro and Hauser’s definition of opportunity teaching. It also justifies being granted its own category for social transmission: coordination.

Dewey (1966) thought that the existence of an immediate purpose for the activity—such as the group acquisition of a large prey item—was critical if the goal was to facilitate learning. He proposed that “… primary or initial subject matter always exists as a matter of an active doing, involving the use of the body and the handling of material” (Dewey, 1966, p. 184). Some have posited that the use of the hand was the vehicle for the encephalization of humans (F.R. Wilson, 1999) and is the mechanism by which our intelligence is best expressed (Crawford, 2009). In human cultures, learning through the handling of materials can happen through tasks as
varied as the production of communal crafts (Crown, 2010; Lancy, 2008; MacDonald, 2010), the delivery of messages (Reagan, 2005), and hunting (MacDonald, 2010). Thus, learners contribute to the group’s perceived needs in a fashion that makes their actions meaningful and allows for the interactive socialization so critical to Dewey’s perception of growth (James Campbell, 1995; Dewey, 1966; Popp, 1998). This idea applies to humans and many social animals (S. L. Brown & Vaughan, 2009; Drea & Carter, 2009). Some experimental research suggests that when juveniles beg for food from adults, as opposed to participating directly in foraging, this behavior leads to a delay in skill acquisition (Ossi-Lupo, 2010).

Unlike the social carnivores, where many procedures are transmitted with little in the way of verbal instruction (Hewlett, et al., 2011; Lancy, 2008), much of human information transmission (i.e. declarative knowledge) occurs vocally (Csibra & Gergely, 2011). Compared to a highly social primate such as the vervet monkey, the aforementioned hyenas are less adept at utilizing the information contained within other group members’ calls to determine what sort of response is warranted (Holekamp et al., 1999). A significant convergence may have occurred in group organization due to similar predatory behaviors between humans and social carnivores. However, social carnivores appear to rely more frequently on rules of thumb when making social decisions than do primates (Holekamp, Sakai, & Lundrigan, 2007). Though significant ecological rationality exists for the development of such problem-solving heuristics in humans (Todd, 2000), Dewey (1929) thought that rigidity can lead a man into “… a ditch out of which he cannot get, whose sides enclose him, directing his course so thoroughly that he no longer thinks of his path or his destination” (p. 173). This natural inclination toward habit may explain both Dewey’s and contemporary scientists’ (S. L. Brown & Vaughan, 2009; Gazzaniga, 2008; Popp, 1999; D. S. Wilson, 2008; F. R. Wilson, 1999) emphasis on the importance of behavioral
plasticity. Flexibility is of particular import when environments are highly variable and involve forcible encounters with many obstacles to survival (Pagel, 2012; Ridley, 2010). Often this is put in the starkest relief with regard to food. When one is unsure from where or what the next meal will come, the ability to rapidly acquire and transmit new knowledge is critical. Animals that engage in this lifestyle are considered gatherers, the next group that share part of the human EEA.

**Gathering Teachers**

I have investigated methods of social transmission that fall under the heading of what Dewey (1997a) called process learning and what Thornton and Raihani (2008) called progressive teaching. This proto-pedagogical method is reserved for procedural knowledge, though neither of the organism groups was identified as teachers because the transmission happened more as a product of cognitive architecture in the case of the primates and of the sociality required for group predation in the hunters. According to Caro and Hauser’s (1992) definition, the fact that teaching was most readily identified in cooperatively breeding species may be because humans also are cooperative breeders and share a life history attuned to practices that they have separately converged upon (Hoppitt et al., 2008). Another theory is that it may a product of the temporal and energetic investment required of both teaching (Caro & Hauser, 1992; Thornton & Raihani, 2008) and cooperative breeding (R. Heinsohn & Legge, 1999). For many cooperative breeders, this cost is offset by the benefits of kin selection (Covas, Dalecky, Caizergues, & Doutrelant, 2006; Nichols et al., 2012). This is not always the case (Clutton-Brock et al., 2000; Nichols, et al., 2012), as when inter-family instruction occurs in animal teachers (Thornton & Raihani, 2010) and human teachers (Hewlett, et al., 2011). These similarities hint at particular adaptive trade-offs and ecological conditions that serve as the impetus for both social practices.
In birds, mammals, and invertebrates, cooperative breeding often is observed in habitats with inconsistent food availability (Doolan & Macdonald, 1996; R. G. Heinsohn, 1991; Monnin, Ratnieks, & Brandao, 2003). Though this can apply to group predators, these large social carnivores often migrate with prey items (Andrews, Pitman, & Ballance, 2008; Walton, Cluff, Paquet, & Ramsay, 2001) or at the very least preferentially favor particular prey species (Hayward & Kerley, 2005). As demonstrated earlier, social carnivores most often learn through contribution to the group’s overall effort, whereas for most cooperative breeders, foraging is often independent (Doolan & Macdonald, 1996; R. G. Heinsohn, 1991; Monnin, et al., 2003), necessitating a different learning modality. At first glance, the method appears to be that of master and apprentice, which should not be surprising given that many of the observed cases of social transmission in gatherers occur in primates (Ossi-Lupo, 2010; Rapaport, 1999; Roush & Snowdon, 2001; Ruiz-Miranda et al., 1999). However, being more experienced does not make individuals more prestigious. They are not engaging in a challenging behavioral sequence that necessitates imitation. Rather, the information being transferred is often about the palatability of particular foods (Ossi-Lupo, 2010). Dewey (1997a) stated that such knowledge is, therefore, not so much about a process as it is about information. This knowledge requires not progressive teaching, but fixed teaching that, as described earlier, is expressly for declarative knowledge.

Some of the strongest experimental evidence of fixed teaching comes from the research done by Richardson et al. (2007). Their research investigated tandem-running ants using landmarks to identify paths between food and the nest site. In the ants, instructors receive feedback from the learners through antennae taps. The ants only move toward the food site once they have made contact, and they vary their speed based on the feedback they get from the learner. The cost to the instructor is a four-fold increase in the time it takes to get to the food, but
the learner can find its way back to the nest in much less time than it would otherwise. During moves to new nest sites, learners become instructors and carriers of naïve individuals. This action provides for a more efficient move and allows the colony to take advantage of the available resources (Richardson, Sleeman, McNamara, Houston, & Franks, 2007; Thornton & Raihani, 2008).

Using behaviors like the one described above, cooperatively-breeding species are able to out-compete sympatric species that share similar habitat requirements (Zack & Ligon, 1985). Consequently, colony members can help naïve individuals be aware of resource opportunities. Though some food neophobias are overcome by the presence of other individuals eating in cooperative breeders (Perry, 2011), experiments have demonstrated that naïve individuals solicit novel foods more often than familiar foods (Voelkl, Schrauf, & Huber, 2006). Inexperienced individuals appear to be aware of their need to acquire knowledge. The awareness of their ignorance, however, can extend to the experienced colony members, who will share new food items more often than familiar ones, suggesting a desire to facilitate learning in others (Rapaport, 1999). Transmission of declarative knowledge, therefore, happens vertically between parent and child, horizontally between children or between adults, or obliquely between indirectly related adults and children (Thornton & Clutton-Brock, 2011). This activity mirrors that of humans, who learn about palatable and poisonous plants through siblings, cousins, aunts, uncles, parents, and grandparents (Hewlett, et al., 2011; Zarger, 2010).

In humans, the acquisition of environmental knowledge about food often occurs in conjunction with language development (Zarger, 2010). Therefore, in non-humans the active sharing described above is associated with vocalizations or gestures (G. R. Brown, Almond, & Bergen, 2004; Midford, Hailman, & Woolfenden, 2000), which make it a form of coaching
The best experimental evidence for teaching the link between vocalization and food comes from pied babblers, a bird species in which adults condition their nestlings to expect food after a purr call. This call elicits a begging response prior to parental food provisioning (Raihani & Ridley, 2008). Increased exposure to purr calls produces earlier learning in the nestlings. Early learning provides the immediate benefit to the learner of increasing its chances to receive food and an extended benefit to the parent and the offspring when fledging occurs. Parents use the purr call to encourage fledged chicks to move toward the parents and away from danger.

Anthropologists have identified that many indigenous societies also utilize the overt linking of call to context (Zarger, 2010). Dewey advocated for the practice as well (1997a). According to Dewey:

… if the idea is not grasped, nothing is gained by using a more familiar word; if the idea is perceived, the use of the term that exactly names it may assist in fixing the idea … As every meaning is set in the context of some situation, so every word in concrete use belongs to some sentence (it may itself represent a condensed sentence), and the sentence, in turn belongs to some larger story, description, or reasoning process. (p. 185)

The pedagogical instinct of Dewey, indigenous tribesmen, and cooperatively breeding animals to link the declarative knowledge of acquired language to both spatial and emotional contexts is justified by contemporary neuroscience. The seat of processing this type of knowledge, the hippocampus (LeDoux, 1996), also is utilized in interpreting the source of emotions (Phelps, 2004) and in the organization of spatial information (LeDoux, 1998).

The hippocampus may seem like a clearinghouse for disparate information until one analyzes these associations from an evolutionary perspective. As an ancient structure embedded
within the reptilian portion of the brain (Lieberman, 2002), the hippocampus is associated with processing language of a basal nature that likely links different cognitive inputs and outputs. In nature, the alarm call for predators is among the most widespread of call types in the animal kingdom (Seyfarth & Cheney, 2010). This call requires a visual and spatial context in birds (Lachlan, Verhagen, Peters, & Cate, 2010; O'Loghlen, Rothstein, & Sealy, 2004) and primates (Hauser, 1988; Seyfarth & Cheney, 1990) to be learned and utilized. When initially learning the correct context in which to apply a predator-specific alarm call, vervet monkeys often over-generalize its application, giving the eagle alarm call for birds that do not pose a threat (Hauser, 1989; Seyfarth & Cheney, 1986). This common mistake is similar to the over-extensions that human toddlers make in applying new words (E. V. Clark, 2003). Therefore, these over-extensions may be due to an over reliance on location and its link to language (Skerry, et al., 2013). These kind of errors dissipate with time and experience in humans (Hewlett, et al., 2011) and non-human primates (Seyfarth & Cheney, 1990). The dissipation illustrates that declarative language acquisition is a socially learned process (Janik & Slater, 2000).

Since Dewey (1958) considered that, “… all experience is ultimately social: it involves contact and communication” (p. 38), he would commend the natural transmission patterns for declarative knowledge in humans and non-humans because they are experiential, social, and purposeful. The learning of language, however, requires that an individual is able to produce the sounds necessary to transmit the information. This may explain why a recent review established that the ability of animals to learn words far outpaces their ability to produce them (Seyfarth & Cheney, 2010). This difference probably is due to limitations in fine-motor control (van Schaik & Burkart, 2011). The production of language, because the development of vocal coordination is a process, requires not fixed teaching, but progressive teaching (Thornton & Raihani, 2008). As
described in the primate sub-section, one widely deployed method for this is through a naïve apprentice mimicking the behaviors of an experienced and prestigious master. This practice usually leads to an energetically wasteful period of trial and error. Cognitive scientists from Dewey’s time to today (Dewey, 1933, 1997a; van Schaik & Burkart, 2011) recognize that human actions are exacerbated by the inclination for over-imitation (Lyons, et al., 2011) and may be limited in non-primates by a predilection for asocial learning (van Schaik & Burkart, 2011). Therefore, a pedagogical methodology should have developed in non-primate gatherers whereby the instructor teaches the skill in steps to the pupil. This exact process was observed in meerkats (Thornton & McAuliffe, 2006).

Meerkat adults teach their young how to handle prey that is difficult, such as lizards and spiders, and dangerous prey, such as scorpions. Rather than immediately consuming the prey, the adult incurs a cost by providing dead, disabled, or live prey depending on the pups’ developmental level. Caro and Hauser (1992) would have identified this as a refined form of opportunity teaching. The condition of the provisioned prey is determined by changes in begging calls by the young, which suggests there are rules of thumb for the instructors’ response to pupils. However, adults do modify their behavior based on feedback they receive from the pupils, nudging prey that is not being engaged, retrieving prey that has escaped, and disabling prey if it is proving too difficult for the young to handle. These handling behaviors were analyzed longitudinally and were shown to accelerate the learners’ successful prey acquisition development and provide more instructors to the colony in subsequent years (Thornton & McAuliffe, 2006).
The meerkats adjusting their teaching to their students makes teaching a cooperative endeavor (Thornton & Raihani, 2008). Dewey (1966) would have lauded this conclusion because, as he wrote in *Democracy and Education*:

> When the parent or teacher has provided conditions which stimulate thinking and has taken a sympathetic attitude toward the activities of the learner by entering into a common or conjoint experience, all has been done which a second party can do to instigate learning. The rest lies with the one directly concerned ... This does not mean that the teacher is to stand off and look on ... [his role becomes] participation, sharing, in an activity. In such a shared activity, the teacher is a learner, and the learner is, without knowing it, a teacher—and upon the whole, the less consciousness there is, on either side, of either giving or receiving instruction, the better. (p. 160)

Therefore, Dewey would not have cared that the meerkat teacher’s response to its pupils is rigidly dictated by vocal cues (Thornton & McAuliffe, 2006), even though this research suggests that the teacher is not fully conscious of the students’ needs as individuals (Csibra & Gergely, 2011; Skerry, et al., 2013; Thornton & Raihani, 2010). Dewey championed the idea that the individual students’ abilities and proclivities must be used to direct instruction (this idea is discussed in Chapter Five). This stance seems to place him in opposition to the rigidity of meerkat instructors’ responses to their pupils. However, Dewey’s lack of concern about the research would be because he recognized that a teacher must use his or her own best judgment—conscious or not—for the method selection based on the inputs provided (Dewey, 1966, 1997a). By providing a cooperative experience, the meerkats engaged in what Dewey would have considered effective teaching of a desirable skill.
In the passage above, Dewey’s decision to mention not just teachers, but also parents was an insightful one from an evolutionary perspective. Many instances that are defined as teaching in animals are between mother and child (Bender, Herzing, & Bjorklund, 2009; Boesch, 1991; Caro & Hauser, 1992; Raihani & Ridley, 2008; Thornton & Raihani, 2008, 2010). In an oft-cited instance described at length in the following sub-section, a mother chimpanzee corrected her offspring and demonstrated the appropriate method for cracking nuts using a hammer and anvil (Boesch, 1991). Although this type of correction is not frequently observed, chimp daughters learned termite fishing more quickly than sons by more than two years. The daughters also showed greater fidelity to the practice of their mothers, probably because they spend more time observing them (Lonsdorf, 2005; Lonsdorf, Eberly, & Pusey, 2004). Infants of both genders more often attended to the mothers’ actions than any other group members (Inoue-Nakamura & Matsuzawa, 1997). Humans share this practice, with daughters relying on mothers for early education through modeling and, to a lesser degree, through formal teaching (Hewlett, et al., 2011; Konner, 2010; Lancy, 2008).

As humans age, however, much of the education burden falls to other group members (Hewlett, et al., 2011; Lancy, 2008; Lancy, et al., 2010). In light of the evidence above, the shifting of that burden may be attributable to humans’ status as gathering cooperative breeders (Russell & Lummaa, 2009), because such oblique transmission was not common among other, non-cooperatively breeding primates (Inoue-Nakamura & Matsuzawa, 1997; Lancy, 2008; Lonsdorf, 2005; Lonsdorf, et al., 2004). In cooperative breeders, alloparenting is widely practiced, which is the babysitting of offspring that is not one’s own. The alloparenting that is common among higher primates has been associated with how well the mother is integrated into the group. Consequently, it affects how much her offspring learns (Lancy, 2008). This finding
suggests that the possession of positive affiliative relationships—social pair-bonds—is critical to the transmission of knowledge and skills. With a wide variety of taxa exhibiting pair-bond related social transmission, this identification is the final category of non-humans to be evaluated.

**Pair-bonds and Pedagogy**

Research on primates and mammals shows that species that live in large social groups need large brains in relation to body sizes (Byrne & Bates, 2007; Dunbar, 1992, 1993). In contrast, bird species do not seem to show a correlation between brain size and sociality (Emery, Seed, von Bayern, & Clayton, 2007). Instead, in birds a relationship exists between the forebrain and the ability to respond flexibly to the environment and develop and use technical innovations (i.e. tools) (Lefebvre & Sol, 2008). Within both groups, however, the parents and alloparents bear the developmental cost of encephalization, resulting in extended care periods (Isler & Van Schaik, 2009; Martin, 1996). With the time and proximity necessary for social transmission patterns to transpire, species with extended periods of parental care are well positioned to engage in all of the aforementioned pedagogical practices and they develop the trust in their teachers necessary to do so.

Dewey recognized that trust is necessary for teaching (1933) long before it was demonstrated experimentally. He stipulated that the “… more a teacher is aware of the past experiences of students, of their hopes, desires, chief interests, the better will he understand the forces at work that need to be directed and utilized for the formation of reflective habits” (p. 36). He thought that if the students trusted their instructors, “… methods of instruction and discipline that are technically faulty may be rendered practically innocuous by the inspiration of the personal method that lies back of them” (Dewey, 1997a, p. 47). Experimental studies support
Dewey’s supposition. The studies showed that children use an heuristic of familiarity when selecting who to trust, either based on personal attachment (i.e. social pair-bonds) (P. L. Harris & Corriveau, 2011) or on who demonstrated consistent possession of accurate information (Corriveau & Harris, 2009; Henrich & Broesch, 2011). This desire extends beyond humans. According to de Waal’s BIOL theory, individuals of many species and taxa possess an innate predilection to imitate the behavior of individuals to whom they are bonded (de Waal, 2001, 2009; Perry, 2011). Such actions may strengthen the bonds between the actors and the imitators (Perry, 2011) since copying behavior can be interpreted as an outward manifestation of empathy (de Waal, 2009).

Teaching in non-humans is considered to be a cooperative and an altruistic endeavor (Hoppitt, et al., 2008; Thornton & Raihani, 2008), placing the teacher and student into a dyad of care. In this relationship, the one caring—the teacher—does not so much engage in quid pro quo reciprocal cooperation as provide what is necessary for the individual who is cared for—the student—to achieve his or her desired goal (Noddings, 2003, 2010). Behavioral biologists call this activity targeted helping (de Waal, 2009). By focusing on the needs of the individual, the ethic of care and the act of targeted helping echoes how Dewey (1966, 1997a) thought the selection of teaching methods should transpire. Teaching methods should be based not only on the subject matter, but also on the student. And as a student of evolution, Dewey would expect to see such a practice represented, albeit in a rudimentary fashion, by the deployment of all of the aforementioned transmission methods between individuals who share a social bond.

Following is a brief survey of how highly encephalized creatures that share strong social pair-bonds transmit information and skills. The results are presented in order of increasing pedagogical complexity.
**Coordination.** Individuals who share close affiliative relationships are apt to develop coordinated behavioral routines. This practice often occurs between two individuals in a mating pair-bond. The individuals develop elaborate social rituals and incur an immediate fitness cost in learning the process. They also incur a deferred cost because the ritual probably is not transferable to any subsequent relationship (Perry, 2011). Similar unique interactions can develop between mothers and offspring as they develop behavioral idiosyncrasies while both mature in their respective roles (Hrdy, 1999, 2009). Finally, behavioral sequences develop between friends, who often are members within a single social group. In white-faced capuchin monkeys, one individual will make a part of himself or herself vulnerable as a form of bond-testing (Perry et al., 2003), while affiliated chimp males use the same pant-hoot vocalization (Mitani & Brandt, 1994). Although this form of coordinated learning is most often documented among pair-bonding primates, other mammals have been observed in similar exhibitions.

Cheetahs form natural coalitions in the wild and captivity (Caro, 1993; Chadwick, Rees, & Stevens-Wood, 2013), and in the relationships formed in captivity, the cheetahs exhibit the affiliative behavior that characterizes social pair-bonds. In the wild, these coalitions allow for the coordination of predatory activities (Caro, 1994). And while territorial defense may be the primary reason for cheetahs’ social behavior, (Caro, 1994; Caro, Fitzgibbon, & Holt, 1989), the side-benefit of coordinated predation has facilitated the horizontal transmission of group hunting processes in cheetahs and other solitary carnivorous mammals (Luhrs, Dammhahn, & Kappeler, 2013).

The development of novel coordinated behaviors is not reserved for mammals. Ravens develop life-long monogamous pair-bonds and many unique hunting tactics. These tactics range from a pair alternating between dispensing whipped cream from a pressurized can and
consuming the frothy product, to herding chickens into corners to create easy pickings. In the arctic, two ravens were seen killing a baby seal when one covered the hole in the ice that was the ostensible escape route while the other bludgeoned the pup to death. In this last example, the ravens demonstrated rudimentary collaboration with each individual taking on a specific role during the event. Ravens exhibited more elaborate collaboration when one was observed chasing crossbills through building corridors. His mate ambushed the prey and steered them into glass windows, resulting in a stunned flock that became easy pickings (Marzluff, 2013).

Coordination, cooperation, and collaboration do not require that a species with social bonds be predatory, however. Elephants are among the most cooperative of species. They demonstrate that they understand the necessity of coordination in a rope-pull experiment better than rooks, another highly social corvid (Plotnik, Lair, Suphachokshakun, & de Waal, 2011). In more natural settings, elephants solicit help more often from affiliates with whom they have developed a social bond (Soltis, Leong, & Savage, 2005) with the likely goal of working together to solve shared problems (Poole & Moss, 2008). These bonds initially are facilitated in elephants through extended periods of maternal and allomaternal care that extends up to nine years, followed in females by becoming members of their natal herd and in males by joining an all-bull group (Lee & Moss, 1999).

Dewey would not be surprised by the relationship between affiliative bonds and successful transmission of information. In his last major pedagogical work, *Experience and Education*, Dewey argued that for teachers to be successful, they must feel a part of the community. In such a situation, students cease being a class of individuals and instead become a social group where, “The teacher loses the position of external boss or dictator but takes on that of leader of group activities” (Dewey, 1963, p. 59). By reframing the teacher’s role, the students
see the teacher as an authentic leader and the type of figure they are inclined by evolution to follow (Niedermeyer, 2012). To lead authentically, a teacher would require a significant capacity for social and emotional cognition, which cognitive neuroscientists have tied, in part, to the possession of von Economo neurons (VEN) (Allman, Watson, Tetreault, & Hakeem, 2005). This piece of neural architecture allows for the taking of others’ perspectives (de Waal, 2009). Therefore, the bond strength in elephants may be facilitated by the fact that elephants possess VENs (Hakeem et al., 2009). The discovery explains why elephants recoiled at the sight of an affiliate that was about to touch an electrical fence (Poole & Moss, 2008). It also creates a foundation for the cooperative capacity they share with corvids, who also possess VENs (Bugnyar & Heinrich, 2005; Dally, Emery, & Clayton, 2006).

Cetaceans (Butti, Sherwood, Hakeem, Allman, & Hof, 2009) and primates (Allman et al., 2010; Evrard, Forro, & Logothetis, 2012) are the only other animals groups who possess these specialized social neurons. Both have the ability to take others’ perspectives (Bekoff & Pierce, 2009; de Waal, 2009). As mentioned earlier, primates, elephants, and cetaceans posses mirror neurons (Blakeslee, 2006). We would therefore expect animals of those species to imitate those to whom they are most closely bonded as another facet of their social transmission capacities. This supposition is addressed in the sub-section below.

**Imitation.** As mentioned previously, individuals engaged in a pair-bond are more likely to develop elaborate greeting rituals that allow for the establishment (and reestablishment) of their relationship (Perry, 2011). Often, these routines involve imitation. Horizontal transmission occurs between a monogamous pair in many birds, including several corvids (Emery, et al., 2007). Neonatal imitation in primates (Byrne, 2002) allows for vertical information transmission, which is described in the primates section above. Neonatal imitation most often occurs between
mother and child, who in some primate species, share a strong pair-bond (Hrdy, 1999, 2009). For orangutans, which have the greatest inter-birth interval of all mammals (van Noordwijk & van Schaik, 2005), this provides eight years for the mother and offspring to bond and transmit information vertically. Therefore, though overlapping home ranges between different orangutan mother-child pairs allow for access to similar foods, young orangutans often possess identical feeding habits to those of their mother, while differing significantly from those of their other cohabitants (Jaeggi et al., 2010). Such extensive imitation could be a product of social facilitation—increased comfort with a novel activity due to the presence of conspecifics—though juveniles more often attend to their mothers’ actions when they involve extractive foraging (e.g. termite fishing) as opposed to more simple activities. These observations were often followed by purposeful practice of the activity on the juvenile’s own (Jaeggi, et al., 2010). Such intentional imitation ensures that the offspring maintains dietary preferences similar to their mother’s.

Dolphins (Herman, 2002) and orcas (Abramson, Hernandez-Lloreda, Call, & Colmenares, 2013) demonstrate purposeful imitation in captivity. In both species, the trainers mediated the animals’ mimicry. However, the animals continued to exhibit behaviors of conspecifics, as opposed to heterospecifics (i.e. their trainers). It has been demonstrated in several animal species that interspecific affiliative pair-bonds can occur (Colbert-White, Covington, & Fragaszy, 2011; Hess, 2008; Perry, 2011). These phenomena suggest that the impetus for this (decidedly) oblique transmission may in fact be quite similar to that of the vertically transmitting orangutans. Further support for the supposition that mimicry is natural for some cetaceans comes from a juvenile orca not involved in the study. While its mother was being trained, the juvenile attended to her behavior in such a fashion that it spontaneously imitated much of the novel behavioral sequence that was a part of the mimicry training.
(Abramson, et al., 2013). Its behavior indicates that imitation could play a natural role in the transmitting procedural knowledge for cetaceans.

Imitation also plays a role in the largest of terrestrial mammals. Transpiring on a much more global and temporal scale, elephant daughters extensively imitate their mothers’ behaviors. Consequently, the herd’s accumulated knowledge passes from matriarch to daughter before the throne is ceded to the sufficiently informed next generation (O'Connell, 2007). The need to transmit the full store of information to the next generation and the need for the pupils to acquire it explains, in part, the imitative practices of children Dewey observed in and around the schoolyard (Dewey & Dewey, 1962). In the book he wrote with his daughter, *Schools of Tomorrow*, Dewey noted that the goal of a child’s imitative play was “… to make his life a replica of the life of his parents” with the impulse for mimicry being so strong that “… children are just as apt to copy the coarseness, blunders, and prejudices of their elders as the things which are best” (Dewey & Dewey, 1962, p. 79).

Whether talking about children on the playground or an elephant herd attempting to find a watering hole (Foley, Pettorelli, & Foley, 2008), large scale, high-fidelity transmission includes procedural knowledge and declarative knowledge. Species such as elephants and humans possess a need to transmit a high volume of skills and information to those with whom they share strong social bonds. In those species, a third technique, coaching, can be deployed.

**Coaching.** Coaching previously was defined as the teacher providing positive or negative feedback to encourage or discourage a particular behavior (Caro & Hauser, 1992). Only a small number of species were observed engaging in this cognitively demanding method of social transmission. Elephants have demonstrated anecdotal coaching through negative feedback. A grandmother elephant observed that her daughter had little chance of success with her aggressive
attempts to extract her calf from a mud pit. This sequence precipitated a poke in the posterior by the grandmother, forcing the mother to give the calf the space necessary to extricate himself (Holmes, 2009). We do not know if this feedback led to learning. However, because elephants possess the neurons necessary for long-term memory and pair-bonding (de Waal, 2009) it is likely that the grandmother’s intervention resulted in her daughter’s learning how to handle similar situations in the future.

Vervet monkeys show definitive evidence of coaching. Vervet monkeys are a species that has strong social bonds between mother and daughter (Silk, 2007) and between associated group members (Cheney & Seyfarth, 1986, 1990). These monkeys use predator-specific alarm calls (Seyfarth, Cheney, & Marler, 1980a, 1980b), and each call requires a different behavioral response. Consequently, young vervets must develop the capacity to produce the calls. Much of vocal production and some of the comprehension in vervets was demonstrated to be developmental (Hauser, 1989). As mentioned in the primate section of this chapter, learning the appropriate use of the calls probably occurs through social interaction. When juvenile vervets mistakenly call (e.g. giving the eagle alarm for a non-predatory bird), adults echo the call less often. When the call is accurate, they do echo (Caro & Hauser, 1992; Seyfarth & Cheney, 1986). This differential feedback for the learner may serve as encouragement, especially in light of the anecdotal observation that mothers punish their offspring after inaccurate calls (Caro & Hauser, 1992). Even though adult response calls are not specifically linked to vocal learning in juvenile vervets, exposure to accurate calls has been shown accelerate the apprehension of their appropriate use (Hauser, 1988; Seyfarth & Cheney, 1990). The coach’s feedback or lack thereof may train young monkeys in this species to call correctly.
In modern pedagogical textbooks the acts described as coaching would be classified as direct instruction (Marzano, 2004). Dewey would have appreciated the coaching observed in primates. This statement would surprise those who erroneously pegged Dewey as an advocate for a purely student-driven education. But Dewey bristled when people tried to label him or his philosophy. So, in *Experience and Education*, the book that served as his response to those who misapplied his educational philosophy, Dewey (1963) made clear his frustration with those who had taken student-centered education too far (this issue will be addressed at length in Chapter Five). In the book, he expresses his disbelief in the fear some teachers have when providing not only materials, but also instructions on how they might or might not be used. He concluded that although the teacher abuses his or her station by imposing too many of his or her own ideas on the pupils, “It is impossible to understand why a suggestion from one who has a larger experience and a wider horizon should not be at least as valid as a suggestion arising from some more or less accidental source” (Dewey, 1963, p. 71).

Though coaching has been suggested to exist based on anecdotes in a variety of primates (Caro & Hauser, 1992), experimental evidence of the practice is limited. Dewey, a great advocate for experimentation, would therefore have taken great interest in the evidence provided by two species with the kind of strong social bonds that he thought should exist between student and teacher. In the first study, a male baboon was provided experience with unpalatable fruit while the rest of his troop was not. Through aggressive behavior, he threatened approaching juveniles from his troop and kept them from consuming the affected fruit (Fletemeyer, 1978). In the second, experienced tamarins changed their food call rate and the deployment of alarm calls. Their loud noises discouraged inexperienced troop members from consuming a desirable food item that had been peppered (Snowdon & Boe, 2003). In the latter study, individuals with no
direct experience with the undesirable object coached others about the appropriateness of avoidance. The coaches instead learned from those with direct knowledge of the food. This transmission pattern also has been observed in crows. For the pair-bonding corvid, the information transferred was not about food, but about a human (a person in a caveman mask) associated with trapping. Researchers showed that the transmission went horizontally and vertically about the specific potential threat (Marzluff, Walls, Cornell, Withey, & Craig, 2010).

These coaching examples are a step beyond cooperative learning. Rather than learning together, a knowledgeable individual shapes through feedback a naïve individual’s actions. While quite successful at declarative knowledge transmission, coaching does not play a significant role in acquiring procedural knowledge, particularly of skills that entail multiple steps. Instead, knowledgeable individuals seeking to transmit skills that are more complicated use opportunity teaching, which is Caro and Hauser’s (1992) second purposeful pedagogical method.

**Opportunity Teaching.** For most large terrestrial predators, acquiring prey is among the most difficult of tasks. For most social carnivores, transmission comes through cooperation, with naïve juveniles growing into their roles as contributors. Cheetahs, the aforementioned solitary carnivore given to social pair-bonds and predatory coordination, use this method. The capacity to pair-bond also affects the way in which solitary hunting tactics are transmitted. Cheetah mothers provide their young with a variety of prey items exhibiting different stages of distress, from dead Thomson’s gazelles to injured hares to intact prey items. This behavior seems to be based on the cubs’ ability to consume and capture the target species (Caro, 1994; Caro & Hauser, 1992). This example fits Caro and Hauser’s (1992) aforementioned definition of opportunity teaching where a teacher purposely puts the pupil in a learning position. It is unknown for the cheetahs whether
the selective provisioning is based on rigid developmental cues from the cubs—similar to those of meerkat teachers (Thornton & Clutton-Brock, 2011; Thornton & McAuliffe, 2006; Thornton & Raihani, 2008)—or dependent on the mother recognizing individual cubs’ needs. It is also not known if the opportunities that the cheetahs do provide are linked to the development of hunting skills. However, it has been shown in another feline that maternal activity can promote behavioral development. House cat mothers provide their kittens with prey items and modify their behaviors in response to the attention the kittens pay to it. The mother cats also appear to modify their provisioning strategies based on the abilities of different kittens of the same age. This teaching probably facilitated the kittens becoming adept predators at a younger age than they would have otherwise (Caro, 1980a, 1980b; Caro & Hauser, 1992). These experimental conclusions for a fellow felid suggest that the purpose of cheetah provisioning is to provide learning opportunities, even if no imputation exists by the mother of the cub’s state of mind (Thornton & Raihani, 2008).

In other species that have demonstrated the ability to bond socially, however, some indications show that individuals can identify others’ needs. Dolphins and elephants provide targeted help to distressed individuals (de Waal, 2009) and utilize a variety of social transmission practices. In individuals where these two capacities are combined and utilized together, one expects to see opportunity teaching take place. Field researchers’ observations suggest that they have seen this type of pedagogy in both species.

In elephants, simulated estrous provides the best evidence for teaching. During this act, older females that are not in estrous signal their receptivity to males. A 28-year data review rejected the possibility that such behavior is anomalous—the product of hormonal imbalance—or that it has direct benefit to the actor herself. The researchers instead concluded that this odd
behavior might be a demonstration for young females in their first period of estrous. Through it, knowledgeable females demonstrate the correct behaviors and the suitors toward which they should be directed, males in musth (Bates et al., 2010). Given that females often spend their entire lives with a stable natal herd (Moss, 1988), and that they become especially close with their bond group (Moss & Poole, 1983), the transmission of this suite of behaviors is most likely to occur between socially bonded individuals.

For some pods of bottlenose dolphins in the Atlantic, the difficult skill that needs to be transmitted is how to capture fish. Analysis of video footage of wild dolphins who were habituated to human presence showed that mothers modified how long they chased prey that had been rooted out of the sand (i.e. they spent additional time). The mothers used more frequent and more exaggerated reorientation behaviors such as redirecting and herding the prey when their own calves observed them, but not others’ calves (Bender, et al., 2009). The researchers concluded that, because the modification occurred only when the calves observed their dolphin mothers and were not just near them, the behaviors were for the express purpose of teaching. This conclusion is bolstered when it is taken into consideration that the still nursing calves were provided with opportunities to pursue a prey item that the mother could use to produce the milk that was the basis of the calves’ diets. Still, it is not known whether providing these opportunities for observation and participation accelerates the learning process of the calves. Consequently, the effectiveness of the practice is unknown (Bender, et al., 2009).

However, in orcas—the largest member of the dolphin family—knowledgeable individuals not only have been observed modifying their behavior in the presence of their offspring, but that modification has been linked to the development of a difficult skill. For orcas, one of the more dangerous predation tactics involves intentional stranding on a beach to try to
capture elephant seal pups in the shallow surf (Guinet, 1991; Guinet & Bouvier, 1995). Widely deployed in the southern hemisphere (Guinet & Bouvier, 1995; Lopez & Lopez, 1985; Rendell & Whitehead, 2001), this ability becomes refined over several years. The ability begins as a sort of social play when naïve juveniles join their parents or other adults in the pod in group-stranding events. These events initially occur without the presence of prey items. As the calves grow and become more experienced, the stranding takes place when prey are present (Guinet, 1991). This occurred in a pod that took up temporary residence around the Crozet archipelago in the southern Indian Ocean. Two juveniles were in the group. One made frequent forays onto the beach accompanied by an adult, most often its mother. The other’s trips onto the prey-covered beach mostly were unaccompanied. The former received support from its mother through prodding with her rostrum (i.e. her nose). Initially the support was a shove in the direction of the seal pups. When the juvenile orca secured the prey item, the mother provided additional support by pushing the juvenile toward the safety of the water (Guinet & Bouvier, 1995). The other juvenile had no such assistance on most of its forays. This may explain why the former calf became a successful predator of elephant seals a year earlier in its development than the latter (Rendell & Whitehead, 2001).

These behaviors seem to meet Caro and Hauser’s definition of the acts required of opportunity teaching. However, because of the small sample size and the observational nature of the studies, it is difficult to definitively conclude that teaching is taking place. As described earlier, meerkats can teach without imputing the mindset of the pupils. Based on the elephants’ and dolphins’ capacities for imitation and targeted helping and considering the behavioral processes above, these teachers have may have recognized the students’ relative naiveté. In these instances, the knowledgeable participant demonstrated and allowed the learners to observe the
activity and experience it on their own accord. This would have struck Dewey as a very natural and human form of transmitting information and skills. According to him, “The word, the gesture, the act, the occupation of another, falls in line with *some impulse already active* and suggests some satisfactory mode of expression, some end in which it may find fulfillment” (Dewey, 1997a, p. 160). By taking the pupil’s natural inclination toward observation and the aim of the act itself (i.e. courtship in elephants, feeding in the members of the dolphin family), the method came to be inextricably bound to the subject. They all may look different, but all fall under the heading of opportunity teaching. This implicit desire for pedagogical categorization may be why Dewey sought to extol the virtue of a teacher having a thorough understanding of general methodologies while at the same time not being bound to them. To him:

> Part of [a teacher’s] learning, a very important part, consists in becoming master of the methods which the experience of others has shown to be more efficient in like cases of getting knowledge. These general methods are in no way opposed to individual initiative and originality—to personal ways of doing things. On the contrary they are reinforcements of them. For there is radical difference between even the most general method and a prescribed rule. The latter is a *direct* guide to action; the former operates indirectly through the enlightenment it supplies as to ends and means. (Dewey, 1966, p. 171)

By becoming a master of methodology, an expert in their subject, and by knowing their students, teachers are better able to create opportunities for their students to learn, be they human or animal. Through possessing these characteristics, the primate teacher develops the trust (Corriveau & Harris, 2009; P. L. Harris & Corriveau, 2011) and prestige (Horner, et al., 2010) necessary for his or her demonstrations to transmit effectively information. The possession and
exhibition of these traits can facilitate active teaching, the final and most purposeful form of social transmission.

**Active teaching.** Other than in humans, this form of teaching only has been observed in our closest living relative, the chimpanzee. Boesch’s (1991) study shows that chimp mothers modify their behaviors so their offspring can develop one of the most difficult skills for a chimpanzee, nut cracking. Rather than exhibiting the typical practice of carrying their hammers when they leave to forage for the nuts, mothers with offspring that have begun to show interest in nut-cracking leave the hammers and anvils on the ground. The mothers offer most of the nuts to the novice cracker in a fashion that mirrors the tool and toy provision observable in countless human societies in order to facilitate learning in children (Lancy, 2008; Lancy, et al., 2010).

Beyond providing the opportunity to crack the nuts, however, the mothers observed their offspring. On two occasions, the mothers intervened in what seems to have been an attempt to change their offsprings’ behaviors. On the first occasion:

… Salome was cracking nuts of the very hard *Panda* species. Sartre, 6, took 17 of the 18 nuts she opened. Then, his mother watching, he took her stone hammer and tried to crack the nuts by himself. These nuts are tricky to open as they consist of three kernels separately embedded in a hard wooden shell, and the partly opened nut has to be replaced precisely each time to gain access to the different kernels. After successfully opening a nut, Sartre replaced it haphazardly on the anvil in order to attempt access to the second kernel. But before he pounded it, Salome took it in her hand, cleaned the anvil, and replaced the piece carefully in the correct position. Then, with Salome observing him, Sartre successfully opened it and ate the second kernel. (Boesch, 1991, p. 531)
So, though her son was doing as she might have expected when she handed over the tool, Salome interrupted both her and her son’s activity (observation), making the teaching active. In the second instance:

… Ricci’s daughter, 5-year-old Nina, tried to open nuts with the only available hammer, which was of an irregular shape. As she struggled unsuccessfully with this tool, alternately changing her posture, hammer grip and the position of the nut, Ricci was resting. Eventually, after 8 min of this struggle, Ricci joined her and Nina immediately gave her the hammer. Then, with Nina sitting in front of her, Ricci, in a very deliberate manner, slowly rotated the hammer into the best position with which to pound the nut effectively. As if to emphasize the meaning of the movement, it took her a full minute to perform this simple rotation. With Nina watching her, she then proceeded to use the hammer to crack 10 nuts (of which Nina received six entire kernels and a portion of the other four). Then Ricci left and Nina resumed cracking. Now, by adopting the same hammer grip as her mother, she succeeded in opening four nuts in 15 min. Although she still had difficulties and regularly changed her posture (18 times), she always maintained the hammer in the same position as did her mother. (Boesch, 1991, p. 532)

In this instance, the intercession was much more elaborate and demonstrative, becoming an activity unto itself. It was active teaching.

Observed instances of active teaching have only been seen in this population of wild chimps and only in anecdotes with language trained chimps correcting other language trained chimps (Caro & Hauser, 1992). The rarity of observed instances of active teaching may explain why Caro and Hauser (1992) and Thornton and Raihani (2008) did not include active teaching as one of their principle teaching modes. Several researchers have concluded that humans are the
only animal to possess a natural pedagogy (Csibra & Gergely, 2011; Premack & Premack, 1996). Yet the natural pedagogy we are thought to possess (Csibra & Gergely, 2011), while potentially unique, does not need to be deployed often. So, even as our natural pedagogy requires the highest levels of cognition to use, it does not mean that it is the best method to use in every instance. I think Dewey recognized this paradox. As he wrote early in his career as an educator, a teacher should not be:

… concerned with the subject-matter of the science as representing a given stage and phase of the development of experience. His problem is that of inducing a vital and personal experiencing. Hence, what concerns him, as teacher, is the ways in which that subject may become a part of experience; what there is in the child’s present that is usable with reference to it; how such elements are to be used; how his own knowledge of the subject-matter may assist in interpreting the child’s needs and doings, and determine the medium in which the child should be placed in order that his growth may be properly directed. He is concerned, not with the subject-matter as such, but with the subject-matter as a related factor in a total growing experience. (Dewey, 1956a, p. 23)

Therefore, Dewey saw that the teacher’s job was to determine how best to proceed with a given lesson based on his or her knowledge of the subject, of the student, and of pedagogical methods. Dewey thought this knowledge came from a teacher’s own experiences and from those who shaped his or her species into the highly social, pair-bonding primate the human is today.

This perspective explains why Dewey devoted several pages of his initial volume on education, *The Child and the Curriculum* (1956a), to an analogy that captured the struggle of the educator to craft both meaningful and purposeful lessons centered on using a map:
The map does not take the place of an actual journey. The logically formulated material of a science or branch of learning, of a study, is no substitute for the having of individual experiences. The mathematical formula for a falling body does not take the place of personal contact and immediate individual experience with the falling thing. But the map, a summary, an arranged and orderly view of previous experiences, serves as a guide to future experience; it gives direction; it facilitates control; it economizes effort, preventing useless wandering, and pointing out the paths which lead most quickly and most certainly to a desired result. Through the map every new traveler may get for his own journey the benefits of the results of others’ explorations without the waste of energy and loss of time involved in their wanderings—wanderings which he himself would be obliged to repeat were it not for just the assistance of the objective and generalized record of their performances. That which we call a science or a study puts the net product of past experience in the form which makes it most available for the future. It represents a capitalization which may at once be turned to interest. It economizes the workings of the mind in every way. Memory is less taxed because the facts are grouped together about the varying incidents of their original discovery. Observation is the difference between looking for a needle in a haystack, and searching for a given paper in a well-arranged cabinet. Reasoning is directed, because there is a certain general path or line laid out along which ideas naturally march, instead moving from one chance association to another. (Dewey, 1956a, pp. 20-21)

Dewey recognized the importance of utilizing what today is identified as the unique human capacity to ratchet, or to build upon, the previous generations’ discoveries (Whiten, 2011). And yet, Dewey embraced the much more basal need for experiential learning. For him, the selecting
of a method was, therefore, about generating experiences from the subject, topic, concept, or bit of arcane jargon under investigation by the student. The map allusion and its use make clear the leaders’ or teachers’ need to recognize the geographic obstacle or the subject matter ahead. The leader must be able to select the appropriate tool or route to navigate the method so that the followers, or the students, get the most out of the journey. What is not clear, however, is from whom the map and the impetus for the journey should come. Dewey suggests in both of these passages that for even the most appropriate method to be effective, it must perpetuate student movement in the chosen direction. In the next chapter, I investigate what Dewey thought should serve as the map and the path for education.
Chapter 5:

The Origin(s) of Direction

The previous chapter supported Dewey’s theory that education is at its root a social endeavor with knowledge transmitted between individuals. This theory is due partly to discoveries made in cognitive ethology, a relatively new field. For Dewey, the logical next step was to determine from where that information should come or to establish who, or what, is in charge of directing a student’s education. Because sociality is necessary for the process to occur, society must provide the initial impetus for education. Dewey spent a considerable amount of time and ink addressing this perspective.

Direction from Society

In his work, Human Nature and Conduct, Dewey (1929) determined that the norms of behavior were the outward manifestation of a culture’s unwritten social morality contract. He concluded that the “… problem of social psychology is not how either individual or collective mind forms social groups and customs, but how different customs, established interacting arrangements, form and nurture different minds” (p. 63). Dewey recognized that the crucible of society forced individuals to develop habits to find acceptable methods for discharging natural impulses such as eating and courting. These habits established cultural norms in the process.

Most of Dewey’s experiences, however, came from traversing just the Western first world. In the 100 years since he wrote about natural impulses and their interface with societies, it has been discovered that virtually all human societies—and those of non-human primates and group-living cetaceans—possess culturally unique behavior norms. Among monkeys and apes, these arise principally through the physical greetings associated with individual affiliations (Bonnie & de Waal, 2006; Nakamura & Uehara, 2004; Perry, 2011; Perry, et al., 2003). With cetaceans, this
transpires through the call production unique to the pod (Foote, Osborne, & Rus Hoelzel, 2008; Janik & Sayigh, 2013; Moore & Ridgway, 1995; Strager, 1995). Humans demonstrate both of these modes of affiliatory behavior and a wide array of others (Pagel, 2012).

The ability to distinguish individuals who are in the group as opposed to outside the group may be the foundation of culture. Manifesting itself initially as tribalism (Ridley, 1996; E. O. Wilson, 2012), human groups developed increasingly complex ways of establishing membership to a particular clan. These ways take advantage of locally available resources and technology (Pagel, 2012). David Sloan Wilson, the evolutionary psychologist, (2003, 2008), claimed that the ultimate purpose of religion, a centerpiece of most cultures, is to help individuals establish a group by centering their customs and, as Dewey (1929) suggested, their morality around a sacrosanct entity. In cases such as Judaism, the elaborate nature of the tenets, practices, and behavioral expectations produced not only homogenous suites of behavior, but also homogenous sets of genes (D. S. Wilson, 2003, 2008).

The pressure to conform to the proscribed cultural norms may explain why, for both indigenous Non-Western cultures (Reagan, 2005) and the United States (Webb, 2006), the basis of formal education has been dictated by and derived from the morals of society. Some contemporary evolutionary psychologists have concluded that for most societies, morals come to be canonized by religion. By ascribing to this cultural tenet, each subsequent generation ensured not the direct transfer of its own genes, but the transfer of social practices that prevented the gene pool from drying up (D. S. Wilson, 2003, 2008). Interestingly, in spite of the time period in which he was raised, Dewey was far from religious himself. Over time, he drifted away from his Protestant roots toward a spiritually agnostic—if not outright atheistic—life (Dalton, 2002). However, he understood that the society was a central pillar of any individual’s world and that
educating students for entry into society was of great import. In his estimation, at the turn of the last century:

The modification going on in the method and curriculum of education is as much a product of the changed social situation, and as much an effort to meet the needs of the new society that is forming, as are changes in modes of industry and commerce. (Dewey, 1956b, p. 8)

Dewey established early in his career that education must act at the behest of society. His early writings indicate that he possessed a great deal of hope for progress: progress with regard to social welfare, economic opportunity, and class mobility. All of these could be achieved through a democratic education.

Two decades later, with the publication of Human Nature and Conduct, Dewey (1929) stated that social change on a national scale was never as great as it was perceived at the local level. He thought the structures that supported societies often were crumbling edifices of their original construction and they failed to perform even the basic expectations of their original charges. This social degeneration occurred because it came under the watch of leaders who were pale imitations of those who had inspired the development of the prevailing cultural expectations, albeit for a very different time and place. Leaders of this ilk had, for Dewey (1929), come to:

… dominate the actual situation. They encourage routine in others, and they subsidize such thought and learning as are kept remote from affairs. This they call sustaining the standard of the ideal. Subjection they praise as team spirit, loyalty, devotion, obedience, industry, law-and-order. (p. 68)
These powerful individuals achieved influence over the masses through the teaching separation of thought and action. Today such people prey on individuals’ neurological (Gazzaniga, 2008) and cultural plasticity (Pagel, 2012). These people favor what Dewey (1929) considered a “popular education … of disseminating as a matter of authoritative information for the many what the few have established by thought … converting an original docility to the new into a docility to repeat and conform” (p. 70). Dewey saw this type of education as constructed to transmit the sort of mechanical activity modes championed by Frederick Taylor’s scientific management tenets (Ritzer, 2010; Taylor, 1914).

In such a classroom, Dewey (1966) identified that “… a premium is put on physical quietude; on silence, on rigid uniformity of posture and movement” (p. 141), directing students to suppress their natural impulse and foster control over a population. In an education aimed to address such a dictate of society, Dewey (1966) stated that, “Achievement comes to denote the sort of thing that a well-planned machine can do better than a human being can” (p. 236). Such rigid educational expectations can produce individuals with the sort of rigid habits that prevent them from being able to respond to dynamic environments (Dewey, 1929; Hall, 2010). These individuals could be replaced eventually by automated systems built to work on the logical principles that have been championed by a society set on perpetuating its current iteration (von Drehle, 2013).

Dewey (1929), however, viewed this social trajectory as a pathway to societal collapse. Instead, rather than using students’ docile plasticity as a medium for the installation of discipline, he saw it as the opportunity to advance society through the development of solutions for temporally and environmentally unique problems at local levels. These changes provided inspiration and models for change at the national level, thus reviving the dynamic and
democratic American ethos. This aim was achieved through the selective deployment and modification of old habits and the creation of new ones (Dewey, 1929, 1966). Dewey grounded his justification on research performed in what today is known as cognitive neuroscience.

Dewey’s protégé Myrtle McGraw was present for, if not a part of, the birth of this field. McGraw ran some of the first experiments that evaluated the effect of learning on the electrical signals of the brain (Dalton, 2002). Dewey may have felt vindicated to learn that contemporary neuroscientists were making claims based on data and experiences that were almost identical to those he made almost a century earlier (Cohen, McClure, & Angela, 2007; Hall, 2010). Cohen et al. (2007) considered the use of old habits to be a form of environmental exploitation and attempts to create effective behaviors to be exploration. Cohen et al. (2007) asserted that, “The need to balance exploitation with exploration is confronted at all levels of behavior and time-scales of decision making from deciding what to do next in the day to planning a career path” (p. 933). This discovery is an almost perfect echo of Dewey’s pragmatic calls for behavioral balance between robust habits and docile plasticity, down to the same key terms Dewey (1963) used when he advocated for the “… systematic utilization of scientific method as the pattern and ideal of intelligent exploration and exploitation of the potentialities inherent in experience” (p. 86; emphasis added).

Support for Dewey’s thought that the students’ directions must come from more than the prevailing culture alone is found in anthropological literature. Throughout indigenous cultures across the globe, the expectation exists that the culture’s morality will be vertically transmitted with high fidelity to each subsequent generation. This theory often is coupled with the flexibility to develop new habits in response to environmental shifts (Reagan, 2005). For some groups, reliance on this flexibility became a way of life, most notably for the Rom, which is a group
known to some as gypsies (though it must be noted that the latter term is considered pejorative).

One of the Rom culture hallmarks is the multi-occupational approach to earning a living. Members, most often males, evaluate the economic and psychological needs of those who ascribe to the prevailing culture (Okely, 1983; Reagan, 2005). Doing work that ranges from farm labor to junk dealing, coppersmithing to roofing, the flexibility of Rom economic culture ensures that money can be made in even the most trying of times (Sway, 1988). Their cultural plasticity made it possible for the Rom to withstand centuries of marginalization and, at times, persecution (Reagan, 2005).

Many cultures are much less flexible than the Rom, but historically, those societies that allow for the evolution of culture have been more apt to survive. Societies that conservatively cling to familiar practices, even in the midst of newly colonized environments (e.g. Icelanders colonization of Greenland), are more apt to disappear (Diamond, 2005). For many cultures, this evolution comes from the incorporation and adaptation of ideas from outside the community. This exchange allows societies ranging in space and time from the hunter-gatherer tribes in Tasmania 30,000 years ago to today’s industrialized agricultural societies to survive in dynamic environments (Ridley, 2010). From an evolutionary perspective, the cognitive roots of the capacity to assimilate new ideas—to ratchet them—is a uniquely human trait. This allows societies to build upon the social structures and technological innovations developed by their ancestors (Whiten, 2011).

While he did not articulate this uniqueness in such terms and with such scientific veracity, Dewey (1929) held cultural evolution up as a model for how societies develop their moral customs. He suggested that effective teachers should take differences in culture into account when selecting their methods (Dewey, 1966). He thought that an awareness of the
potential need for cultural evolution was critical for preparing students for entry into society, because:

When the school introduces and trains each child of society into membership within such a little [classroom] community, saturating him with the spirit of service, and providing him with the instruments of effective self-direction, we shall have the deepest and best guaranty of a larger society which is worthy, lovely, and harmonious. (Dewey, 1956b, p. 29)

At the beginning of his career Dewey determined that the key to helping students develop into valuable members of society was not to prepare them for a specific society, but to prepare them for living socially in an ever-changing world (Dewey, 1956b). This difference ensured that while the society in which the school was nested would have some bearing on how formal education was conducted, the direction also would come from something more ephemeral, the environment.

**Direction from the Environment**

Outside of the student’s home, the classroom is the most important venue for learning what it means to be a productive citizen. Yet, as Dewey (1966) saw it, the classroom had become a place where students were inculcated into the values historically assigned to each subject (e.g. poetry used to transmit religion and morals). This was the case even if the true value of a subject lay in its ability to provide means to a learner’s desired end. In his estimation, this practice came about because “… inherited traditional matter and … subjects … represent mainly the energy of some influential person or group of persons in behalf of something dear to them” (Dewey, 1966, p. 241). The subjects continued to be part of the curriculum under the auspices of providing something instrumental to the student’s success in society. However, individuals and groups
established a subject’s importance with no awareness of students’ capabilities or the local environmental conditions.

Dewey (1929) thought it a philosophical travesty that outside impositions create societal constructs that students must bend to fit within, not actively craft themselves. For Dewey, the school’s charge was to take advantage of this innate social malleability. However, rather than simply train students to utilize the prevailing processes and modes of thought, Dewey expected the school to move beyond the artificial disintegration of means and ends. Instead, the school should provide the kind of meaning that comes from social interaction. For him:

A society is a number of people held together because they are working along common lines, in a common spirit, and with reference to common aims. The common needs and aims demand a growing interchange of thought and growing unity of sympathetic feeling. The radical reason that the present school cannot organize itself as a natural social unit is because this element of common and productive activity is absent. Upon the playground, in game and sport, social organization takes place spontaneously and inevitably. There is something to do, some activity to be carried on, requiring natural divisions of labor, selection of leaders and followers, mutual cooperation and emulation. In the schoolroom the motive and cement of social organization are alike wanting. Upon the ethical side, the tragic weakness of the present school is that it endeavors to prepare future members of the social order in a medium in which the conditions of social spirit are eminently wanting. (Dewey, 1956b, pp. 14-15)

The result of his desired school restructuring would move away from the conditions described above to produce citizens capable of shaping society. The structure of society would then
become one that did not necessarily fit the democratic ideal of previous citizens, but would fit the present conditions because the students were allowed to shape it (Dewey, 1929).

Dewey thought these abilities were honed not through mechanistic training toward some pre-determined ideal, but through having to respond to the adversity that occurs when individuals and groups face obstacles that prevent the easy achievement of their goals. To that end, he considered:

A pupil who has worked through some confused intellectual situation and fought his way to clearing up obscurities in a definite outcome [to be one that] appreciates the value of clarity and definition. He has a standard that can be depended upon. He may be trained externally to go through certain motions of analysis and division of subject matter and may acquire information about the value of these processes as standard logical functions, but unless it somehow comes home to him at some point as an appreciation of his own, the significance of the logical norms—so-called—remains as much an external piece of information as, say, the names of rivers in China. He may be able to recite, but the recital is a mechanical rehearsal. (Dewey, 1966, p. 235)

As opposed to this de facto training of students, Dewey’s preference was to provide environments that present students with not only challenges, but also the opportunity to develop a method for surmounting them. This practice would bring more definite and greater meaning to the students’ acquired knowledge.

Dewey’s idea that authentic problems provide the direction for education has been echoed by ancient philosophers (Hall, 2010; Jaspers, 1962) and contemporary ones (Crawford, 2009). Shakespeare, one of today’s most over-looked educational philosophers, championed this theory. The playwright may have been the keenest observer of human impulse and behavior that
has ever existed. Quoting from a speech near the end of the bard’s last play, “The Tempest,” the educational philosopher Lee Shulman (2004) suggested that the sorcerer Prospero’s words to the couple he is marrying off—“[I] promise you calm seas [and] auspicious gales”—are the greatest gift a student could receive from his or her education. Shulman explains that through the challenge presented by the auspicious gales, students get to test their mettle, their character, and their ability to use all the knowledge and skills they have learned. At the end of the tempest, by ensuring the relative safety of the calm seas, students can assess not only their present state, but also evaluate what actions were most critical for successful navigation and what was learned in the process.

Both Shulman’s idea and his use of an analogy to grant it greater meaning is evocative of Dewey’s writing and thought process. For Dewey to be satisfied with such a claim, however, support would need to come from a more scientific investigation. This support can be found in the cognitive fields that he helped launch.

As a part of his career-long quest to evaluate the origins of wisdom, psychologist Paul Baltes asserted that the seeds of wisdom develop their roots during early adolescence (Baltes & Staudinger, 2000), with adversity in this period spurring its growth (Baltes & Smith, 2008; Hall, 2010). Traced back to the physiological level, a behavioral research practice Dewey (1929) championed, early exposure to environmental stress produced juvenile squirrel monkeys that produced lower levels of stress hormones when exposed to new environments. The authors called this early exposure to a new environment stress inoculation. The monkeys’ behaviors also were affected. They consumed more food than their un-inoculated counterparts and investigated the new environment—a wire-mesh cage—even as the others would not (Hall, 2010; Parker, Buckmaster, Schatzberg, & Lyons, 2004).
In a subsequent study with the monkeys, stress inoculation affected cognition. The monkeys were provided with the novel challenge of getting food from inside of a clear box with a less than obvious access point. The un-inoculated monkeys gave in to the impulse to grab at the food that they could see in spite of their repeated attempts being thwarted each time. Those who dealt with environmental stress early in their lives were more likely, and more quick, to discover the solution (Hall, 2010; Parker, Buckmaster, Justus, Schatzberg, & Lyons, 2005). Similar studies with rats allowed researchers to locate the affects of early stress on the brain. Exposure to novelty shortly after birth appears to alter the development of the hypothalamic-pituitary-adrenal (HPA) axis, a region of the brain that releases stress hormones (Hall, 2010). This, in turn, has a positive impact on social (Tang, Reeb, Romeo, & McEwen, 2003) and spatial memory (Tang, Akers, Reeb, Romeo, & McEwen, 2006). Therefore, a substantial justification from various fields exists for Dewey’s position on the need for environmental challenges to provide students with at least some of their direction to promote personal growth.

Paradoxically, though stress has shown its potential as a catalyst for learning, it also can inhibit knowledge and skills acquisition. As demonstrated in baboons, long-term exposure to low-level stress can impair the development of neuronal connectivity (Sapolsky, 1996), which is critical for learning (Bransford & Brown, 2000). Stress caused by a dearth of available food has a negative impact on cognition in the juveniles of at least one species of monkeys, bonnet macaques (Kaufman et al., 2007). These two discoveries suggest that the students’ learning environments must be constituted in such a way that stress is temporary and derives from the correct sources. In most indigenous cultures (Reagan, 2005), the parents or alloparents ensure the comfort that is necessary for learning (Maslow, 1970). In the classrooms of a developed country, the amelioration of these problems is often a part of the social contract with the government.
The identification of worthwhile aims, however, seems to derive from the same source regardless of the situation: an individual’s social interaction within his environment.

As described in the previous chapter, for many individuals this begins with the observation of elders, people with whom the learner shares a close association and who serve as masters to the student’s apprentice. Dewey (1997a) recognized this, stating that:

The presence of adult activities plays an enormous role in the intellectual growth of the child because they add to the natural stimuli of the world new stimuli which are more exactly adapted to the needs of a human being, which are richer, better organized, more complex in range, permitting more flexible adaptations, and calling out novel reactions. (p. 161)

Dewey identified that students were more likely to identify worthwhile behaviors and tasks than to fulfill their natural impulses when in the presence of adults modeling constructive activities. He considered these behaviors to be useful habits, having been chosen for their ability to release the appropriate impulses based on the context (Dewey, 1929). Contemporary evolutionary psychologists consider those actions to be either secondary learning (Geary, 2007) or secondary heuristics (F. R. Wilson, 1999).

Considering that hominids evolved in conditions of uncertainty, the ability to develop behavioral responses appropriate for local conditions was critical to the survival of the human lineage (Pagel, 2012; F. R. Wilson, 1999). This extended into all of the constructs of cultures, including religion (D. S. Wilson, 2003, 2008) and academics (Geary, 2007). In such social structures, the opportunity existed for the rapid and largely passive assimilation of the folk knowledge in various disciplines such as psychology, biology, and physics (Geary, 2007). Unfortunately, at times, what previous members of the population learned may no longer be
locally adaptive. Dewey (1929) recognized this potential conundrum, writing that, “Without habit there is only irritation and confused hesitation. With habit alone there is a machine-like repetition, a duplicating recurrence of old acts. With conflict of habits and release of impulse there is conscious search” (p. 180). Since Dewey’s passing, the struggle to develop successful behaviors has been investigated at length in the classroom. The challenge of facilitating secondary learning of evolutionarily novel abilities, such as phonemic awareness, led to the development of purposeful, adult-mediated instructional practices (Csibra & Gergely, 2011; Geary, 2007).

This conclusion echoes what was demonstrated in the previous chapter. Adult members of the group often spur the transmission of both secondary and primary heuristics and learning. The activity could stem simply from their presence. However, often the activity is linked to the model they provide, intentionally or not. For many of these behaviors, be they nest-building in great apes (van Schaik & Burkart, 2011), selecting foraging locations in meerkats (Thornton & Clutton-Brock, 2011; Thornton & Hodge, 2009), or chasing prey in dolphins (Bender, et al., 2009), a primary heuristic is involved. Dewey (1929) considered primary heuristics to be innate behaviors. This identification suggests that the skill or knowledge could be learned in the absence of an experienced model (Thornton & Clutton-Brock, 2011; van Schaik & Burkart, 2011), albeit in a slower fashion (Thornton & Raihani, 2008, 2010). But for culturally novel behaviors, such as rats stripping pine cones (Terkel, 1996), macaques washing sweet potatoes in Japan (Kawai, 1965), or dolphins using sponges while foraging (Sargeant & Mann, 2009), acquisition of the skill is necessitated only if utilized by other social group members. The possession of such novel skills promotes survival and reproduction, for it either encourages bonding with other group members (Perry, 2011; Perry, et al., 2003) or it provides opportunities
for acquiring resources not otherwise available (Terkel, 1996). This recognition underscores the
importance of vertical transmission within any animal society because it ensures the acquisition
of skills that are adaptive in the given environment (van Schaik & Burkart, 2011).

For Dewey (1966), the ability to recognize the utility of a particular subset of acquired
knowledge or skills spoke to its instrumentality. Whatever a student learns becomes associated
with a behavior that allows for the expression of some biological impulse. He thought that:

… what is desirable is that a topic be presented in such a way that it either have an
immediate value, and require no justification, or else be perceived to be a means of
achieving something of intrinsic value. An instrumental value then has the intrinsic value
of being a means to an end. (Dewey, 1966, pp. 242-243)

The ideal direction, therefore, would be reinforced constantly by the intrinsic value of the
educational aim in the student’s mind. For non-humans, this is often a product of the social and
ecological environment. This also is case for humans.

Given humans’ natural inclination to imitate (de Waal, 2009; Lyons, et al., 2011), an
impulse must exist to conform to group norms. But in students, regardless of age, there is often a
conscious emulation of provided models. In many non-Western cultures, an apprenticeship
system exploits this desire (Lancy, 2008; Lancy, et al., 2010; Reagan, 2005), though it may
provide more of an immediate benefit to the mentor and the parents than it does to the apprentice
(Lancy, 2008). Yet, formal apprenticeships also take advantage of the instinct to seek out
mentorship at the outset of adolescence (Egan, 1997). Often, this quest for mentorship in
activities that seem worthwhile occurs in conjunction with the romanticizing of idealized and
spectacular versions of achievement (Egan, 1997; K. Robinson & Aronica, 2009; F. R. Wilson,
What the mentors are doing has the intrinsic value Dewey (1966) described as a key to effective education.

A student’s recognition of an activity’s intrinsic value demonstrated by a trusted adult probably activates the aforementioned instinct of imitating those with whom one shares an affiliative pair-bond. This internal shift allows the mentor to act as a facilitator, providing direction for the student (K. Robinson & Aronica, 2009). This shift allows for feedback delivery and allows the learner to identify areas where improvement could be made (Crawford, 2009; F. R. Wilson, 1999). Considered coaching in non-humans by Caro and Hauser (1992), such feedback often is delivered harshly in animals (Fletemeyer, 1978; Holmes, 2009), in indigenous societies with rigid cultures of apprenticeship (Lancy, 2008), and in modern contexts such as a motorcycle shop (Crawford, 2009). The blunt criticism can be off-putting for learners who previously identified activities as having intrinsic value (F. R. Wilson, 1999). However, criticism draws attention to the instrumentality of particular acts, such as the subtle adjustments to the damping on a motorcycle’s front end (Crawford, 2009), to metallurgy in a modern blacksmith shop (F. R. Wilson, 1999), or to the agreement of subject and verb in a compound sentence (my own personal experience). This feedback forces students to stretch themselves (K. Robinson & Aronica, 2009) and encourages them to see things in a new way, whether they are aspiring scientists (D. S. Wilson, 2008) or puppeteers (F. R. Wilson, 1999).

In many cases, however, the transmission of knowledge and skills is not vertical, nor is it oblique (i.e. master to apprentice or mentor to mentee). Instead, the transmission is horizontal, from peer to peer. In animals, the purpose of vertical and oblique knowledge transmission is of information and skills shown to be adaptive in a stable environment. Horizontal transmission perpetuates cultural evolution (van Schaik & Burkart, 2011), allows for the response to
environmental shifts (Gruber, Muller, Strimling, Wrangham, & Zuberbohler, 2009; Thornton & Clutton-Brock, 2011; Whiten, 2011), and can lead to the development of new affiliative behaviors (Perry, 2011).

Dewey would have considered horizontal transmission a natural outcropping of a classroom that facilitated natural social interactions within an environment that presented students with challenges. In classrooms where the knowledge is passed only from teacher to student, a competitive atmosphere develops as students struggle to achieve mastery of some cultural construct that is a remnant of a bygone era (Dewey, 1966). Students in a classroom where the direction comes from the environment more than from society behave quite differently. Dewey (1956b) asserted that, in a class:

Where active work is going on, all this is changed. Helping others, instead of being a form of charity which impoverishes the recipient, is simply an aid in seeing free the powers and furthering the impulse of the one helped. (p. 16)

By activating the natural human impulse for altruism (de Waal, 2009), this classroom becomes a crucible for the development of morality, which Dewey (1929) thought underpins all social interactions. Always dependent on context, Dewey’s idea of morality has been echoed by Noddings’ (2003) theory of caring, whereby the one caring addresses the needs of the cared for by taking the other’s perspective. This relationship is reciprocal, with the roles potentially reversed. This is more apt to happen with individuals engaging in acts horizontal transmission. The perpetration of cultural evolution inevitably leads to changes in the social environment, and either actor is as probable as the other to be positioned as the knowledgeable one caring.

In cases of vertical and oblique transmission, however, the parents, masters, mentors, or teachers most often possess information or skills thought to be important. They may feel it is
incumbent upon them to transmit the knowledge to their charges because they care for their pupils. This inclination makes sense because most secondary learning seems to require some sort of purposeful transmission (Geary, 2007). Dewey (1966) identified this himself, stating that:

An individual [may] not be moved by some matter because he does not grasp how his attainment of some intrinsic good depends upon active concern with what is presented [and] … it is obviously the part of wisdom to establish consciousness of connection. (p. 242)

If, however, a teacher truly does cares for his or her students, he or she will take into account not only the instrumental knowledge he or she hopes to transfer, but also its potential intrinsic value to the students. The teacher would realize that “Getting command of technique and of methods of reaching and testing generalizations is at first secondary to getting appreciation” (Dewey, 1966, p. 233).

The caring teacher, the one who facilitates the kind of growth in students that Dewey saw as education’s purpose, would therefore recognize that “The proof of a good is found in the fact that the pupil responds; his response is use. His response to the subject shows that the subject functions in his life” (Dewey, 1966, p. 242). Such a classroom, therefore, would ensure that the direction provided would come not only from the society and the environment, but also from the students.

**Direction from the Student**

Dewey recognized early in his career as an educator that while the social norms and environmental challenges may provide a general direction to students, for growth to occur, the student’s specific aim must come from within. He recalled that:
Plato somewhere speaks of the slave as one who in his actions does not express his own ideas, but those of some other man. It is our social problem now, even more urgent than in the time of Plato, that method, purpose, understanding, shall exist in the consciousness of the one who does the work, that his activity will have meaning to himself. (Dewey, 1956b, p. 23)

By positioning the student as the conscious actor, Dewey separated his perspective from the prevailing notion that students were to become cogs in the wheel of an industrialized society bent on perpetuating its present state (Dewey, 1929, 1956b, 1963, 1966). Dewey did not expect the rigid transmission of information that has been termed cultural literacy (Hirsch, 1988). Instead, by emphasizing the instrumentality of subjects and topics, Dewey thought it best to let students first determine that the information embedded within the curriculum was intrinsically meaningful. Therefore, in his view:

The way to enable a student to apprehend the instrumental value of arithmetic is not to lecture him upon the benefit it will be to him in some remote and uncertain future, but to let him discover that success in something he is interested in doing depends upon ability to use number. (Dewey, 1966, p. 240)

By suggesting this method might be true for even the most abstract and academic of subjects, math, Dewey sought to ground education in that which he spent his entire career championing: experience.

**Experience.** Dewey thought that previous experiences provide context when one is in the midst of experiencing. This framing of experience allows meaning to be derived in the present and provides a clearer view of the future. However, this is dependent on the participant’s past (Dewey, 1963, 1997a). Dewey’s conclusion may explain why those who research contemporary
wisdom, such as philosophers, psychologists, and cognitive neuroscientists, have done so with an eye on the society’s elders. The greater the number of relevant experiences, the more discerning one becomes about the relevance of inputs (Hall, 2010). Therefore, the teacher seeking to provide a meaningful education to the students must see to it that “… connectedness in growth [is] his constant watchword” (Dewey, 1963, p. 75).

By engaging in this practice, teachers are more apt to help students recognize the intrinsic value of subjects. The students will more likely use what they learn through experience as instruments to achieve their desired ends. In Dewey’s (1956a) estimation:

If the subject-matter of the lessons be such as to have an appropriate place within the expanding consciousness of the child, if it grows out of his own past doings, thinkings, and sufferings, and grows into application in further achievements and receptivities, then no device or trick of method has to be resorted to in order to enlist “interest.” (p. 27)

For Dewey, avoiding tricks meant that, in a classroom that derives its direction from the student, the teacher does not need to sugar coat material, nor is there a need to define its purpose as disciplinary. Dewey (1956a) took issue with these oft invoked pedagogical practices; the former because it removed learning from context and the latter because it prepared students to use knowledge and skills in specific contexts. These methods ignore the “… fact that life is its own excuse for being” (Dewey, 1966, p. 243). Dewey (1929) was concerned that it would produce a rigidity of habits that would stifle potentially creative responses to changing environments. As mentioned above, such rigid heuristics can be adaptive when one seeks to exploit a stable resource. However, they prevent the counterbalance of exploration and discovery necessary in dynamic situations (Cohen, et al., 2007; Hall, 2010).
By constructing a course of study with a student’s interests in mind, activity in the classroom seems meaningful. Whether in meerkats in the Kalahari desert (Thornton & Hodge, 2009), chimpanzees in the Congo (Boesch, 1991), hunter-gatherer societies (Hewlett, et al., 2011), the Rom (Reagan, 2005), or children who live on the streets (Wolseth, 2010), learning occurs most naturally when it is purposeful, be it socially or via trial and error (van Schaik & Burkart, 2011). Among scholars in the developed first world, where formal education is institutionalized, researchers recognize that students are more apt to engage with material (Csikszentmihalyi & Schneider, 2001; Shernoff, et al., 2003) and remember what they have learned when they feel as if they are being educated in a fashion that feels purposeful and personal (Brophy, 2010). Perhaps in response to these discoveries, in the past two decades, an expectation for differentiated instruction has developed (Gregory & Chapman, 2012; Tomlinson, 1999) even in the midst of standardization (Levy, 2008; McTighe & Brown, 2005; Tomlinson, 2000). This change suggests that it has at least been acknowledged that students should determine some of their educational direction. Dewey recognized this more than a half century earlier. He wrote that:

What is required is that every individual shall have opportunities to employ his own powers in activities that have meaning. Mind, individual method, originality (these are incontrovertible terms) signify the quality of purposive directed action. If we act upon this conviction, we shall secure more originality even by the conventional standard than now develops. (Dewey, 1966, pp. 172-173)

Dewey, therefore, would have appreciated the research that justifies differentiated instructional methods. However, he probably would continue to be frustrated by the heavy emphasis on standardized tests as the primary indices for evaluating individual student growth in
contemporary education (Ravitch, 2011; Ripley, 2013), having expressed this concern on more than one occasion (Dewey, 1963, 1966).

Instead of the present educational approach that mirrors those he decried, Dewey probably would have preferred the education offered in places such as the Laboratory for Making Things. In the school, what students are able to do with their hands is viewed on the same cognitive plane as symbolic representation and abstract thought. In this environment, student-teacher-curriculum interactions are the norm. This unique school often places the teacher as the learner and asks students to explain what it is they have built and why it works (Bamberger, 1991). According to the school’s creator, Jeanne Bamberger:

We spent a lot of time in the lab helping kids to move between building things, then making descriptions of what they were doing. For this particular group of kids, the biggest problems were with any kind of symbolic, verbal, or numbered material—getting things on paper—and moving back and forth between action and description. We found kids … whose problem was not so much doing math but representing it. Some of them, for example, were terrific at solving mechanical problems, solving problems in building a gear machine, or figuring out how to connect electric circuits. But—and this is the critical point—when they would make instructions so someone else could build what they had built, or when they tried to describe how it worked … their descriptions, their drawings, and even their notations might focus on features quite different from those you or I might think were the important ones, or were the ones kids are taught to notice in school. (in F.R. Wilson, 1999, p. 283)

Repositioned as the explainers of thought, the students became the educators. This shift motivated students to fight through their discomfort with meta-cognition and engage self-
reflection. Dewey (1997a) thought this process was necessary to cement the learning achieved through the act of experiencing.

A school with this emphasis allows students to operate within what Sir Ken Robinson (2009) called their element or preferred mode of experiencing and interpreting the world. Were schools to embrace his idea that each person possesses a given element, he envisioned the elimination of the subjects’ hierarchy in favor of a personalized education that promotes an interdisciplinary understanding of the world achieved on students’ own terms. In such a system, the benchmarks to be assessed would be based on the work quality the students chose to do as opposed to students being quantified based on a single, one-size-fits-all standard (K. Robinson & Aronica, 2009).

By focusing on students using their natural talents and building on the experiences achieved through their use across all disciplines, these educational philosophies embody what Dewey had championed more than a half-century earlier. They also provide the opportunity for students to enter a critical state of being recently labeled flow. Described by its author, Mihaly Csikszentmihalyi (1993), flow can occur:

… when challenges are high and personal skills are used to the utmost … The first symptom of flow is a narrowing of attention on a clearly defined goal. We feel involved, concentrated, absorbed. We know what must be done, and we get immediate feedback as to how well we are doing … The depth of concentration required by the fine balance of challenges and skills precludes worrying about temporarily irrelevant issues. We forget ourselves and become lost in the activity … The well-matched use of skills provides a sense of control over our actions, yet because we are too busy to think of ourselves, it does not matter whether we are in control or not, whether we are winning or losing. Often
we feel a sense of transcendence, as if the boundaries of the self had been expanded … In those moments the awareness of time disappears, and hours seem to flash by without our noticing. (pp. xiii-xiv)

The description of an individual who has entered a state of flow is evocative of Dewey’s own description of play. For Dewey (1966), the difference between play and work was a product of the amount of time lapsed between the means and the end. In work, a significant temporal gap exists between one’s activity and its ultimate outcome. In play, the end and the means are bound together and make the activity worthwhile in its own right. The motivation to engage in the activity moves from extrinsic, such as “I need to finish this paper” or “I must score a goal,” to intrinsic. In intrinsically motivated activity, the actor is driven by the desire to keep doing what he or she is doing, be it writing an expository essay or playing schoolyard soccer. To achieve such a state, one must be in one’s element. In a truly educational atmosphere, students achieve this fusion of means and ends, no matter what the act of experiencing is called.

A classroom that allows for this freedom of both expression and engagement requires that the student direct some of the activities, just as Dewey advocated. Yet, late in his career, Dewey (1963) came to lament his association with what was considered progressive, child-centered education. He did not think it led to misdirected activity but that it did lead to the directionless activity he referred to as fooling around (Dewey, 1966). As opposed to the purposeful play described above, what Dewey (1966) considered “fooling around” would be the probable outcome in a classroom that allowed the child alone to set the course of instruction. This was because:

When spontaneity or naturalness is identified with more or less casual discharge of transitory impulses, the tendency of the educator is to supply a multitude of stimuli in
order that spontaneous activity may be kept up … This method overlooks some of the essential conditions of the attainment of genuine freedom … [because] direct immediate discharge or expression of an impulsive tendency is fatal to thinking. Only when the impulse is to some extent checked and thrown back upon itself does reflection ensue. (Dewey, 1997a, p. 64)

For Dewey, the released impulse must serve as a means to some end; it must have a purpose. This necessity is probably why, as described above, he considered both the society and the environment as critical for channeling those impulses to develop effective habits.

By placing students within a classroom that reflects social conditions and presents challenges for the expression of natural impulses, the opportunity exists for students to determine their own aims and their own courses of action. This environment allows the sort of experiencing and experience necessary to promote learning. Dewey (1963), therefore, thought that:

It is part of the educator’s responsibility to see equally to two things: First, that the problem grows out of the conditions of the experience being had in the present, and that it is within the range of the capacity of the students; and, secondly, that it is such that it arouses in the learner an active quest for new information and for production of new ideas. (p. 79)

Through the classroom maintenance that stimulates students socially and environmentally, a teacher fulfills part of his or her first responsibility and all of the second. However, a child’s chosen activities may veer into fooling around if the identified course of action is outside the range of the student’s capacity. The recognition that students must be ready for particular activities, such that they can be the means to achieving some end, suggests that Dewey thought an understanding of human development should be implicit in the classroom structure.
Development. Dewey (1956a) recognized early the importance of understanding cognitive development for educators. It was not until later in his career, however, that he obtained a scientific understanding of the process to add to his existing empirical—experiential and anecdotal—grasp of the process (Dalton, 2002; Dewey, 1958). Therefore, he would have appreciated research that demonstrates in myriad species the capacity to complete culturally transmitted tasks that include acquiring fruit (Ossi-Lupo, 2010), removing husks (Corp & Byrne, 2002), and building nests (Jaeggi, et al., 2010). Completing culturally transmitted tasks often depends on the acquisition of strength and dexterity achieved in the normal course of growth. In some cases, the mentors for such tasks will not assist with lessons until their potential pupils have achieved a level of developmental readiness (Boesch, 1991; Guinet & Bouvier, 1995; Thornton & McAuliffe, 2006). A similar pattern exists in humans. Anthropologists who study hunter-gatherer (MacDonald, 2010), agricultural (Lancy & Grove, 2010), and industrialized cultures (F. R. Wilson, 1999) have observed that the intentional transmission of knowledge and skills does not begin until the achievement of a threshold capacity has been reached by the learner. Often, this threshold is determined simply by age, which can be indicative of natural patterns of both physical and cognitive development.

Such recent discoveries lend scientific credence to one of Dewey’s philosophical muses, Jean-Jacques Rousseau (Dalton, 2002; Dewey, 1966; Noddings, 2010). Rousseau believed that children, more specifically boys, were naturally good. If furnished with the right surroundings and allowed to attend to their own desires, they developed naturally, allowing them to maintain their goodness (Noddings, 2010; Rousseau, 1979). Rousseau’s philosophical beliefs came to be accepted more widely during Dewey’s rise to prominence (Noddings, 2010). This acceptance took place during a time when the psychologist Jean Piaget and the psychiatrist Maria
Montessori separately posited that children go through specific developmental patterns (Montessori, 1995; Noddings, 2010; Piaget, 1964, 1976). Given Dewey’s training as a philosopher and his work in psychology, such support from his science-minded contemporaries provided justification for his early career claim that “Development is a definite process, having its own law which can be fulfilled only when adequate and normal conditions are provided” (Dewey, 1956a, p. 17). Dewey’s involvement with Myrtle McGraw’s research (Dalton, 2002) coupled with his career long investigation into the effects of experience, however, eventually led him to the conclusion that development was not as rigid as the aforementioned theorists suggested (Dewey, 1966).

Dewey had an advocate for his view in a contemporary of whom he had no knowledge, Lev Vygotsky. A Russian developmental psychologist working in the 1920s and 1930s, Vygotsky’s extensive work on children’s concept formation was not available in the United States until after Dewey’s death. In his writing, Vygotsky was quite critical of Piaget’s work (Vygotsky, 1978, 1986). Like Dewey, Vygotsky (1986) recognized that “Any learning a child encounters in school always has a previous history” (p. 84), and “learning should be matched in some manner with the student’s developmental level” (p. 85). The educational direction of students, therefore, should be a product not only of their natural pattern of development, but also of the development that came as a product of their experiences. The result of Vygotsky’s (1986) inquiries was the theory that children possess zones of proximal development. He considered these zones to be:

… the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (p. 86)
Vygotsky’s conclusion that the child’s education could be enhanced by social interaction is at odds with Rousseau (1979). Rousseau thought society is the root of the student’s descent from perfection, justifying Dewey’s frustration with the limitation of both Rousseau’s and Montessori’s (Dalton, 2002) perspectives on child development.

The evidence in the previous chapter shows the necessity of social interaction for effective cultural transmission both horizontally and vertically in animals and humans. Contemporary cognitive neuroscience demonstrates that these experiences can reshape a learner’s cognitive architecture. Termed neural Darwinism, synaptic associations are either strengthened or weakened based on an individual’s interaction with environmental and social stimuli (Edelman, 1987). This interplay can have visible effects on specific regions of an individual’s brain (Goswami, 2004). The interplay also helps to create anticipatory feedback loops (Hall, 2010). The release of the neurotransmitter dopamine creates these loops. This was demonstrated experimentally in a laboratory setting where individuals played a simple video game. The game had a very specific goal—capturing digital crabs off the side of a pier—and initially, participants produced a dopamine burst when they identified the best place to plant their pot. After several successful efforts, the dopamine began to be released in anticipation of the capture (Hall, 2010). The dopamine release when a player first engaged in the activity can be linked to trial and error, a process Dewey (1966, 1997a) considered the basis of all learning. The subsequent anticipatory release of dopamine seems to instead produce experiential learning (Hall, 2010), which psychologists from Pavlov to Skinner to Dewey have linked to habit formation.

When a person’s anticipated result does not occur, however, more dopamine is released (Hall, 2010; Hollerman & Schultz, 1998; Schultz, 1997; Schultz, Dayan, & Montague, 1997;
Schultz & Dickinson, 2000). This may be the brain’s way of inspiring the body to seek out new solutions. The brain could be bridging the mind-body dualism Dewey (1929, 1958) sought to ameliorate (this dualism will be dealt with at length in the next chapter). Also, it could be lending scientific justification to Dewey’s (1966) determination that students need to be presented with problems so that their learning provides a means to a solution.

As Dewey recognized, students of a given age cohort may be in the same developmental state in a very coarse sense. However, individual experience ensures all students are not in the same developmental space nor do they have the same goals. These differences present a challenge for the teacher, for to Dewey (1963):

Experiences in order to be educative must lead out into an expanding world of subject-matter, a subject-matter of facts or information and of ideas. This condition is satisfied only as the educator views teaching and learning as a continuous process of reconstruction of experience … [Therefore] Adaptation of the method to individuals of various degrees of maturity is a problem … and the constant factors in the problem are the formation of ideas, acting upon ideas, observation of the conditions which result, and organization of facts and ideas for future use. (pp. 87-88)

This focus provides the educator with a mentality similar to that of the student. Uncertainty exists with regard to the course of action based on past experience, future goals, and present social and environmental conditions. This pedagogical paradox may explain why Dewey (1966) thought teachers should position themselves as keen observers and learners within their own classroom. The paradox also may explain why Nel Noddings (2010), one of Dewey’s contemporary champions, sees the teacher and student as reciprocal members of a caring dyad. Both teacher and student on occasion slip back and forth between the role of being the one caring
and the cared for. The complication that comes from this kind of relationship explains why Dewey saw the teacher not as the dictator of a student’s education, but as the director.

**Direction from the Teacher**

As described above, Dewey recognized that several idealized versions of education impacted the direction determined for a group of students. A balance must be struck between these potentially competing forces to promote growth valued by the learners. Dewey was unique in his belief that this balance could not be introduced at the level of the nation, the state, the district, or the school. For Dewey, educational equilibrium was (or was not) achieved at the behest of the teacher. Therefore, in spite of Dewey’s association in the eyes of many educational philosophers and historians with the initiation of the progressive and child-centered movements (Egan, 2002; Gutek, 2004; Webb, 2006), his ideas placed control in the hands of the teacher. This emphasis meant that, (1956a):

… the value of the formulated wealth of knowledge that makes up the course of study is that it may enable the educator to determine the environment of the child, and thus by indirection to direct. Its primary value, its primary indication, is for the teacher, not for the child. It says to the teacher: Such and such are the capacities, the fulfillments, in truth and beauty and behavior, open to these children. Now see to it that day by day, the conditions are such that their own activities move inevitably in this direction, toward such culmination of themselves. Let the child’s nature fulfill its own destiny, revealed to you in whatever science and art and industry the world now holds as its own. (p. 31)

This statement comes from his early work on education, *The Child and the Curriculum*. It demonstrates Dewey’s positioning of the teacher as the director of students from the beginning. Like effective play directors, teachers identify the strengths and weaknesses of their actors (their
natural development and experiences), the conditions they can affect (the classroom), and those that they cannot (the prevailing community culture). Teachers also know what tools are at their disposal (their subject matter knowledge and methodology) that can be used to make the entire cast feel as if their roles are critical to the production’s success.

Rather than carry his metaphor through to fruition, however, Dewey analogized teaching in a different way. He compared the teacher to a farmer with students as crops. Viewed through this lens:

A farmer who should passively accept things just as he finds them would make as great a mistake as he who framed his plans in complete disregard of what soil, climate, etc., permit. One of the evils of an abstract or remote external aim in education is that its very inapplicability in practice is likely to react into a haphazard snatching at immediate conditions. A good aim surveys the present state of experience of pupils, and forming a tentative plan of treatment, keeps the plan constantly in view and yet modifies it as conditions develop. The aim, in short, is experimental, and hence constantly growing as it is tested in action. (Dewey, 1966, p. 105)

Dewey recognized the teachers' need to be able to respond to the social, environmental, and developmental conditions that are present for their students at a class’ inception. He also thought teachers need to be aware of shifts in any of the interrelated components that impact student growth. Therefore, he would not be surprised at the autonomy granted teachers in countries with the today’s highest rated educational systems (Ripley, 2013). Instead, he may have been appalled at the standardized practices employed by his own nation in an effort to teacher-proof the classroom (K. Robinson & Aronica, 2009).
Thus, in a manifested Deweyan education, the teacher acts a guide for students. Teachers help students make discoveries about their world through the experiences they have both in and out of the classroom and about their role in shaping their world based on their own unique talents, abilities, and proclivities (Dewey, 1929). For Dewey (1956a), this sort of “… guidance is not an external imposition. It is freeing the life process for its own most adequate fulfillment” (p. 17). Teachers fulfill their roles through the wisdom they acquired through their own experiences, whether as teachers, students, or citizens. Having learned from experiences through reflection about the potential transferability of knowledge and skills to a new situation, a teacher is granted a sort of experiential clairvoyance. For Dewey (1966), this:

… foresight functions in three ways. In the first place, it involves careful observation of the given conditions to see what are the means available for reaching the end, and to discover the hindrances in the way. In the second place, it suggests the proper order or sequence in the use of means. It facilitates an economical selection and arrangement. In the third place, it makes choice of alternatives possible. If we can predict the outcome of acting this way or that, we can then compare the value of the two courses of action; we can pass judgment upon their relative desirability. If we know that stagnant water breeds mosquitoes and that they are likely to carry disease, we can, disliking that anticipated result, take steps to avert it. Since we do not anticipate results as mere intellectual onlookers, but as persons concerned in the outcome, we are partakers in the process which produces the result. We intervene to bring about this result or that. (p. 102)

The teacher’s intervention that Dewey refers to is not the purposeful indoctrination of students to the prevailing culture. Rather, the intervention is the identification of socially transmitted habits that will bring about the achievement of the learner’s foreseen end.
Dewey selected the teacher as the director who guides students through the brambles of their environment and toward a desirable outcome that is socially acceptable. By making this charge the teacher’s primary job, Dewey grounded the origin of education’s direction in evolution. As described in the previous chapter, active teaching only has been observed anecdotally and only described in detail for one species other than humans, that of chimpanzees. A possible second species, orcas, demonstrate that opportunity teaching may be active. In both, the learner set his—in the case of the orcas—or her—in the case of the chimps—sights on achieving some end. For the orcas, the end is achieved when a seal is captured on the beach and brought back into the water for consumption, while for the chimpanzees success is a cracked nut. In both, the students had to surpass a developmental threshold and achieve some level of competence in necessary skills and knowledge for the teachers to allow—and perhaps encourage—the learners to participate. Still, the learners experienced failure, with frustration exhibited by the chimp pupil and the young orca’s stranding event leaving it short of the seal and stuck on the beach. The teachers observed these failures and provided what the learners needed, be it a repositioning of the nut on the anvil, a demonstration of the correct holding of the hammer, or a timely nudge. These acts suggest a mind capable of reading the others’ intentions (Leslie, 1987; Premack & Woodruff, 1978). Through this insight, teachers can provide the sort of guidance Dewey identifies as their role.

That both species form affiliative pair-bonds (de Waal, 2009; Rendell & Whitehead, 2001), should not be surprising, as it provides the physical and emotional proximity necessary to form a caring dyad (Noddings, 2003). When such a relationship is developed between instructors and pupils, teachers are most often in the caring role. That means the teachers identify what their
charges need to achieve their goals. For Dewey (1966), this meant more than simply determining the path that is most obvious to the instructor, because:

When we come to act in a tangible way we have to select or choose a particular act at a particular time, but any number of comprehensive ends may exist without competition, since they mean simply different ways of looking at the same scene. (p. 110)

In *How We Think*, Dewey (1997a) explained that this capacity to recognize alternative paths and to envision other outcomes is what makes a thought, and ultimately an action, become fully formed. For teachers, this is pedagogical content knowledge (Shulman, 2004), which, along with their knowledge of their students, allows them to envision the outcomes of various pairings of subject and method in the established classroom environment.

**Achieving Directional Balance**

Considering that educators are the product of experiences that were viewed and reflected upon by their own particular culture, judgment and values are associated with every selected classroom activity. Dewey used the words judgment and values extensively (1966, 1997a), as do philosophers and cognitive neuroscientists (Hall, 2010). The words judgment and values describe what is necessary to complete an act of thought and to behave wisely. Most societies throughout history expected these activities of their teachers (Reagan, 2005). As an educator, Dewey (1966) espoused his own educational values in *Democracy and Education*, saying that:

… the kind of experience to which the work of schools should contribute is one marked by executive competency in the management of resources and obstacles encountered (efficiency); by sociability or interest in the direct companionship of others; by aesthetic taste or capacity to appreciate artistic excellence in at least some of its classic forms; by
trained intellectual method, or interest in some mode of scientific achievement; and by
sensitiveness to the rights and claims of others—conscientiousness. (pp. 243-244)

Each of Dewey’s values derives from one of the aforementioned dictators of education. His
emphases of sociability, aesthetic appreciation, and conscientiousness can be traced back to the
dictates of society, while the environment drives those of executive competency and scientific
achievement. Additionally, all of the values fall under the students’ purview of their own
direction. This equalized apportionment exemplifies the emphasis Dewey placed on balance
throughout his works and justifies his being identified as a pragmatist more than as a progressive.

Recently, Dewey’s career-long attempt to achieve systemic reform by brokering a
philosophical truce between the competing forces of education was determined to be in vain
from its outset (Egan, 2002). Educational theorist Kieran Egan (2008) compared Dewey’s aim to
the ancient Greek practice of using the relative health of a slaughtered heifer’s liver to determine
a society’s course of action. This determination derives from the discovery that cultural
institutions, like those of the ancient Greeks, can become steadfast traditions. Consequently,
social groups find it impossible to realize that the adherence to and use of the activity hinders
progress. Egan’s (2008) example was through a thought experiment from the viewpoint of a 22nd
century historian looking back at western education. In that fictional historian’s estimation:

… twentieth century people, even though they conducted endless inquiries and
commissions and task forces into schools’ ineffectiveness, simply failed to identify the
fundamental problem. Most reformers were intent on insisting that some particular
changes would make the system finally more effective. They seemed unable to recognize
that the real problem lay in what they so took for granted that they never questioned it. (p. 5)
For Egan, education’s problem was not that it had failed to achieve a cohesive and balanced direction taken from the forces that drive a society to produce learned citizens. Rather, Egan was concerned that these forces were allowed to provide direction in the first place.

Throughout his career of work dismantling the attempts made to reform education through the maintenance of these conflicting aims (Egan, 1997, 2002, 2008), Egan sought to refocus education on developing what he calls students’ cognitive tools. Invoking Vygotsky’s (1978) analogy that the brain and body use the mind as the tool to achieve its goals, Egan described in detail the levels of understanding humans acquire. He determined that there are five tools and that they are acquired in sequence. The first tool is somatic understanding, whereby individuals acquire the ability to investigate their environment through senses and interpret their findings through emotions. The second tool is mythic understanding, in which an individual grasps the abstract dichotomies of the world, such as good/evil and courage/cowardice, through story. The third tool is romantic understanding, in which individuals seek to determine the world’s limits, such as the biggest/strongest/longest/heaviest objects in every venue individuals encounter. Egan places great emphasis on this tool because it is achieved in early adolescence, the age that lies at the heart of schooling. The fourth tool is philosophic understanding, a cognitive achievement that grants an individual the ability to interpret abstract thought and produce rules that may be applicable to other situations. The final tool is ironic understanding. An individual who has acquired this tool can utilize all of the other tools and evaluate each of their limitations in any situation (Egan, 1997, 2008). Therefore, whether working separately or together, at their root the deployment of these tools allows learners to identify both the patterns and incongruities in their world and respond to them. In Egan’s estimation, this should be the goal of education.
Egan’s new direction for education evokes the sort of meta-heuristics some have advocated as the solution to the pervasive memes problem (Brodie, 1996) and the desire to seek patterns of patterns (Bateson, 2002). Such redirection seemingly places Egan at odds with the idea of balance that pervades much of Dewey’s work. Egan flouts this difference in the title of his book, *Wrong from the Beginning: Our Progressivist Inheritance from Herbert Spencer, John Dewey, and Jean Piaget*. And yet, in his quest for balance, Dewey not only attempted to build bridges between conflicting purposes of education, but he tried to demolish the barriers between what he considered the false dichotomies of human understanding. In so doing, he drew attention to the perils of dogmatic adherence to past institutions (Dewey, 1966). This stance suggests that Dewey, like Egan, did not possess the predilection for the maintenance of institutions for the sake of tradition alone. The apparent similarity between their views explains why Egan (2008) suggests that:

> We might sensibly follow John Dewey’s advice: “It is the business of an intelligent theory of education to ascertain the cause for the conflicts that exist and then, instead of taking one side or the other, to indicate a plan of operation proceeding from a level deeper and more inclusive than is represented by the practices and ideas of the contending parties.” (p. 36)

Egan’s invocation of Dewey’s statement from *Experience and Education* suggests that he saw Dewey on a quest similar to his own. For both, the goal is to have education serve as the conduit by which students exhibit the most possible growth.

In Egan’s estimation, this comes through the acquisition and application of the five cognitive tools described above, since they grant the learner a deeper and more nuanced understanding of world. For evolutionary psychologists, this is achieved through the
development, the use, and the refinement of primary and secondary heuristics (Geary, 2007). For both, however, growth is achieved through venues in which concrete and abstract thoughts can interact and build upon one another with the knowledge and skills acquired in the course of living. Dewey spent the latter part of his career investigating this interface. He recognized that humans possess the cognitive tools and heuristics such as inquiry and creativity, the forums of art and science, and the impulses necessary to bring seemingly disparate realms of thought together. Were all of these cognitive and cultural possessions to work in concert, the outcome would be no less than the amelioration of the mind-body dichotomy that Dewey saw as the limiting factor for understanding. This fusion is what Dewey sought for education. It will serve as the subject for the next chapter.
Chapter 6: Handling Abstractions with the Tools of the Mind

That John Dewey’s last two major works, *Art as Experience* and *Logic*, were devoted to two subjects on opposite poles of the intellectual spectrum exemplifies his quest to investigate experience in all forms. For *Art as Experience*, he sought the company of his era’s most renowned artists and respected critics (Dalton, 2002; Dewey, 1980). While writing *Logic*, he became entrenched in the details of research in the fledgling field of developmental neuroscience (Dalton, 2002; Dewey, 2008). For one book, he was immersed in conversation and engagement with not only the works of art, but also the working of the art. For the other book, he evaluated proposed methodologies and the hypothetical implications of print outs of brain-wave activity. One topic seemingly could not be more concrete while the other could not be more abstract. However, Dewey (1980) thought that one could not exist without the other. He concluded in *Art as Experience* that “Philosophy is said to begin in wonder and end in understanding. Art departs from what has been understood and ends in wonder” (p. 270). Neither one deserved more exalted status than the other because neither one proved to be an ultimate end. Both enhanced and enlivened experience because both involved invention and inquiry. Both required abstract and concrete knowledge to reach any sort of consummation.

Dewey investigated each separately even as he was seeking the abolition of what he saw as the artificial division separating what, taken together, are the outward manifestation of thought derived from experience. He may have made this decision from his dissatisfaction with his previous attempt to ameliorate this false dichotomy, his work *Experience and Nature* (Dalton, 2002). Serving as his attack on what was understood to be the canonical positions of philosophy, *Experience and Nature* sought balance between many of philosophy’s key dualisms:
abstract/concrete, practical/theoretical, mind/body, empirical/scientific, culture/nature, individual/universal. Dewey asserted the dualisms left people, be they academics or laypersons, entrenched in their various beliefs about what constitutes worthwhile knowledge and wisdom (Dewey, 1958). These artificial polarizations prevented the progress he thought civilization required for humanity to achieve the balance characteristic of healthy natural systems.

Though the dualisms that served as his dueling partners came in the aforementioned identifiable forms, from an educational standpoint, all do not need to receive equal treatment in the quest to achieve balance. An emphasis on two will suffice: concrete/abstract and mind/body. This chapter’s goal is to identify how Dewey’s proposed amelioration of these dualisms is justified (or modified) by contemporary research in fields that provide an evolutionary explanation of what it means to think like a human.

**The (Thin) Line between Concrete and Abstract**

As described in Chapter Four, at its root, education is about the social transmission of knowledge and skills necessary for—as explained in Chapter Five—students growing into the people they want to become in the community in which they were raised. Among virtually all other animals and for most of human history, this development involves primary and secondary knowledge that is either declarative or procedural. Regardless of sub-category, the knowledge was of practical import. It involved acquiring food, constructing a shelter, or navigating a complicated social network. These activities made its acquisition and deployment concrete. Such knowledge can be juxtaposed with that which began during The Scientific Revolution and The Great Enlightenment (Dewey, 1958; Foucault, 1973). This movement produced the theoretical and perhaps universal truths from which contemporary logical and abstract thoughts are derived.
Dewey (1997a) identified a problem with a limited portion of the populace possessing an understanding of the new conceptual rules. He stated that, in education:

Teacher and student alike tend to set up a chasm between logical thought as something abstract and remote, and the specific and concrete demands of everyday events. The abstract tends to become so aloof, so far away from application, as to be cut loose from practical and moral bearing. The gullibility of specialized scholars when out of their own lines, their extravagant habits of inference and speech, their ineptness in reaching conclusions in practical matters, their egotistical engrossment in their own subjects, are extreme examples of the bad effects of severing studies completely from their ordinary connections of life. (pp. 50-51)

Dewey’s apparent abhorrence for education’s separation of abstract from concrete is derivative of his concern that this practice stratifies knowledge based on type. He observed that societies valued knowledge that was concrete and practical less than that which was derived from abstract theorems. This value thereby justified the social elevation of those who had mastered the latter. The division was deemed rational because the separation between concrete and abstract is what separates man from nature. For classical philosophers it was teleological, the transcendence of man’s mind over his animal body. Therefore, those who achieved this level of understanding were considered more fully human than those who had not.

Dewey saw that the problem with this interpretation was that it suggested only some people are capable of achieving this pinnacle of human understanding. In his estimation, though some people tend to spend more time in the abstract problems presented by logical theorems, all people are in a constant state of acquiring abstract knowledge. The reason most people do not recognize that they possess an understanding of the abstract is because “… what is abstract in
one period of growth is concrete at another” (Dewey, 1997a, pp. 136-137). Once something previously unknown has its meaning fixed it can be manipulated in a physical or mental fashion. The ability to use knowledge makes it practical, and therefore concrete, in the one who wields it. The innate desire to utilize knowledge to craft one’s direction explains why, as Dewey (1958, 2008) described in various works, children are so apt to apply new words in as many contexts as possible. Dewey refers to a child who sees a horse for the first time and uses the words “big dog” to describe it. Dewey uses this linguistic misapplication to demonstrate the innate desire to utilize a word that is becoming concrete. Consequently, the word’s use reinforces the child’s understanding of a previously unidentified, and therefore abstract, animal.

Dewey’s description of these verbal missteps can be substantiated by anyone who has engaged with toddlers, who, in the process of developing language, frequently make these linguistic over-extensions (E. V. Clark, 2003). The aforementioned mistakes occur because vocabulary acquisition is an exercise in classification. Learners are able to affix groups with perceived similarities with a label that establishes their relationship, though often the rationale behind the relationship is abstract or misinformed (Vygotsky, 1986). What Dewey did not know, but would have appreciated, is that over-generalizations of classificatory terms exist in several other animals that have vocalizations with particular meanings. This misuse of vocabulary—limited in the wild to predator-specific alarm calls in non-human primates—disappears with time and experience both in monkeys (Hauser, 1989; Seyfarth & Cheney, 1986) and humans (Hewlett, et al., 2011). Perhaps more important to Dewey’s goal of rectifying the false concrete/abstract dichotomy is the recent discovery that sequences of sound events can be perceived and processed not only by humans but also by animals. These sequences are referred to as natural syntax.
Syntactic Sequencing

Syntax is the effect of the order in which words are presented (Chomsky, 1965, 2002) and was long thought to be the sole providence of humans. Recent research suggests otherwise. In birds that, like humans, primarily utilize vocalizations for communication, a natural syntax exists in their calls (Lachlan, et al., 2010). Although vocalization is physiologically more limited in non-human primates than in humans, several other species in this order exhibit call syntax (Hailman, 2008; J. G. Robinson, 1984). The syntactic reasoning of bonobos, also known as pygmy chimpanzees, in response to English was shown in laboratory experiments to be similar to that of human toddlers (Savage-Rumbaugh, et al., 1993), in some ways surpassing the skill level of five year-olds (Lyn, Greenfield, Savage-Rumbaugh, Gillespie-Lynch, & Hopkins, 2010). That this capacity exists innately within social animals makes evolutionary sense. As Dewey (1997a) wrote, the “… primary motive of language is to influence (through the expression of desire, emotion, and thought) the activity of others [while] … its secondary use is to enter more intimate social relations with them” (p. 179). These purposes meant that:

The heart of language is not “expression” of something antecedent, much less expression of antecedent thought. It is communication; the establishment of cooperation in an activity in which there are partners, and in which the activity of each is modified and regulated by partnership. (Dewey, 1958, p. 179)

Dewey’s conception of the basal impulse for language has been echoed by contemporary evolutionary biologists, regardless of whether their research focuses on human (Calude & Pagel, 2011) or non-human (Krebs & Dawkins, 1984; Seyfarth & Cheney, 2010) communicators. Therefore, any language instincts would be beneficial, because it allows for more rapid and more accurate information processing. Underpinning these instincts, as Vygotsky (1986) and
subsequent evolutionary linguists have suggested (Chomsky, 2002; Pinker, 2007), must be the neurological wiring necessary to process linguistic abstraction.

Although a portion of syntax in humans and non-humans may be innate, a portion has to be learned (Bruner, 1983; Savage-Rumbaugh et al., 1993). This recognition suggests that the production of syntactically correct language requires procedural learning, which has its seat in the basal ganglia (Blakemore & Frith, 2005). Therefore, communication between individuals would be disrupted by injuries to this brain region. Research with rats shows that acts of allogrooming—the grooming of others—is like language. Both are syntactic and critical to social standing. Therefore, injuries to the basal ganglia affect the expected sequence of behaviors—the rat’s grooming syntax—terminating the episode (Aldridge, Berridge, & Rosen, 2004; Cromwell & Berridge, 1996). Broca’s area, a region of the brain critical for processing of language in humans, has been considered by some to be a part of the basal ganglia (Ullman, 2006). This conclusion strengthens the case that when learning syntax, humans tap into brain regions used when processing behavioral sequences. Dewey (2008) himself noted this, concluding that:

Language did not originate association, but when it supervened, as a natural emergence from previous forms of animal activity, it reacted to transform prior forms and modes of associated behavior in such a way as to give experience a new dimension. (p. 62)

Dewey’s emphasis on association suggests an innate cognitive quest exists to determine relationships, particularly sequential relationships, between events and activities. As he recognized, the ability to make predictions about future events based on present conditions is advantageous (Dewey, 1997a). From an evolutionary perspective, the ability is adaptive. Therefore, animals can be trained through classical and operant conditioning. It is advantageous to drool when one hears a bell or to press down a lever if the event or activity often is followed
by a reward of food. Although these associations are learned, the ability to learn the association is innate.

When manifested through language, the basal process of associative thinking can show the listener the speaker’s cognitive links. In his research on thought processes in non-literate cultures, Soviet psychologist A.R. Luria studied individuals who were presented with depictions of four objects. They were asked to exclude one depiction that was operated from a situational position such as concrete thought as opposed to working from a classificatory, i.e. abstract, model. One trial showed a hatchet, a saw, a hammer, and a log and resulted in the response:

They’re all alike. The saw will saw the log and the hatchet will chop it into small pieces.

If one of these has to go, I’d throw out the hatchet. It doesn’t do as good a job as the saw.

(Luria, 1976, p. 56)

This participant’s response suggests he evaluated each object in terms of its relationship, its association, with others in the series. This results in an evaluative comparison between the saw and the hatchet as tools that can be used on the wood. The hammer was not mentioned in the participant’s answer, perhaps because its application to the wood is about affixing something to the wood as opposed to subdividing it. Luria addressed this during his debrief with the participant. Luria explained that the first three objects are tools. The participant countered that, “Yes, but even if we have tools, we still need wood—otherwise we can’t build anything” (Luria, 1976, p. 56). For Dewey, this would have been an overt manifestation of his idea that for anything to have concrete meaning, such as an object, an action, or an experience, it must have a purpose. As he saw it, “When thinking is used as a means to some end, good, or value beyond itself, it is concrete; when it is employed simply as a means to more thinking, it is abstract” (Dewey, 1997a, p. 138).
Individuals within primarily oral cultures include those that most closely adhere to the hunter-gatherer lifestyle ascribed to pre-agricultural humans. For these individuals, the need for purpose is born out in the words that exist in their languages. Within such cultures, wide vocabularies exist for items, occurrences, and conditions that have direct bearing on their survival. For example, plants that are poisonous or have medicinal value have names, as do animals that are prey items or that are predatory threats; even weather patterns that impact daily activities are assigned specific words (Ong, 1982; Zarger, 2010). However, a categorical word does not exist for plants or animals. Dewey (1958) identified the use of such abstract classification as a hallmark of contemporary philosophical thought. Therefore, the difference in cultural vocabularies may be a product of a word’s necessity to a particular social group. This necessity is demonstrated in the specificity of alarm calls in vervet monkeys briefly described above and at length in Chapter Four. Consequently, experienced—and therefore wise—individuals apply the eagle alarm call only to those birds that present a threat as opposed to those that do not. Naïve individuals often are incapable of making this distinction (Seyfarth, et al., 1980a).

Luria found that this social component of language shaped his participants’ thought processes with regard to their view of themselves. One exchange between Luria and the participants transpired:

Question: “What sort of person are you? What’s your character like? What are your good qualities and short-comings? How would you describe yourself?”

Answer: “I came here from Uch-Kurgan, I was very poor, and now I’m married and have children.”
Question: “People are different—calm, hot-tempered, or sometimes their memory is poor. What do you think of yourself?”

Answer: “We behave well—if we were bad people, no one would respect us.”

Answer [another individual]: “What can I say about my own heart? How can I talk about my character? Ask others; they can tell you about me. I myself can’t say anything.” (in D.S. Wilson, 2008, p. 225)

Such answers show the desire to put everything in a context, making self-reflection and perception a challenge. This attitude would be inconceivable to a person raised in a literate society (Ong, 1982; Seyfarth & Cheney, 2010; D. S. Wilson, 2008). Dewey did not conduct similar studies nor was he privy to those Luria conducted. However, Dewey knew that, “The modern habit of using self, ‘I,’ mind, and spirit interchangeably is inconceivable when family and commune are solid realities” (Dewey, 1958, p. 209). He seemed to be aware of the apparent need for group-oriented, practical thoughts when an individual resides in a society that must transfer all information in an oral and social fashion.

Dewey recognized that the linguistic patterns Luria described are closer to the primary language heuristic than the abstract individualized academic language of modern and literate western cultures. This recognition may be what drove Dewey to suggest that:

The defect of nominalism lies in its virtual denial of interaction and association. It regarded the word not as a mode of social action with which to realize the ends of association, but as an expression of a ready-made, exclusively individual, mental state … Interaction, operative relationship, is as much a fact about events as are particularity and immediacy. Language and its consequences are characters taken on by natural interaction
and natural conjunction in specified conditions of organization. Nominalism ignores organization, and thus makes nonsense of meanings. (Dewey, 1958, pp. 184-185)

Dewey puts specific, categorical language under the heading of nominalism and explains at length its contribution to the advancement of human understanding. The problem is not that this type of language cannot advance thought but that it becomes an expectation that it should serve as both the launch point and the end of a child’s education. Because of the cultural emphasis on abstraction, Dewey (1997a) determined that:

The vocabulary of things studied in the schoolroom is very largely isolated; it does not link itself organically to the range of ideas and words that are in vogue outside the school. Hence the enlargement that takes place is often nominal, adding to the inert, rather than to the active, fund of meanings and terms. (pp. 181-182)

With the aim of facilitating the acquisition of vocabulary in the classroom that can be used in the outside world, Dewey identified that educators should not fight against the natural purpose of language. Rather, they should “… direct pupils’ oral and written speech, used primarily for practical and social ends, so that gradually it shall become a conscious tool of conveying knowledge and assisting thought” (Dewey, 1997a, p. 179).

Dewey’s instinct for language’s use as a cognitive tool and the ways in which it is socially wielded was prescient. Evolutionary psychologists have collected considerable evidence on the primary functions Dewey identified: expression, cognition, and interaction (Prinz, 2012). Jesse Prinz (2012) wrote that the expressive theory of language suggests that the language’s primary purpose is to communicate by expressing emotions or thoughts; it is not to craft thoughts. This stands in opposition to the cognitive theory, which holds that language is the primary mode of thought and the principle way in which cognitive inputs are processed. The
interactive theory holds that its purpose lies at the interface between the two, ameliorating the dichotomy in a Deweyan fashion. The interactive theory stipulates that thoughts can be developed and shaped with and without language; at times, language assists the process, while at others it is an impediment.

Regardless of its original purpose, with power that can be deployed in multiple ways, contemporary evolutionary psychologists think of language as “… our most important ‘tool’” (Barash, 2012, p. 274). Dewey (1958) recognized this as well, writing that:

… at every point appliances and application, utensils and uses, are bound up with directions, suggestions and records made possible by speech; what has been said about the role of tools is subject to a condition supplied by language, the tool of tools. (p. 168)

Therefore, the use of language provides more possibilities for the employment of another hallmark of humanity, tools (Barash, 2012; F. R. Wilson, 1999). One might infer that Dewey was not only speaking to the primacy of language’s position in the human capacities hierarchy, but also of its position temporally as it relates to human brain development. Yet, as described earlier, some of the linguistic patterns that differentiate human language from other vocalizing primates (Hess, 2008; Prinz, 2012) can be traced to the brain’s basal regions. Broca’s and Wernicke’s areas—brain regions associated with the production and processing of language in humans—have homologs in non-human primates [Broca’s (Gil-da-Costa, et al., 2006; Taglialatela, et al., 2008) and Wernicke’s (Gannon, et al., 1998; Spocter, et al., 2010)]. Therefore, the limited language production of non-human primates (Seyfarth and Cheney, 2010) may not be due to the possession of a unique brain region in humans. Instead, the difference may be in linkages between the regions devoted to fine motor skills and language processing, with strong connections between these areas identified in birds (Nottebohm & Liu, 2010; Riede & Goller,
and humans (Falk, 2009; F. R. Wilson, 1999). Because of their neural limitations, non-human primates use gestures to enhance communication between individuals (Pollick & de Waal, 2007). Vocalizations and gestures, used individually or in conjunction with one another, activate the language production areas in chimpanzee brains (Taglialatela, et al., 2008).

Dewey recognized the power of gestural communication and its link to language, even absent adequate neurological and primatological research, writing that:

Signaling acts evidently form the basic material of language. Similar activities occur without intent in man; thus a babe’s scream attracts the attention of an adult and evokes a response useful to the infant, although the cry itself is an organic overflow having no intent. So too a man’s posture and facial changes may indicate to another things which the man himself would like to conceal, so that he “gives himself away.” “Expression,” or signs, communication of meaning, exists in such cases for the observer, not for the agent. (Dewey, 1958 p. 177)

Dewey determined that the need to communicate and to interpret the communications of others served as the impetus in finding meaning in gestures and, eventually, language. The words that make up a language are not constructed purposely; rather, he concluded that because:

… all language or symbol-meanings are what they are as parts of a system, it does not follow that they have been determined on the basis of their fitness to be such members of a system; much less on the basis of their membership in a comprehensive system. (Dewey, 2008, p. 55)

Instead, Dewey saw these symbol-meanings as functional within a given context before being repurposed for new situations. He thought their meanings became refined through their
successful use. Therefore, for Dewey (1958) “The story of language is the story of the *use* made of these occurrences; a use is eventual as well as eventful” (p. 175).

**Language: The Tool of (and from) Tools**

Dewey identified that language’s symbolic success occurs through the manipulation of the available communicative materials; this manipulation is possible because of the natural human capacity for association. In the course of drawing this conclusion, he inadvertently stumbled across a metaphor for language that may have betrayed its true origin. The hypothesis that the use and the creation of tools provides the psychological and even neurological underpinnings for the development of language has been under consideration for more than three quarters of a century (Buhler, 1930; Vygotsky, 1986; F. R. Wilson, 1999). In 1930, Karl Buhler, a contemporary of John Dewey’s of who the latter probably had no awareness, wrote that:

… before language comes *thinking in terms of tools*, i.e., the realization of mechanical connections and the invention of mechanical means for mechanical ends. To put it briefly, before the advent of speech, action comes to have a *subjective meaning*; i.e., it becomes consciously purposive. (p. 30)

The contextualization of action as a means to achieve an end is an overt manifestation of Dewey’s (1980) idea of how activities achieve meaning. This contextualization places it in a specific cognitive sequence that some call episodic awareness (Donald, 1991; F. R. Wilson, 1999). Dewey had a similar perception of the tools’ effect on thought process:

By its nature technology is concerned with things and acts in their instrumentalities, not in their immediacies. Objects and events figure in work not as fulfillments, realizations, but in behalf of other things of which they are means and predictive signs. A tool is a particular thing, but it is more than a particular thing, since … It possesses an objective
relation as its own defining property. Its perception as well as its actual use takes the mind to other things … [Therefore a] tool denotes a perception and acknowledgement of sequential bonds in nature. (Dewey, 1958, pp. 122-123)

Independent of Buhler, Dewey had come to the same conclusion: once the hand could hold and use an object, that object became a tool. Consequently, the person’s perception of the world and its possibilities were changed.

That this development occurs at around the age of one is evident to anyone who has watched his or her own children once they begin to crawl. Suddenly mobile, the children begin to grab everything in sight. The explosion of actions available to children when this occurs—particularly with regard to their environment—precipitates rapid physical and cognitive development that occurs in a sort of positive feedback cycle. People began to understand this circular sequence in Dewey’s time because of the work of his protégé Myrtle McGraw (Dalton, 2002). For toddlers, the hands operate as de facto concept generators, allowing for the release of the impulse to connect objects through space and time via the primary heuristic of trial and error. With this new capacity for establishing causation, the interface between thought and language takes on a third contributor: the hand (F. R. Wilson, 1999).

The ontogeny of a brain that allows an individual to identify the causal sequence of events brings us back to syntax. This time, however, we find that natural syntax is grounded within the naturally perceived link between space and time. Having been addressed by philosophers and physicists, the apparent paradox of time and space’s inextricable bond has been ameliorated independently by every culture, achieved through the repeated invention of the calendar. By positioning days, weeks, months, or years in concrete order on a physical medium, the abstraction of time is made concrete. This positioning provides the context necessary to make
its progression meaningful (Nunez, 1999). This is necessary, for the perception of time when one is in the midst of an experience is inextricably bound to space (Malafouris, 2013). In his quest to naturalize philosophy, Dewey (1958) drew the same conclusion. Linguistically, this link may seem severed, with the only space existing between words that are spoken occurring in time. However, in sign language, the causal and associative links between the words—its natural syntax—is dictated both by the distance between the active body parts in space and how far apart the signed words are in time. This difference results in a grammatical structure that, when directly translated, is significantly different from that of spoken language, but is no less understandable (Lane in F. R. Wilson, 1999, pp. 197-198).

That sign language has its own grammatical structure as opposed to being a gestural representation of a spoken one lends credence to the claim that it fits the most stringent definitions of language (Armstrong, Stokoe, & Wilcox, 1995; F. R. Wilson, 1999). Investigations into the affects of both language types on the brain give this interpretation further support. When brain areas associated with speech are affected, the aphasias—i.e. speech limitations—manifest themselves in similar ways for people regardless of whether their primary language is oral or signed (Poizner, Klima, & Bellugi, 1987; F. R. Wilson, 1999). When linguistic developmental patterns are observed clinically, deaf children acquire language in the same sequence of characteristic stages as those with hearing. This discovery applies not only to those children who are monolingual but also those who are bilingual, whether both languages are signed or one is signed and the other is spoken. Perhaps most amazingly, even those rare children who can hear but whose parents cannot—leaving the children with signing as their primary language—develop linguistically in the same fashion as all other children (Petitto, 1987, 2000; Petitto & Marentette, 1991; F. R. Wilson, 1999).
Therefore, the episodic nature of syntax derives from a more basal linkage that exists in humans related to time and space. The existence of this link becomes clear when evaluating the speech patterns of different cultures. In spite of the significant differences in the linguistic constructs of various languages, the words used to talk about time often are the same as those used to orient a body in space. This practice is most obvious in the near universal use of the word “ahead” to describe events that will transpire in the future (Malafouris, 2013; Nunez, 1999).

The movement through and orientation of the body in space provides an individual with information through the activation of the brain’s sensorimotor areas. The cognitive linguists Lakoff and Johnson (1999) concluded that the human brain is:

… structured so as to project activation patterns [from these] areas to higher cortical areas … Projection[s] of this kind allow us to conceptualize abstract concepts on the basis of inferential patterns used in sensorimotor processes that are directly tied to the body. (p. 77)

Contemporary neuroscience has shown that the body and the brain work together to understand abstraction. This discovery has produced an amelioration of the mind-body dualism set up by Descartes, a dichotomy that has been maintained by many modern philosophers. The hypothesis that there is no rigid separation of the mind and body is referred to as the embodied mind (Malafouris, 2013). Dewey (1958) prognosticated this discovery and believed that “… the physical is transformed into something mental, psychic.” However, Dewey feared that such a discovery would demonstrate that “… psychic existence [was] sure to be inherently more ideal than physical” (p. 131). He thought that the quest to identify the “‘seat’ of the mind” (pp. 291-292) would result in fallacious claims both about the hierarchy of knowledge and the definitive location of an ephemeral entity. Dewey’s concern has been shared by legions of subsequent
neuroscientists (Gallagher, 2005; Goldin-Meadow, 2005; Goldin-Meadow & Wagner, 2005; Lakoff & Johnson, 1999; Malafouris, 2013; F. R. Wilson, 1999). Dewey concluded that Descartes’ creation was a false dichotomy because he thought that experiences could be generated only if the body and the mind are bound together. Therefore, meaning is produced through the body and mind’s interaction with each other and with the world. For him:

The world is subject-matter for knowledge, because mind has developed in that world; a body-mind, whose structures have developed according to the structures of the world in which it exists, will naturally find some of its structures to be concordant and congenial with nature, and some phases of nature with itself. The latter are beautiful and fit, and others ugly and unfit. Since mind cannot evolve except where there is an organized process in which the fulfillments of the past are conserved and employed, it is not surprising that mind when it evolves should be mindful of the past and future, and that it should use the structures which are biological adaptations of the organism and environment as its own and its only organs. In ultimate analysis the mystery that mind should use a body, or that a body should have a mind, is like the mystery that a man cultivating plants should use the soil; or that the soil which grows plants at all should grow those adapted to its own physico-chemical properties and relations. (Dewey, 1958, p. 277)

Dewey describes that the emergence and the evolution of an organism with a mind occurs because it possesses a body that has adaptive structures. This description illustrates his view of the continuity of nature between the organisms that are able to detect and respond to sensory inputs and the organisms that are able to integrate the perceptions of the present with the memories of the past to produce conscious action. The passage also demonstrates that Dewey
was at the vanguard of ecological thought, envisioning that the type of soil, i.e. the body, influences the development of the plant, i.e. the mind. What he failed to recognize, however, is that in his analogy, the plant will change the soil. Based on the plant’s use of nutrients and its introduction of new ones, the changes can be so dramatic that the soil becomes better suited for a different plant. At some point in this ecological succession, a measure of balance will be achieved. But the two participants, the body and the mind, will continue to work on each other to respond to the environmental conditions that affect them individually and as a unit.

The extension of this metaphor is important. Dewey (1958) determined that an individual has a mind “… when it reaches that organized interaction with other living creatures which is language-communication” (p. 258). His writings also suggest that language and “… its consequences react upon other events, physical and human, giving them meaning or significance” (p. 173). Dewey never directly addressed how thought and language grew together, but he probably would accept and appreciate Vygotsky’s writing on the subject. Vygotsky (1986) suggested that the capacities for thought—the internal product of a mind—and language develop separately until an individual recognizes that thought can be expressed by language. Once a person reaches this developmental threshold, thought and language are no longer separate; they work on each other and with each other, one shaping the other.

**From Physical to Cognitive Tools**

Dewey would not be surprised that these (or any other) cognitive tools exist in an internal mutualism. As he demonstrated throughout his works, Dewey thought that “Whatever influences the changes of other things is itself changed” (Dewey, 1958 p. 73). Several philosophers with evolutionary bents share this sentiment (Bateson, 2002; Bateson & Bateson, 2000; Dennett,
Some contemporary neuroscientists also share this idea, since they have demonstrated that the use of tools in the process of achieving desired ends rewires the brain.

In non-human primates, Japanese macaques clearly illustrate this discovery. Macaques rarely use tools in the wild (Tomasello & Call, 1997). However, when presented with the opportunity, they have taken advantage of newly available objects to solve novel foraging problems (Tanaka, Tokida, Takefushi, & Hagiwara, 2001; Tokida, Tanaka, Takefushi, & Hagiwara, 1994). Such observations helped precipitate the development of successful tool use training protocols for macaques (Ishibashi et al., 2002). The training allowed researchers to investigate the effects of tool use on the primate brain. In a series of experiments, Iriki and Sakura (2008) demonstrated that when a macaque used a rake to retrieve previously irretrievable food items, an expansion occurred along the axis in the activity of the brain area that connects sight to touch. This area is known as the visual somato-sensory receptive field (Malafouris, 2013). The expansion was present in ways that were not present in monkeys that did not use the tools. The findings led the researchers to write, “it appeared that either the rake was being assimilated into the image of the hand or, alternatively, the image of the hand was extending to incorporate the tool” (p. 2232). The body was working with the tool while the tool was working on the monkey’s brain.

A subsequent experiment involved the rake with which the monkeys had become familiar. The food retrieval did not allow the monkeys to see their own arms. They had to watch a video projection of their arms to navigate the rake to acquire the food (Iriki & Sakura, 2008). The macaques were successful after several weeks of practice. This timeline aligned with a prior discovery that novel connections between neurons can be formed as a product of the behavioral
requirements of tool use (Hihara et al., 2006). Their discovery led Iriki and Sakura (2008) to posit that:

If external objects can be reconceived as belonging to the body, it may be inevitable that the converse reconceptualization, i.e. the subject can now objectify its body parts as equivalent to external tools, becomes likewise apparent. Thus, tool use may lead to the ability to disembodify the sense of self from the literal flesh and blood boundaries of one’s skin. As such, it might be precursorial to the capacity to objectify the self. In other words, tool use might prepare the mind for the emergence of the concept of the meta-self. (p. 2232)

It will be difficult, if not impossible, to prove that the monkey’s perception of itself changed. However, the study demonstrates that the monkey’s awareness of the extent of its body and its body’s location can be manipulated and abstracted in ways previously ascribed only to humans.

If the findings of Iriki and Sakura (2008) achieved at an earlier date, they may have been used to predict the results of a study that investigated neural activation patterns when making stone tools. In the study, it was discovered that the brain areas activated when novice tool-makers create the artifact most representative of the early human lineage, the Oldowan stone tools (Stout & Chaminade, 2007), were not in the prefrontal regions associated with planning and abstraction that seem to be uniquely human (Malafouris, 2013). Instead, they were in a more basal region that links motor function and sight (Orban et al., 2006). Subsequent studies have shown that, when using the more advanced knapping techniques needed to create Acheuelan stone tools, a more distal and human brain region know as the ventrolateral prefrontal cortex is activated (Stout, Toth, Schick, & Chaminade, 2008). Therefore, though the production of more
modern stone tools may have required new cognitive architecture, the neural foundation for tool making was laid early on the road to humanity.

With less than modern human minds making stone tools and with non-human primates demonstrating the ability to incorporate tools into their self-perception, the cognitive archaeologist Lambros Malafouris (2013) drew a unique conclusion. He determined that “Stone tools are not an accomplishment of the hominin brain; they are instead an opportunity for the hominin brain—that is, an opportunity for active material engagement” (p. 169). Malafouris expanded on this statement, positing that it is the hominin lineage’s work with external materials that has shaped both the brain and the mind of modern humans. He termed his idea Material Engagement Theory (MET). MET suggests that the modern human mind is the product of thousands, even millions, of years of our lineage’s engagement with the materials of the surrounding environment. We bend, hew, crush, and knap them to our will. By actively engaging with materials, the modern human brain began to be shaped. The shaping gave advantage to those with more neural activation in response to the use and creation of tools and to those with increased neural plasticity, which is a hallmark of humans as a species (S. L. Brown & Vaughan, 2009; Gazzaniga, 2008). In using external materials, the constructions that were made and the act of making them came to be as much the raw materials for thought as the materials themselves. These activities allowed the concrete to be abstracted by a mind that extended beyond the cranium and beyond the body to include objects created and used by the individual agent.

Malafouris’ MET is the product of the knowledge created by a few thousand years of philosophy, a few hundred years of archaeological artifacts and paleoanthropological fossils, and a few decades worth of brain research. This manifested itself in a theory with the kind of interdisciplinary backing that Dewey sought for his hypotheses on the importance of experience.
Dewey’s investigations were much wider reaching—probably because of the relative dearth of paleoanthropological evidence and complete lack of PET and fMRI technology—but he sought to produce a theory as comprehensive as Malafouris’. On several occasions, Dewey wrote of the effect of tools and materials on the mind. In one characteristic passage from *Experience and Nature*, he invokes the essence of MET, writing:

> The first step away from oppression by immediate things and events was taken when man employed tools and appliances, for manipulating things so as to render them contributory to desired objects. In responding to things not in their immediate qualities but for the sake of ulterior results, immediate qualities are dimmed, while those features which are signs, indices of something else are distinguished. A thing is more significantly what it makes possible than what it immediately is. The very conception of cognitive meaning, intellectual significance, is that things in their immediacy are subordinated to what they portend and give evidence of. (Dewey, 1958, p. 128)

Dewey steadfastly adhered to an interdisciplinary process of understanding of the mind. His hypothesis was that the mind could not be separated from the body, from the objects that shape it, or from the environment within which it resides. Today this adherence seems prescient. What is even more impressive is his advocacy for the use and development of tools early in a student’s educational process, especially because his advocacy occurred well before his deep interdisciplinary dive into the nature of the mind.

In his early educational treatise, *The Child and the Curriculum*, Dewey (1956a) described at length how a child benefits from an investigation of tool-based processes. For example, a child gains from knowing how cotton is milled into a ubiquitous fabric using tools of varying levels of technological achievement. Dewey allowed students to not only work with the raw materials but
also develop them. He felt this granted insight to educational fields that were kept in separate units and classes because of the absence of purposeful context. In his subsequent tome on schooling, *Democracy and Education*, Dewey (1966) explained how the identification, creation, and use of tools gave purpose to the actions and language used in the classroom. These tasks prevented work from seeming like drudgery and instead made it seem like play. In his final work on the matter, *Experience and Education*, Dewey (1963) emphasized that the tools a student develops and uses, be they cognitive or physical, must have value in the present experience. The tools must help the student move toward the fulfillment of a natural impulse within the constructs of the given culture. Therefore, were one to read only Dewey’s works on education, one could conclude that Dewey unwittingly stumbled across methods justified a century later by research in fields which did not exist when he did. Taking his body of work in total, however, leads to a different conclusion: Dewey spent his life trying to understand of the development of the human mind, a process over which education held significant sway.

Therefore, through creating and using tools as a part of formal education, an effective teacher creates a learning environment that (1) promotes appropriate development and takes advantage of the natural predilection of children to use their hands; (2) encourages further cognitive development and helps to establish the neural pathways that form our natural syntax; (3) exposes children to the tools that are the focal objects of the established culture; (4) engages the students in activities that seem immediately purposeful to them based on the available adult models; and (5) bridges the gap between play and work, allowing what is done the classroom to derive from the intrinsic motivation characteristic of informal education. The use of hands and tools in a classroom, particularly in early childhood, does more than that. Pedagogical theorist Kieran Egan (1997) wrote that individuals who use tools move beyond the capacity to
understand the world through simple sensory inputs and into the realm in which there are internal representations of those inputs. These individuals move from possessing only a somatic understanding of their world to possessing a mythic understanding. The acquisition of this new cognitive tool utilizes the more basal ability of causal reasoning—which led to the aforementioned natural syntax—in conjunction with the ability to use language and thought together to understand the world through stories.

**Solutions through Stories**

We begin to tell stories when we are toddlers, probably because we have concluded that events happen sequentially in space because some sort of agent guides the objects interactions with each other. The presumption of agency can apply to those objects and events that are without intent, such as a large rock that one tripped over or a mudslide that blocked a highway one needs to travel. Though this interpretation of the described events is erroneous, the assumption of agency is probably an evolutionary (by)product of social living. Through the inference of intentions, one can make predictions about how entities will interact in the future (Dennett, 2013). For toddlers, the need to make predictions about the world based on what they know to be ordinary transpirations with definitive causes leads to the use of definitive words, such as “always” and “sometimes.” An adult might hear a child say: “We always get jelly beans after we eat all of our dinner” or “Sometimes Abbie comes over after I go to Julie’s.” An exponential increase in usage of this word type occurs between an individual’s second and third years (Bruner, 1990).

When there are occurrences outside of the ordinary, toddlers are pushed to develop explanations that, as Jerome Bruner (1990) described in his book *Acts of Meaning*, get the story right (p. 92). Bruner found that toddlers are apt to tell and retell stories of what has transpired to
them until they are satisfied. Retellings are more likely if the events are exceptional. To get his own story right, Bruner invokes Dewey, writing that, “John Dewey proposed that language provides a way of sorting out our thoughts about the world and there are chapters in *Narratives from the Crib* confirming his conjecture” (p. 88). Dewey, however, did not see language alone as the creator of explanations about the world. He thought, “Through speech a person dramatically identifies himself with potential acts and deeds; he plays many roles, not in successive stages of life but in a *contemporaneously enacted drama*. Thus mind emerges” (Dewey, 1958, p. 170; emphasis added). According to Dewey, through the production of a personal story in light of lived experiences, a person becomes a person. However, these toddler-invented stories, in their attempts to explain extraordinary happenstances, consistently juxtapose the canonical everyday experiences and events with that which was abnormal. This probably is because the toddlers still are working out what is canonical (Bruner, 1990).

As an individual moves out of toddlerhood and into childhood, however, the emphasis changes. Having been fully grounded in the basic behavior canon of their culture, children entering elementary school are more interested in fantasy worlds. This interest prepares them to achieve Egan’s (1997) mythic understanding. Having achieved this type of understanding, young students can interpret the binary distinctions such as good and evil and they have developed enough familiarity with language to use it to produce vivid mental images. The stories that are attractive to a mythical understanding of the world follow the same pattern as those simple stories toddlers begin to tell themselves (Bruner, 1990). The stories have a character faced with a conflict, and his or her series of attempts to overcome the conflict produces a plot with a final resolution (Gottschall, 2012). The listener’s interest is ensured because these characters face the highest of stakes (Nettle, 2005). These heightened stakes bring clarity to abstract concepts such
as good and evil that seem to be understood in toddlerhood (Egan, 1986) and perhaps infancy (Prinz, 2012). The clarity allows children to affix moral labels in the canonical context of their given culture (Dewey, 1929). This probably is why the longest lived stories are grounded in evolutionarily universal conflicts played out in fantastic circumstances (Barash & Barash, 2008; Dutton, 2009; Nettle, 2005) and why certain story patterns, such as the hero quest (Joseph Campbell, 2008), appear to be transcultural if not universal.

For a story to captivate its audience, however, additional elements must be present. Primarily, the expected grammar of the story must be present and a foundation in the culture’s basic tenets, practices, and beliefs must be evident (Bruner, 1990). This may be why Dewey (1980) emphasized the necessity of good literature to capture the rhythm of its readers’ lives. Secondarily, but perhaps more importantly, the story must have a narrator’s voice present to deliver the story (Bruner, 1990). Today, this narrator can take many forms depending on the medium. However, classically for humans, this narrator was the tribe’s or village’s resident storyteller, a bard in the Homeric sense (Dutton, 2009; Ong, 1982).

Groups revered gifted storytellers because they could use stories to transmit the cultural canon of beliefs, practices, behaviors, and morals (Ong, 1982). The ability to faithfully transmit culture ensured that storytellers earned the trust of generations inculcated in the culture, conferring upon them a level of prestige felt by the next generation. The effective storyteller became, in the mind of the listener, an authentic leader (Niedermeyer, 2012). The storyteller’s status makes it possible for a well-told story to change a listener’s actions by reframing what is culturally acceptable (Gottschall, 2012). This ability may explain why many non-Western cultures have no word for the profession of teacher (Reagan, 2005). Instead, they look to the best
storytellers as the people to socially transmit important cultural knowledge (Lancy & Grove, 2010).

Bruner and Gottschall suggest we not only craft a narrative to make sense of our lives, but cast ourselves in the role of the hero. If this is true, then these trusted storytellers serve as our archetypal guides as we engage in our own individual hero quests. The storytellers help us navigate the perils and conflicts that serve as the impetus for our quest for answers. They provide the backdrop for our making sense of our ventures in light of those who have come before us. In the process, they help us to grow into the people we want to be. Storytellers forge the link between canonical fantasy and reality that is a part of their culture’s daily existence for their listeners and learners. Consequently, they help move their charges from a world of somatic and mythic understanding into one that also includes romantic understanding.

According to Egan, students who use this cognitive tool are curious about the limits of their existence. They are no longer as aroused by the giant of fables as they are by the tallest person who ever lived. In a successful classroom, the teacher, therefore, is cast not only in the role of the storyteller, but also in that of the guide. The teacher assists the students as they heroically make discoveries about the world in which they live (Egan, 1992, 1997). Although Egan clearly and passionately advocated these dual roles, Dewey posited it nearly three quarters of a century earlier. Dewey (1997a), like Egan, was frustrated that:

… too often it would almost seem as if pains had been taken to deprive the material of school observations of all life and dramatic quality, to reduce it to dead and inert form. Mere change is not enough, however. Vicissitude, alteration, motion, excite observation; but if they merely excite it, there is no thought. The changes must (like the incidents of a well-arranged story or plot) take place in a certain cumulative order; each successive
change must at once remind us of its predecessor and arouse interest in its successor if observations of change are to be logically fruitful. (p. 194; emphasis added)

For Dewey, the goal was not for students to be able to recall factoids or even to be able to analyze a set of texts in a critical manner. His goal was to develop a transferable understanding of a subject that would allow the students to abstract meaning from an experience and use that newfound discovery to create concrete solutions to life’s problems.

Dewey was, therefore, drawn instinctually to the story form of transmission using naturally perceived limits. This appeal existed because he recognized that:

*Philosophy was a telling of the story of nature after the style of all congenial stories, a story with a plot and a climax, given such coherent properties as would render it congenial to minds demanding that objects satisfy logical canons.* (Dewey, 1958, p. 88)

To satisfy a student’s logical canons, Dewey identified that the story must be coherent to the teacher and to the student. This belief explains his steadfast adherence to the practices of creating and of utilizing students’ experiences to generate stories of understanding. The students are then able to use their natural proclivity for creating and using cognitive and physical tools. It also allows students to do so through their own natural learning heuristics, such as observation and mimicry and trial and error. Students then not only envision themselves as the heroes of their own fables of discovery, but they also get to act heroically.

The student is most likely to ascend to the status of hero (Gottschall, 2012), and develop a contextual and synthetic understanding of new knowledge, when engaged in play (S. L. Brown & Vaughan, 2009). This double benefit, in retrospect, may explain why Dewey placed such an emphasis on play throughout his writing on education. He identified that if a student’s activity is intrinsically motivated, it will be perceived as play (Dewey, 1966). The playful attitude that
ensued would push children to think critically as they attempted to release their natural impulses in the learning environment fashioned by the teacher (Dewey, 1956b). Dewey thought from the beginning to the end of his career that play should be the centerpiece of an effective classroom. His attitude toward play explains why, in *Art as Experience*, he draws the conclusion that “Play remains as an attitude of freedom from subordination to an end imposed by external necessity … transform[ing] material to serve the purpose of developing experience” (Dewey, 1980, p. 279). Therefore, through the facilitation of play, the teacher can create an environment wherein the student can craft objects and narratives that promote both engagement and understanding.

**The Majesty of Metaphors**

For teachers to provide a playful environment filled with stories both of their own telling and with those generated by the students, they need to develop some cultural and dramatic scaffolding. When presenting fables orally, storytellers in non-literate societies lean heavily on gestures to help convey a story’s actions and feelings (Ong, 1982). This procedure is not surprising, as many people speak with their hands, often in a more animated way when presenting material with an emotional connection (Busso & Narayanan, 2007; Casasanto & Jasmin, 2010). As described earlier, chimps communicate via a combination of vocalizations and gestures, as do many other primates and non-primate animals. These indicators suggest that storytellers may use a more basal pattern of social transmission to captivate their audience than the purely human act of telling a story through language. Or, perhaps the storytellers use gestures for a different benefit: to lighten the cognitive load (Goldin-Meadow, 2005; Goldin-Meadow & Wagner, 2005). Using a cognitive tool helps when the goal is to transmit a story faithfully from memory, particularly one of length and complexity like the Homeric epics, which are layered with lessons regarding values, tribal animus, and social comportment (Dutton, 2009; Ong, 1982).
The use of cognitive tools by the storyteller does not end there. Many assume that storytellers memorize each line of their culture’s epics, stories that might take hours if not days to recite. However, when performances were recorded of different storytellers and of the same storytellers at different times and in different places, the playback demonstrated that significant variation occurs in the words—and even in the side stories—that are used. On the recordings, the storytellers did maintain the critical plot elements, and in most cases, the meter (Ong, 1982). Analysis of the differences and similarities of the performances illuminates how the performers cobble together the same stories using different combinations of their well-worn phrases. When setting a scene or reintroducing a character within the prescribed meter, storytellers often rely on phrases that are understood or concrete to listeners because of their repeated use and reference both inside and outside the performance. Odysseus, for example, was referred to as clever 72 times in the Homeric poems (Ong, 1982). Such linguistic patterns evince the repeated deployment of habits that Dewey (1929) identified as the crux of cultural maintenance, a practice that allows for the successful and acceptable response to familiar situations.

The transportability of these phrases speaks to the metaphoricity of the human mind (Malafouris, 2013). Humans can recognize that relationships exist between objects, that objects can be combined to create tools, and that new relationships are created when tools are used. According to Malafouris (2013), these capabilities influence an individual’s perception of subsequent relationships. Gregory Bateson (2002) came to the same conclusion more than a quarter century earlier. Without brain research, he identified that the human mind seeks patterns, and perhaps more importantly, patterns of patterns, to make sense of the world. Before him, Dewey used metaphors to clarify his philosophical positions and educational arguments, likely a product of the techniques he found in the works of the classic philosophers (Dalton, 2002;
Dewey, 1958; Jaspers, 1962). The educational practices of many non-Western societies also make use of the metaphoricity of the human mind. Among those that have been traditionally non-literate (Reagan, 2005), and those who were among the first to develop written language (Wolf, 2008), the use of proverbs, riddles, and idioms serve as the primary basis for the transmission of folk knowledge between generations (Reagan, 2005).

**Focusing on Artful Objects**

In the cases described above, culturally accepted phrases are more symbolic than what the words individually represent to the speakers and listeners. They are a part of the cultural canon, effectively being utilized as focal objects. A phrase coined by Albert Borgmann (2009), the focal thing or object is an item that is associated contextually with various cultural practices. It is derived from the Latin meaning of focus, *hearth*. In ancient Roman culture, the meaning of the hearth was bound to its role as a heater, as a purpose for chopping wood, as a place of marriage, as a family burial location, and as a cooking stove. The hearth was a symbol of meaningful activity and ascended to the status of what Borgmann identified as a focal object. Across cultures spanning the timeline of humanity, countless objects certainly achieved this status. Although Dewey did not have an established phrase to cement the concept, he was aware of its power. He recognized that:

A tool or a machine, for example, is not simply a simple or complex physical object having its own physical properties and effects, but is also a mode of language. For it *says* something, to those who understand it, about operations of use and their consequences. To the members of a primitive community a loom operated by steam or electricity says nothing. It is composed in a foreign language, and so with most of the mechanical devices of modern civilization. In the present cultural setting, these objects are so
intimately bound up with interests, occupations and purposes that they have an eloquent voice. (Dewey, 2008, p. 52)

The eloquent voice Dewey mentions is evocative of Borgmann’s conclusions with regards to focal objects. It subconsciously speaks to the tools’ embodied nature and how they can shape the brain’s functioning.

The invention of written language best demonstrates the idea that material objects affect neural processing in humans. To recognize abstract shapes such as letters or drawings (Cohn, Paczynski, Jackendoff, Holcomb, & Kuperberg, 2012), the brain must appropriate a cortical region developed for object and face recognition (Dehaene, 2010). As an individual becomes increasingly literate, a correlated decrease occurs in his capacity to recognize faces (Cantlon, et al., 2011). The reduced capability suggests a competition exists for the neural space necessary to allow for visually symbolic processing. The brain must be rewired for reading.

Prior to the existence of written language, and in contemporary societies that have remained non-literate, objects probably had a similar effect on the brain, conveying meaning to those who have a discerning eye. As described by Denis Dutton (2009) in The Art Instinct, such objects convey meaning, because among people familiar with the craft and who are immersed in culture symbolism, there is a clear understanding of what passes for local craftsmanship. Misunderstandings can happen in myriad ways. An outside observer might identify an artifact as art when in reality it is nothing more than a trinket for tourists. Conversely, an object can captivate an experienced individual with a discerning eye, but a naïve observer may not give it a second glance. Dewey (1980) identified that such recognition derives from a familiarity not just with the finished product, nor from a familiarity with the tools used for crafting the focal object, but from a familiarity with the conventional practices involved with working in a particular
medium. For those who make the connection between the means and the ends, a greater understanding exists of what is before them. An increased desire to produce sacred objects is what turns work into play (Dewey, 1963) and a worker into an artist (Dewey, 1980). Evolutionary psychologists have argued that the capacity to envision and create greater meaning than the medium, the process, or the product alone is what makes artistic activity the mind’s playground (Barash, 2012; Boyd, 2009).

Dewey (1980) would have extended the playground metaphor into the observer’s mind. As he explains in *Art as Experience*, what is seen in the work is a product of the viewer’s own past experiences; and not just life experience, but cultural experience. This inclusion allows certain objects, be they tools or totems, works of literature or pieces of music, to serve as the centerpieces of an individual and a society’s ethos. Dewey possessed an innate understanding of this process, having written that, for many people:

Making and using tools may be intrinsically delightful. Prior to the introduction of machinery for quantitative production and sale of commodities for profit, utensils were themselves usually works of art, esthetically satisfying. This fact does not however define them as utensils; it does not confer upon them their characteristic property. In like manner, the pursuit of knowledge is often an immediately delightful event; its attendant production possesses esthetic qualities of proportion, order, and symmetry. (Dewey, 1958, p. 151)

Objects bring organization to a culture and produce an operational and universal understanding of the world for a group of frequently interacting individuals. These iconic constructions may be written or verbal, seen or held. And the knowledge generated and transmitted through them represents the culture’s collective wisdom or common sense.
The Development of Common Sense

Dewey frequently referred to common sense, having concluded that it was a product of the paired capacities to think symbolically and to transmit socially. He recognized that common sense was a powerful tool for individuals, be they human or not. It provided easily accessible habits of thought that produced rapid responses to familiar situations (Dewey, 1929), and it created templates for behaving in novel situations with some identifiable characteristics (Dewey, 2008). Today, these habits have new names: rules of thumb to the layperson and heuristics to psychologists. Working off of an if-then logic (D. S. Wilson, 2008), heuristics provide an oxymoronic pattern of rigid behavioral plasticity resulting in predictable responses to common, but variable, situations. Non-human animals rely to varying degrees on such mechanistic thinking (Holekamp, et al., 2007), as do humans. For humans, the cost of such rigidity—a less than ideal result—is often counter-balanced by the benefit of a predictable, and therefore, survivable outcome (Todd, 2000). That the scale is more often tipped in favor of predictability may explain why, historically (as described in Chapter Two), most cultures utilize familiar practices in new and challenging situations (Diamond, 2005).

The opposite of such inflexibility is the true behavioral plasticity that is a hallmark of the human animal. The behavioral plasticity of humans extends farther into adulthood than in any other animal. Therefore, the cost of being behaviorally flexible, i.e. the tendency to break under pressure, must have been evolutionarily outweighed by the benefit, i.e. the ability to develop new patterns of activity in response to novel situations, in order for it to have been maintained (S. L. Brown & Vaughan, 2009). Dewey knew this long before specific terms existed to articulate his perspective. He often lamented the behavioral ruts that people—both as individuals and as societies—carved out and traveled upon (Dewey, 1929), preventing the progress he thought was

Subsequent investigations by Bruner (1990)—a linguistic constructivist after Dewey’s own heart—have demonstrated the power of common sense. Bruner found that people grounded in the parables and proverbs of their culture more easily can change the stories around which their life has been built than reflect on the potential fallacy of a lifetime of beliefs. There appears to be a neurological basis for this practice. The brain’s interpreter invents an explanation, i.e. a story, for the circumstances surrounding an experience, even when presented with contravening evidence (Gazzaniga, 2008). As mentioned earlier, the philosopher Daniel Dennett (2013) suggests this is a product of not only the human need to identify causation, but also a natural presumption of intentionality lying behind activity. Dewey recognized this tendency as well, writing “Since the mind naturally demands some principle of continuity, some connecting link between separate facts and causes, forces are arbitrarily invented for that purpose. Fantastic and mythological explanations are resorted to in order to supply missing links” (Dewey, 1997a, p. 148). For Dewey (2008), this demonstrated the importance of inquiry and scientific thought and the need to seek the true means by which events occur. Only then can one accurately internalize an event’s true meaning.

The Significance of Science

In his final, and what some biographers have considered his most ambitious work (Dalton, 2002), *Logic: A Theory of Inquiry*, Dewey (2008) attempted to demonstrate that inquiry was a natural process and not the artificial construction of a sub-class of pedants. The author
chosen to introduce the most recent edition of the work suggests Dewey at least partially failed in his endeavor (Nagel, 2008). However, in light of recent research in the emerging field of cognitive ethology, what Dewey considered the foundation of inquiry—testing with the analysis of results—is present both in non-human primates and in other animal groups. In the field, it has been given a new name: trial and error learning. The problem with this technique, as described above, is the human proclivity to see causation where only correlation or coincidence exists. This leads to misinterpretation. When used in conjunction with our abilities to learn through observation—which Dewey (2008) considered a part of inquiry—and infer intent, trial and error learning may produce the over-imitation described earlier (Lyons, et al., 2011). This practice will be repeated countless times in various circumstances with different social combinations and will span generations. In due course, over-imitation probably produces the cultural canons described above that become a person’s and a people’s common sense. Seemingly, this process occurs in spite of its being rooted in the practices that allow for engaging in inquiry, a pre-requisite for scientific thought.

Perhaps this deviation from what seems to be the logical course from inquiry to scientific thought is why Dewey (2008) considered that:

The problems of science demand a set of data and a system of meanings and symbols so differentiated that science cannot rightly be called “organized common sense.” But it is a potential organ for organizing common sense in its dealing with its own subject-matter and problems and this potentiality is far from actualization. In the techniques which affect human use of the materials of physical nature in production, science has become a powerful agency of organization. As far as issues of enjoyment, of consumption, are concerned, it has taken little effect. Morals and the problems of social control are hardly
touched … Science takes its departure from common sense, but the return road into common sense is devious and blocked by existing social conditions. (pp. 82-83)

Dewey thought scientific inquiry was the testing ground for what unscientific inquiry produced, which were the culturally established habits accepted by the community as meaningful. His apparent frustration explains why Dewey emphasized the need for science education and wrote extensively about it at every point in his career. For all of his emphasis on science, however, he never elevated it above any other subject. He went to great lengths to ensure this was not the case. This decision is the product of a simple conclusion; for Dewey, science was not a subject but a thought process.

By reframing science in this fashion, Dewey (1958) was able to conclude “… what makes any proposition scientific is its power to yield understanding, insight, intellectual at-homeness, in connection with any existential state of affairs, by filling events with coherent and tested meanings” (p. 163). For such a proposition to become manifest, the process by which it is achieved must involve observation and testing. Observation activates inductive reasoning often linked with the synthesizing of hypotheses, and testing is associated with the deduction associated with overt experimental analysis. In typical Dewey fashion, however, rather than viewing the two forms of reasoning as distinct and different, he held them up as another false dichotomy. He wrote, “Observations formed by variation of conditions on the basis of some idea or theory constitute experiment” (Dewey, 1997a, p. 152). For him, this meant “Experimental thinking, or scientific reasoning, is thus a conjoint process of analysis and synthesis, or, in less technical language, of discrimination and assimilation or identification” (Dewey, 1997a, p. 152). When reading Dewey, it becomes obvious that for him, scientific thought ameliorates two instinctual dichotomies: the desire to observe and test and the desire to break apart and build. It
also serves to ameliorate the dichotomy with which this chapter began, that of concrete versus abstract knowledge.

As described above, for Dewey the difference between knowledge that is concrete and knowledge that is abstract derives from its ability for knowledgeable individuals to use it in novel situations. This hurdle explains why Dewey (1997a) considered that:

No conception, even if it is carefully and firmly established in the abstract, can at first safely be more than a candidate for the office of interpreter. Only greater success than that of its rivals in clarifying dark spots, untying hard knots, reconciling discrepancies, can elect it or prove it a valid idea for the given situation. (p. 107)

Dewey’s recognizing this challenge provides further context to his staunch advocacy for experiential learning. This practice allowed students to wrestle with abstract ideas in the course of surmising means to surmount life’s problems (Dewey, 1956a, 1956b, 1963, 1966). Dewey knew that each subject was built around its own theories and explications. Therefore, he envisioned an education that would allow students to view their troubles through varied lenses, with the teacher providing the support necessary for students to complete their inquiries in a scientific fashion.

The result of this pedagogical process is a solution to a student’s immediate problem and produces a cognitive tool that the student can deploy in the future. Egan (1997) wrote that students who attain this cognition level develop a philosophical understanding and, therefore, are able to generalize with regard to what they learn. These abstractions become refined when they are used in specific situations. This refinement helps generate better and better schemes from which conclusions can be drawn following the acquisition of new experiences. Although Dewey
failed to present his case as succinctly as Egan, he drew similar conclusions 70 years earlier, writing that in abstract fields like mathematics:

… essence becomes wholly “intellectual” or scientific, devoid of consummatory implication; it expresses the purely instrumental without reference to the objects to which the events in question are instrumental. It then becomes a starting point of reflection that may terminate in ends or consequences in human suffering and enjoyment not previously experienced. Abstraction from any particular consequence (which is the same thing as taking instrumentality generally), opens the way to new uses and consequences. (Dewey, 1958, p. 192)

The ability to use a newly developed understanding, no matter how classically abstract that understanding may seem, makes it a tool. A cognitive tool is an object that, though used mentally, can be manipulated and used by the mind just as a familiar external object can be manipulated and used by the hands.

In light of the destruction of the barrier that existed between body and mind by both Dewey (1960, 1963) and by the contemporary literature so ably synthesized by Malafouris (2013), it would seem that science represents the most prized tool in an individual’s cognitive tool box. However, though any tool may have meanings in and of itself, these meanings are a product of science’s use as a means for engaging in meaningful activity (Dewey, 1960, 1963). Therefore, for Dewey (1960), scientific thought:

… carried on inside the head, can make some headway in forming the plan of a building.

But it takes actual operations to which the plan, as the fruit of thought, gives instrumental guidance to make a building out of separate bricks, or to transform an isolated sensory quality into a significant clew to knowledge of nature. (p. 113)
Dewey’s idea that an engineer’s plan and the process of construction work in concert to direct mind and body was recently investigated using potters and clay. Within those studies, potters achieve both a greater sense of body ownership and control. The ownership is a product of the afferent—outwardly imposed and internally processed—sensory feedback provided by the clay and its movement on the wheel. However, potters feel more control, more agency, when activities are efferent, that is internally planned and outwardly directed (Tsakiris & Haggard, 2005a, 2005b). Therefore, Malafouris (2013) suggests that there is “… a two-way interaction between the two, such that … agency will change the experience of ownership and, at the same time, this altered sense of ownership can change the very experience of agency” (p. 224).

This interface between afferent and efferent perception that results in manipulating cognitive and physical tools serves as the denouement to Dewey’s (1960) conclusion that:

… action is at the heart of ideas. The experimental practice of knowing, when taken to supply the patter of philosophical doctrine of mind and its organs, eliminates the age-old separation of theory and practice. It discloses that knowing is itself a kind of action, the only one which progressively and securely clothes natural existence with realized meanings. For the outcome of experienced objects which are begot by operations which define thinking, take into themselves, as part of their own funded and incorporated meaning, the relation to other things disclosed by thinking. There are no sensory or perceived objects fixed in themselves. In the course of experience, as far as that is an outcome influenced by thinking, objects perceived, used and enjoyed take up into their own meaning the results of thought; they come ever richer and fuller of meanings. (pp. 167-168)
Dewey’s idea that thought can influence an experience or a memory has a scientific basis. In various settings it has been demonstrated that the brain treats false memories no differently than those that are true and that the way something is remembered can change over time (Brainerd & Reyna, 2005; Gottschall, 2012). Dewey (1980, 1997a) perceived this and reminded his readers that a person makes sense of his experiences in light of previous experiences. He proposed that, as people acquire more experiences, the way in which those experiences are contextualized and categorized would change. People will develop new metaphors for explaining relationships (Malafouris, 2013) and begin to identify the patterns of the patterns they see (Bateson, 2002). In the process, a person’s story changes and the new story gives them a new theory about how some aspect of life works.

As described above, such individual theories are considered a person’s common sense. They lay the groundwork for science and provide an idea that can be tested. Testing an idea with the goal of either supporting or invalidating it is abstract because it is without a true purpose. For Dewey, science that was applied to the problems that individuals and societies face was to be held in the highest esteem, for that was science done with a purpose. He noted that:

“Application” is a hard word for many to accept. It suggests some extraneous tool ready-made and complete, which is then put to uses that are external to its nature. To call the arts applications of science is then to introduce something foreign to the sciences which the latter irrelevantly and accidentally serve. Since the application is in human use, convenience, enjoyment and improvement, this view of application as something external and arbitrary reflects and strengthens the theories which detach man from nature, which, in the language of philosophy, oppose subject and object. But if we free ourselves from preconceptions, application of “science” means application in, not application to.
Application *in* something signifies a more extensive interaction of natural events with one another, an elimination of distance and obstacles; provision of opportunities for interactions that reveal potentialities previously hidden and that bring existence new histories with new initiations and endings. (Dewey, 1958, p. 162)

For Dewey, art was a consummation of sorts for science because it brought science greater meaning. Art provides new experiences, both through the act of creation and through the reflection on past experiences its production precipitates. That this will generate new theories, followed by the requisite tests and subsequent experiences, returns us to a modified version of the tautology developed by Dewey (1980) with which this chapter began. While art still moves its participants from understanding to wonder, it is science instead of philosophy moving its participants from wonder to understanding.

The science-minded philosopher Gregory Bateson (2002) investigated the trouble with such tautologies. He identified that they result in vicious circles that are destined to put a machine operating under such logical principles into a runaway state unless one considers time. Bateson wrote about the difficulties with fitting governors onto 19th century steam engines. He explained how physicist Clark Maxwell identified that all of the engineers’ equations correctly defined the feedback loop whereby the connections led from the governor to the fuel intake to the cylinder to the flywheel and back to the governor. However, they failed to recognize that the entire system had an embodied relationship with time. Therefore, to use the governor to make the steam engine a self-correcting system, the effect of time generated emergent properties in the system, affecting the dynamic relationship between the interacting parts.

The inclusion of time can do more than simply make mechanical systems fully functional. Time can turn lines of circular reasoning into a wheel conveying its idea passengers
toward a new conclusion or into a gear ratcheting thoughts to ever-higher levels of understanding. In these metaphors, time easily can be linked to the experiences one acquires with age. However, as explained above, in the human mind time inextricably is bound to space. Therefore, any tautology must take into account not only time, but the space in which it is spent. Dewey’s (1980) conclusion that art can turn into science and science can turn into art must, therefore, not only account for when things transpire, but also where they transpire. One could be flippant and say that an experience occurs wherever an experience occurs, and that within a particular environment and particular conditions under which an event and an activity transpired, a space can be objectively defined. As I have attempted to make clear throughout this chapter, however, there exists a cognitive environment in which experiencing take place: the mind. Therefore, a space must exist in which wonder turns into understanding and understanding turns into wonder. There must be somewhere for science to beget art and art to beget science.

And there is: the imagination.

Malafouris (2013) emphasized the imagination and its importance for Material Engagement Theory when he described the creation of a tool, a piece of art, or system of cataloging tradable goods. Egan (1992, 1997) explained that the imagination should serve as the basis for education in the middle years. Gottschall (2012) and Bruner (1990) gave their explanations of how we use our imaginations to produce stories to help make sense of our place in the world. Dennett (2013) and Bateson (2002) wrote of the imagination as a place to evaluate hypotheses. And for Dewey, the imagination was the foundation for his ideas about psychology and education; he even used his own imagination as a testing ground for his philosophical theories. Therefore, imagination is the product of mind linked to a body through evolutionary processes. It has helped produce language, causal awareness, the invention of tools, the
perception of intentionality, and symbolic representation. Taken together, all of these capacities allow for the creation of abstract thoughts that can be used for concrete purposes. Dewey would have been thrilled to know that the imagination was at the root of what makes the human experience unique. This realization would have allowed him to justify the kind of education he thought all citizens deserve, the manifestation of which will be described in the next and final chapter.
Chapter 7:

Re-Imagining Dewey’s Educational Revolution

Considering that John Dewey’s career spanned fifty years and included investigations into fields as varied as developmental neuroscience and fine art, it is clear that it was great both in terms of time and of space. Throughout his writing, Dewey maintained that experience was the fuel for everyone from artists to philosophers, from students to psychologists. The previous chapter demonstrated that Dewey thought people primarily generate these experiences as their internal pendulum swings from wonder to understanding via philosophy and science, and swings from understanding back to wonder via art. He linked this to a mind that extends through a body and into the tools and materials engaged by its owner. What Dewey failed to identify, however, was a setting for this movement to take place. As indicated in the last chapter, imagination is that setting.

Imagination: A Venue for Learning

Between the concrete sensorial processing of the physical world and the abstract symbolic representation of one’s thoughts, the imagination was envisioned by Dewey (1980) as, “… a way of seeing and feeling things as they compose an integral whole. It is the large and generous blending of interests at the point where the mind comes in contact with the world” (p. 267). For him, the imagination provides a venue for processing what has happened and what one wants to happen. Therefore, in Dewey’s (1980) estimation, “Imaginative experience exemplifies more fully than any other kind of experience what experience itself is in its very movement and structure” (p. 281). The imagination is a place where experiences both are processed and generated. Imagination is the only place in which one can simultaneously derive knowledge from the act of experiencing (its movement) and the acquired experience (its structure). The power of
this capacity may help explain why early in his career Dewey (1956b) concluded that children live in their imagination because it is from there that they can derive the most meaning. This aligns with Bruner’s (1990) description of the invented explanations that pre-school age children readily generate for discrepant events. The theory also parallels Egan’s (1992) notion that imagination must be harnessed to have educational success with 8- to 15-year olds.

Adults engage in similar practices. As Jonathan Gottschall (2012) concluded in *The Storytelling Animal*, we all conceive of ourselves as the hero of our internal and personal narratives. For most individuals, this means a perception or outright reconstitution of experiences that are at odds with objective reality. For some, this means finding the imaginary world of virtual reality more real than the physical world in which they exist (Gottschall, 2012). Dewey (1958) observed this tendency before digital second lives were possible, stating that:

The conversion of the logic of reflection into an ontology of rational being is thus due to arbitrary conversion of an eventual natural function of unification into a causal antecedent reality; this in turn is due to the tendency of the imagination working under the influence of emotion to carry unification from the actual, objective and experimental enterprise, limited to particular situations where it is needed, into an unrestricted, wholesale movement which ends in an all-absorbing dream, (p. 68)

Dewey recognized the natural instinct both to perceive and invent causality. Evolutionary philosopher Daniel Dennett (2013) wrote a similar description of this very human tendency, describing both its power and its problems. The imagination’s capacity not only to identify causal relationships, but also to form worlds, creates what Dewey (1966) considered the imaginary realm.
It may seem counter-productive to generate artificial worlds. However, the ease with which students fall into the development of imaginary realms is not to be stifled because the student is simply at play. This state allows the student to test the newly acquired knowledge in a low-stress environment. It prevents the student from falling into the behavioral ruts Dewey so rued by helping envision novel responses in novel situations. Egan would likely explain that this is what allows children to cement their developing understanding of abstraction through self-created myths. It also allows teenagers to test their developed abstractions using their imagination as what Dennett (2013) calls an “intuition pump.” Dewey (1958) would concur, having written that, “Imagination as mere reverie is one thing, a natural and additive event, complete in itself, a terminal object rich and consoling, or trivial and silly, as may be” (p. 220). Were that the limit imagination in the classroom, however, the teacher would have set the stage for its devolving into what Dewey (1966) considered fooling around. Instead, he hoped to observe an, “Imagination which terminates in a modification of objective order, in the institution of a new object [that] is other than merely added occurrence” (Dewey, 1958, p. 220). Dewey (1958) thought that, because this use initially begins as speculative on the student’s part, “It involves a dissolution of old objects and a forming of new ones in a medium which, since it is beyond the old object and not yet in a new one, can properly be termed subjective” (p. 220). What some might consider the limit of this deployment of the imagination, its subjectivity, is what Dewey would have championed because it was, by its nature, contextual. It was the envisioning of a change in—or better yet, progress for—society.

This capacity for optimistic prognostication was a consistent refrain for Dewey throughout his works on psychology (How We Think, Human Nature and Conduct, and Logic). He identified that the imagination allowed for “dramatic rehearsals” of how events transpire in
response to particular courses of individual action (Dewey, 1929, p. 190). Because the rehearsals happen in the mind, there are no repercussions. Instead, individual actors are provided with feedback that allows for their behavioral selection. Subsequently, individuals are confident in their decisions and optimistic about the outcomes. This human tendency to look on the bright side is connected to the capacity to learn from mistakes (Bengtsson, Lau, & Passingham, 2009). Evolutionary psychologists have also linked the natural bias for optimism (Sharot, 2011) to the ability to shape the environment in a fashion that embodies a person’s optimized vision of the future (Geary, 2005). Dewey (1997a), who never had access to this research, concluded that, “The healthy imagination deals not with the unreal, but with the mental realization of what is suggested” (p. 166). He recognized people required their imagination to produce an inner vision and see it come to fruition (Dewey, 1980). As an educator, he concluded that this clairvoyance only happened if the students drew on their own experiences as a source for the prediction of potential solutions (Dewey, 1997a). Using their imaginations, students developed optimistic outlooks when envisioning potential outcomes.

Educational Experiences

Unfortunately, the necessity for grounding education in experience is the tenet of Dewey’s educational philosophy that educational theorists most often misconstrue. It occurred most recently, and perhaps most notably, by Kieran Egan. Though he wrote a previously noted book with the ominous title, Getting It Wrong from the Beginning: Our Progressive Inheritance from Herbert Spencer, John Dewey, and Jean Piaget, Egan’s frustration with Dewey started much earlier. It began in print with Teaching as Story Telling, a 1986 work that started his aforementioned quest to create an educational philosophy centered on the development of cognitive tools. In that book, Egan expressed his frustration with pedagogical methods that
operate on the assumption that students learn by proceeding from that which is familiar and concrete before moving toward greater and greater abstraction. Although he hinted at the origin of this prevailing practice in this book, in the more comprehensive volume, *The Educated Mind*, Egan (1997) officially pinned this methodology squarely on John Dewey. This conclusion led to his eventual and proverbial throwing of Dewey under the school bus in his declaration that it was because of Dewey that American education had gotten “it wrong from the beginning” (Egan, 2002).

Egan was not alone in this presumption, and Dewey recognized that even his contemporaries misinterpreted his educational philosophy. Consequently, *Experience and Education* was written as a remonstration of the misunderstanding and misapplication of the principles and practices he presented in his previous works on educational philosophy and pedagogical practice. Dewey apparently felt that he needed to clarify how direction was to be provided to students in a classroom that cared about who they were as individuals. The direction he sought stood in opposition to the institutionalized form of cultural inculcation and social control that education had been in the century before his work, but clarification was needed to prevent classrooms from simply being venues for student misbehavior. Unfortunately, this aim prevented Dewey from addressing Egan’s aforementioned issue with Dewey’s presumed philosophy. Dewey did, however, address Egan’s concern.

As determined through a more comprehensive reading of Dewey’s major works in fields other than education, Dewey’s take on experience was much more nuanced than Egan thought. Dewey (1929) recognized that habits were the products of impulses being expressed through socially and culturally mediated activity, and in such rigid behaviors, there existed both power and limitation. The limitations were evident to him. In his continual championing of the need for
progress and change, Dewey explained how an over-reliance on previously established behaviors produced ruts that made it difficult to respond to the dynamic nature of environments, thereby reifying the barriers erected in a stratified society. He covertly grounded his critique in evolution’s principles. He recognized that in an ever-changing world, a lineage’s continued success—be it natural or cultural—is achieved only through modifying the existing material. Dewey (2008) writes in *Logic*:

Present actual means are the result of past conditions and past activities. They operate successfully, or “rightly,” in (1) the degree in which existing environing conditions are very similar to those which contributed in the past to formation of habits, and (2) in the degree in which habits retain enough flexibility to readapt themselves easily to new conditions. The latter condition is not readily fulfilled by lower organisms; when it is fulfilled a case of “evolution” occurs. The potential conditions for its fulfillment are present in the activities of human beings in much larger measure. But the inertial phase of habit is strong, and, so far as it is yielded to, human beings continue to live on a relatively animal plane. (p. 46)

From an evolutionary standpoint, one of the principal reasons for the success of humans is behavioral plasticity, to which Dewey refers. This plasticity allows the species to respond to environmental change in ways their ecological competitors could not. This capacity is the product of a brain that has remained in a largely juvenile state, allowing for a mind capable of significant feats of learning throughout adulthood (Gazzaniga, 2008). For contemporary neuroscientists (Dalton, 2002; Edelman & Tononi, 2000; Hall, 2010) and for Dewey, plasticity means that both the brain and the mind are altered through experiences. This conclusion would lead Dewey back to experience and its role in education. Dewey concluded that, if experience
produces learning, and education’s goal is to produce learning, education must consist of experiences.

The acquisition of experience, however, is not the only way in which learning transpires. In Dewey’s estimation, the very act of experiencing was affected by one’s own past experiences. Be it viewing art (Dewey, 1980), a social interaction (Dewey, 1929), or a scientific experiment (Dewey, 2008), one’s perception of actions as they happen cannot be objective. Experience is colored by and processed through a filter of past experiences and must be subjective (Dewey, 1997a). Bateson (2000, 2002) and Malafouris (2013) wrote that this subjective processing is done via the previously established relational patterns between objects that exist in the observer’s mind. The perception is made analogically, often through metaphor. Dewey may not have been overtly aware of this. However, Dewey knew it instinctually, as do all manner of educational practitioners in non-literate societies who use the proverbs described in the last chapter. His works are filled with the metaphors, by which he made sense of the transpirations of life.

As described earlier, habits have limitations. Therefore, since metaphors serve as the habits of thought, they can limit an individual’s capacity to perceive reality (Bateson, 2000). However, through their use, they also become the tools with which a person works his or her way through the world. Therefore, though Dewey considered concrete experience to be education’s foundation, this did not mean teachers had to lead by proceeding directly from that which was concrete in their physical environment. Rather, teachers had to proceed from that which was concrete in their students’ mental environment. For Dewey (1980), this realization meant that a person’s inner vision, “… remains as the organ by which outer vision is controlled, and it takes on structure as the latter is absorbed within it” (p. 268). He saw that this absorption occurs as plans are put into action. Malafouris (2013) and MET would concur. This interface
occurs when cognitive tools are used to identify and craft physical tools. This process creates a feedback pattern between intention, activity, and outcome. When knapping stone, one of the oldest forms of human tool use and development, the knowledge about a tool comes from both its use and its creation. Individuals learn as they think and as they act (Malafouris, 2013). As Dewey’s above quotation implies, cognitive tools enliven physical tools, which in turn provide individuals with new cognitive tools.

For a teacher wanting to manifest a Deweyan philosophy, this has tremendous implications with regard to instructional practice. If, as Dewey stipulates, “… intellectual tools are indefinitely more flexible in their range of adaptation than other mechanical tools” (Dewey, 1966, p. 226), and the goal is to use experience to promote personal growth, then the focus of education should change. As described in Chapter Five, when teachers are designing a lesson, they cannot solely focus on the state-sponsored curriculum. They must also account for the tools their students possess and for how the experiences produced in the classroom will be shaped by their students’ past experiences, present circumstances, and future aims. For Dewey (1966), that meant:

The educational value of manual activities and of laboratory exercises, as well as of play, depends upon the extent in which they aid in bringing about a sensing of the meaning of what is going on. In effect, if not in name, they are dramatizations. Their utilitarian value in forming habits of skill to be used for tangible results is important, but not when isolated from the appreciative side. Were it not for the accompanying play of imagination, there would be no road from a direct activity to representative knowledge; for it is by imagination that symbols are translated over into a direct meaning and integrated with a narrower activity so as to expand and enrich it. (p. 237)
Dewey’s conclusion that a student’s imagination will take inspiration from his or her educational environment means the way in which a lesson is framed is of paramount importance for the teacher. Dewey (2008) thought that “… a problem must be felt before it can be stated” (p. 76), and those feelings probably derive not only from the objective circumstances, but also from the student’s prior experiences. Therefore, for the student and the teacher:

The way in which the problem is conceived decides what specific suggestions are entertained and which are dismissed; what data are selected and which rejected; it is the criterion for relevancy and irrelevancy of hypotheses and conceptual structures. On the other hand, to set up a problem that does not grow out of an actual situation is to start on a course of dead work, nonetheless dead because the work is “busy work.” (Dewey, 2008, p. 112)

Dewey’s concern for busy work derives from his frustration with coursework that is assigned without an immediately perceived instrumental purpose. Students view this work as nothing less than drudgery (Dewey, 1966). Therefore, in consideration of all of the aspects that impact the decision about the class’ direction, teachers must be attuned to the past, present, and future of their students.

Creating an Environment for Learning

Teachers seeking to develop direction for their students must be aware of the availability of the requisite tools before setting the classes’ course. They need knowledge both of the cognitive tools the students possess and of the physical tools that have been used to navigate situations similar to what they have presented. They must also know the cognitive tools that might be added to the students’ repertoires to broaden their futures’ horizons. Because of students’ differing backgrounds, this may seem difficult. However, the teacher should feel
emboldened, because when inspiring students to think about the material, they should not be concerned about a homogenous understanding. This freedom should be felt because, for Dewey (1997a):

All thinking whatsoever—so be it is thinking—contains a phase of originality. This originality does not imply that the student’s conclusion varies from the conclusion of others, much less that it is a radically novel conclusion. His originality is not incompatible with large use of materials and suggestions contributed by others. Originality means personal interest in the question, personal initiative in turning over the suggestions furnished by others, and sincerity in following them out to a tested conclusion. (Dewey, 1997a, p. 198)

In this passage from How We Think, Dewey emphasizes both the individuality of original thoughts and the need for others’ contributions in their development. This fusion is indicative of his career-long quest to overcome false dichotomies. It also aligns more specifically with his educational theory, which was in large measure grounded both in the need for individual experience to promote learning and in the social nature of educational practice.

Given his stated quest for individuals being allowed and encouraged to engage in original thought, Dewey probably would have found himself invigorated by the movements inside and outside the educational establishment to foster students’ individuality as learners. Howard Gardner’s theory of multiple intelligences is taught to pre-service teachers (Dixon, White, & Smerdon, 2003, January; You & Jia, 2008), and school districts are adopting brain-based learning programs (Goswami, 2006). Not coincidentally, there has been a national movement toward differentiation in instruction (Tomlinson, 1999, 2000). Those who can change education apparently have realized that students must be treated as individuals for learning to occur.
However, as described in Chapter Two, the very act of institutionalizing a program—dating back to Herbart’s methodology (Webb, 2006)—provides the kind of rigid structures that force children to use their natural neural plasticity as a means of conforming to the culture of the classroom. Such practices force students to embody the docile plasticity that Dewey (1929) saw as the barrier to social change. Therefore, one must look outside of the establishment to find ideas that evoke Dewey’s educational ideal. Sir Ken Robinson (2009) has concluded that every person has his or her own given element. Others have determined that people who play to their personal strengths become leaders (Rath & Conchie, 2008). Csikszentmihalyi’s (1993) flow theory identifies how certain kinds of activities promote the engagement and creativity that produce original thoughts. I think Dewey would be satisfied with the adoption of any of these ideas because they all are grounded in the individual nature of personal growth. Dewey would think growth is possible through each framework because they all emphasize the power of experience to shape learners’ perceptions. This power exists because individuals possess an embodied mind crafted by the interactions they and they alone have had with the various objects in their unique environment.

That unique environment is a frequent subject in Dewey’s writing, which one might expect of an evolutionary thinker. It is manifested both physically through objects and materials and socially through direct and indirect interactions. While teachers affect the class’ direction by manipulating the environment, as mentioned in the passage above, they also affect the achievement of the desired ends through the suggestions contributed by others. These suggestions come from the method the teacher selects to transmit the information. As described in Chapter Four, an effective teacher considers the type of knowledge to be transmitted, the context in which it is being learned, and the end to which it will be used before selecting the
method by which the knowledge, be it declarative or procedural, will be presented to the students.

In natural settings with culture present but without the institution of formal education, there is a relationship between transmission method and knowledge type. In animals and humans, the need to transmit and acquire procedural knowledge is most often facilitated through observation and mimicry when the skill is individualized, whereas when it involves working as a part of a group, it involves incrementally increased participation. Conversely, declarative knowledge requires coaching with fixed teaching patterns that allow the knowledgeable individual to provide overt or covert feedback to the learners. These observations suggest that a teacher possesses an innate capacity to generate pedagogical content knowledge. Unfortunately, this capacity is often stifled in one of two ways. It can occur either through the over-emphasis on content because of the rigidly standardized subject tests taken by students (Ravitch, 2011), or through the over-emphasis on pedagogy during teacher preparation and professional development programs (Begeny & Martens, 2006). Dewey sought a balance between the two because he saw both as vehicles for the achievement of a greater end: individualized student growth with regard to transferable experiences. Dewey thought method and subject were bound inextricably to each other and wrote, “Instrumental devices were developed in order that the observations might be made; definite techniques for using the instruments followed” (Dewey, 2008, p. 77). In a Deweyan education, therefore, the devices or tools—be they physical or cognitive—would be identified as useful through the direction set by the teacher-provided problem. The techniques for using the tools that could help solve the problem would be transmitted in the fashion most effective based on the tool’s type, the student’s aim, and the cultural context.
Art and Science: The Vehicle for Learning

I have established that the setting for a Deweyan education is a student’s imagination. I have also established that the fuel is the problem framed by the teacher and perceived by the student, and that the aim is the growth that comes from the acquisition of experiences that become tools of understanding. In light of Dewey’s emergence during the time of the automobile, it seems appropriate that all that remains for me to describe is the vehicle with which to convey the passengers—the students and future creators of culture—toward progress. Considering he already created the self-propelling wheel that turns from wonder to understanding and back, we must therefore think of our educational vehicle as both art and science.

That Dewey would conclude that the height of understanding resided in two subjects on seemingly opposite poles of a continuum of knowledge should by now not be surprising. Nor should it be surprising that he saw fit to ameliorate this dichotomy. He began by attempting to knock pedants off their respective pedestals in both fields. He took pains in Art as Experience to skewer those at one end of the continuum who thought that the only objects that qualify as art are those that are considered fine and are appreciated by those of high society. On the other end of the continuum, he attempted in Experience and Nature to shred all classical and phenomenological philosophers who attempted to place themselves on a different intellectual plane than those given to other thought patterns. In a sort of capstone (or headstone) to both, Dewey (2008) drew the conclusion in Logic that the diminishment of status of the artisan and his actions:

… prevented the utilization of the immense potentialities for attainment of knowledge that were resident in the activities of the arts—resident in them because they involve
operations of active modification of existing conditions which contain the procedures
constituting the experimental method when once they are employed for the sake of
obtaining knowledge, instead of being subordinated to a scheme of uses and enjoyments
controlled by given socio-cultural conditions. (pp. 64-65)

In drawing attention to the artisan as the downtrodden one upon which both art and
eperimentation are built, Dewey allows us another glimpse into his insight that art and
philosophy are linked in a circle, with the former turning understanding into wonder and the
latter turning wonder into understanding.

He began to open his readers’ eyes by intimating that when he speaks of art, he is not
speaking simply of that which is traditionally thought of as art such as drawing, painting, music
and poetry. He thought that anything that produces a unique, original, consummation is art. It is
art because it is an object imbued with meaning beyond what is outwardly observable. For
Dewey (1980), an object becomes art when, in:

… the first manifestations of a child of an impulse to draw up to the creation of a
Rembrandt, the self is created in the creation of objects, a creation that demands active
adaptation to external materials, including a modification of the self so as to utilize and
thereby overcome external necessities by incorporating them in an individual vision and
expression. (p. 282)

This modification of the self speaks to the use of the tools so often associated with arts. But it
speaks even more broadly than that: it speaks to that which is invented. Artists are not the only
ones who change our culture; writers and engineers, architects and repairmen also change it.
They turn devices into focal things (Borgmann, 2009), whether their medium is in the fine or the
stochastic arts (Crawford, 2009).
In Dewey’s (1958) estimation, there does exist:

… a difference in kind between the thought which manipulates received objects and essences to derive new ones from their relations and implications, and the thought which generates a new method of observing and classifying them. It is like the difference between readjusting the parts of a wagon to make it more efficient, and the invention of the steam locomotive. One is formal and additive; the other is qualitative and transformative. (p. 222)

This difference between these modes of thought, however, does not preclude a person from calling one art and the other not. The two address different problems and, therefore, require different thought processes. For Dewey, art was something that was discovered spontaneously through the reflection of either the observer or the artist. This reflection took place through his or her previous life experiences interacting with the object represented in the medium the artist used. For Dewey, this meant art came in many forms not considered art by most philosophers. Among the more unique additions to his expanded pantheon, he thought that because “Science uses the medium that is adapted to the purpose of control and prediction, of increase of power … it is an art” (Dewey, 1980, p. 320).

Dewey’s consideration of science as art serves to ameliorate the aforementioned dualism that existed between art and philosophy. He considered that, “Both logically and educationally, science is the perfecting of knowing, its last stage” (Dewey, 1966, p. 219). This notion aligns with his expectation that philosophers follow the experimental tenets of science before drawing teleological conclusions (Dewey, 1958). By placing such a high value on science, it seems Dewey was at odds with his own frustration with the elevation of some knowledge above others. He went to great lengths, however, in both Democracy and Education and How We Think to
describe the perils of this perspective for a person charged with teaching students science. He recognized that teachers in this position likely would feel that they have two goals. The first goal would be to help students understand what the great scientists discovered. The second would be to organize their lessons in the most logical fashion so that understanding can be achieved with maximum efficiency. Unfortunately (or perhaps fortunately), this is not how science works. Making discoveries is a messy process (Dawkins, 2013) and, like art, often is dictated by the subject and the medium. To convey that science is otherwise is a disservice that Dewey himself recognized.

Instead, Dewey (1966) saw that an understanding of science was most likely to be achieved by a student through:

… following, in connection with problems selected from the material of ordinary acquaintance, the methods by which scientific men have reached their perfected knowledge, [helping him] gain … [an] independent power to deal with material within his range, and avoid … the mental confusion and intellectual distaste attendant upon studying matter whose meaning is only symbolic. Since the mass of pupils are never going to become scientific specialists, it is much more important that they should get some insight into what scientific method means than that they should copy at long range and second hand the results which scientific men have reached. Students will not go so far, perhaps, in the “ground covered,” but they will be sure and intelligent as far as they do go. And it is safe to say that the few who go on to be scientific experts will have a better preparation than if they had been swamped with a large mass of purely technical and symbolically stated information. In fact, those who do become successful men of
science are those who by their own power manage to avoid the pitfalls of traditional
scholastic introduction to it. (p. 221)

Should students be allowed this entry into science, coming to view it not as an end but as a
means, they will grasp what Dewey thought was most important about science. They will have
been set on a path that allows them to use their acquired experiences more profoundly. This step
in their growth changes the nature of their experiences because, according to Dewey (1966):

Science is experience becoming rational. The effect of science is thus to change men’s
idea of the nature and inherent possibilities of experience. By the same token, it changes
the idea and the operation of reason. Instead of being something beyond experience,
remote, aloof, concerned with a sublime region that has nothing to do with the
experienced facts of life, it is found indigenous in experience:—the factor by which past
experiences are purified and rendered into tools for discovery and advance. (p. 225)

By emphasizing science as an experiential process and as a sort of cognitive tool, Dewey lent
credence to his statement that science was perfecting knowing. This support comes through the
demonstration that what he really sought was not so much an understanding of science, but a
capacity for inquiry.

As the focus of his last major work, *Logic*, Dewey (2008) defined inquiry as “… the
controlled or directed transformation of an indeterminate situation into one that is so determinate
in its constituent distinctions and relations as to convert the elements of the original situation into
a unified whole” (p. 108). This definition is much broader than that which is applied to science
and the scientific process. The most significant difference is because, as conceptualized, “There
are no set rules to be followed [with inquiry]. The only ‘rule,’ it might be said, is to be as
intelligent and honest as lies within one’s power” (Dewey, 2008, p. 480). That Dewey ascribes
so little rigidity to the process of inquiry may explain why in *Art as Experience* he states, “A well-conducted scientific inquiry discovers as it tests, and proves as it explores; it does so in virtue of a method which combines both functions” (Dewey, 1980, p. 169). He stretches inquiry’s abilities even further in *How We Think*. In it, he concludes “… any subject, from Greek to cooking, and from drawing to mathematics, is intellectual, if intellectual at all, not in its fixed inner structure, but in its function—in its power to start and direct significant inquiry and reflection” (Dewey, 1997a, p. 39). Dewey made connections both overtly and covertly between inquiry and art, much as he made the connection between art and science described earlier.

Through these connections, Dewey not only sought to bridge the gap between the fields, but also to demonstrate that the two sustain each other. They help propel the learner from wonder to understanding and from understanding back to new wonderings. He may have explained it best in *The Quest for Certainty*, when he wrote that:

> … in the end thinkers in all lines are dependent upon the mathematician and the physical inquirer for perfecting of the tools employed in their respective callings … But science thus conceived is not a final thing. The final thing is appreciation and use of things of direct experience … [the] natural objects experienced in relations and continuities that are summed up in rich and definite individual forms. (Dewey, 1960, pp. 221-222)

For Dewey it seemed that, though art and science can exist without each other, they rely on each other to bring meaning to the world and its events. Scientific inquiry is what allows the “… the thinker [to] be freed from the tyranny of sense stimuli and habit, and this emancipation is … the necessary condition of progress” (Dewey, 1997a, p. 155). However, the ultimate product of accumulated scientific knowledge, philosophy, “… like art moves in the medium of the imaginative mind, and, since art is the most direct and complete manifestation there is of
experience as experience, it provides a unique control for the imaginative ventures of philosophy” (Dewey, 1980, p. 297). Together, art and inquiry provide the setting for a person to acquire the experiences necessary for a person to gain a meaningful understanding of the world.

Inquiry is, at its root, analytic while art—and more broadly, invention—is synthetic. This places Dewey’s two primary vehicles for learning through experience at the top of Bloom’s taxonomy. Rather than separate the pair through some form of hierarchical stratification, Dewey embraced both as existing and interacting with each other at what some consider the pinnacle of human understanding. Through his investigations, Dewey (1997a) concluded that, “Analysis leads to synthesis; while synthesis perfects analysis” (p. 115). Therefore, it would have invigorated him to know that, in education today, there is a grassroots movement with a focus on both of these important modes of understanding. The movement is for Science Technology Engineering and Math (STEM) academies, academic programs that encourage students both to inquire and to invent (Scott, 2012). Consequently, these schools have produced significantly better results in students who go into STEM fields for their careers (Wai, Lubinski, Benbow, & Steiger, 2010). However, Dewey would have been more excited by the Science Technology Engineering Arts and Math (STEAM) academies (Sousa & Pilecki, 2013). In these programs, the educational practices he saw as most likely to activate students’ imagination and produce the authentic experiences critical for learning are fully integrated into the curriculum. One can envision these schools returning to the vision that begat Dewey’s own experimental school. When he was in the process of creating his school, long before longitudinal studies with multiple regression analyses were possible, he observed:

Many anthropologists have told us there are certain identities in the child interested with those of primitive life … [with] a sort of natural recurrence of the child mind to the
typical activities of primitive peoples; witness the hut which the boy likes to build in the
yard, playing hunt, with bows, arrows, spears, and so on. Again the question comes:
What are we to do with this interest—are we to ignore it, or just excite and draw it out?
Or shall we get hold of it and direct it to something ahead, something better? Some of the
work that has been planned for our seven-year-old children has the latter end in view—to
utilize this interest so that it shall become a means of seeing the progress of the human
race. The children begin by imagining present conditions taken away until they are in
contact with nature at first hand. That takes them back to a hunting people, to a people
living in caves or trees and getting a precarious subsistence by hunting and fishing. They
imagine as far as possible the various natural physical conditions adapted to that sort of
life; say a hilly, woody slope, near mountains, and a river where fish would be abundant.
Then they go on in imagination through the hunting to the semi-agricultural stage, and
through the nomadic to the settled agricultural stage. The point I wish to make is that
there is abundant opportunity thus given for actual study, for inquiry which results in
gaining information. So, while this instinct primarily appeals to the social side, the
interest of the child in people and their doings is carried on into the larger world of
reality. For example, the children had some idea of primitive weapons, of the stone
arrowhead, etc. That provided occasion for the testing of materials as regards their
friability, their shape, texture, etc., resulting in a lesson in mineralogy, as they examined
the different stones to find which was best suited to the purpose. The discussion of the
iron age supplied a demand for the construction of a smelting oven made out of clay and
of considerable size. As the children did not get their drafts right at first, the mouth of the
furnace not being in proper relation to the vent as to size and position, instruction in the
principles of combustion, the nature of drafts of fuel, was required. Yet the instruction was not given ready-made; it was first needed, and then arrived at experimentally. Then the children took some material, such as copper, and went through a series of experiments, fusing it, working it into objects; and the same experiments were made with lead and other metals. This work has been also a continuous course in geography, since the children have had to imagine and work out the various physical conditions necessary to the different forms of social life implied. What would be the physical conditions appropriate to pastoral life? To the beginning of agriculture? To fishing? What would be the natural method of exchange between these peoples? Having worked out such points in conversation, they have afterward represented them in maps and sand-molding. Thus they have gained ideas of the various forms of the configuration of the earth, and at the same time have seen them in their relation to human activity, so that they are not simply external facts, but are fused and welded with social conceptions regarding the life and progress of humanity. The result, to my mind, justifies completely the conviction that children, in a year of such work (of five hours a week altogether), get infinitely more acquaintance with facts of science, geography, and anthropology than they get where information is the professed end and object, where they are simply set to learning facts and fixed lessons. As to discipline, they get more training of attention, more power of interpretation, of drawing inferences, of acute observation and continuous reflection, than if they were put to working out arbitrary problems simply for the sake of discipline.

(Dewey, 1956b, pp. 48-54)

Dewey’s early career experimentation with such interdisciplinary practices made sense to him, because he was a man who would eventually devote his career to an interdisciplinary
investigation into the human experience. His educational program utilized the students’ imaginations and natural methods for learning the various forms of knowledge. It allowed for experiential learning because it took its direction from the varied sources that are—and have always been—the impetus for the existence of public education. Unfortunately, Dewey was ahead of his time. The STEAM academies he effectively invented have only just now been rediscovered. However, as the ever-optimistic Dewey would have pointed out, they have been rediscovered.

**Revolution, Thy Name Is Dewey**

Dewey did not simply want students to learn through art and science. He wanted teachers to recognize that art and science embody every aspect of education. Ironically, Dewey, an evolutionary philosopher, concluded that it is two uniquely human endeavors serving together that creates the vehicle for educational and social progress, and not basal outputs shared with a wider swath of fellow animals. Dewey’s de facto doppelganger Egan would appreciate this turn, considering that ironic understanding is his final cognitive tool… or perhaps he would not appreciate it. After all, Egan (1997, 2008) claimed at the conclusion of his books, *The Educated Mind* and *The Future of Education*, that by structuring education around the cognitive tools possessed by man alone rather than around the intractable opposing forces of socialization and development that are possessed by all social animals, it finally would align with man’s evolution.

As demonstrated throughout this dissertation, Dewey, like Egan, wanted to naturalize education. In the process, Dewey sought to ameliorate the dualisms of his philosophical and social predecessors. He concluded that the best way to facilitate growth in students was through experiences that provide students born with a gift for metaphoricity the cognitive tools that would assist them in future experiential learning. Across his fifty year career, Dewey saw many
problems with the way education was structured; he concluded that it teetered on pillars built upon false dichotomies. His goal became the unification of the divided dualisms so education could rest firmly upon its foundation. In the process, Dewey sought to modify the existing materials and structures, rather than completely gutting and rebuilding education. Consequently, Dewey was using evolutionary principles to change education more than Egan was using them. As Darwin noted, his theory was built on the principle of descent with modification. He surmised that the successful structures of predecessors became the scaffolding and framework for new and different adaptations to new and different environments. Subsequent research has demonstrated that the evolutionary process Darwin initially described works both biologically and culturally (Dawkins, 2006; Pagel, 2012; D. S. Wilson, 2003; E. O. Wilson, 2012). As they progress, both biological and cultural evolution can produce dead ends. Creatures and cultures that once were well-adapted can find that the dynamic nature of the world has created conditions where adaptations become maladaptive, working against a species or a culture’s progress. Dewey (1929, 1958) identified such a turn as the root of his society’s ills. In response, he wanted to change the fate of society by changing education. His prescriptions were developed with evolution in mind, for he sought progress without being a progressive purist. He achieved this feat in his first, his last, and his most substantial work on education through the overt identification of the ideas he sought to conserve from his predecessors (Dewey, 1956a, 1956b, 1963, 1966). This made him a philosophical pragmatist, a product of the breadth of his investigations. Unfortunately, Dewey was also a victim of the evolutionary process. The highly specialized ecology of education left little room for his generalist tendencies to survive.

However, hope exists today for Dewey. The environment of education—and of the country at large—are disturbed to the point that a generalist like him can flourish. Dissatisfaction
is growing with beliefs and cultural practices that have long defined the United States. The Affordable Care Act passed Congress to expand health care coverage to millions of uninsured Americans (Collins & Nicholson, 2010). Same sex marriage is supported by a majority of the United States’ population (Baunach, 2012; Corvino & Gallagher, 2012). Together, these changes suggest that a sentiment for the kind of caring Dewey (1929) expected to see in successful social groups is beginning to permeate the country. The growing disconnect between product, device, and consumer (Borgmann, 1999, 2009) is perpetuating a movement toward local sourcing (Goodman, Goodman, & DuPuis, 2011). The movement is also promoting a greater valuation for focal objects and the stochastic arts associated with their maintenance (Crawford, 2009). Now there are opportunities for each person to become the artist Dewey (1980) thought they could be.

The need for experience that Dewey championed is being recognized in various professions known for their explicit training methods. Medical schools are revising their practices to include case studies and patient interactions from the beginning of student enrollment (Shulman, 2004), while experiential apprenticeship is now seen as a viable transmission method in skilled labor (Kane & Harhoff, 2012).

A series of positive but disparate movements is hardly a harbinger of the rise of Dewey because his pragmatic approach was derivative of the interactive system level thought that is most difficult to enact. However, we see indications of movement on this front. Interdisciplinary teams are forming to develop treatments for previously incurable cancers, a move that was inconceivable less than a decade ago (Gomes et al., 2012; Rhiem, Pfeifer, Schmutzler, & Kiechle, 2012; Tortolina et al., 2012). Environmental degradation and poverty, once treated as separate problems, are now recognized as enmeshed global issues that must be addressed together for any change to have a lasting impact (Bolwig, Ponte, Du Toit, Riisgaard, & Halberg,
2010). The need for such system level analysis is also beginning in education. The success of other nations is starting to be viewed not through the limited lens of single classroom practices but in light of how an entire society functions (Tucker, 2011, 2012). It seems change is on the horizon in the US as well. New common core standards are to be adopted by 45 states, all with an emphasis on students’ abilities to do as opposed to the previous emphasis only on knowing (Pearson & Hiebert, 2012). The goal is now for all students to exit their mandatory education having achieved college or career readiness (Conley, 2010). The question for education has become: from what sources does the United States derive its model for the integration necessary to achieve a populace that, when they graduate high school, is college and career ready?

I would argue that by returning to Dewey’s notion that continuity exists between even that which seems diametrically opposed—art and science, nature and culture, mind and body, subject and method—we can understand the appeal that evolution had for Dewey as a thinker, particularly one with a vested interest in education. In light of Dewey’s emphasis on the importance of animalistic impulses in a human’s daily existence, had he been given modern evidence and a bit longer time on earth, he would have come to see education as a continual process. He would view the branches of education as being similar to the tree of life. He would see the processes by which students learn stretch backward in time and connect humans with animals who share similar genetic, social, and environmental life histories. And he would see education stretching forward in time to utilize our uniquely human capacities in conjunction with our new technology to respond in unforeseen ways to unpredictable environments. He would agree that it is education’s goal to make students college and career ready. Therefore, given his unique capacity to analyze the world from an evolutionary perspective through lenses provided by different disciplines and then use the information he gained to create a functional, malleable,
and testable synthesis, I have reached this dissertation’s conclusion: John Dewey was an evolutionary thinker in search of an educational revolution. Finally, the time is right for Dewey’s work to be revisited and for his vision of a society mobilizing itself for perpetual progress to be realized through education.

The aim of this dissertation has been to ameliorate what I perceived to be Dewey’s final unreconciled dualism: the rift between his evolutionary philosophy and the ideals of his theory of education. As I come the end of this quest, it seems only appropriate to give this now-achieved aim a name that speaks to the interdisciplinary nature of its erstwhile creator. Therefore, let me be the first to usher in the era of John Dewey’s REvolutionary Education.
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