THE POSSIBLE ROLE OF INTUITION IN THE CHILD'S EPISTEMIC BELIEFS IN THE PIAGETIAN DATA SET

by

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ABSTRACT

JOHN BICKART. The possible role of intuition in the child's epistemic beliefs in the Piagetian data set (Under the direction of DR. CHARLES HUTCHISON)

U.S. schools teach predominately to the analytical, left-brain, which has foundations in behaviorism, and uses a mechanistic paradigm that influences epistemic beliefs of how learning takes place. This result is that learning is impeded. Using discourse analysis of a set of Piagetian children, this study re-analyzed Piaget's work. This study found that, although the participating children answered from both an intuitive and an analytical perspective, Piaget's analysis of the interviews ignored the value in the intuitive, right-brain answers; Piaget essentially stated that the children were only doing valuable thinking when they were analytical and logical. Using other comparable re-analysis as the yardstick, this study extended Piaget's original interpretations. Implications for teaching and learning are also described. This study also extends a call for research into a pedagogical balance between analytic and intuitive teaching.

DEDICATION

This is dedicated to Wendy for her ideas and for her unwavering belief.

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CHAPTER 1: INTRODUCTION AND STATEMENT OF THE PROBLEM

"If children grew up according to early indications, we should have nothing but geniuses." Goethe

This study addressed the problem that education in the U.S. needs fundamental change (Darling-Hammond, 2010, p. 260). It explored the notion that increases in testing and teacher accountability for delivering curricula and improving test scores perhaps are going in the wrong direction (Bruner, 1986). The problem is that educational research has not sufficiently researched an alternative to the behaviorist model that sees the human being as a machine, nature as a controllable factory, and the physical world as atomistic parts only (Skinner, 1953; Thorndike, 1913/2010). The result of this model causes education to reinforce the child's analytical thinking while ignoring the child's intuitive thinking (Bruner, 1960, 1983, 1986; Nisbett, 2003; Whorf & Carroll, 1964). Therefore, this study went back to a historical turning point that was instrumental in setting up education in the U.S. to teach mostly to the reasoning analytic part of the brain, instead of keeping a balance with the creative, intuitive side. For this reason, the rich data set of Piaget (1929/2007) was used to re-interpret his children's interviews in order to explore a possible use of intuitive epistemic beliefs to balance our current emphasis on analytical epistemic beliefs.

Several theorists, including Piaget, Vygotsky, James, Dewey, Bruner, and Bandura contend that before schooling, the child has a way of knowing and learning

(Bandura, 1971; Bruner, 1960, 1983, 1986; Dewey, 1910, 1916/2005; James, 1984; Piaget, 1929/2007, 1950, 1959, 1976; Piaget & Inhelder, 1969; Piaget & Valsiner, 1927/2001; Vygotsky, 1962, 1966/2002, 1979; Vygotsky & Cole, 1978). At first, the child cannot analyze these whole ideas into parts and explain what he or she sees. The child's intuitive perceptions of *egocentricity*, *purpose or intention*, and *interconnectedness* in the world set up paradoxes that directly oppose logic and reason (Piaget, 1929/2007, 1950; Piaget & Valsiner, 1927/2001). Since these three types of intuitive perceptions are basic to Piaget's definition of intuition, an example of each will be given. An example of *egocentricity* in the intuitive child can be seen if the child thinks the sun is shining just for him or her, perhaps so that the child can have fun playing outside. This overlaps with an example of assigning *purpose or intention* to the sun in that the child refers to the reason that the sun is out is so that it could make nice weather for him or her. Both of these examples overlap with an example of *interconnectedness* in that the child refers to the sun as having some connection to what the child is doing as if the sun is affected by and conscious of the child. There are several other traits of intuition shown in the analysis of this study; these are mentioned because they are key and because they demonstrate a strong tendency to overlap and intersect with each other. Piaget refers to the fact that many of the traits of intuition overlap and are themselves interconnected. According to Piaget, the intuitive child does not yet have the analytical ability to separate parts of the external world and keep them apart in the abstraction of thought. "Compared with us he would experience much less the sensation of the thinking self within him, the feeling of a being independent of the external world" (Piaget, 1929/2007, p. 37). Thus, the intuitive child is embedded in and interconnected with the world. This strong

connection causes two things. A way of learning that lets the child remain close and in contact with the things he or she is learning about. But it also causes a conflict with a logical, reasoning approach to learning. The question that was raised in this study is whether both ways of learning are useful. Currently, education suppresses the ability to stay intuitively connected while learning in order to reinforce the ability to use formal reasoning.

Therefore, adults often dismiss the child's way of knowing and learning by saying that, "He does not understand, yet," or "She is still learning that." Vygotsky claims that Piaget erroneously treated this intuitive phase of childhood as a stepping stone toward more formal thinking (1962). Since so many educators have respected Piaget's rich descriptions of the child's early thinking as it goes from intuitive notions to more formal reasoning (Bruner, 1986), pedagogy has moved toward a reinforcement of formal, analytical thinking while downplaying a balancing use of the earlier interconnected, relational, intuitive thinking. This unbalanced approach did not come from a recommendation from Piaget; it had roots in a broader movement toward analytical, mechanistic thinking since ancient times (Dewey, 1916/2005). Prior to the studies of Piaget, education in the U.S. had first adopted the behaviorist principles of breaking down concepts (Skinner, 1953; Thorndike, 1913/2010) without enough balancing activity of putting them back together to see a larger picture that is more than the sum of the parts (Bruner, 1960; Dewey, 1910). Then education adopted principles implied by the Piagetian interviews that further encouraged the reinforcement of analytical thinking which trumped intuitive thinking (Bruner, 1986). Therefore, schooling primarily reinforces the logical way of reasoning and discards the child's intuitive epistemic beliefs

(Bruner, 1960, 1983, 1986; Dewey, 1916/2005; Vygotsky, 1962).

Several theorists however, have long contended that an intuitive epistemic belief has potential value in teaching and learning (Bruner, 1960, 1986; Burton, 1999a, 1999b, 2010; Dewey, 1910, 1916/2005; LeVasseur, Macaruso, & Shankweiler, 2008; Vygotsky, 1962; Vygotsky & Cole, 1978). Even Piaget claims that the child has a "keen appreciation" (1929/2007, p. 125) of the contents of consciousness - of thoughts, names, and dreams. The problem was that educational pedagogy made little use of intuition because intuitive awareness of ideas in their whole state is hard to articulate. The intuitive "child's efforts at introspection are extremely crude" (Piaget, 1929/2007, p. 125). For example, children often invent explanations of where babies come from, such as the parents having purchased the baby. Here, their "first impression is of a connection between babies and parents" (Piaget, 1929/2007, p. 225), and since the child cannot analyze the source or parts of this connection, explanations are invented.

The intuitive child has the whole idea, but she or he cannot necessarily separate the self from the whole, nor can the child separate the parts of the idea from each other. The child is embedded in the idea and in the world – and all seems as one connected, whole entity:

> This paradox is closely related to the following facts. The child may be aware of the same contents of thought as ourselves but he locates them elsewhere. He situates in the world or in others what we seat within ourselves, and he situates in himself what we place in others. (Piaget, 1929/2007, p. 125)

The rich Piagetian data set is full of attempts to prove that the child cannot separate the self from the world (Piaget, 1929/2007, 1950, 1959, 1965, 1973, 1976; Piaget & Inhelder, 1967, 1969; Piaget & Valsiner, 1927/2001). This study agreed with these proofs. There is a problem here, however. While Piaget's implications and recommendations have had a

renewed impact on U.S. education in the last decade to move from behaviorist ideas toward more constructivist ones (Case, 1988; Marchand, 2012), they also lean strongly toward discarding both the intuitive notions of the child and the intuitive method of learning and knowing as the child approaches abilities to think with formal logic. In school, this leads to reinforcing analytical, logical thinking by de-emphasizing intuitive thinking, rather than sustaining both methods of thought. An example of this might be where a first grade child is shown a lit candle in a science experiment. The child intuitively connects to the whole candle: it's beauty, it's brilliance, it's connection to the sun. The teacher interrupts by asking analytical questions about names of the attributes of the candle: the color of the flame, the way the wick burns, the heat. In order to move the lesson forward to record testable facts in the child's mind, the child is made to break relationship with the candle.

The purpose of this study was to explore the role of intuition. In one school, I saw an example of intuition and analysis in balance. The teacher showed the child the parts of a flower. This was an analytical act. Then, she shared qualitative impressions of the flower's beauty while in the whole state: its fragrance, the way it opens over a period of days, its response to light, warmth, and its relationship with other species. This was an intuitive act. The analytic act of labeling parts was very helpful for communication, but if the teacher had stopped there, she would have reduced the flower and its whole context to words and phrases. When she intuitively balanced this by letting the children experience the flower in a larger context, she restored wholeness and interconnectedness. What the child gets from intuiting everything as whole is not just a restoration of the child's original, a priori experience of the world. It completes the journey the child embarks on

when learning to separate and cognize the world, by finishing with the whole that was broken down for the sake of understanding. Analysis is one of the highest activities of all species, but it is a partial act, the origin and consummation of which is in intuition.

If one asks the question, "What, if anything, would intuitive epistemic beliefs do to dis-enable a child", the answer is as follows. According to Arnheim (1986a), the danger is in going too far; for if a set of epistemic beliefs is that all thought is dual, made up of an intuitive portion and an analytic part, and if education were to cause an imbalance in either direction, intuitively or analytically, the child suffers. Other than this danger, the research does not report anything about being intuitive and perceiving the interconnectedness of all things that can harm the child during school, or for that matter during the whole of life. One objection that might be raised is that, as the child is intuitively perceiving oneness, he or she may lose focus and the ability to analytically ask critical, pointed questions. It must be recalled, as Arnheim (1986b) suggests, that every thought enters the mind intuitively in a whole, undivided state, but each thought process ends analytically in a clear, conscious judgment of the idea that arrived. During this analysis, the mind sees what it thought and tests each idea against experience and reason. So, intuition should not hurt if the analysis remains equally strong. Intuition should only open the individual to become more intelligent from an increase in the volume and breadth of what the mind receives.

If one asks the question, "What, if anything, would intuitive epistemic beliefs do to enable a child", the answer can be seen in Appendix A. Answers to the question, "How would a holistic intuitive epistemology work for a child?", can be found in Appendix B.

This study explored how these Piagetian studies have made the assumption that

there is not enough value in intuition to sustain it throughout life. It re-analyzed the Piagetian interview data to extract the thoughts that come from an intuitive wholeness that the child experiences and treat it as a subject of investigation, rather than a lack of consciousness of self, only. It is not that there is any disagreement that the child has a lack of ability to separate the self and the world, as Piaget has stated – it is simply that this may have been overlooked as an asset.

This study explored the role of the child's intuition to see if it is worthy of further investigation as a viable, useful epistemic belief. For a working definition of viability, this study started from the constructivist, rather than the positivist view that "conceptual operations are viable if they fit the purposive or descriptive contexts in which we use them" (Glasersfeld, 1995, p. 14). In order to establish viability of the child's intuition, this study compared the children's discourse to those of quantum physicists. Discourse analysis of quantum physicists explored similarities in the discussion of *entanglement* and the *observer effect* to discourse analysis of child interviews where the children intuitively discuss interconnectedness and the holistic aspects of nature.

The train of thought I used to call for further research into the role of intuition in education, if stated in skeletal form, is this: In the last two-and-a-half centuries since Newton, scientists have evolved from a logical positivism to a posture willing to consider such paradoxical notions as the simultaneous wholeness and separateness of nature (entanglement), and the question of whether an observer can affect that which is being observed (observer effect). Science has moved past positivism. It has re-entered into a relationship of respect with ancient, holistic ways of knowing (Schrodinger, 1944/1992), modes of thought of indigenous peoples (Whorf & Carroll, 1964), and the epistemic

beliefs of Eastern cultures (Nisbett, 2003). However, while science has evolved, education in the U.S. has not. It treats the right-brain activities of intuitive thought (Gardner, 1993, 2008) as a stepping stone stage of early childhood that should be discarded as thinking reaches the supposedly more useful skills of logic, reasoning, and analysis. Where modern science has started to employ both the ability to intuitively embrace paradoxes and wholes – in balance with reasoning and analyzing – education has discouraged intuition and spent its resources encouraging analytical forms of knowing and learning (Bruner, 1986). This study asserted that the field of education needs to research this evolution and consider how it applies to the human learning process. Neils Bohr describes how Einstein favored usefulness as a deciding factor in the employment of sense impressions in an article called, *"Discussion with Einstein on epistemological problems in atomic physics"* (Bohr, 1949). Therefore, this study started from the assumptions of science that perhaps the intuitive child knows something worthy of investigation - something viable or useful.

1.1 Operational Definition of Intuition for this Study – Holistic Intuition

The definition used for holistic intuition is *a perception for which the source may be unknown and for which the whole content of the idea is at first perceived without knowledge of the parts*. Further, the intuitive apprehension of wholeness allows for paradox – the simultaneous inclusion of both that which is logically true and not logically true. When a child in school is receiving a holistic intuition, by the definition in this study, he or she is strictly observing - not reacting. Since it is not possible, however, to isolate intuitive thought from analytic thought because every thought we have comes in as intuitive, then ends as analytic (Arnheim, 1986b), it does not make sense in one respect

to ask, "When is a person thinking intuitively?" All children and all adults think both intuitively and analytically. The exploration of this study served to ask for more research into what would happen if children were taught to dwell longer and with more respect on the use of the intuitive portion of a thought. For example, when the teacher reads a first grade class a story, it may happen that many children are still 'in the story' for a period of time after the reading stops. During this time of connection with the story, children may still be predominantly in receiving mode, or intuitive mode. They may be sensing deep principles of life (Nisbett, 2003). If the teacher interrupts this time too quickly and asks the children to talk about the story, this could take them into a predominantly analytic mode which will break the connection they had. They cannot stay in the story if they are to talk about it; they must step out of the story in order to look at it. Thus analysis cuts off intuition. Both have wonderful benefits, but each must have time to do its work. The same is true of human relations, you cannot be with another person in a deep, meaningful way if you are only talking about the relationship. Many of the most wonderful moments of our lives are wonderful because our analytic mind is suspended and we have the pleasure of experiencing something with our full attention. Thus the definition of holistic intuition refers to the first half of thinking, where the person is in contact with the whole idea and has not yet thought about where the idea comes from or what it means. Throughout this study, *epistemic belief* was also referenced. It should also be defined at this time. This is the belief that a person can learn and come to have knowledge by some method. Thus, an *analytic epistemic belief* is that one can learn and know by thinking analytically, such as with the process of reading, writing, and doing arithmetic - reasoning activities. An *intuitive epistemic belief* is that one can learn and know by

thinking intuitively, such as sensing the connection that humans have with each other and to the rest of the natural world - receiving holistic intuitions that one holds without proof. The subject of this study was a call to explore the usefulness of intuitive epistemic beliefs in education in the U.S.

To address whether the child is aware of the source of an intuitively received thought, Piaget concludes that the intuitive child is clearly aware of what the consciousness contains - without knowing where the contents came from:

> It is possible to feel acutely the results of a mental process (logical reasoning or affective reasoning) without knowing how such a result came about. This is precisely the case with the child and is what is meant when the child's "intuition" is spoken of; a true perception of the contents of consciousness but no knowledge of how these contents were acquired, such is the paradox of this "intuition." (Piaget, 1929/2007, p. 125)

It is important to note that this study defined the role of intuition in a different way than some scholars do. Whereas Piaget refers at times to intuition as a stepping stone: "an intuitive thought whose progressive articulations lead to the threshold of the operation" (Piaget, 1950, p. 136), in other words as a deficit. He sees it as a stage to go through before logical operations, as misconceptions, as unfounded perceptions, or as stepping stones toward reasoning - the working definition of intuition for this study emphasized the ability of intuition as a valuable asset for teaching and learning.

Throughout history, the desire to measure and then be accountable to measurements has increased. According to Skinner, this is a mechanistic tendency:

> Descartes did not assert that the human organism always operates in this way. He favored the explanation in the case of animals, but he reserved a sphere of action for the ‘rational soul’ – perhaps under religious pressure. It was not long before the additional step was taken, however, which produced the full-fledged doctrine of ‘man a machine.’ The doctrine did not owe its popularity to its plausibility – there was no reliable support for Descartes’ theory – but rather to its shocking metaphysical and theoretical implications.

> Since that time two things have happened: machines have become more lifelike, and living organisms have been found to be more like machines. … At the same time, we have discovered more about how the living organism works and are better able to see its machine-like properties. (Skinner, 1953, pp. 46-47)

The role of intuition and the definition of holistic intuition has also come under the scrutiny of these historical paradigms (Kuhn, 2004) and has therefore been defined as a measurable entity, a separate part of the human machine (Skinner, 1953). In ancient times, the human was not considered to be a machine and, in an opposite manner, intuition was considered a stage of thought to be nurtured in the apprenticeship of the young and kept vibrant throughout life (Houston, 2007; Stone, 1976). But even the modernists and post modernists do not look to intuition as a stage of thinking, but seek to separate it from analytical thought so that it can be measured by itself (Gardner, 1993, 2008; Piaget, 1959; Piaget & Valsiner, 1927/2001; Vygotsky, 1962, 1966/2002). Arnheim asserts that separating intuition and analysis within the process of thought is impossible. He claims that each thought has two sides that are always connected, the intuitive and analytical. He describes how every thought arrives in the mind as a whole perception that does not necessarily come with identifications such as, where it came from, whether it makes logical sense, or what parts make it up. Then, as the thought is picked up by the mind and examined, Arnheim observes that we take it apart and judge it for soundness (1986a, 1986b). This arriving stage may be viewed as intuition and this examining stage may be viewed as analysis. Thus, each thought is made up of two inextricable parts, intuition and analysis (Arnheim, 1986a, 1986b; Bruner, 1960, 1983, 1986, 2004). They cannot exist as separate entities because they merely describe the arrival and observation of a single entity. By definition, then, the arrival or intuitive stage of perception of a thought has not yet divided the thought into parts, so it is a whole. The

analytical act of looking at the thought that has arrived can, and often does, take the idea apart.

1.1.1. Historical Treatment of the Definition of Intuition from Ancient to Post Modern

If one looks at the definition of intuition as the first stage of every thought and at the definition of analysis as the second, final stage, then one can make use of the first stages of humankind and the first stages of a child's life to seek further examples of intuition. Invoking a phylogenetic perspective, ancient history becomes a study of a time where humans were more intuitive and less analytic (Wynter, 2001). Similarly, invoking an ontogenetic perspective, early childhood becomes a rich vein of research of the intuitive stage (Piaget, 1959; Piaget & Valsiner, 1927/2001). Evidence exists of flourishing ancient civilizations where the great majority of people could not read, write, or perform any form of sophisticated mathematical operations (Diop, 1974; Houston, 2007; Stone, 1976; Teresi, 2003; Wynter, 2001). Yet, these people had a strong command of language. The children learned to speak quite well. This fact alone casts a long shadow on modern learning theory. Let us look then to ancients and to children to see intuitive thoughts that also had greater use in the mind, in addition to the ability to reason logically. It is helpful to look at early humankind and early childhood because the modern human is predominated by analysis and only gets to see intuitive thinking as a fleeting first portion of each thought (Bruner, 1986).

Vygotsky describes early types of childhood thoughts using the word autistic (not to be confused with the current use of this term). He gives respect to these thoughts as necessary throughout life, and later shows how these are constantly present in his theory of the social affects of learning. He makes it clear that these thoughts are not a partially

completed form of logical thought or reasoning as Piaget often implies (Piaget, 1959; Piaget & Valsiner, 1927/2001). He also dispels notions that early autistic thoughts are merely simplistic imaginations:

> If one takes into account phylo – and ontogenetic development, one immediately recognizes that the autistic thought can be neither the most primitive nor the original form of mental development.
>
> Even if one assumes the evolutionary point of view and considers child development in purely biological terms, even then autistic thinking fails to suit the role assigned to it by Freud and Piaget. Autistic thinking is neither the first step, nor is it the basis upon which all further developmental stages might be built. It is also incorrect to portray autistic thinking as a form of hallucinatory imagination prompted by the pleasure principle, which allegedly precedes the reality principle. (Vygotsky, 1962, p. 20)

Vygotsky's point is that early, autistic thought – what Piaget will often call egocentric thought – is not a stepping stone toward more formal thinking, it is its own, necessary part of the thinking process:

> We have thus found that autistic thinking, in neither its genetic, structural, nor functional aspects, shows itself as a primeval force and basis for the development of thought. Egocentric thought, therefore, may not be considered as an intermediary between such a hypothetical beginning and the higher stages in the development of mind. The place and the role of egocentrism must therefore be reconsidered.
>
> As we have seen, the concept of the child's egocentrism is a major focus of the entire psychological theory of Piaget. Apparently the chaotic multitude of disparate traits of the child's logic finds its structural order and generative cause in the principle of egocentrism. That is why a challenge to the primacy of egocentrism is a challenge to Piaget's entire theoretical construction. (Vygotsky, 1962, pp. 25-26)

Vygotsky observes that a form of egocentricity persists well beyond early childhood in the form of egocentric speech that often appears as an instrument of the thought process of the formal thinker:

> Our findings indicate that egocentric speech does not long remain a mere accompaniment to the child's activity. Besides being a means of expression and of release of tension, it soon becomes an instrument of thought in the proper sense

– in seeking and planning the solution of a problem. (Vygotsky, 1962, p. 31)

So, Vygotsky concludes that Piagetian studies that look upon early forms of thinking as stepping stones toward formal thinking which, at a later time can be discarded, impact our learning theory, and thus our educational system negatively. They hold us back from teaching and using the necessary stages of thought that arise spontaneously as a necessary part of each thought process. Therefore he concludes that,

> We believe that two processes – the development of spontaneous and of nonspontaneous concepts – are related and constantly influence each other. They are parts of a single process: the development of concept formation, which is affected by varying external and internal conditions but is essentially a unitary process, not a conflict of antagonistic, mutually exclusive forms of thinking. Instruction is one of the principal sources of the schoolchild's concepts and is also a powerful force in directing their evolution; it determines the fate of his total mental development. If so, the result of the psychological study of children's concepts can be applied to the problems of teaching in a manner very different from that envisioned by Piaget. (Vygotsky, 1962, p. 157)

In conclusion, the historical role of intuition may be viewed as a necessary half to every thought – the other half being analysis. This would suggest that creating a theory of learning and then an entire educational system that reinforces formal, logical thinking, without recognizing the intuitive, paradoxical, whole ideas that inform each of our analyses is like teaching someone with two legs to walk only using one.

1.1.2. Quantum Physics – Where Intuition is Equally Useful to Analysis

The U.S. educational system operates in a way that reinforces analytic thought and assumes that intuitive portions of thought and intuitive phases of childhood are mere stepping stones toward analytic, formal reasoning. And further, it assumes that these phases should be discarded as they are passed. Piaget implies this throughout his studies and thusly has had an influence in directing pedagogy to its present state:

> The forms of thought we have been describing can be analysed only through observation, since young children's intelligence is still far too unstable for them to be interrogated profitably. After about 4 years, on the other hand, short experiments with the subject, in which he has to manipulate experimental objects, enable us to obtain regular answers and to converse with him. This fact alone indicates a new structuring. In fact, from 4 to 7 years we see a gradual co-ordination of representative relations and thus a growing conceptualization, which leads the child from the symbolic or preconceptual phase to the beginnings of the operation. But the remarkable thing is that this intelligence, whose progress may be observed and is often rapid, still remains pre-logical even when it attains its maximum degree of adaptation 1; up to the time when this series of successive equilibrations culminates in the "grouping", it continues to supplement incomplete operations with a semi-symbolic form of thought, i.e. intuitive reasoning; and it controls judgments solely by means of intuitive "regulations", which are analogous on a representative level to perceptual adjustments on the sensori-motor plane. (Piaget, 1950, pp. 142-143)

It is important to note that the child, moving from three or four to seven years old is gaining abilities while also losing faculties. He or she gains what Piaget calls "operational methods" (Piaget, 1950), but she loses parts of the ability to instantly see a whole picture.

This definition of holistic intuition is inclusive of Eastern and Western thought. Nisbett (2003) discusses Eastern principles of dialectism where he demonstrates that in the East there is belief in a principle of constant change. This is the belief that the world constantly changes then causes the Eastern principles of contradiction and relationship. "Change produces contradiction and contradiction causes change; constant change and contradiction imply that it is meaningless to discuss the individual part without considering its relationships with other parts and prior states" (Nisbett, 2003, p. 200).

In addition to the Eastern principles of dialectism mentioned above, there is another reason for centering this definition on the handling of whole ideas. Besides the fact that there are repeating patterns in children's discourse on certain issues of wholeness (Piaget, 1929/2007, 1950, 1959; Piaget & Inhelder, 1969; Piaget & Valsiner,

1927/2001), the object of this study was to correlate the children's responses on wholeness to that of the observations and descriptions of wholeness of quantum physicists (Einstein, 1920/2010, 1950/2011; Schrodinger, 1944/1992). Specifically, issues of wholeness are directly related to two basic tenets of quantum physics: 1) *complementarity*, and 2) *entanglement*. In both of these theoretical concepts, the conventional sense of formal logic is challenged – but theoretical conclusions seem to match intuitive notions that children express. *Complementarity* was first defined by Bohr in discussion with Einstein:

> In fact, it is only the mutual exclusion of any two experimental procedures, permitting the unambiguous definition of complementary physical quantities, which provides room for new physical laws, the coexistence of which might at first sight appear irreconcilable with the basic principles of science. It is just this entirely new situation as regards the description of physical phenomena that the notion of complementarity aims at characterizing. (Bohr, 1949)

One can compare Bohr's notion of complementarity with the Eastern principle of dialectism. Further, complementarity and dialectism line up directly with the child's holistic ideas that allow for opposites to be true at the same time. *Entanglement* is described by Schrodinger as a tenet of quantum physics whereby one might know the whole without knowing much about the parts. The child seems to be able to do this. This confounds logic, but supports certain aspects of the mechanics of quantum effects. The next section will explain this further.

Piaget (1929/2007) reports that most of the children in the intuitive stage that he interviewed had similar notions of connectedness between the sun and the child. He specifically notes that these notions seem to appear a priori in the child, not from experience. For example, many children believe that the sun and moon participate in our lives and that they know "what we are doing" (Piaget, 1929/2007, p. 223). This directly

maps to the kind of thinking a quantum physicist must do in order to entertain experimental results in studying certain of the quantum effects in entanglement phenomena. Certain entanglement experiments imply that individual material particles in one way are separate and simultaneously, in another way are connected. There are two parts to this comparison of the thinking of the quantum physicist and the child. First, both the quantum physicist and the child need a way of thinking that allows for connectedness of matter that, at least on some level appears to be separate. Second, both need a way of thinking that allows the thinker to hold these two paradoxical ideas together as one whole concept, which, at times, one necessarily must not take back apart. So, both the child and the quantum physicist exhibit the same aspects of an epistemic belief that can entertain paradox; they both can know whole ideas without knowledge of the parts, even though this confounds the normal use of logic.

1.2. Statement of the Problem and Purpose of the Study

This study questioned the role of intuition in education in the U.S. and recommends further research to determine if it would be valuable to the reasoning adult to have kept the child-like ability to see whole ideas, intuitively. It questioned that if there were a way to re-integrate this faculty, could both faculties exist simultaneously in an adult with profitable result? The entire point of this study was to consider what, if anything is lost as the child goes from intuitive to operational methods, and to consider if this represents a loss of something that could be useful to the fully logical adult.

One consequence of a person who has retained a balance of intuition and analysis might be the way Stiglitz (2002) describes the ability to negotiate longer lasting trade agreements in a global economy; the intuitive side appreciating multiple cultures and the

analytical side calculating the legal terms. Another consequence might involve the vision of Senge (2008) to implement sustainable practices of agricultural resource management that balances the analytic profit motive with the long term, big picture of clean natural byproducts. A third consequence of the intuitive, relational sense of the whole might change human relations in issues of diversity in the U.S. School children are taught analytical mental methods of separation in thinking in order to read, write and perform arithmetic; but this analytical thinking does not just turn off when the school child looks at the differences in a classmate who is culturally different. The analytical training may cause a lack of appreciation for relationship and heighten awareness of difference (Bruner, 1960, 1983, 1986, 2004).

Some existing scholarly research that focuses on the early, intuitive stages of the child's epistemic beliefs includes such studies as meta-communication markers, verb usage, and childhood spiritual references (Haskins, 2009; Pramling, 2006; Pramling & Samuelsson, 2001). All of these studies suggest that the intuitive stage of childhood that pre-dates the child's ability to perform formal operational thinking has a use that is beneficial. This study extended this area of research to explore the role of intuition in the child's epistemic beliefs in this pre-operational phase by comparing it to the thought processes of scientists engaged in the study of light and quantum effects. This was done by questioning whether there is evidence that the child’s intuition has usefulness that has not been sufficiently addressed in the literature and whether the child’s intuition is useful enough to nurture it over the lifespan, along with formal operations. These two research questions are articulated more fully in an upcoming section. The significance of doing such research has implications for education in the U.S. It points toward a recommended

shift toward greater inclusion of the role of intuition in education. It suggests that schools keep the intuitive capabilities of the child alive past the early childhood stages.

1.3. Current Research Studies

Current research studies are starting to challenge the pedagogy of teaching formal abstraction prematurely to young children who are still thinking intuitively. Jaeger (2007) claims that many models of literacy learning assume that the young child can think formally, whereas most beginning readers/writers are in Piaget's pre-operational or intuitive stage. These challenges also expose and denounce deficit thinking that assumes the child who is unable to perform formal operations is not actively engaged in some other viable epistemic belief. Such research characterizes the positive aspects of learning that are active in the child at this time, noting that education must reinforce the intuitive first, then move on to formal logic and reasoning. Jaeger (2007) argues that children of this age use a semi-logic without causality, abstraction, the concrete, and the unconscious. He claims that verbal instruction is generally ineffective, here. In addition to challenging the pedagogical trend of teaching analytical reasoning at increasingly early ages, research shows that other challenges to the dismissal of the child's intuitive epistemic beliefs are surfacing (Donaldson, 1989; Pramling, 2006; Pramling & Samuelsson, 2001).

There is a gap in the research however, to qualitatively establish or map the similarities between the early child's learning style to some group that uses this learning style constructively, such as scientists or any of the groups mentioned above, thus signifying that the intuitive child has a useful epistemic belief. The purpose of this research, therefore, was to map those similarities between the early child and certain

scientists. The method was to contrast the Piagetian child interviews to scientists' narratives using discourse analysis to make comparative assessments of the epistemological patterns.

Ultimately, this research focused on the potential viability of the learning style of early childhood as a supplemental addition to the dominant learning style that is reinforced today in education – that learning style that is commonly used by the later child and adult who uses formal operations to learn and know.

The Research Questions for this Study

1. In the pre-formal stage of a child's development, is there evidence that the child's intuition has usefulness that has not been sufficiently addressed in the literature?
2. In the pre-formal stage of a child's development, is the child's intuition useful enough to nurture it over the lifespan, along with formal operations?

1.4. Assumptions of the Study

The literature abounds with research studies on intuition that often speak of two epistemological paradigms: intuitive and analytical (Arnheim, 1986a, 1986b; Bruner, 1960, 1983, 1986, 2004; Burton, 1999b; Eisner & National Society for the Study of Education, 1985; Jaeger, 2007; Johansson & Kroksmark, 2004; Kelemen & DiYanni, 2005; Kuhn, 2004; Pariser, 2008). This study was not making the point that there are only two realities out of the multiple realities that have been uncovered in sociological contexts, nor was it the contention of this study that there are only two ways of knowing and learning. The division of the mind, brain, and human epistemic belief into two – intuition and analysis – is merely one way to speak about a reality that is clearly more

complex than the human mind can comprehend. The dual nature of this division is but one way to look at epistemic belief, and it is quite likely – although outside the scope of this study – that it can be shown to be symbiotic with other schema that consider there to be multiple ways the human learns and comes to know (Gardner, 1993, 2008; Glasersfeld, 1995; Kuhn, 2004). On the one hand, there is a division to the body, the mind, and nature that manifests in a dual nature – we have two eyes, two arms, two sides to the brain, so it is not unfounded to use this duality as a scheme (Arnheim, 1986b; Bruner, 1986). But, on the other hand, this study in no way meant to imply that there are only two ways – it merely assumed that the dual scheme of looking at the intuitive and analytical parts of thinking were a viable way of breaking up the process of thought.

1.5. Significance of the Study

"To see a world in a grain of sand,
And a heaven in a wild flower,
Hold infinity in the palm of your hand,
And eternity in an hour."
William Blake, *Auguries of Innocence*

The contribution of this study was to extend Piaget's rich set of interview data and analysis. The re-analysis examined comparisons of children's discourse with working quantum physicists' discourse. The Piagetian legacy already included discourse analysis that recognized the patterns in the intuitive responses of the children as repeatedly implying that natural objects such as the sun have life, intention, purpose, and an interconnectedness to the whole of nature. The contribution of this study was to start with what the Piagetian studies already revealed in the intuitive patterns of discourse of the children. After that, this study re-analyzed them to see if they correlated in any way to the patterns of discourse of quantum physicists.

While this study suggested further research into intuition as a viable epistemic belief, some researchers have already begun (Donaldson, 1989; Kelemen & DiYanni, 2005; Pramling, 2006; Pramling & Samuelsson, 2001). An example is a study by Kelemen and DiYanni (2005) that discusses teleo-functionality, which is the assignment of an intentional purpose to an object or behavior, such as, the pencil is for writing. This is an aspect of learning and knowing that seems to be present before schooling and in fact before the child's physical experiences of any kind. They believe that "children's teleo-functional intuitions might reflect an indefeasible, innate, cognitive bias, that is present from birth and entirely autonomous from other explanatory mechanisms" (Kelemen & DiYanni, 2005, p. 7). Intentionality becomes part of the child's epistemic belief, such that "it is possible that children do more than simply view objects as existing for useful purposes. Instead, they may draw on their intention-based design stance to more richly construe objects as existing for intentionally designed purposes" (Kelemen & DiYanni, 2005, p. 6). The significance of these examples is that they suggest that further studies into child intuitions may reveal useful epistemological constructs that are alternative to the educational methods of the past half century that have largely discarded any use of what Piaget so aptly categorized as the intuitive notion of artificialism.

1.6. Theoretical Framework

There are two theoretical frameworks that informed this research: a) opportunity cost theory, and b) deficit theory. In the next section, these frameworks are discussed.

1.6.1. Opportunity Cost Theory

Opportunity cost theory comes from the economic sphere. It refers to the price one pays by choosing a path – when that path means missing another opportunity. Deficit

theory, as described above, helps to address the unfortunate sociological mis-reference of intuition as deficient thinking. Both premises describe how education in the U.S. today treats intuition as a glass half empty, rather than a glass half full. In other words, the true cost of a choice could conceivably be the price you pay to make your choice added to the price you pay for not taking the alternate path. At the least, the true cost is the price you pay for one choice as opposed to the other. Applied to education, in the context of this study, the pedagogical decision to train children to think analytically can force intuitive thinking to be pushed out of the child's set of epistemic beliefs. If this is done, there is a cost of the time and resources to school a child in analytical, logical reasoning, plus an unnecessary cost of the missed opportunity for the child to retain intuitive thinking capabilities. Bruner (1986) asserts that the human mind has two modes which are alternately employed in understanding – the intuitive and the analytical. Hutchison (2005), referencing world view theory, argues that the individual uses two main modes of knowing and learning. One way is through a filter from one's background, which can be a detriment if one is thinking in one paradigm and finds oneself surrounded by a culture that uses another paradigm. The other way is to think with unimpeded cognition. World view theory suggests that if the teacher has an awareness of the paradigm the student is coming from, he or she can cross cultural boundaries to reach that student.

The suggestion of this study was that not enough is truly understood of the intuitive paradigm of thinking to reach the intuitive child. For example, if a teacher is explaining how trees grow, very often the point is made that all of the various parts of the tree and the environment are important. On the other hand, however, the teacher usually says something like, "the trees compete for light and water." If the teacher stops there, the

lesson of survival and competition is left alone without balance. This lesson is partly true to nature - but it is not the whole story. The intuition in the child may suggest that nature is also symbiotic and helpful, somehow. Intuitive children often state that somehow there is relationship and benevolence also existing in nature (Piaget, 1929/2007, 1950; Piaget & Inhelder, 1969; Piaget & Valsiner, 1927/2001). The teacher should therefore continue to the larger picture of the whole set of trees connected to each other and to the plot of earth and the animals in their contextual environment. Together, groves of trees create a biological environment of shade and nutrition for each other to survive better than if one lived alone. Further, they work together to hold the soil from draining away. Even further, their out-breaths of oxygen are used by the animals, as the animals breathe out carbon dioxide which the trees use. This bigger picture balances the partial picture that trees compete with each other. All of it is true, so all of it should be included. This attempt toward the whole picture is an intuitive act; breaking down the whole into parts is an analytic act. If the child is only told the competitive part of the story, what is the child to think when considering a world view and the various cultures of her or his classmates? The point is not that the child should be told that the world is totally benevolent, as they seem to state in their initial set of epistemic beliefs (Dewey, 1910, 1916/2005); but neither should the child be told that the world runs solely on competition. Partial pictures are analytical only. The suggestion of this study was that it might be useful to balance whole pictures with partial pictures so that children can entertain useful world views.

The theoretical framework of cost theory relates to world view. Hutchison (2005) explains that world view theory holds that in understanding nature, for example, one can access understanding by other pathways than reason. So, if the educational system in the

U.S. does not teach the child to keep both paradigms of learning, reasoning or analytical and intuitive, an unnecessary price is paid for the missed opportunity of growing up to think with only one side of the mind. Nisbett (2003) compares epistemic beliefs geographically, demonstrating that as one moves from Eastern to Western ones, thinking moves from one paradigm to the other. If the school systems do not keep both forms of learning active, the children suffer from the imbalance. An example of this comes from Japan. Ogawa (1989) refers to the way Japanese elementary schools used Oriental world views in science classes, whereas the high schools used Western ones. The students did well in science in elementary school, then had trouble in high school when the Western way it was taught caused a disharmony with their world view. One might conclude from this example that the Japanese science students would have been better prepared if they had simply been trained in the Western tradition from the start of their schooling, but others might conclude that students would be better prepared to keep their traditional world view. This latter interpretation of the above situation focus on the *harmony* aspect of Hutchison's comments (2005, 2010). Applying the opportunity cost theory here might suggest a long term plan to expose the students to both world views.

1.6.2. Deficit Theory

According to Guo, "The deficit model of difference leads to conflation of 'difference' and 'deficiency' (2010, p. 162). Deficit theory can refer to many kinds of difference from societal norms. When referring to immigrants, deficit modeling leads to "remedial lifelong learning programs to bring immigrant individuals into line with dominant norms" (2010, p. 163). Each generation brings its own aversions to diversity and therefore seeks to re-establish norms by naming differences as deficits.

This study explored the role of intuition to see if it is useful as opposed to seeing it as a deficiency. If the appreciation of diversity is to be increasingly inclusive of new differences that each next generation brings (Chomsky & Foucault, 2006), then society will have to increase its appraisal of whole systems, relationships, and interconnectedness – in short, the tenets of the intuitive stage of perception. This will mean that society will have to cease deficit thinking toward the intuitive form of cognition as a learning style or epistemic belief and bring it into balance with the praise it affords the analytic set of epistemic beliefs. Deficit modeling in pedagogy has long been denounced as applied to biases toward children, families, and sometimes teachers from non-mainstream cultures (Delpit, 2006; Delpit & Dowdy, 2002; Ladson-Billings, 2009). But awareness of problems of deficit modeling in cognitive learning styles is still rather low in U.S. education (Pramling, 2006).

CHAPTER 2: LITERATURE REVIEW

This study explored a role of intuition in education that has been partially unexplained and understudied. The role of intuition in learning has been documented (Arnheim, 1986b; Bruner, 1960, 1983, 1986, 2004; Burton, 1999a, 1999b, 2010; Eisner & National Society for the Study of Education, 1985; Haskins, 2009; Johansson & Kroksmark, 2004; Kelemen & DiYanni, 2005; Pariser, 2008; Vygotsky, 1966/2002, 1979; Vygotsky & Cole, 1978; Wertsch, 1985). Notwithstanding, some current researchers who contradict such calls for further exploration of the uses of intuition refer to the children's intuitions in the negative – as misconceptions, or unfounded perceptions (Reuven Babai, Sekal, & Stavy, 2010; Smith & Hungwe, 1998; Tretter, Jones, Andre, Negishi, & Minogue, 2006; Watson & Kelly, 2005; Yair & Yair, 2004).

The working definition of holistic intuition centers on the child's abilities in handling whole ideas versus parts of ideas, based on Nisbett (2003), Whorf (1964), and Bruner (Bruner, 1986).

> A holistic intuition is a content of consciousness that is perceived as true, for which the source is unknown and for which the content of the idea is at first perceived as a whole entity, without necessarily knowing the parts.

According to Nisbett (2003), this definition of holistic intuition is inclusive of Eastern and Western thought. He discusses Eastern principles of dialectism where the principle of constant change causes principles of contradiction and relationship or holism as follows: "Change produces contradiction and contradiction causes change; constant change and

contradiction imply that it is meaningless to discuss the individual part without considering its relationships with other parts and prior states" (Nisbett, 2003, p. 200). In an effort to more fully explore the role of intuition this study sought existing research that investigates cases where young children have valuable perceptions coming from intuition.

2.1. Learning Theories And Intuition

In this section, intuitive cognition as a deficit model is examined, and literature that shows cases where the deficit model has and has not been redeemed will be noted. Finally, studies that highlight intuition as an issue of diversity will be reviewed.

2.1.1. The Deficit Model in Education

In order to examine the role of intuition in education as an epistemic belief that has been ignored, this study caste the role of intuition within a larger framework.

Much has been written over the last three decades about the overarching framework of deficit modeling in education in the U.S. This literature deals with sociological differences that are looked upon as deficits because they do not follow the dominant norm (Apple, 2004; Asante, 1991; Delpit, 2006; Delpit & Dowdy, 2002; Dewey, 1916/2005; Du Bois & Edwards, 2007; Freire, 1998a, 1998b, 2000; Freire & Freire, 1994). Since intuitive thinking precedes logical reasoning, studies of the specific type of deficit modeling that applies to the use of intuitive thinking examines how these students are viewed as partial adults who do not have the full complement of reasoning skills that the adult has. Basically, these studies fit in with a host of other sociological deficit models where students are seen as a glass half empty (Rebell & Wolff, 2008; Wiggan, 2007; Woodson, 1968, 2005). Rather than applying principles of diversity,

appreciating the multiple realities of an individual's epistemic beliefs, or embracing multicultural education, deficit models in U.S. education have been detracting from attempts to be inclusive, democratic, and critical for over a century (Anderson, 1988; Baglieri, Valle, Connor, & Gallagher, 2010; Delpit & Dowdy, 2002; Eisner & National Society for the Study of Education, 1985; Guo, 2010; Hirsch, 2006; Horvat & O'Connor, 2006; Ladson-Billings, 2009; Louv, 2005; Lyons, 2010; McIntosh, 1988; Murray, 1968; O'Malley & Pierce, 1996; Olsen, 2010; Sercombe, 2010; Tangen & Spooner-Lane, 2008).

Deficit modeling looks to deficiencies in the student rather than external factors that may be inhibiting the student from learning. Studies document that looking for the cause of a child's difficulty in learning, pedagogical methods, teachers, administration, curricula, and resources are sometimes passed over when a deficit model is in place (Anderson, 1988; Baglieri et al., 2010; Bell, 1994; Carnoy, Gove, & Marshall, 2007; Curry, 2000; Delpit, 2006; Delpit & Dowdy, 2002; Eisner & National Society for the Study of Education, 1985; Guo, 2010; Harry & Klingner, 2006; Ladson-Billings, 2009; McIntosh, 1988; Rebell & Wolff, 2008; Wiggan, 2007, 2008, 2010, 2011; Woodson, 1968). Once the student is made the central issue, a lack of appreciation of diversity of races, cultures, and languages can be missed (Anderson, 1988; Baglieri et al., 2010; Bell, 1994; Carnoy et al., 2007; Curry, 2000; Delpit, 2006; Delpit & Dowdy, 2002; Eisner & National Society for the Study of Education, 1985; Guo, 2010; Harry & Klingner, 2006; Ladson-Billings, 2009; McIntosh, 1988; Rebell & Wolff, 2008; Wiggan, 2007, 2008, 2010, 2011; Woodson, 1968).

Delpit (2006), Kozol (2005), and Eleanor Armour-Thomas (2004) report on deficit modeling as regards cultural minorities and its impact on such areas as teacher

training, student assessment, and teacher assessment. They report that it makes teachers of color seem inferior and keeps minority student test scores down. Delpit points out that blindness to these biases is endemic to the power culture. She demonstrates how many forms of testing do not include multiple intelligences, thereby favoring one culture over another. Another deficit model she exposes deals with the way cultural ritual can be decontextualized and therefore dismissed. Delpit advocates remediation of deficit modeling by fostering students' *connections* and *context,* which are key features of intuitive thinking (Vygotsky, 1966/2002).

Kincheloe (2004) asserts that there is a pressing need to examine deficit thinking in urban schools in the U.S. He characterizes current modus operandi in handling problems in our urban schools as often reducing itself to crisis management and survival. Kozol (1992, 1996, 2005) concurs in recommending resistance from teachers to protest treatment of urban students. He describes several deficit models: keeping urban students separate but equal, dismissing complaints as victim thinking, trying business-like run schools, teaching urban students to assume lower jobs in society, testing with high stakes, and instituting NCLB. All of this deficit thinking has the common characteristic of one societal group looking at what is wrong with another. A thorough review of the literature on this subject must then ask where and when the main thrust of deficit thinking started in U.S. education.

Origins of deficit thinking appears in Woodson (2005) in his seminal work, *The Mis-education of the Negro*. Woodson very strongly states that when you control a man's thinking, you do not have to control his actions – Woodson is foundational in identifying the deficit model in the U.S. He considers educational systems in the U.S. and in Europe

to miss the mark both for the black and the white students. The mis-education is precisely that the negro is inferior to the white, a conclusion the dominant class makes by deficit modeling. Woodson outlines how teachers were powerless to change the political system. Redemption, according to Woodson, would come when education begins to look at assets instead of deficits.

2.1.1.1. Redeeming Deficit Thinking

Mainstream writers claim that the essence of the redemption of deficit thinking lies in following and using the complexity of educational issues to turn views of deficits into views of assets (Apple, 2004; Freire, 1998a, 1998b, 2000; Freire & Freire, 1994; Giroux, 1988). This same argument holds that a significant portion of students' downfall lies in society's lowered expectations. Just as Delpit (2006) proposes to redeem deficit thinking by overriding the elitist notion of ignoring difference, Freire (2000) speaks of moving past caring about stereotypes to taking action, to correct them. It is precisely the differences in students that hold each student's unique genius (Delpit, 2006; Delpit & Dowdy, 2002). Kincheloe (2004) argues that redemption must also result in reducing the number of dropouts. He cautions that many urban dropouts are pushed out – deficit modeling against certain forms of diversity in the system such as standardized testing will not let them complete requirements. Many others are not counted in the statistics for reasons that include: boredom, teachers, pregnancy, jobs, and lack of success models. As another way to redeem deficit modeling, Wiggan (2007) advocates including the student's voice in uncovering wrongs and seeking solutions to racial differences in achievement in education. He suggests qualitative interviews to ascertain student perspectives. He

believes that this may reveal new insights. He suggests that issues such as: class, genetics, expectations, and oppositional tendencies would benefit from student input.

If one searches in the literature for redemption of deficit modeling, back to the origins of the educational system in the U.S., it can be seen that it was founded on a revolutionary movement away from the monarchical treatment of the citizens of Europe, and while it did not start with true inclusion of all peoples; it did aspire to overcome deficit thinking as regards inclusion. Like Dewey's (1916/2005) democratic conception of education, early pedagogical writings of Horace Mann (1989) attempted to move away from Eurocentric deficit modeling. He believed that the teacher should include many types of students and earnestly try to reach them.

2.1.1.2. From Deficit to Diversity

What were formerly seen as deficits are starting to become defined in the positive, as aspects of diversity (Ladson-Billings, 2009). In the last decade, an increasing awareness of a lack of tolerance, acceptance, and genuine respect for new forms of diversity has led to much research in the literature. Studies are emerging that addresses equal opportunities for both genders (Curry, 2000; Deegan, 1991; McIntosh, 1988; Stone, 1976), acceptance of sexual preference (McIntosh, 1988), recognition without lowered expectations of disabilities (Baglieri et al., 2010), awareness of environmental sustainability (Louv, 2005), and detection for alternate forms of cognition (Acredolo & Acredolo, 1980; Case, 1988; Eisner & National Society for the Study of Education, 1985; Murray, 1968; Sercombe, 2010). Thus, in extending the definition of diversity, research shows that society is receiving pressure to include issues of globalization and a re-examination of educational origins (Asante, 1991; Hutchison, 2010; Stiglitz, 2002;

Wiggan & Hutchison, 2009). This has spawned a third, ancillary trend of studies that investigate original, historical indigenous methods of learning and their application to today's students (Asante, 1991; Diop, 1974; Kunjufu, 2002; Ladson-Billings, 2009; Melear & Pitchford, 1991; Norman, Ault, Bentz, & Meskimen, 2001; G. Thomas, 2008; Traore, 2007; Traoré & Lukens, 2006; Whorf & Carroll, 1964; Wiggan, 2010). So, in order to examine the role of intuition in education, it has been shown that the exclusion of it can be seen as a form of deficit modeling that excludes intuitive epistemic beliefs from pedagogy. Therefore, if one extends the inclusion of issues of diversity to encompass original, indigenous thinking, a door is opened to consider intuitive thinking as an alternative method of cognition.

2.1.2. Cognition and Learning

2.1.2.1. Including Forms of Cognition as an Issue of Diversity

If one entertains alternate forms of thinking as a type of diversity to be appreciated, many possibilities open up. Research on group thinking, circle thinking, and collaborative thinking (Asante, 1991) necessitate an intuitive epistemic belief that embraces whole ideas (Bruner, 1960, 1983, 1986, 2004; Wynter, 2001). Another group of studies look at how the world is becoming flat due to globalization and therefore need multicultural learning paradigms (Darling-Hammond, 2010; DeMarrais & LeCompte, 1995; King & American Educational Research Association. Commission on Research in Black, 2005; Lemert, 1999, 2004; Lipman, 2004; Senge & Barker, 2008; Stiglitz, 2002; Wang, 1997; Wiggan & Hutchison, 2009; Xie, 2010). One research trend studies the origins of various learning methodologies in order to examine what may have been lost in the march of time, and what may be relevantly resurrected to be of benefit today (Asante,

1991; Brown, 1923; Darwin, 2007; Darwin & Dawkins, 2009; Dewey, 1916/2005; Diop, 1974; Du Bois & Edwards, 2007; Houston, 2007; King & American Educational Research Association. Commission on Research in Black, 2005; Loewen, 1995; Swann, 2009; Teresi, 2003; Traore, 2007; Wiggan, 2010; Woodson, 1968, 2005).

In addition to focusing on trends of globalization and the re-examination of educational origins, a third, ancillary trend is necessary for this literature to be thorough. Indigenous methods of learning and their application to today's students form a comparative and contrasting discussion of learning theories that employ socio-cultural, social contextual, and transformative methodologies (Apple, 2004; Asante, 1991; Bandura, 1971; Freire, 1998b; Giroux, 1988; Goleman & Boutsikaris, 2006; Goleman & Senge, 2007; Goleman & Whitener, 2005; King & American Educational Research Association. Commission on Research in Black, 2005; Mezirow, 1996, 1997; Palmer, 1993, 1998, 2004; Palmer, Zajonc, & Scribner, 2010; Vygotsky, 1966/2002; Wertsch, 1985; Wiggan, 2007; Woodson, 1968, 2005; Xie, 2010). These are some of the main forms of diverse learning methods, but what is the significance for diversity in education in the U.S.? The importance of considering cognition as a diversity issue can be seen by looking at the body of literature that has already been compiled to study cases where there was a lack of appreciation of diversity in cognition.

2.1.2.2. Diversity Issues that Hinder Student Cognition

The overall purpose of this literature review was to examine aspects of epistemic beliefs that are related to intuitive thinking as a possibly useful learning strategy. Therefore studies that investigated how intuitive thinking and other societal trends have been considered a deficit was researched above. This connects to literature that

researches diversity issues, as forms of learning and cognition have newly begun to be studied as connected to diversity. Thus this review therefore continues with cases of a lack of appreciation for diversity that can hinder cognition. One instance can be seen in the research of Ainsworth and Wiggan (2006). They argue that student achievement has micro (agency) and macro (structure) issues, which are currently debated separately. They feel that when taken together, one would look at neighborhood effects on students (structural) more closely. This might lead to schools promoting the agency of higher achievement in order to address oppositional behavior more directly and more constructively. In a similar case of a diversity issue affecting school performance, Meyer (2000) argues that attempts to leave housing segregated by race kept peace in the short term in isolated neighborhoods, but forestalled the inevitable, fully developed equality of treatment to all races. W. T. DuBois (2007) openly disagreed with Booker T. Washington's industrial training program that replaced higher education of the intellect. These cases can be compared to the historical backlashes (Wiggan, 2008) where racial differences cause blacks to value education higher than whites and poor neighborhood housing leads to poor education (Meyer, 2000). As recipients of lack of appreciation of diversity, many blacks see achievement, in school and in property ownership, as cultural agency to counter white supremacy, citing that neighborhood contextual effects predate and overshadow lowered educational achievement (Horvat & O'Connor, 2006, p. 166). Youth from disadvantaged neighborhoods lose social control and capital. This leads to limited job opportunities, and poor schools. In all of these cases, student learning and cognition are hindered from biases in the U.S. educational system and society. In order to

better understand roots of these societal ills, the next section will look more broadly outside of the U.S. to the global scale and outside of the modern era to ancient times.

2.1.2.3. The Significance of Studying Original Forms of Cognition

Many globalization analysts and researchers have become more inclusive of areas of the diverse interests of humankind such as education and health services in addition to paying such close attention to market-driven interests of the economy (Darling-Hammond, 2010; Palmer et al., 2010; Senge & Barker, 2008; Stiglitz, 2002). This may be motivated by a sense of completeness (Glazer, Smith, & Spirituality in Education, 1999; Senge & Barker, 2008; Teresi, 2003; Wertsch, 1985), or perhaps a sense of the need for humanity to re-circle back to its roots, according to theories that modern society may be re-connecting with its distant past at this time in history (Asante, 1991; Brown, 1923; Diop, 1974; Graves, 1875; Houston, 2007; King & American Educational Research Association. Commission on Research in Black, 2005; Ptahhotep, Kagemna, Gunn, & Amenemhet, 1985; Stone, 1976). Other researchers have argued directly against the intuitive type of thinking as it relates, in their opinion to earlier forms of thinking that were only stepping stones to more formal forms of thought (Reuven Babai et al., 2010; Smith & Hungwe, 1998; Tretter et al., 2006; Watson & Kelly, 2005; Yair & Yair, 2004).

Stiglitz (2002) found a practical and imminent need arising to improve education in countries that have been lent money in order to keep the global economy afloat. He claimed that keepers of the global banks may otherwise find themselves making quick fixes, rather than longer lasting reform. Just as Stiglitz recommended inclusion of issues of education as a key part of global reform because it is part of the root causes that can heal a country, others (Stone, 1976; Wynter, 2001) warn that, in reforming education,

lessons need to be included from our distant past. This means studying and extracting wisdom from ancient, indigenous learning methodologies (Asante, 1991). The significance of this for global educational reform is directly tied to the reason that global economic reform is failing today. This next section, then looks into a case in point where modern education toward logical reasoning and analytic thinking can be informed and supplemented by ancient forms of intuitive thinking.

2.2. Logic Versus Intuition

2.2.1. Forms of Intuition in Afrocentric Thinking

A strong case where a form of intuitive education has been researched is in the multicultural movement to include context sensitive pedagogy in urban schools. In 2005, the AERA commissioned the book *Black Education* to record, at this critical time of globalization, the state of affairs and an agenda for transformation for education in the U.S. for African Americans in relation to the world. In *Black Education*, King, Wynter, Lee and others wrote of the roots of African teaching and learning that go back to pre-recorded history (Asante, 1991; Diop, 1974; King & American Educational Research Association. Commission on Research in Black, 2005; Wiggan, 2010; Wiggan & Hutchison, 2009). Asante's description of African epistemic beliefs uncovered a deeply social aspect to learning. The individual's learning process is not only aided by entering into dialogue with a group, but also through relational aspects by: receiving encouragement, scaffolding, and increasing self-efficacy from the group. Learning in circles, a type of learning that claims to transform character is achieved by meandering through ideas where a circle of individuals think as if they were one person, according to Asante (King & American Educational Research Association. Commission on Research

in Black, 2005). Mesirow (1991) builds on the idea of transformation of the interaction that aligns more with right-brain, intuitive, relational activities. An historical backdrop for the pedagogy in which early African society situated its first educational institutions reveals highly intuitive approaches that parallel the way Mesirow and Asante re-connect to the ancient ways (Diop, 1974; Houston, 2007; Stone, 1976). There are hindrances to modern educational systems making use of ancient examples, however.

Wynter (2005) argues that one hindrance to using the intuitive methods from the legacy of Afrocentric pedagogy lies in a fundamental rule that science keeps reinforcing that she calls biocentrism, the idea that humans are merely physical, bilogical beings with no higher abilities. Wynter's recommendation toward clearing this hindrance is to re-connect the present to the past:

> I am making the hypothesis that the modern world has actually been brought into being on the basis of three very powerful revolutions. One was the "Copernican Revolution," which gave rise to the physical sciences. The next was the "Darwinian Revolution," which gave rise to the biological sciences. And Fanon's revolution is the one that will give rise to an entirely new science, which will be that of the nature-culture mode of being human. Notice. This is very important. It's not one or the other (nature versus culture). It is the co-relation. (King & American Educational Research Association. Commission on Research in Black, 2005, Appendix B-2)

Wynter thus directs the literature to paradigms that apply the intuitive ability of relationship thinking to science. The next section therefore reviews literature that integrates intuition, epistemic beliefs, and science.

2.2.2. Intuitive Thinking and Scientific Discourse

The sociological research above is mostly in agreement that social problems arise where non-intuitive deficit modeling and lack of appreciation of diversity impact student cognition. In scientific literature, however, there are contradictory studies as well as those

consistent with intuitive approaches to learning and advancing the frontiers of science. As the industrial revolution took place during the nineteenth century, education was impacted by great changes in society, science, and technology (Dewey, 1910, 1916/2005). Scientific epistemic beliefs were largely positivistic (Kuhn, 2004). Nisbett (2004) and Whorf (2003) relate that the social construction of reality was basically associated with geographical location and language. In order to place pedagogy into this picture so that it is fully situated in context, the ancient literature above from the socio-cultural sphere must be connected to the literature on scientific forms of thinking.

Wynter (1964) has suggested that education extrapolate from the 50,000 year history of original African learning methods to arrive at the modern conclusion to join nature and culture, holistically. Asante (Asante, 1991) has argued that Afrocentric forms of learning exemplify social aspects that reinforce self-efficacy from group encouragement, while fostering the act of grasping ideas in their whole form. Asante stressed that the Afrocentric view sees feeling, knowing, and acting as an inseparable whole. He contended that there are deep remnants of the process of thinking in wholes that comes from the various, ancient African cultures that facilitate learning. Like Du Bois (2007), Asante asserts that these ways of thinking in wholes span many, diverse cultures. It is a principle of intellectual endeavor in general that a student can learn best by seeing, on the one hand, analytical parts of a whole, and on the other hand, the whole in its inextricable unity. So, to connect this to scientific thinking, consider modern scientific theories that can only be penetrated at a clear level of understanding by embracing a whole idea (Schrodinger, 1944/1992). Therefore, the next section will follow literature that deals with scientific thinking further.

The history of the scientific study of light and quantum effects divides into three camps: 1) those scientists who interpret experimental data to mean that light is a particle, as with Newton's corpuscular theory, 2) those who theorize that it is a wave, as with DeBroglie's wave theory, and 3) those who assert the paradoxical idea that it is both, as with Schrodinger's explanation of quantum theory. The intuitive way of thinking can entertain paradoxical ideas, but science was positivistic in Newton's time and theories sought for explanations of light as if it were one thing only: separate pieces of matter. This analytic approach is contradictory to newer intuitive theories that holistically hold that light can be both a wave and a particle, and that it can remain connected, even when separated by space. This new scientific thinking manifests in ways that the analytic mind cannot fathom (Schrodinger, 1944/1992). This occurs in quantum theory when experimental phenomena seem to have mutually exclusive parts that defy relationship, except paradoxically (Bohr, 1949; Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965; Goethe, 1840/1970; Schrodinger, 1944/1992). This new thinking is needed in quantum physics experiments, but also in education, itself, as a science. This echoes Wynter's (2001) claim that humankind has the potential at this time in history, to assume a role of conscious participation of aspects of sociology that we had only passively observed before. Wynter argues that: "it is we who are the agents and authors of ourselves" (King & American Educational Research Association. Commission on Research in Black, 2005, p. 70). This leads to the field of quantum physics, which seems to witness a parallel situation.

In the study of quantum physics, two kinds of phenomena arise where a new kind of scientific thinking is required. One type of phenomenon deals with experimental

results that have seemingly contradictory results. Some examples of the quantum physics concepts known as *complementarity*, where light is considered both a wave and a particle, *superposition,* where physical entities seem to occupy the same location, and *entanglement*, where one physical entity can occupy more than one location, all present paradoxical notions to Newtonian physics and the linear mind and are therefore examples of the first type of phenomena (Bohr, 1949; Einstein, 1920/2010, 1950/2011; Schrodinger, 1944/1992; Zajonc, 1993). The other type of phenomenon deals with a level of connectedness that stretches our definitions of social interaction. Examples of this type come from the quantum theoretical interpretation called the *observer effect*. With the observer effect, some physicists interpret that the experimenter affects the experiment by the act of observation (Schrodinger, 1944/1992). It should be noted that there are other interpretations of the results of these and many of the quantum effects. The point here is that the interpretations that are here under discussion make epistemological use of intuitive thinking. Since some of the earliest quantum physics results produced Young (1804a, 1804b) in the double slit experiment, scientists have adopted a mixture of intuitive and analytical thinking in order to make interpretations. Analytical, positivist notions did not survive this Kuhnian (2004) paradigm shift.

As stated above, the first connection of the observer effect to Afrocentric epistemic beliefs is that they both can be understood by using intuitive thinking, but another, more subtle connection is that they both imply that there is a social, contextual influence on cognition. The nature of Afrocentric learning is built on the relationship of one person with another (Asante, 1991; Wynter, 2001). The interpretation of the observer effect that asserts the possible affect of the observer on the experiment, like the ancient

Afrocentric epistemic beliefs, implies that, through conscious interaction, there is a affective relationship not only of one human on another, but of the human on matter. Thus the literature in both sociological studies of Afrocentric learning and scientific studies seeking to interpret quantum effects imply that a type of relationship thinking that lies in the intuitive realm of thought is useful.

A study conducted by Greene & Prichard (2004) crosses the teaching of science with Afrocentric learning, suggesting the need for both the analytic and holistic ways of thinking to be present to make a complete view of a scientific phenomenon. This study cites the National Science Teachers Association in suggesting that there be more cooperative learning in science classrooms. Like Asante, they define cooperative learning as involving more talking, data gathering of real world problems and less emphasis on one right answer. Another application of science teaching that underscores the need for Afrocentric learning methodologies is the teaching of physics in China.

China has, for quite a long time, had a Confucian style of learning that excelled in the dissemination of wisdom from teacher to student; but it did not choose to use student interaction almost at all. Students in China do not get very interactive, they "are reluctant to participate in classroom activities; they hardly volunteer replies; they seldom answer, let alone initiate questions" (Xie, 2010, p. 10). The literature shows that some Chinese educators are now moving toward social contextual learning, and performing research to show its efficacy (Wang, 1997; Xie, 2010). This is therefore a further application of what has been traced in the literature to be similar to researched Afrocentric learning methods.

Vygotsky is the originator of a concept known as the zone of proximal development (ZPD) (Vygotsky, 1962, 1966/2002, 1979; Vygotsky & Cole, 1978). He

defines the ZPD as the distance between a child's: "actual developmental level as determined by independent problem solving" and the higher level of: "potential development as determined through problem solving under adult guidance or in collaboration with more capable peers". Some Chinese educators are moving toward Vygotsky's research (Wang, 1997; Xie, 2010). This is noted here, because research shows that what Asante (1991), Wynter (2001), and Lee (2002) describe as the social interactive learning all draw from ancient, Afrocentric learning roots. More specifically, "most students in China are accustomed to closed-ended confirmatory reasoning, and feel more comfortable with classical physics", "Rarely have students met an open-ended question in class. But, in modern physics, exploratory approaches are widely employed" (Wang, 1997, pp. 333-334). And so, there is evidence that old ways of thinking may be needed once again for some of the newest ventures of humankind.

Although the teaching of science is based on the scientific method, there are activities that engage the human mind, alternatively, in operations that, by their nature are mutually exclusive, namely the act of *observing* and the act of *analyzing* (Boorstin, Luce, & Daniel, 1983; Carter, 2008; Danovitch & Keil, 2008; DiSessa, 1982; Glasersfeld, 1995; Kelemen & DiYanni, 2005; Krajcik et al., 1998; Kuhn, 2004; Marx, Blumenfeld, Krajcik, & Soloway, 1997; Metz, 2004; Rivera Maulucci, 2011; Yair & Yair, 2004). Thus, it follows that one cannot purely observe unless analytic thought is suspended. And conversely, one cannot continue observing while one engages in the thought process whereby analysis of that which was observed is performed.

Much recent, research literature has been devoted to the balance, or imbalance, of a pedagogy that reinforces analytical thinking. Contradictory research favors the fruits of

analytic thinking and formal reasoning in that it yields: clarity, articulate language, abstract concepts, and the command of mathematical operations. Alternatively, there also exists recent, research literature on a balanced approach to pedagogy that would advocate for occasional suspension of analytical thought in order to nurture the side of mind used for observation, qualitative experiences, and evolving, implicit, living concepts (Jaeger, 2007; Klein, 2007, 2010; Metz, 2004). Yet a third vein of research in this discussion of analytic versus intuitive thought reveals literature that claims that one cannot isolate these two activities of the mind. It holds that learning involves integrated ways of knowing with possible, multiple intelligences (Arnheim, 1986a, 1986b; Bruner, 1960, 1983, 1986, 2004; Burton, 1999b; Eisner & National Society for the Study of Education, 1985; Gardner, 1993, 2008; Haskins, 2009; Johansson & Kroksmark, 2004; Kelemen & DiYanni, 2005; Krist, 2010).

To review, then, this section presents literature that suggests that over the last two centuries, scientific thinking has evolved to include the use of ancient, intuitive epistemic beliefs. In education, this topic is largely not considered, but where it is, researchers disagree on whether to use intuition in education at all, and if so, there is further disagreement on whether to keep intuition in balance with analytic forms of reasoning. This leads to the theories of epistemic beliefs and their evolution through paradigmatic change, which will be covered in the next section.

2.2.3. Epistemological Paradigms

Some literature over the last half-century discusses the pedagogical use of intuitive capabilities in education (Arnheim, 1986a; Bandura, 1971; Eisner & National Society for the Study of Education, 1985; Glasersfeld, 1995; Johansson & Kroksmark,

2004; Piaget, 1950; Piaget & Inhelder, 1969; Vygotsky, 1966/2002, 1979; Vygotsky & Cole, 1978; Wertsch, 1985). Some treat intuition as a form of knowing where the individual comprehends a whole idea without yet knowing the parts (Reuven Babai et al., 2010; Burton, 1999b; Danovitch & Keil, 2008; Haskins, 2009; Jaeger, 2007; Johansson & Kroksmark, 2004; Kelemen & DiYanni, 2005; Krist, 2010; Quale, 2011; Smith & Hungwe, 1998; Tretter et al., 2006; Watson & Kelly, 2005; Yair & Yair, 2004). Another interpretation of intuition deals more with the manipulation of the parts of an idea but stresses the fact that the knower does not know the derivation of his or her conclusion (Arnheim, 1986a; Bruner, 1960; Eisner & National Society for the Study of Education, 1985; Haskins, 2009; Kelemen & DiYanni, 2005). All, however, define intuition as an ability to see a whole idea.

More recent studies find agreement in the surge of interest in intuitive education in the wake of the U.S. space program of the 1960s and the pedagogical innovations that followed (Burton, 1999b; Jaeger, 2007; Watson & Kelly, 2005; Yair & Yair, 2004). During this same time period, early child cognition studies also had a rebirth in the works of Piaget, Vygotsky, Bandura and others (Arnheim, 1986b; Ball, United States. Office of Educational, Improvement, & Michigan State University. National Center for Research on Teacher, 1990; Bruner, 1960; DiSessa, 1982; Eisner & National Society for the Study of Education, 1985; Heaton, 1992; Kliebard, 1988; Lampert, 1990; Prawat, 1992; Putnam, Lampert, Peterson, Center for, & Teaching of Elementary, 1989). Contradictory literature finds intuition as a spurious and questionable form of thinking that is carried over from immature, childish thinking (Reuven Babai et al., 2010; Klein, 2007; Piaget, 1929/2007, 1950). The purpose of this study was to use the literature to question if there

is use to the way the pre-formal child, as a naturally intuitive learner, thinks, in the context of the fabric of the classroom (Bandura, 1971; Case, 1988; Piaget, 1950; Piaget & Inhelder, 1969; Vygotsky, 1979; Vygotsky & Cole, 1978; Wertsch, 1985).

CHAPTER 3: METHOD

3.1. Introduction

The purpose of this study was to explore whether the pre-formal child has a viable epistemic belief in place – an intuitive paradigm that stands on its own that is distinct from the child's beginning formal reasoning. Intuition was defined in Chapter One as an equal and necessary partner to the analytical thinking process. The description from Chapter One asserted that, beginning with the work of Vygotsky (1962), the value of intuition, seen strongly in egocentrism and persisting into later life, is portrayed by Piaget as a stepping stone to logical thinking. However, this is an under-valuation of intuition, according to Vygotsky. The intuitive stage of childhood, where Piaget outlines the child's egocentrism may have a value that is worth using as a way of learning both during early childhood and then, throughout one's schooling and later life:

> As we have seen, the concept of the child's egocentrism is a major focus of the entire psychological theory of Piaget. Apparently the chaotic multitude of disparate traits of the child's logic finds its structural order and generative cause in the principle of egocentrism. That is why a challenge to the primacy of egocentrism is a challenge to Piaget's entire theoretical construction. (Vygotsky, 1962, pp. 25-26)

This study therefore compares child intuition to a purposefully selected set of key scientists who use both intuitive and analytical investigative processes in varying proportions, namely, Newton, Faraday, Maxwell, Goethe, Einstein, and Schrodinger. The purpose of this chapter is to describe the methodology by which this comparison was done. A discourse analysis (Gee, 1999) of Piagetian interview data published in *The*

child's conception of the world (Piaget, 1929/2007) was used to address the research questions that guide this study. The research questions were as follows:

1. In the pre-formal stage of a child's development, is there evidence that the child's intuition has usefulness that has not been sufficiently addressed in the literature?

2. In the pre-formal stage of a child's development, is the child's intuition useful enough to nurture it over the lifespan, along with formal operations?

Since this study was a re-analysis of Piaget's work, attention has been focused on 1) the selection of the data set from Piaget's work, 2) the rationale for the purposeful selection of the data set of scientists, and 3) the discourse analysis of each data set.

Why a Discourse Analysis of Piaget's Interviews?

The critical approach to pedagogy, according to Freire (1998b, 2000), argues for the fierce act of telling the student about her true state of oppression, and then listening to the wisdom of youth – a wisdom that has not yet become tainted. Dewey (1916/2005) echoes the idea of treating the student as a valuable source in that the student still has eyes that an adult may have lost:

> Children, if they could express themselves articulately and sincerely, would tell a different tale; and there is excellent adult authority for the conviction that for certain moral and intellectual purposes adults must become as little children. The seriousness of the assumption of the negative quality of the possibilities of immaturity is apparent when we reflect that it sets up as an ideal and standard a static end. The fulfillment of growing is taken to mean an accomplished growth: that is to say, an Ungrowth, something which is no longer growing. The futility of the assumption is seen in the fact that every adult resents the imputation of having no further possibilities of growth; and so far as he finds that they are closed to him mourns the fact as evidence of loss, instead of falling back on the achieved as adequate manifestation of power. Why an unequal measure for child and man? (Dewey, 1916/2005, Chapter 4: Education as Growth, para. 3)

Dewey shows that there are two things to keep learning from children: 1) unlearning the bad habits that adults develop, but more than this, 2) a re-learning must take place where the adult must re-discover how to think like a child. Re-learning will be discussed next.

According to Bruner (1986, 2004), deficit thinking toward the intuitive forms of cognition as a learning style or epistemic belief is built on an older form of positivist science and research which entered the foundations of pedagogy through such influences as Skinner (1953) and Thorndike (1913/2010) to persuade school children to learn and think analytically, not intuitively. This suppression is partly done through school discourse in science education (Burke, 1980, 1985; Eisner & National Society for the Study of Education, 1985; Glasersfeld, 1995; Kuhn, 2004). Through language, teachers inadvertently miss children's situated meanings that are "grounded in actual practices and experiences" (Gee, 1999, p. 53) when the children explain scientific phenomena. Gee (1999) claims that teachers often use the cultural context of the rational adult world to ask questions and to interpret children's answers. In essence, a power struggle is in play when this happens, and in such situations, the adult is oppressing the child (Freire, 2000). By not reinforcing or possibly even recognizing the situated meaning of the child, the teacher has imposed the cultural bias of the rationalistic meaning on the child and dismissed the intuitive meaning. For example, according to Piaget (1929/2007, 1950, 1959; 1969), children can believe the paradoxical ideas that objects of nature can be both *inert* and *alive* - at the same time. The situated meaning of the child in this case teaches the adult at least one important lesson. The child is teaching that opposites are sometimes true. This lesson in the ability to handle paradox maps directly onto the physics concept of *complementarity* - that light may be both a particle and a wave (Einstein, 1920/2010).

The child's situated meaning also maps directly onto the principle of Eastern dialectism, as opposed to the Western law of non-contradiction (Nisbett, 2003). More than this, the child may be insinuating that matter can respond to consciousness, which would map onto one interpretation of the quantum principle of the *observer effect* - that perhaps the human act of observing, can alter some part of the physical world. Dismissing possible intuitive epistemic beliefs disrespects the child and loses possible mind openings for the adult. Note the specific example where this was done by Piaget:

> Moreover, we shall see in studying child artificialism that to a child almost all bodies are born and grow; the sun and moon "are born and grow (poussent)," mountains, stones, iron "grow" etc. The facts clearly prove that the origin and growth of things cannot serve the child as criteria for distinguishing the living from the inert. From this point of view there is perfect continuity between all natural objects. (Piaget, 1929/2007, p. 229)

This is treating the child with deficit model thinking: Piaget has only noticed how the child did not see the logical answer. Re-analysis of this child interview would say that the child believes both paradoxical ideas, because to the child, things can be both inert *and* alive in some sense that does not fit some adults' common sense positivist definition of life.

To consider the child's intuitive notion as possibly useful, one would not discard the child's notion of animism as incorrect; one would respect it as another possible way of thinking. This concept is currently found to be useful in teaching children in many Eastern cultures, African cultures, South American cultures and indigenous cultures of Native Americans (Nisbett, 2003; Whorf & Carroll, 1964). One example of such respect for intuitive thinking can be seen in the way Nisbett (2003) asserts the difference in how Westerners and Easterners handle paradox and contradiction, where the "Western insistence on this pair of logical principles and the Eastern spirit of dialecticism are, on

the surface at least, in direct opposition to each other" (Nisbett, 2003, p. 201). Thus a teacher who uses the cultural context of the intuitive child as opposed to the rational adult might interpret children's discourse quite differently and with a considerable measure of respect.

3.2. Discourse Analysis

Gee (1999) defines discourse analysis as a use of language that fits the situation to construct meaning, which then recursively changes the original situation. Since the pre-formal, intuitive child is often using language to achieve relationship as opposed to communicate logical ideas (Donaldson, 1989), it does not make sense to form hypotheses of the substance of a child's mind by listening to child discourse and analyzing it as you would an adult's discourse (Gee, 1999). This study used discourse analysis in two ways, broadly as a qualitative research to explore the human phenomenon of intuition, and more specifically where children's answers to adult examiners in the Piagetian interviews can be re-analyzed to find new patterns that may suggest useful meaning.

Why Discourse Analysis?

Using discourse analysis of the child's answers to science questions provided a way to explore the role of intuition in the child's epistemic beliefs. It was an attempt to re-analyze Piaget's interpretations of the use of the intuition of children. Other scholarly studies (Pramling, 2006; Pramling & Samuelsson, 2001) have performed a re-analysis of Piaget's interviews of intuitive children and concluded by a method of discourse analysis of meta-communicative markers in the children's answers that the children are making claims. They indicate that children intuitively know something that they cannot articulate to the adults. Similarly, this study sought to re-analyze Piaget's interviews using

discourse analysis of inferred attributes of interconnectedness of parts to the whole. Therefore, in the same vein that Pramling's (2006) methodology compared children's meta-communicative markers to infer a possible viability of the children's intuitions, this study compared intuitive, scientific references to the wholeness of nature that are shared between children and scientists, in order to look for possible inferences to the viability of the children's intuitions. An emphasis in this study is on the contrast between seeing the epistemic beliefs of the young child as a glass that has been historically considered half empty of the ability to perform logical operations (Piaget, 1929/2007), but is now also being considered as a glass that is half full of the ability to sustain an intuitive sense of the wholeness of things (Bruner, 1986).

Discourse Analysis Described

As hinted earlier, the specific methodology used discourse analysis to re-analyze portions of the original Piagetian data set of child interviews. The analysis of the study reports thematic similarities and differences in the tenets of learning and knowing of the children to that of a purposeful selection of scientists. It synthesizes the overarching tenets as an early child epistemic belief to explore a possible new form of pedagogy – intuitive education.

There are two ways of viewing discourse analysis, the broad qualitative research approach and the specifics of the functional analysis of the discourse. The next sections will discuss each of these.

The Broad Research Approach

The broad research approach for this study was a qualitative method of inquiry to explore a human problem. This study sought to "emphasize a 'complex, holistic picture,'

a reference to a complex narrative that takes the reader into the multiple dimensions of a problem or issue and displays it in all of its complexity" (Creswell, 1998, p. 15). More specifically, in order to research the role of intuition in learning and knowing, the open approach to the phenomenon of intuition has been used whereby "following Husserl, as interpreted by Schutz, all possibilities are equally possible for the knowing subject" (Martinez, 2009, location 4264). After the study was completed, comparative analysis between the children's reactions to the interview questions and the scientist's narratives were performed using functional narrative discourse analysis (Gee, 1999), which is discussed in detail below. The child and scientist parts of the study were as follows.

The re-purposing of portions of the Piagetian data set of child interviews were combined and contrasted with historical discourse from selected scientists. This was an extension, a re-analysis of the interpretations that were concluded from the historical interviews of children by Piaget. As described in the previous chapters, extensive use has been made of Piaget's work to inform pedagogy of the role of logic, rational thinking, and analysis, but little attention has been directed to the pedagogical use of the child's thinking before the child is able to wield analytical thought processes: so the discourse analysis outlined below has been conducted to extend the original analysis. Here is an example whereby Piaget interviews Roy, a six year old boy. Roy's words are in italics.

> "Can we make the clouds grow bigger?—*No.*—Why do they grow bigger?—*Because we grow bigger* (Roy admits thus what he has just denied).—Why do you grow bigger?—*Because I eat.*—Does that make the clouds bigger too?—*No, they grow because they know that we do."* And after a moment: "How did the clouds start?— *Because we were growing.*—Is it we who make them grow bigger?—*No, it isn't us, but the clouds know we are growing."*
>
> In other words, the universe is a society of like beings living according to a well-ordered code of rules; every analogy is at the same time a logical relationship since analogy signifies common or interacting purposes and every purpose is a cause. One even feels that, for Roy, the members of this universe

> necessarily imitate each other so that when we grow the moon and the clouds are forced to follow suit. (Piaget, 1929/2007, p. 262)

Piaget analyzes that Roy is incorrectly creating myths as a stepping stone toward sound reasoning. In re-analyzing this interview, one might say that Roy may very well be teaching the adult interviewer a wise lesson when he refuses to separate the intentions of the sun and moon from his own, much like the Hopi expresses a flash of light (Whorf & Carroll, 1964). The Hopi says "flash" for the event. There is no subject, such as light, as in "the light flashes." If the Hopi used a subject it would require a predicate with a verb that does the flashing. To the Hopi, this is an assumption that some separate object is doing the flashing. This to the Hopi would be a projection of separateness of the observer onto the phenomenon. It would be projecting that some separate actor performed the act of the flash. It would be a further assumption to assign a verb tense to this act signifying a separate time and place when and where the flash came from. Like the child speaking of the sun and moon as participating with the human, the Hopi uses the epistemic belief that starts from connectedness and must be proven otherwise.

Children 5-7 years of age have been targeted. They are capable of verbalizing their thoughts because these interviews from the Piagetian studies yield discourse that shows that these children are at the cusp of learning to think formally, yet are still in the pre-formal stage, which Piaget labels with the generally accepted term *intuitive* (Piaget, 1929/2007, 1950; Piaget & Valsiner, 1927/2001). It is precisely because there is controversy over some aspects of Piaget's ideas on the stage theory of child development that similar aged children have been targeted. Donaldson (1989) re-analyzes Piaget, noting differences in both the age that children exhibit various forms of reasoning and intelligence, as well as varied forms of knowing that can be seen by re-interpreting

children's discourse. In this study, Donaldson (1989) also suggests that small changes in the interaction process with the child can make a significant difference in revealing what the child knows and how the child learns. Bruner (1986) concurs. Bruner also describes how the Western, adult mind must be taken out of the equation when analyzing and interpreting meaning in what the child has said and how the child has reacted. Gee (1999) calls this situated meaning and cautions that the *situatedness* is quite subtle with children. Situated meaning for children implies that they live in a non-intellectual world view during early childhood that can easily be mis-interpreted through an analytical, intellectual lens.

The Specific Functional Narrative Discourse Analysis

Children's answers to adult examiners in the Piagetian interviews can be re-analyzed to find new patterns that may suggest useful meaning. The argument centers on the assumption that the adults in the interviews in *The Child's Conception of the World* (Piaget, 1929/2007) listened to the children through a rationally constructed frame of mind (Gardner, 1993, 2008). Thus, a projection of analytical thinking was placed on the children's answers and they were interpreted through a lens of formal logic (Bruner, 1986). Were the interviews in the Piagetian data set to be re-purposed through a lens of intuitive thinking, extensions of the Piagetian conclusions might be possible. To study this point, this research uses current studies that re-analyze Piaget's rich data set. In this way, adult reasoning is eliminated to reveal when the child was communicating about a non-analytical way of learning or knowing. In short, this study explores the possibility or existence of an alternate way of knowing or an alternate set of epistemic beliefs of the child.

Similar Research to this Study

Recent research that has re-analyzed the original Piagetian data in *The Child's Conception of the World* (Piaget, 1929/2007) suggests children as saying that they know something that they cannot express (Pramling, 2006). In essence, this is another study that argues that the pre-operational child is not just a glass that is half empty. Perhaps, before being able to do formal operations, the child is able to learn and know: they have viable epistemic beliefs (Pramling, 2006; Pramling & Samuelsson, 2001):

> *The Child, 2006; Pramling & Samuels* deals with children's understanding of a variety of phenomena, for example: thought, dreams, rain, and even reality as such. Piaget's work is tremendously rich (not least in excerpts from children's reasoning, explaining, describing), but also therefore under-analysed[3]; and for the present concern, not analysed in terms of how the children qualify their answers. (Pramling, 2006, p. 456)

The evidence of this current study comes from a discourse analysis that watches for meta-communicative markers (such as "like" or "as if"). Patterns of children's use of the markers in the original Piagetian interviews correlate across children for certain similar interview questions. More importantly, the children's use of markers is not across many other interview questions, signifying that when there is a correlation, the children have a feeling that they know something in those certain areas. Pramling therefore assumes the possibility of the child signifying a knowing that simply cannot be expressed as answers to certain questions. Pramling follows in the footsteps of Donaldson as she asserts that interviews are highly sensitive because she had "repeatedly seen that young children's interpretations of language may be powerfully influenced by context, so that they fail to show adequate respect for the words" (Donaldson, 1989, p. 70). Pramling claims that a gap exists in our interpretations of children because we see them through the lens of our adult way of thinking. We do not extract our own self from our socio-cultural perspective

(Gee, 1999). In other words, for the socio-culture that in this case is childhood itself, an adult interviewer can have both pre-set ideas of an answer to an interview question and also a pre-set way of thinking through the problem that question poses with background expectations that are usually taken for granted (Pramling, 2006).

Piaget's Interpretation of Children's Cognition

Piaget interviewed the children with questions about such natural objects as the sun and moon, and constructed clear, extensive theories as to why and when the children attributed life to non-living objects, *animism*, or human-made origins to natural objects, which is called *artificialism*. He noted intuitive notions of natural objects having *purpose* and *intention*. He also reports that the children often speak of human existence before and after birth. He constantly reported instances of children inventing myths to explain *connectedness* of parts of the world such that "the feeling of a connection precedes the myth and actually gives rise to it" (Piaget, 1929/2007, p. 262). The concept of connectedness is perhaps the most pervasive notion in that it seems to underlie many other notions:

> Let us imagine a being, knowing nothing of the distinction between mind and body. Such a being would be aware of his desires and feelings but his notions of self would undoubtedly be much less clear than ours. Compared with us he would experience much less the sensation of the thinking self within him, the feeling of a being independent of the external world. (Piaget, 1929/2007, p. 37)

Piaget clearly reports that the children are still embedded in the world with a connection of self and world that the adult does not have. This study questions whether there is use in this epistemic posture. Piaget clearly walks away from it, favoring the adult view that we simply are not connected, that the self and the world are separate. The question is

whether there could be another way to interpret the children in a re-analysis of Piaget's interviews.

Another position on how to interpret the children is alarmingly direct. It asserts that the children know something; that there is a rich vein to investigate by following their assertions. The reason for this comes directly from Gee (1999) and Bruner (1986). The tenets of discourse analysis that is being followed can be stated thusly: if the language of the interviews follow a pattern that is not random, then there may be meaning in the discourse (Bruner, 1986; Gee, 1999). The type of discourse analysis that was recommended in this case was not the detailed analytical act of taking the minute parts of the sentences apart. It was the type where situated meaning was found through the socio-cultural context of the children. The re-analysis in this study was one way to provide a reading of the thinking balance between intuitive and analytic practices that avoids being subjected to powerful alternative readings. But this is not new. One can find it in many cultures that are ancient, Eastern, Afrocentric, and indigenous. Wherever epistemic beliefs have an overarching backdrop of the interconnectedness of nature, the use of paradox or contradiction, and the assignment of purpose to life, one can find this alternate way of thinking.

The Original Piagetian Child Interviews

The Piagetian interviews, which are presented in this section, are typical of the many that were conducted. They contain convictions that the children consistently claim. The children often assert that the sun is alive, speak of a connection between them and the sun and the moon, assume natural objects have a purpose, say contradictory statements and hold to both as simultaneously true, and constantly allude to objects being

made by someone. The important point to note, however, using basic tenets of discourse analysis, is that they do not do this in all cases, but instead do this in concert with each other, in certain cases only. This suggests meaning. The possibility that they are unveiling a paradigm that is visible to them, but not necessarily to us seems likely. Perhaps a viable way of knowing and learning is causing this consistent set of responses over the rich data set of the Piagetian interviews and the years of replications of the Piagetian interviews over the last half century. Perhaps this is what can be inferred from the way Donaldson (1989), Gee (1999), and Bruner (1960, 1983, 1986, 2004) suggest that adults can miss what the children really mean.

In connection with the questions above, Bruner (1960, 1983, 1986, 2004), for example, consistently contends that the reason we do not believe that the children know what they are talking about is that we constantly fall back on our lens of rationality. Arnheim (1986a, 1986b; 1985) asserts that it appears that the rational mind cannot see the possibility that what appears as separated objects are somehow connected. This takes the thinking of the intuitive mind. The rational, analytical mind needs to be accompanied by the intuitive mind to consider holistic concepts like the relationships connected to the *purpose* of a natural event or the *intention* of an element of nature. However, if one stays true to the logical conclusions from seeing the patterns of recurring discourse elements, then either we need a theory to explain how and why the children agree, or we must open our minds to the possibility that they can tap into a form of knowing and learning that is intuitive, not analytical. With this in mind, it is instructional to consider some interviews.

Excerpts have been recorded in Appendix C from a study by Pramling (2006) that re-analyzes Piagetian interviews. It has original Piagetian examples of child interviews

from *The Child's Conception of the World* (Piaget, 1929/2007) with accompanying re-analyses by Pramling. Pramling re-interprets Piaget's analyses, concluding that the children are insinuating that they know more than Piaget's analysis allows. Donaldson (1989) likewise re-analyzes child interviews of Piaget concluding that there is more use to the children's epistemic beliefs than has been stated in Piaget's analyses. The research in this study built directly upon the work of Pramling and Donaldson with a further re-analysis that specifically compares the usefulness of the child's intuition to the thinking used by quantum physicists in the areas of *paradox* and the *observer effect.*

Pramling builds on the re-analysis of Piaget (Piaget, 1929/2007) using the work of Margaret Donaldson (1989), because he similarly criticizes Piaget for interpreting what the children say by listening to them as if they were adults. In her landmark book, *Children's Minds*, Donaldson advocates for listening to the child without resorting to a projection of adult thinking onto the child:

> Chomsky obviously thinks of the child's task as that of learning the sort of thing which language is for Chomsky himself. And so indeed it is – in the long run. But in the shorter run, during the early years of life, it may be something very different.
>
> For Piagetian theory, the effect of the adult conception is less direct, for Piaget is less concerned with language learning. And when he does talk about it he is much more sensitive to differences between what language has become for the adult and what language is for the child in the early stages. However when he himself, as an experimenter, *uses* language as part of his method for studying children's thinking, he appears to lose sight of the significance of this issue. (Donaldson, 1989, p. 58)

Donaldson reiterates throughout the book that children are connected to the questioner and the world in a way that precludes them from taking any meanings in isolation. She underscores that the child comes from the period before language proficiency, when he or she was in a state of connection to situations, listening to other people for the situated

meaning in the discourse of the language, not for the isolated meaning of the words and logic. To carry this thought further, the next section will look into how a situation can affect meaning and how discourse models can reveal interpretation of those meanings.

Situated Meanings and Discourse Models

This study used a method of qualitative inquiry to compare the interviews of the children and scientists. Two primary tools of discourse analysis were used: 1) discourse models and 2) situated meaning. Discourse models can be, and often are presumptions that are made by the questioner or observer by projecting one's own ideas and meaning onto that which is said by the speaker, then imposing meaning onto the situation according to this interpretation (Foucault, 1971). This applies to scientific discourse as well as interviews with children. Gee agrees that discourse models "are largely unconscious theories we hold that help us to make sense of texts and the world" (1999, p. 54). In our case, these models are the epistemic beliefs of the children that are unconscious to both the children and the teachers. Discourse models are sometimes called cultural models, which is reminiscent of the association between the oppression of one cultural group over another. But in our case, the human being that matures to think logically, usually loses the ability to think intuitively, and therefore forms the dominant cultural group called 'adults' who cannot understand the way the cultural group called 'children' think – and often end up seeing those children as small adults that only have half of their faculties.

A tension in the social sciences between agency and structure involves an ongoing discussion as to which has greater influence over social events: the ability to freely make a choice (agency), or functional methodologies that limit free choice (structure). As seen

in Fairclough (2003), research that involves discourse analysis must constantly take both into account. This is definitely the case with interviews of young children because they respond to the whole situation surrounding the adult and the perceived amount of authority inherent in the structure of the institution that the adult represents. Schooling is just such a case.

Situated meaning is a research tool used to make sense of narrative from the context of the individual uttering the narrative, the culture in which it is set, and any other environmental factors that could affect it. According to Gee, “it should be obvious to anyone that words take on different meanings (have different situated meanings) in different contexts of use” (1999, p. 53). For example, often a word or phrase can mean different things to different groups – or to the same group at different times. Gee describes how “socially and culturally distinctive identities people can take on in society” (Gee, 1999, p. 61) can have words that vary in meaning within the discourse or across discourses. He notes the critical nature of the use of these differences, in that “these different social groups are often in competition with each other over things like power, status, and the 'right' to claim to know” (Gee, 1999, p. 61). This is precisely the case with the way a child is often talked down to – or passed over – because the adult thinks the child simply is not making sense.

One case in point comes from a story where children and adults are asked about a scientific idea about the light of a lit candle. When asked how far the light from the candle goes, various answers ensued:

> Many children claimed that the light from the candle travels only a short distance ("One meter at the most," "About one foot") or stays where it is at the candle ("Just stays there and lights up," "Stays there," p. 9). Some children suggested that the distance the light travels from the candle depends on whether or not it is day

or night, claiming that the light travels further at night. (Gee, 1999, p. 62)

Gee goes on to analyze the discourse, taking into account the context of both the children and adults who were not being scientific and thus exhibited different situated meanings from the science-oriented questioners.

Children who are answering from an intuitive contextual paradigm are trying to use words that almost always are interpreted to have meaning in analytical, rational contexts. Besides the mismatch of the child's and adult's situated meanings and discourse models, the Euro-centric languages of the West create an almost impenetrable barrier to communication with children. The child's language most closely resembles language of the East or many of the indigenous cultures (Nisbett, 2003; Whorf & Carroll, 1964).

The methodology of this study therefore sought to re-analyze the children's interviews from the context of the intuitive, so that we could see through their eyes. This study therefore applied a discourse analysis of the situated meanings and discourse models of the intuitive epistemic beliefs across the multiple cases of the children and scientists interview narratives.

3.3. Validity

Validity can be defined as that which "relates to the issue of whether the research findings are actually providing appropriate and valid evidence for the claims being made by the researcher" (Prior, 2003, p. 149). While the internal validity judges how well conclusions may be drawn and external validity judges how well the findings may be generalized, Merriam (1998) underscores that to have both internal and external validity in educational qualitative research, a study should go further than to collect and analyze data; it should improve education with long term effects from explanatory contributions

that cause the reader to think through new perspectives they may not have seen before. According to Gee, the “validity of an analysis is not a matter of how detailed one's transcript is. It is a matter of how the transcript works together with all the other elements of the analysis to create a ‘trustworthy’ analysis” (Gee, 1999, p. 106). Because the methodology of this study was qualitative, it sought trustworthiness by the rigor of two things. How well it compared the children’s responses to the working definition of holistic intuition, and how well it assessed the correlation between the usefulness of the children’s intuitions and the intuitive discourse of the selection of scientists. Although the analyses of the original interviews that were conducted by Piaget have come under criticism for assigning fairly rigid stages to child development (Case, 1988) as well as making generalizations from locally selected populations of participants (Marchand, 2012), this study was externally valid because it generalized the epistemological use of intuitive traits of children and scientists to other individuals who have already been shown to exhibit intuitive traits, regardless of differences in stage, age, or sociological disposition. This study used Piaget's original archival data specifically to show that even then, Piaget's selected population of children from that historical period and from that socio-geographical location demonstrated intuitive capabilities that were not noticed as useful to education as useful learning tools. These observations should be transferable to other groups of children and adults who exhibit the same intuitive thinking. The external validity comes from the fact that this study did not contest or validate the existence of these exhibited intuitive traits as a defined stage or in a defined population; it merely explored the use of them as learning tools by anyone who has these intuitive traits. Although the study is qualitative, the results are generalizable to the population of pre-

formal children across cultures, in the same degree that Piaget's rich data set has proven to be so. The internal validity must bear up under two measures: 1) in the identification of intuitive thought, and 2) in the inference of the usefulness of intuitions. The first test of internal validity is guided by the rigor of Piaget's handling of his population of pre-formal children (1929/2007, 1959). The second is guided by employing Bandura's (1971) rigor in identifying "response novelty" as new ideas that are made up of previously known common behavioral elements but are arranged in a way that is new. Bandura stresses that to qualify as new or novel, a response must exhibit patterns of arrangement of old parts that would not have any appreciable probability of coming together, were it not for the agency of the person creating the novel response. This rigor directly applies to the discourse analysis of patterns of language of children's responses to those of the scientists. Special attention was given to alternate explanations of causations of the children's patterns of discourse to identify other factors that could affect any appreciable probability of such patterns being similar to the patterns in the discourse of the scientists. The trustworthiness of the research demands, at the very least that the reader was given enough detail of the data collection and analysis to see if there can be agreement with the conclusions that are drawn (Merriam, 1998). Because the children's responses are compared to archival text from the scientists, full detail of the scientist source material and contextual circumstances surrounding the publication of these texts was given.

3.4. Reliability

Reliability in social research refers to the "requirement that the 'findings' of any research program are independent of the particular circumstances in which the research was carried out" (Prior, 2003, p. 149). In this study, enough procedural detail was given

so that the set of interviews which were extended from the original Piagetian set could be replicated by other researchers using the prescribed procedure. Repeated interview trials have historically been conducted by many researchers (R. Babai, 2009; Barrouillet & Special Issue: Dual-Process Theories of Cognitive, 2011; Case, 1988; Donaldson, 1989; Green, 1985; Green & Piel, 2010; Wavering, 2011; Wilhelm, 2009). Triangulation took place through the Pramling study (2006). It also re-analyzed the Piagetian data set of child-responses from *The Child's Conception of the World* (Piaget, 1929/2007), and concluded that more investigations into the usefulness of the children's intuitive ideas may be fruitful. Reading and re-reading the interview data was a form of attempted adherence to issues of reflexivity, trustworthiness, and reliability. The patterns that emerged after several reads of the interviews and the accompanying analyses evolved beyond personal bias through the process of iteratively putting oneself in the place of the interviewee and attempting to immerse oneself in the phenomena (Moustakas, 1994).

3.5. Researcher Subjectivity

Knowing the subjectivity of the researcher is of the utmost importance in conducting a study, because it is a certainty that a human being cannot be completely objective. This issue is especially important for this study because it re-analyzes the master scientist, Piaget and challenges whether the questions put to the children set up misconceptions of the children's answers. It is clear that "where the researcher is the primary instrument of data collection, subjectivity and interaction are assumed" (Merriam, 1998, p. 103). The re-analysis in this study looked at the questions and answers of the children paired with the interpretations of the meanings of those interviews made by Piaget. It then re-analyzed the interviews from a viewpoint of the

child's holistic intuition. In doing this, it stepped back from the somewhat positivistic mindset of the era in which Piaget operated and, to the best of the researcher's ability, attempted to strip away motivations from that time that colored the interpretations of the children's minds. It "simply describes what is 'there' in the text without being 'biased' by the 'subjectivity' of the analyst " (Fairclough, 2003, p. 14).

It is a limitation of this study that the researcher is left in the ironic position of having to slay the master, with the master's own sword, as it were - to criticize Piaget for favoring the analytic side of the mind by using a non-positivistic re-analysis of Piaget's original analyses of the children's interviews. In order to do this, epistemic beliefs have been introduced that assert the viability of the intuitive side of the mind. The researcher recognizes that he himself has epistemic beliefs that he may have imposed on Piaget's work. Further, since these epistemic frameworks may be embedded in the very notion of thought, it may be that the researcher and Piaget are talking about two different aspects of thinking. Human beings have epistemic beliefs that span the analytic to the intuitive-holistic spectrum. It may be a limitation of this study to favor the singular position of a balance between analysis and intuition.

In effect, this study attempted to achieve a lens or viewpoint that incorporates more closely what the child was thinking. It tried to look at the language of the child with greater reflexivity. According to Gee, reflexivity is a chicken and egg question, it "reflects an important reciprocity between language and 'reality'" (Gee, 1999, p. 97). Given that this research used language in interviews and interpreted language in archival documents, then again in writing the study to describe the data collection and analysis, subjectivity, in the form of reflexivity can cause misinterpretation and construction of

new meanings from one's own bias. The author must note that he, himself is well-disposed to intuition and has, in the past, defended a group of children and scientists who come from a culture of intuitive people that he identified with. This could have tempted him to unnecessarily praise strengths and under-report weaknesses of evidence. The author, being an intuitive thinker, may have over-estimated his own ability to understand the context and therefore the situated meaning of an interviewee. This may have caused the temptation to jump to a conclusion.

Being aware of the author's sociocultural connection to this culture of intuitive thinkers, as well as the connection as a teacher, allowed for exploration into the preconceived notions about interactions and interpretations of teachers and students (Ladson-Billings, 2009). Being from a group that has been misunderstood and could not find expression (Bell, 1994) or discourse models in the dominant culture's language (Gee, 1999), caused the author to triangulate his thinking by disclosing his tentative approaches to others throughout the research process.

3.6. Selection of Children and Scientists

There were 42 child interviews and six scientist interview sets that were selected. They were not paired on a one-to-one basis, but rather in a supportive fashion, where scientist interview excerpts were mapped onto the children interviews by comparing similar situated meanings in their discourse. As described below, the children were selected because they were intuitive. The key figures of the science of light in pre- and post-Newtonian times were selected because they were of a caliber of those rare scientists who extended the scientific frontier using a balance of analysis and intuition. The goal of the comparisons that mapped scientists' thinking onto children's thinking was to explore

whether intuitive thinking was useful.

Children

The Piagetian data set of interviews of children in the intuitive stage were selected for three reasons. They were extremely rich in detail, quite extensive, and they have had a strong influence on education in the U.S. According to Bruner,

> Piaget's accomplishments were gigantic. Deconstruction, well executed, elucidates the structures that it modifies by analysis, even if in the end it replaces them. In the end, thanks to Piaget, we shall have a better sense of what self, what individuality, what local knowledge mean. (Bruner, 1986, pp. 147-148)

To re-purpose this data set and extend it to show that it always contained evidence of the child's other epistemic beliefs, the intuitive way of thinking is purported to be a direct vein of investigation by Bruner (1986) and Donaldson (1989).

The specific interviews that were purposefully selected from among the 198 child interviews were selected by narrowing the entire dataset in two ways. First, it was limited to the set of children between the ages of five and seven, inclusive. These children, according to Piaget (1959) are most likely to be in the intuitive stage. Then the selection was narrowed to take all of those child interviews that were in chapters of the book that most dealt with questions of thinking. The three chapters were: Part I. *Realism*: Chapter I. The Notion of Thought ... (22 of the 198 interviews), Part II. *Animism*: Chapter V. Consciousness Attributed to Things ... (9 of the 198 interviews), and Part III. *Artificialism*: Chapter VIII. The Origin of the Sun and Moon ... (11 of the 198 interviews). Thus, 42 5-7 year old child interviews were selected.

Scientists

The six scientists were a unique purposeful selection. "Purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain

insight and therefore must select a sample from which the most can be learned" (Merriam, 1998, p. 61). The criteria for the purposeful selection involved those scientists who demonstrated clear examples of intuitive thinking at times and clear examples of analytical thinking at other times. The uniqueness of these individuals has to do with their historically documented contributions as leaders in their field, and the fact that they are known for the clarity of their thinking. Unique purposeful samples demonstrate qualities where they are "atypical, perhaps rare attributes or occurrences of the phenomenon of interest. You would be interested in them because they are unique or atypical" (Merriam, 1998, p. 62).

Isaac Newton has been selected because he is the well-documented representative of rational, logical thinking against which most historians of science and pedagogy measure the shift to the new thinking that is precisely Non-Newtonian – the intuitive, holistic thinking. Johann Wolfgang von Goethe has been selected because he wrote a treatise that directly compared rational, analytical thoughts of Newton on the theory of color to a completely alternative set of his own. This was chosen this for the stark contrast in Goethe's treatment of intuitive thinking in whole concepts as opposed to Newton's use of particulate treatment of light. Michael Faraday and James Clerk Maxwell have been selected because they worked together on the theory of electromagnetism and light from both the intuitive side (Faraday) and the analytical side (Maxwell). Their story is one of synthesis, however, unlike Newton and Goethe. They used both ways of thinking to address the same phenomena and arrive at the same theory. Albert Einstein and Erwin Schrodinger have been selected because they are well-known and well-documented in recent history of science as embodying a new way of thinking

that utilizes rational analytical Newtonian theory, yet adds an intuitive holistic form of thought. This new thinking embraces duality as a co-existing whole Einstein does this in the theories of relativity and Schrodinger in quantum physics. Both of these scientists embrace the principle of complementarity, the assertion that perhaps matter can be made of separate particles, and, at the same time, be made of interconnected waves.

It was predicted that, when the scientists espouse Newtonian ideas, their discourse would correlate to logical, formal thinking in most older children and most adults; but that when the scientists speak of Non-Newtonian ideas, their discourse would look more like the intuitive, pre-operational thinking of most young children and some rare adults.

CHAPTER 4: DATA INTERPRETATION AND ANALYSIS

This chapter addresses the interpretation and analysis of the Piagetian data set of child interviews and Piaget's analysis of them (Piaget, 1929/2007), as well as the researcher's re-analysis of Piaget's interpretations. The re-analysis explored the intuitive epistemic beliefs, in particular.

4.1 Data Set Description

The Piagetian interviews come from the book, *The Child's Conception of the World*, from the three chapters: Part I. *Realism*: Chapter I. The Notion of Thought, Part II. *Animism*: Chapter V. Consciousness Attributed to Things, and Part III. *Artificialism*: Chapter VIII. The Origin of the Sun and Moon (Piaget, 1929/2007). The coding scheme maps the child's epistemic beliefs to those of quantum theory. There are three codes: interconnectedness, paradox, and consciousness. Below is a breakdown of how each is described in Piaget's analysis and how each maps into a quantum physics theoretical construct.

Child's Intuitive Discourse Categories

Interconnectedness

This category deals with how the child sees oneness in the connection of many objects of nature and humankind. It maps into the quantum physics theoretical construct of *entanglement*, which also deals with the simultaneous wholeness and separateness of

nature. The *interconnectedness* category includes the following categories by Piagetian Interpretation:

egocentrism - the belief that an object acts for me
articifialism - the belief that objects have been made by humans or God
participation - the belief that objects of nature and humankind consciously affect one another

Paradox

This category deals with how the child has the ability to handle ideas that do not and cannot exist at the same time if one uses formal reasoning epistemic beliefs only. It maps into the quantum physics theoretical construct of *complementarity*, which considers that there exists some epistemic belief whereby light can be both a wave and a particle, even though logic seems to dictate that these are opposing views. This *paradox* category includes the following categories by Piagetian Interpretation:

contradiction - the ability to believe opposite ideas that cannot logically be true at the same time
animism - the belief that objects of nature have consciousness and are alive
purpose - the belief that objects of nature have ultimate goals
intention - the belief that objects of nature consciously perform acts to achieve goals

Consciousness

This category deals with how the child has a conception of the world as comprised of many conscious entities, that is, ones that are alive and have minds. It somewhat crudely maps into the quantum physics theoretical construct of the *observer effect*, which some physicists interpret as meaning that if a consciousness observes a phenomenon, the phenomenon may be affected. This *consciousness* category includes the following categories by Piagetian Interpretation:

intention - the belief that objects of nature consciously perform acts to achieve goals

purpose - the belief that objects of nature have ultimate goals
participation - the belief that objects of nature and humankind consciously affect one another
animism - the belief that objects of nature have consciousness and are alive
articifialism - the belief that objects have been made by humans or God
egocentrism - the belief that an object acts for me

There is overlapping of the children's references to the categories of interconnectedness, paradox, and consciousness among the children's beliefs because these are not separate ideas; they are themselves interconnected. Thus, a child might *egocentrically* say that the sun is shining for me, implying both the *interconnectedness* of the sun and the child and the possibility that the sun has *consciousness*, with an express *intention* to *participate* in the welfare of the child. Thus many portions of the child interviews have multiple codes.

4.2 Re-Analysis of Piaget's Interpretations

Following is the re-analysis of the Piagetian interviews (Piaget, 1929/2007).

Coding Scheme

Child Epistemic Belief	Quantum Theoretical Construct	**Code**
INTERCONNECTEDNESS: egocentrism, participation, artificialism	**E**NTANGLEMENT	I/E
PARADOX: contradiction, animism, purpose, intention	**C**OMPLEMENTARITY	P/C
CONSCIOUSNESS: intention, purpose, participation, animism, artificialism, egocentrism	**O**BSERVER EFFECT	C/O

Frequency Distribution

Code	**# Codes**	**# Children**
I/E	36	30
P/C	14	12
C/O	36	31

A detailed account of the code assignments with long descriptions of the analysis of the 42 child interviews, Piaget's discourse analysis of them, and the re-analysis can be found in Appendix D. Following is a summarization of the re-reading this study performed of Piaget's discourse analysis. It will give three cases of each of the child's intuitive discourse categories: *interconnectedness*, *paradox*, and *consciousness*. Each case discusses: Piaget's discourse analysis, then a re-analysis, and finally a mapping of the child's epistemic beliefs onto that of a scientist. The interview excerpts are all from *The Child's Conception of the* World (Piaget, 1929/2007). Each excerpt includes the child's age in years and months with interviewer's questions followed by the child's answers in italics.

Interconnectedness Case #1

In a series of interviews about the notion of thought, Piaget asks the children directly, what they think thought is. The following is one example:

> Mont. (7; 0): "You know what it means to think? —*Yes*.—Then think of your house. What do you think with?—*The mouth*.—Can you think with the mouth shut?—*No*.—With the eyes shut?—*Yes*.—With the ears stopped up?—*Yes*.—Now shut your mouth and think of your house. Are you thinking?—*Yes*.—What did you think with?—*The mouth*." (p. 39)

In Piaget's discourse analysis of the child's notion of thought, he describes the child as a being who is interconnected to the world to such a high degree that inner thought and outer, physical reality blend together:

> Let us imagine a being, knowing nothing of the distinction between mind and body. Such a being would be aware of his desires and feelings but his notions of self would undoubtedly be much less clear than ours. Compared with us he would experience much less the sensation of the thinking self within him, the feeling of a being independent of the external world. The knowledge that we are thinking of things severs us in fact from the actual things. (p. 37)

Piaget describes here the intuitive child as being embedded in the world and not experiencing disconnection. He clearly describes how an adult can separate the thinking self from the world and that this "severs us" from the actual things. This study agrees with this analysis of Piaget. The disagreement lies in the fact that Piaget does not mention the value of being able to be embedded in the phenomenon you are observing. It is precisely this ability that has made some scientists great.

Einstein (1920/2010, 1950/2011) speaks of this interconnectedness that the ancients hypothesized (Diop, 1974; Stone, 1976), but was all but forgotten by Newton's (1730/1974; 1979) time. He recaps a portion of scientific history much like Kuhn's analysis of paradigmatic revolutions (2004), whereby scientists had a conflicting dual set of notions in the belief in action at a distance versus the connectedness of fields – but in many cases, he concludes that allegiance to Newton's doctrine was stronger than reasoning:

> Newton's theory is probably the greatest stride ever made in the effort towards the causal nexus of natural phenomena. And yet this theory evoked a lively sense of discomfort among Newton's contemporaries, because it seemed to be in conflict with the principle springing from the rest of experience, that there can be reciprocal action only through contact, and not through immediate action at a distance. It is only with reluctance that man's desire for knowledge endures a dualism of this kind. How was unity to be preserved in his comprehension of the forces of nature? Either by trying to look upon contact forces as being themselves distant forces which admittedly are observable only at a very small distance--and this was the road which Newton's followers, who were entirely under the spell of his doctrine, mostly preferred to take; or by assuming that the Newtonian action at a distance is only _apparently_ immediate action at a distance, but in truth is conveyed by a medium permeating space, whether by movements or by elastic deformation of this medium. Thus the endeavour toward a unified view of the nature of forces leads to the hypothesis of an ether. (Einstein, 1920/2010, p. 3)

Mont, the child in Piaget's interview, speaks of interconnectedness in a rudimentary, non-articulate form, but it is nevertheless not to be mistaken as very different from the

interconnectedness that Einstein voices. The Piagetian discourse analysis, on the other hand, maps into the positivist, separateness in Newton's thinking.

Interconnectedness Case #2

In describing thought, Ron says that thinking is the grass moving:

> Ron (7 1/2): "Can one see thought?—*Yes*.—How?— *In front of you*.—Where? *There* (50 cms away) *or right over there?—It doesn't make any difference. The wind makes the grass move and you see it moving. That is thinking*. —Is it in front of you or in the brain?—*Both, you can think anyhow*.—Can one touch thought?—*Sometimes, when the thoughts are real*." (p. 46)

Piaget analyzes that for Ron, "Words would be bound up with things and to speak would mean to act directly on things. Inversely, external things would be less material and would be endowed with intentions and will" (p. 37). So, here again Piaget's observance is that the intuitive child does not see boundaries between the inner world of thought and the outer world of things. Again, I agree with this observation. More times than not, my disagreement is with Piaget's omission to cite value in pursuing these intuitive notions. Although, much of his contribution to pedagogy comes from his many suggestions on how to encourage the child's abilities to construct meaning as the child gets stronger in the use of formal reasoning (Piaget, 1950, 1959; Piaget & Inhelder, 1969), Piaget often omits commentary that would suggest that education would benefit if intuitive epistemic beliefs were to persist in schooling. Many indigenous, Eastern, Southern, and ancient peoples believe that humankind is affected by and is constantly affecting other parts of nature in ways that are too subtle to measure (Asante, 1991; Diop, 1974; Nisbett, 2003; Stone, 1976; Whorf & Carroll, 1964). I think that Ron is expressing something of this connection when he connects movement of the wind and grass with thinking. I think that he may be using a rudimentary intellect in reasoning, but a powerful intuitive intellect in

metaphorically saying that there are kinds of thinking that are more subtle than modern science has so far detected. Nevertheless, these early tendencies to see interconnection between inner and outer are basically dismissed as precursors to formal thought in Piaget's discourse analysis.

The evolution of thought in science moved from ancient ideas of greater interconnectedness, to modern ideas of separateness. It is just in the last century that there has been movement to integrate these paradigms and consider them both as possibly useful (Kuhn, 2004). Einstein describes how the Newtonian view that the world was a like machine, made of separate physical parts is not a complete description. He asserts that the interconnectedness of Faraday's and Schrodinger's field view, where everything is touching, is needed, also. This is just like the child's intuitive view that supplements the formal reasoning view.

Einstein exhibits a Non-Newtonian – or intuitive – sense of wholeness when he claims that notions of classical mechanics (Newtonian physics), like the material view of the world and the mechanistic view of nature will not be able to completely describe the objects that our senses perceive:

> First we try to get clearly in our minds how far the system of classical mechanics has shown itself adequate to serve as a basis for the whole of physics. Since we are dealing here only with the foundations of physics and with its development, we need not concern ourselves with the purely formal progresses of mechanics (equation of Lagrange, canonical equations, etc.). One remark, however, appears indispensable. The notion “material point” is fundamental for mechanics. If now we seek the mechanics of a bodily object which itself can not be treated as a material point—and strictly speaking every object “perceptible to our senses” is of this category—then the question arises: How shall we imagine the object to be built up out of material points, and what forces must we assume as acting between them? The formulation of this question is indispensable, if mechanics is to pretend to describe the object *completely*. (Einstein, 1950/2011, pp. 28-29)

Thus Einstein underscores the fact that science cannot fully describe the world if it conceives of matter as broken up into separate points. More interconnectedness is necessary. Einstein refers to Newton's mechanistic view of matter – classical mechanics - as believing that matter is made of "material points" (Einstein, 1950/2011, p. 29). He describes how this view leads to an atomistic materiality. Further, Einstein claims that the pairing of a mechanistic predisposition and an atomistic conclusion leads Newton, and those theorists who inductively build the Newtonian view of the whole of nature from the parts, to see atoms as separate and particulate. This stands opposed to the Non-Newtonian view of Faraday (1839/1965) and Schrodinger (1944/1992), which considers nature to made of force fields that spread to infinity and touch everything:

> It is natural to the tendency of mechanics to assume these material points, and the laws of forces acting between them, as invariable, since time alterations would lie outside of the scope of mechanical explanation. From this we can see that classical mechanics must lead us to an atomistic construction of matter. We now realize, with special clarity, how much in error are those theorists who believe that theory comes inductively from experience. Even the great Newton could not free himself from this error ("Hypotheses non fingo"). (Einstein, 1950/2011, p. 29)

So, when Ron said that thinking is the wind moving the grass, there is a second way to analyze his remarks, other than simply observing the lack of boundary between inner and outer. Ron may also be interpreted to have metaphorically expressed that there is connection in the world that goes beyond what can be currently measured.

Interconnection Case #3

When the children were asked about origins of the sun and the moon, they constructed myths. Piaget was careful to note the occurrences of each myth, but he often dismissed them as inadequate articulations or partially formed theories. But, most of the children speak of the sun and moon being connected to humankind and consciously

participating in our affairs. They constantly express an interconnectedness, but they seem to make up myths from the nearest idea to their experience. Following is an example:

> Roy (6; 0): "How did the sun begin?—*It was when life began*.—Has there always been a sun?—*No*.— How did it begin?—*Because it knew that life had begun*.—What is it made of?—*Of fire*.—But how?—*Because there was fire up there*.—Where did the fire come from?—*From the sky*.—How was the fire made in the sky?—*It was lighted with a match*." (p. 258)

Piaget interprets that the tendencies in Roy's thought and the origins of his myths come from possible experiences Roy has had:

> There are, in fact, three tendencies in Roy's thought: (1) An artificialist tendency; the sun and moon have been made by man. Their origin lies in the flame of a match. (2) An animist tendency; the sun and the moon are alive, they know when it is day-time, and what we are doing, etc. (3) A tendency to establish participations between them and ourselves; they grow because we grow, they began to live "because we were made" ("parce que nous, on s'est fait"), etc.

These are accurate observations of the various categories of Roy's beliefs that humankind is connected to nature in that nature is artificial, conscious (animist), and participative in our affairs. The omission here is that there is no mention of a benefit to these tendencies. The intuitive child is depicted as an adult with the deficit of not being able to see reality, so myths are constructed. The reality, according to the time Piaget lived in, is that science could not see any form of connections that Roy refers to between the sun and moon and humankind, so there must not be any worth looking for. Nevertheless, as the child grows, society will call the ability to look for relationship and connection, before we can see a reason to do so - appreciation of diversity. Tolerance and appreciation of another person is founded on the act of seeking relationship before seeing why to do so.

Consider the paragraph where Piaget analyzes that when Roy invents a myth that the sun comes from a match, he had an earlier thought that the sun, moon, and humans are connected by the participations in their intentions and therefore, "it is the myth which

is derived from these feelings and not the inverse. The myth is, in fact, more or less an effort of invention" (Piaget, 1929/2007, p. 260). A little further, Piaget states, "This relation amounted to no more than this, that man in coming to life thereby provoked the same sort of activity in the sun and moon" (Piaget, 1929/2007, p. 260). So Piaget's analysis is that the child makes up myths by deriving or reasoning from fictitious premises of the connectedness of nature and then the child invents other ideas because the child is fixated on presumptions that humans coming to life had an effect on the sun and moon.

In many instances, Piaget projects adult tendencies onto children, thus missing alternative benefits of child-like intuition. In the case above, he does not mention the possibility that Roy may not be trying to express thought by continually straining it, but perhaps by another method altogether. Perhaps Roy is trying to describe ideas in ways that have already been constrained by the language and the expectation of the questioner. It is this way with qualitative versus quantitative descriptions. While they may sound quite different, they may be approaches to the same end. But a listener expecting a quantitative answer may easily miss the value of a qualitative response.

It must be recalled that this re-analysis is not based on the truth or positivistic inquiry into the child's statements; rather it is based on the usefulness of the way the child is thinking and learning, the epistemic belief system of the child. The child starts from a premise that all is connected (Piaget, 1929/2007). This includes the objects of the world: the sun, the moon, the child, and the like. But it also includes the processes of life and nature, like our intentions and desires and purposes. Further, it not only connects things, it also connects times. Thus, the child hears the question basically as something that

presumes separateness in the way it is asked. Therefore the child must begin to please the adult by considering something the adult presumes to be a fair question. To the child however, the question has no clear answer. When the child is answering the adult, the child is using a different thought paradigm and therefore a different language (Donaldson, 1989).

Paradox Case #1

When the children express themselves they do not keep ideas in neatly separated categories. Often the child mixes tendencies to expressing *interconnectedness, paradox,* and *consciousness*. This is evident when Roy explains how the sun and moon get big "*because we get big*" (p. 259). At a later time Roy continues:

> "Can we make the clouds grow bigger?—*No*.—Why do they grow bigger?—*Because we grow bigger* (Roy admits thus what he has just denied).—Why do you grow bigger?—*Because I eat*.—Does that make the clouds bigger too?—*No, they grow because they know that we do*." And after a moment: "How did the clouds start?— *Because we were growing*.—Is it we who make them grow bigger?—*No, it isn't us, but the clouds know we are growing*." (p. 262)

Piaget comments on the fact that Roy can contradict himself without being bothered by paradox, then in another moment he can use language that implies that the universe is ordered, with logical rules:

> In other words, the universe is a society of like beings living according to a well-ordered code of rules; every analogy is at the same time a logical relationship since analogy signifies common or interacting purposes and every purpose is a cause. One even feels that, for Roy, the members of this universe necessarily imitate each other so that when we grow the moon and the clouds are forced to follow suit. Clearly, when Roy is made to define his ideas his participations develop into animistic explanations. (p. 262)

Piaget may be projecting an adult's ability to reason onto Roy when he implies that when Roy is defining his ideas, he develops them into animistic explanations. Piaget implies

that Roy invented the idea that the universe is alive, as a myth that was needed in order to explain what he sees. Perhaps this is so, but what is missed is the possibility that at the same time, in a paradoxical way, Roy may be explaining an opposite idea. Roy may be starting from a larger whole idea that all things have purpose, connection, and intention - that things first exist outside of a place where formal reasoning can touch them. Roy may be trying to say two ideas that are simultaneously true to him, but not logically possible - that the world is well-ordered by logical rules, and that it is not always logical. But to use normal language to do this is difficult, so Roy needs to speak in a type of metaphorical language that allows the sun and moon and wind to come alive to show their obedience to purposeful intention. In using such metaphorical language, Roy resorts, probably unwittingly, to paradox.

Roy sometimes assigns God as the agent of nature's changes, and sometimes he assigns humans as the agent, then at other times, he assigns agency to the object itself ("*they grow because they know that we do*") (p. 262). So, once again, my re-analysis agrees with Piaget, that the child starts from premises that the universe is connected and has the intention to participate in the affairs of humankind. The disagreement is with Piaget's omission to signify this as important or useful. This time, it appears that Piaget does not allow for paradoxical statements to be true at the same time. So, if Roy may be using metaphorical language that contradicts itself in grammar or in fact, Piaget categorizes Roy's statements, but dismisses them soon afterward. Piaget simply moves on to discuss how to make use of constructivist techniques of developing the formal reasoning of the child, thus discarding the intuitive contribution.

As Donaldson (1989) points out in her re-analysis of Piaget, the child is often trying to use the language of the interviewer, thus constraining or distorting the answer to some degree. The child's language does not simply have word meanings that differ, more importantly it has different grammar. Whorf (1964) compares statements of process of the child to those of indigenous peoples like the Hopi and Aztecs. He points out that the Hopi often do not conjugate verbs because of the connection of a thing to where it was and how it is manifesting in the present and future. Roy may very well be teaching the adult interviewer a wise lesson when he refuses to separate the intentions of the sun and moon from his own, much like the Hopi expresses a flash of light. The Hopi says "flash" for the event. There is no subject, such as light, as in "the light flashes". If the Hopi used a subject it would require a predicate with a verb that does the flashing. To the Hopi, this is an assumption that some separate object is doing the flashing. This to the Hopi would be a projection of the observer onto the phenomenon - to assume that something performed the act of the flash - and it would be a further assumption to assign a verb tense to this act since no one knows when and where it came from, nor where it is going. Like the child speaking of the sun and moon as participating with the human, the Hopi uses the epistemology that starts from connectedness and must be proven otherwise. In the modern, technological west we start from the assumption that all things are separate and must be proven to be connected (Kuhn, 2004). It must be recalled that this discussion is not a venue to decide on the truth or falsehood of these assumptions, but rather on their usefulness. Whorf has stated that this connectedness of a child is extremely useful:

> The thoughts of a Hopi about events always include *both* space and time, for neither is found alone in his world view. Thus his language gets along adequately without tenses for its verbs, and permits him to think habitually in terms of space-time. Properly to understand Einstein's relativity a Westerner must abandon his

> spoken tongue and take to the language of calculus. But a Hopi, Whorf implies, has a sort of calculus built into him. (Whorf & Carroll, 1964, p. viii)

Thus, Piaget may be projecting a reasoning, analytical process of thought onto the child in the very way he asks the question. Then, when he interprets the child, he may be missing that the child is simply saying that he cannot conceive of separateness, so mythical answers for impossible conjectures must be invented.

In Piaget's time, society in the modern technological West was in a positivistic, scientific mindset. Kuhn (2004) might say that the prevailing paradigm of thought in this society was that there was one way of finding things out, of finding the right answers. Education in the U.S. was built on pillars of behaviorist and scientific, positivistic thought paradigms (Bruner, 1986) that were uncomfortable with paradox. It was much better to teach definite factual material that could easily be put into test form. The accent was on the objects being known as opposed to the child as a knower (VanSledright, 2008). In an article about how the teaching of history can avoid paradoxes of interpretation, VanSledright asserts that the "standard textbooks, combined with lectures delivered by teachers, are considered definitive. Tests measure the results. The obsession appears to be with the products of historical study, not with the practice of doing it" (2002, p. 1091).

Re-analysis like the samples above need to be done because society has begun to learn to entertain multiple modes of thought as it has learned to globalize its appreciation of multiple cultures (Darling-Hammond, 2010). Roy may be expressing relationships that society needs at this time. Through metaphorical language the intuitive child uses paradox and therefore multiple, contradictory meanings.

Paradox Case #2

Another case of a child speaking paradoxically can be seen in the interview with Reh below. Reh makes contradictory statements that the sun cannot feel and is not alive, yet, Reh says, the sun has the ability to intentionally rise in order to shine or go away if the weather is bad.

> Reh (6 1/2) resists all suggestion concerning clouds, the wind, water, etc., but claims also that the sun doesn't feel. "Can the sun feel anything?—*No* —Why not?— *Because it isn't alive*." But when the sun's movements are recalled more definitely he shows a latent animism: "Why does the sun rise? *So that the sun will shine* (pour faire du soleit).—Why?—*I don't know*.—What does the sun do when there are clouds and it rains?—*It goes away because it's bad weather*.—Why?—*Because it doesn't want to be rained on*," etc. (p. 186)

Piaget analyzes from these paradoxical statements that in "simpler language, it means that, in speaking, the child does not succeed any more than we do - in expressing his thought really accurately; he is continually straining it, through inability to recollect every shade of meaning" (p. 192).

I think that Piaget is projecting an adult perspective onto the child, here. He assumes that the child's only desire is to reason. While I think, that it is of course correct, that the child is always straining toward reasoning and is trying to be like the adult, my re-analysis holds out for the possibility that the child may be simultaneously making another pronouncement. Reh might be moving into and out of statements based on the physical evidence and the qualities of a priori relationships that are assumed to be true about the sun. Reh may be constructing a metaphor to say that the sun must somehow be similar to humankind, and also connected to us. Much the way a scientist moves in and out of measurement and mathematical description of quantitative aspects of a phenomenon versus qualitative descriptions, Reh may be describing some things that can

be verified by physical evidence, while also describing other qualities that come from epistemic beliefs observed in Reh's inner thought. While the quantitative and qualitative can be appear paradoxical, in that the reasoning mind does not always know how to entertain both of them at the same time, they can also serve to complete a holistic view (Bruner, 1960).

Reh may be acting in the way that scientists do in describing light as electromagnetic fields from two very different views that are qualitative and quantitative, yet complement each other to make a whole picture. A well-known case of such descriptions occurred when Maxwell and Faraday worked together on electromagnetic theory. The quantitative approach of Maxwell is useful and necessary to the progress humankind has made in manipulating electricity and magnetism. It also gives a way of understanding the electromagnetic field that is common to many cultures – as mathematics seems to transcend language – though this is a fervent debate in its own right (Kuhn, 2004; Nisbett, 2003; Whorf & Carroll, 1964). The way Faraday describes phenomena by closely tying his language to the sense perceptions – and winding his way toward theory from a comprehension of the whole set of experiments – is useful as an alternative approach. Some students of the electromagnetic field theory of light can learn from the epistemic belief system of Maxwell's communications, while others come to an understanding more easily through Faraday's approach. Maxwell uses a more analytical, quantitative approach and Faraday uses a more intuitive, qualitative approach. There are many times that Faraday uses analysis and Maxwell uses intuition – there is no black and white scenario where one finds either person thinking and learning completely from one epistemic belief. This is how Maxwell used Faraday's observations to corroborate his

own findings. Maxwell induced conclusions analytically from parts, but then he followed Faraday's thinking that proceeded from the whole, by a deductive method, to the parts. Maxwell, therefore used the exercise of following Faraday's path to triangulate his own findings for confirmation and verification:

> When I had translated what I considered to be Faraday's ideas into a mathematical form, I found that in general the results of the two methods coincided, so that the same phenomena were accounted for, and the same laws of action deduced by both methods, but that Faraday's methods resembled those in which we begin with the whole and arrive at the parts by analysis, while the ordinary mathematical methods were founded on the principle of beginning with the parts and building up the whole by synthesis. (Maxwell, 1873/2010, pp. x-xi)

Maxwell, in the above quotation, describes Faraday as starting from whole ideas and moving to parts. This is an intuitive act followed by an analytic act. Perhaps that is the metaphorical orientation of Reh. Perhaps he is also starting from a whole idea, that the sun is alive and has intention, then moving to analysis, straining to explain nature. So, the question is, are we better off encouraging students like Reh to hold two paradoxical views of separateness and of connection? Or, should we dismiss the one, and move on to the other?

Paradox Case #3

One might object to my re-analysis by saying that even the intuitive child is already beginning to reason and logically deduce conclusions from an early age. This is of course true, and is corroborated by many educational and cognitive theorists (Bandura, 1971; Bruner, 1983; Piaget, 1950; Vygotsky, 1962, 1966/2002; Vygotsky & Cole, 1978). The point of my re-analysis is not to say that analytic, logical thinking is not possible during and even before the child is intuitive. The point is that education has not explored a balance of intuition and analysis sufficiently. Schools do not keep intuition alive so that

paradoxical ideas of myth can co-exist with rational ones. In a world where almost every human relationship we have with our loved ones contains paradoxes that we often never solve (Bruner, 1986), we tell children to abandon non-rational tendencies beginning in the earliest years of schooling. Consider the following interview as an example:

> Jacot (6 1/2) believes that the sun is of fire: "How did it begin?—*It was quite tiny*.—Where does it come from? —*From Heaven*.—How did it begin in the sky?—*Always getting bigger*." Jacot says that the sun is alive and conscious. It has grown like a living thing. It was made by human beings. (p. 264)

Jacot irrationally goes back and forth, offering contradicting notions on the origin of the sun. Piaget accurately notes this tendency as pervasive among the children in the intuitive stage. He omits references, however, to the human prerogative to contradict oneself - and whether this can be a constructive act. The prevailing educational theories of Piaget's time demanded that logic be honored, which excluded such irrational statements as Jacot makes. Good pedagogy implied that Jacot must move past such silliness and get on with the business of clear reasoning. It did not allow that, while reasoning is one of the greatest assets of humankind (Schrodinger, 1944/1992), it can profitably coincide with inexplicable intuitions (Einstein, 1920/2010).

When the child reaches Piaget's formal reasoning stage, causal effects can be logically deduced. The child can perceive mechanistic order. According to Schrodinger (a foremost spokesman for quantum theory), however, science had to move past thinking in deterministic ways. Science had to move past regarding the human as a machine. In order to embrace quantum physics, science had to re-embrace some historically earlier ways of thinking. These are ways that the intuitive child thinks - ways that assume a certain amount of order and conscious intention. Schrodinger used the thinking style of the intuitive child as he posited the physical interactions of the world:

> For it is simply a fact of observation that the guiding principle in every cell is embodied in a single atomic association existing only in one copy (or sometimes two) — and a fact of observation that it results in producing events which are a paragon of orderliness. Whether we find it astonishing or whether we find it quite plausible that a small but highly organized group of atoms be capable of acting in this manner, the situation is unprecedented, it is unknown anywhere else except in living matter. The physicist and the chemist, investigating inanimate matter, have never witnessed phenomena which they had to interpret in this way. (Schrodinger, 1944/1992, pp. 77-79)

So, Jacot may be exemplifying a thinking style that not only can serve in social relationships of humans, it might also be good preparation for scientific thinking in interpreting movement of the atoms for the physicist and chemist.

Consciousness Case #1

Often, the children that were interviewed expressed the tendency to attribute consciousness to objects of nature. Piaget observes that this seems to be an a priori notion. Following is an example:

> Kenn (7 1/2): "If you pricked this stone, would it feel it?—*No*.—Why not?—*Because it is hard*.—If you put it in the fire, would it feel it?—*Yes*.—Why?—*Because it would get burnt*.—Can it feel the cold or not?—*Yes*.— Can a boat feel it is on the water?—*Yes*.—Why?— *Because it is heavy when you are on it* (= it feels the weight of the people on board).—Does water feel if you prick it? —*No*.—Why not?—*Because it is thin* (= not solid).— Does it feel the heat of the fire or doesn't it feel anything? —*Yes* (it feels it).—Would the sun feel it if some one pricked it?—*Yes, because it is big*." "Does the grass feel when you prick it?—*Yes, because you pull it*." "If this table were carried to the other end of the room, would it feel it?—*No, because it is light* (= it would offer no resistance, because it weighs so little).—If some one broke it?—*It would feel that*." (p. 176)

Kenn clearly wavers on positivistic scientific reasoning as he varies his explanations of causal events. But, perhaps he is not only trying to give rational explanations. Kenn moves in and out of the idea that the stone (or boat or sun) feel things as if they have consciousness.

In the following, Piaget analyzes the children's discourse to attribute

consciousness to things. Whereas, the science of his time considered physical objects of the external world as completely separate from each other and completely separate from the mind of the human being, the children did not see these boundaries.

> Since the child does not distinguish the psychical from the physical world, since in the early stages of his development he does not even recognize any definite limits between his self and the external world, it is to be expected that he will regard as living and conscious a large number of objects which for us are inert. This is the phenomenon we propose to study and we shall describe it by the current word "animism." (Piaget, 1929/2007, p. 169)

Thus, Piaget notes that the child starts with the consciousness of natural things as an a priori notion, along with the lack of limits between self and the external world. Once again, my re-analysis agrees with this. The problem is always with Piaget's next step. He implies and sometimes outright asserts that these are notions of childhood that must be left behind, when the child moves on to formal reasoning. This study questions whether or not there is use in retaining the ability to think in a way that leaves the question of the consciousness of things as an open issue. I recommend that we allow the child to hold the set of epistemic beliefs that simultaneously hold two opposites. On the one hand, there is the modern scientific evidence that there are living things as opposed to inert things. On the other hand, there is the idea that there is something to the fact that most children have a priori beliefs that consciousness is pervasive in nature. Once again, I do not wish to judge the scientific truth of this as fact or fiction. I only wish to note the epistemic belief that opposite ideas can be true at the same time. It must be noted, that this idea of consciousness overlaps the child's notions of paradox and the interconnectedness of things, but this may be precisely because the child sees ideas as undivided wholes. Also, it must be re-iterated, that it is not Piaget's fault that education founded its pillars on behaviorist premises that reward analytic acts of learning facts as if knowledge of objects

alone is valuable (Thorndike, 1913/2010). This study merely uses Piaget's discourse analysis because it clearly misses the use of the child's intuition, as did most of society of that time (Bruner, 1960).

Piaget lived in a time before science had embraced Einstein's theory of relativity and quantum physics. In order to communicate these theories to oneself and to the world, notions of continuity among the separate parts of the physical world were useful. So, Piaget merely mentioned the intuitive child's tendency to not distinguish between the parts of the world, but Einstein found use for these ways of thinking. Einstein - and actually, Faraday before him – conceived of the world in a significantly different way than did Isaac Newton (Kuhn, 2004; Schrodinger, 1944/1992). Newton's written descriptions often had an analytical, rational, mechanistic view (Newton, 1730/1974; Newton & Einstein, 1979). He wrote of nature as being composed of separated physical particles that interacted through forces like gravity to cause the workings of the objects in the world. Thus, a phrase Newton often used in his paradigm of epistemology and in his scientific description of the world often pictured separate physical objects causing "action at a distance" (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965; Kuhn, 2004; Maxwell, 1856/2010). This concept of action-at-a-distance serves well in this comparative scientist study, because it appeared prominently in the writings of all six of the selected scientists. Since the concept may be foreign, as it comes more from the interior of the physicist's vocabulary, let it suffice to say that it is a pivotal concept on which the analytical versus the intuitive mind divide (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965; Goethe, 1840/1970; Kuhn, 2004; Maxwell, 1856/2010).

So, a re-analysis of Kenn could note that he is synchronous with many children in

attributing consciousness to objects of nature, showing - at least metaphorically - one more way that all of nature may be connected by similar tendencies.

Consciousness Case #2

A pervasive idea among the children interviewed, Piaget explains, is the association of movement with life. This, is then, followed by the association of life with consciousness. Thus in the following example, Schi sees flowers grow, and also thinks that they would know if you tread on them:

> Schi (6, advanced): "Do the clouds feel that they are moving?—*They can feel because it's they that make the wind*." This is Card's theory again and the same argument. Schi also speaks thus concerning flowers: "Do they know when you tread on them?—*They ought to know*," and then explains: "*They must be alive, because they grow*." (p. 183)

Piaget's discourse analysis uses such cases to delineate many forms of what he categorizes as "realism, that is, the confusion between thought and things" (Piaget, 1929/2007, p. 150). This re-analysis does not disagree with this categorization, nor does it disagree that children should learn in school to distinguish between a case where they *think* something and where they *physically experience* some phenomenon. I do disagree with Piaget's final assertion. He claims that when Schi sees connection between thought and thing, between the flower's life, his life, and the possible consciousness of each, that this is a confusion, only. If he had analyzed it as both Schi's left-brain confusion, but also Schi's right-brain speculation, I would agree. My re-analysis would keep value in Schi's statement as possibly having application in ways I do not yet understand. This is a particularly interesting case, because modern biology is currently entertaining the possibility that flowers do have some form of consciousness, a theory that was not mainstream in Piaget's time.

Consciousness Case #3

In the fluid thinking of the right-brain, intuitive child resides the set of epistemic beliefs that there is connection where we do not yet see it and that paradoxes can be true. This mindset worked well for scientists of light and quantum physics in the last century. This same mindset aligns with a social posture that assumes the opposite of deficit modeling when confronted with diversity. In the following example, Font declares that the sun is conscious, that it came from the mountain, and that it is made by humans, among other things:

> Font (6; 9) says that the sun is conscious, it is made of fire and it comes "*from the mountain*.—Where from?— *From the mines*.—What is it?—*People go looking for coal in the ground*." As to the moon: "*It was made by the sun*. —How?—*With the fire from the mountain*.—Where does the moon come from?—*From the mountain*.—What was there in the mountain?—*The sun*—Where does the sun come from?—*From the mountain*.—How did it begin? —*With fire*.—And how did this fire begin?—*With matches*. —And how did the mountain begin?—*With the earth . . . It was people who made it*." (p. 273)

The Piagetian discourse analysis of Font was as follows:

> The principle of these explanations is quite clear. The child starts with two observed facts, namely, that the planets come from behind the mountain and that they are like fire. The synthesis of making the fire come from the mountain follows.

Piaget is lucid in the description of Font's reasoning process. But what about any wisdom Font might have from access to a way of knowing that is somehow other than reasoning? What if Font can think two ways at once - analytically and intuitively? The fluidity with which an intuitive child thinks is precisely what became the new way scientists were beginning to think in Piaget's time. Piaget's omission was not to honor Font's observations that metaphorically refer to connection between humankind and the world of matter. But this is not Piaget's fault. Society, in general, was doing this, and still is. It

is an omission of education in the U.S. to this day to pass over statements like Font's and move on to knowledge in the form of facts and testable knowledge. My re-analysis calls for attention to Font's way of learning, with acceptance of the possibility that there may be more interconnectedness than we now see - in nature and among people.

Schrodinger (1944/1992) uses the epistemic belief system that I think Font is using. In considering how ordered nature is, and also how contradictory ideas can somehow coincide, Schrodinger concludes that the human controls matter. The point here is not to agree or disagree with Schrodinger's theoretical assertions. It is to note his method of thinking and see how closely it resembles that of the intuitive child:

> But immediate experiences in themselves, however various and disparate they be, are logically incapable of contradicting each other. So let us see whether we cannot draw the correct, non-contradictory conclusion from the following two premises:
>
> (i) My body functions as a pure mechanism according to the Laws of Nature.
>
> (ii) Yet I know, by incontrovertible direct experience, that I am directing its motions, of which I foresee the effects, that may be fateful and all-important, in which case I feel and take full responsibility for them.
>
> The only possible inference from these two facts is, I think, that I — I in the widest meaning of the word, that is to say, every conscious mind that has ever said or felt 'I' — am the person, if any, who controls the 'motion of the atoms' according to the Laws of Nature. (Schrodinger, 1944/1992, pp. 86-87)

Thus, Schrodinger applies an intuitive epistemic belief to his method of trying to learn about the movement of atoms in the body that is similar to the way that Font thinks, namely, that conscious intention can impose order on matter. This is in harmony with other scientists in supporting the value of intuitive thought (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965, 1860/2012; Goethe, 1840/1970; Jones, 1870).

4.3 Summary

The problem that caused the re-analysis of this study is not a lack of accuracy or depth of Piaget's scientific observations of the intuitive children. It is that he followed a positivistic bias of his time to pass over potentially valuable uses of the alternative way of thinking that the children expressed. This happened in three forms:

1) When the children spoke of an *interconnectedness* of the physical world. This mapped onto, or is similar to, the quantum effect of *entanglement* because both the children and the scientists allude to physical entities being separate in one sense and connected in another.
2) When they expressed the ability to believe both sides of *paradoxical* ideas that many Eastern and indigenous cultures have historically embraced - a concept that Western science is only beginning to embrace. This mapped onto or is similar to the quantum principle of *complementarity*.
3) When the children implied that many aspects of the physical world have an awareness and *consciousness* capable of intention and participation in human affairs. This mapped onto, or is similar to, a controversial concept that is currently being entertained by some quantum scientists in one interpretation of the *observer effect*.

As the re-analysis shows, Piaget is quite careful to note such forms of intuitive thought, but he does not fully underscore the viability of it as an epistemic belief system that can be leverage for productive learning. Often, he sees it as a stepping stone to more formal reasoning. Sometimes he labels it as childish misconceptions. But most often he simply notes and categorizes intuitive notions with the implication that they are of no use and

must be distanced in favor of logical thought. The pedagogical practices across the United States, which followed on the behaviorist heels of Skinner (1953) and Thorndike (1913/2010), used this logical, positivist bias toward a mechanized view of teaching. This caused rational, analytical reasoning to be favored over intuitive epistemic beliefs. This causes an imbalance was obstructs the most efficient form of learning (Bruner, 1960, 1983, 1986). From the re-analysis in this study of the children's discourse and Piaget's analysis of that discourse, Piaget was seen carrying out this bias such that three themes surfaced in his comments:

> Projection**: A**sking questions or interpreting answers as if the child has reasoned in a similar way to an adult.
>
> Denouncement**:** Proclaiming that the child has made a misconception without looking for possible meaning or use of the child's way of looking at things.
>
> Discredit: Minimization or discarding of the child's intuitive discourse altogether.

The discourse analysis of the 42 child interviews was typical of the 198 interview excerpts which comprise the total published data set in *The Child's Conception of the World* (Piaget, 1929/2007).

In this study, some uses of the intuitive were addressed by epistemic beliefs of the children which have been shown by mapping the children's discourse onto the discourse of scientists who used these forms of thinking in concert with analytical thinking. The consequences of passing over the intuitive discourse of the children as if it were partly formed rational thoughts instead of fully formed intuitive ones are many. They basically fall into three categories, when viewed in terms of the uses of intuitive epistemic beliefs:

Multicultural:
- paradigms of thinking from our past (Kuhn, 2004)
- indigenous thought (Whorf & Carroll, 1964)
- Eastern/African philosophy (Nisbett, 2003)

Scientific:
- color theory (Goethe, 1840/1970)
- electromagnetic field theory (Faraday, 1839/1965)
- quantum theory (Einstein, 1950/2011; Schrodinger, 1944/1992)

Social Diversity:
- awareness of the 'other' in education (Dewey, 1910; Freire, 2000)
- sustainability of the environment (Senge & Barker, 2008)
- family and community (Bruner, 1960; Foucault, 1971)

The next chapter will discuss, in detail, the potential value of intuitive epistemic beliefs if applied to instruction in the U.S. educational system.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

The purpose of this chapter is to discuss some salient observations and issues of this study. This will be done by revisiting aspects of the methodological decisions made in the study. In addition, it seeks to justify further research into education systems that are currently using intuitive epistemic beliefs in balance with analytic ones. It also suggests some implications of how education in the U.S. might change if it moved closer toward this balance. Finally, the optimal qualities of an intuitive teacher are described in the format of the privileges that should be given to such a teacher, in Appendix E.

5.1 Discussion

U.S. schools teach predominately to the analytical, left-brain with foundations in behaviorism using a mechanistic paradigm that influences epistemic beliefs of how learning takes place. The result of this imbalance is that learning suffers (Bruner, 1960, 1983, 1986). The problem is that there is a misalignment. On the one hand, the U.S. still has school curricula, standards, and tests, which are tied to behaviorism. On the other hand, there exists an emphasis on pushing teaching towards constructivist and socio-constructivist learning models (VanSledright, 2002, 2008).

Using discourse analysis of a set of Piagetian children interviews, this study re-analyzed Piaget's work in order to explore the possibility of a useful educational role for the child's intuitive capabilities. Although the children answered from both an intuitive and an analytical perspective, Piaget's analysis of the interviews missed the value in the

intuitive, right-brain answers, thus implying limited use of intuition in the learning process. The reader should not think that I hold Piaget responsible for the lack of emphasis on intuitive learning in education. That emphasis came from the influence of the positivist thinking of the mid-twentieth century (Skinner, 1953; Thorndike, 1913/2010). The behaviorist models of education that held sway in that time caused an emphasis on analytic thought processes. Piaget gave the world a valuable set of insights into constructivist ways of learning. I am trying to show that intuitive pedagogy was not valued enough, even in Piaget's ground-breaking child studies. In what follows, I illustrate the benefits of an education that is a form of pedagogy where intuition is brought back into balance with analytic education. Piaget basically stated that the children were only doing valuable thinking when they were analytical and logical. Using other comparable re-analysis (Kelemen & DiYanni, 2005; Pramling, 2006; Pramling & Samuelsson, 2001) as the yardstick, this study extended Piaget's original interpretations. Since education in the U.S. has not challenged Piaget's omissions, but rather, has followed Thorndike's (1913/2010) and Skinner's (1953) earlier behaviorist recommendations, this study is a call for research into a pedagogical balance between analytic and intuitive teaching.

In order to discuss the implications of an intuitive education, consider five questions which are oriented to different philosophical orientations. These questions are posed as mutually exclusive choices; this is not to imply that both choices are not possible.

1. Should education teach students how to divide and conquer or to seek connectedness and oneness?

2. Is it better for a student to become successful and compete or to have character and integrity?
3. Do we make more productive citizens by improving student test scores or through increased appreciation of multiple world views, intelligences, cultures, and realities?
4. Must schools choose between improving performance in reading, writing, and arithmetic versus improving the ability to relate to people, nature, and beauty?
5. Do we want to see our youth grow up to conquer space, dominate species, and survive or to seek a sustainable relationship with that which is other than your self.

When you went to school, did you lean more toward your creative or business-like side? From 1970 to 2004 the U.S. had a 30 percent increase in writers, where 240 universities have established creative writing MFA (Master of Fine Arts) programs, up from fewer than twenty (Pink, 2006). In other words, we prefer the creative, intuitive, right side of our brains! Recently, Harvard admitted 10 percent of their MBA applicants, while UCLA admitted 3 percent MFA applicants. In other words, UCLA had to turn more MFA applicants away than Harvard had to turn down MBA applicants. This signals movement toward the creative, right-brain MFA degree programs as opposed to the left-brain MBA degree programs. Perhaps this means that there is more competition for the intuitive art of writing and creating or possibly a shift in priorities. MFAs are the new, hot MBAs. More than 50 U.S. medical schools include spirituality, moving away from old school, analytical, and information-based work and toward empathy, narrative medicine, and holistic care. Financial groups are contracting to Indian MBAs, giving cause for U.S.

schools to sharpen our competitive skills; yet U.S. education is still encouraging left-brain activities over right-brain ones. Clearly, society is calling out for a more creative, intuitive individual - and education can help.

The research problem for this study emerged from the point above; that science and business in the U.S. is realizing that people walk on two legs, yet often use only half a brain. This research is a call for a brain balance in schools of analysis and intuition. This has foundations in behaviorism that believe that humans are machines that can be fixed by taking them apart.

As stated in Chapter 1, the U.S. schools to this day emphasize facts and figures, testing children and rating teachers according to student scores (Darling-Hammond, 2010). Our CEOs wonder why new employees cannot solve open-ended problems (Wagner, 2008). Our federal government wonders why we are having globalization issues (Stiglitz, 2002). One conclusion is that at least one change might really make a difference - to allow teachers to be creative and have time to be fascinated at life along with their students. The right-brain fully supports this, and it works quite well with the left-brain. The whole brain person has fun, is creative, loves beautiful things; and at the same time, can be a smart, decisive, and successful member of society. Brain balance can be achieved, and may be significant.

5.2 Implications

It must be recalled from the analysis of this study that although the children did not make correct rational deductions about such natural scientific phenomena as the properties of the sun and moon, they did consistently imply that the sun and the moon have non-rational properties such as being aware of human affairs,

having purpose and intention, and being interconnected to humans to the point that the sun and moon participate in and sometimes cause consequences to humankind. The point the children may have been making, though they could not articulate like a rational adult, is that there is a way of knowing and learning that assumes *connections* throughout the whole of nature that are not perceptible by rational thought or physical investigation at this time. U.S. education could not or was not able to realize or see the point being made by the children, nor did it recommend use of this non-rational way of observing - a trait that many scientists have found useful. This is no different from when teachers are not able to understand that an intuitive child is making a non-rational, yet useful, observation when the child says that the sun is shining so that it will be a nice day for him or her. Often the teacher passes over any value in such a statement, and moves on to some rational fact associated with the accepted canon of scientific knowledge. The potential result is that otherwise capable students may be incorrectly assessed, potentially leading to student frustration. Later, this frustrated student may abandon intuitive thinking, and become a predominantly left-brain thinker. Another way to view this point is in the area of multicultural education. When educators are trained to disregard intuitive world views, there can arise losses of inclusion of paradigms of thinking from our past (Kuhn, 2004), appreciation of indigenous thought (Whorf & Carroll, 1964), and understanding of ancient Eastern (Nisbett, 2003) and African (Asante, 1991) philosophy. For example, it must be recalled from the findings of this study that the intuitive children employ intuitive epistemic beliefs as are necessary for the Eastern ability to handle the paradoxical notion of *the middle way* (Nisbett, 2003). Another form of the intuitive thinking of the child is comparable to the Afrocentric *circle thinking* in groups (Asante,

1991). If modern society continues to ignore intuitive thought it may also lose *scientific* perspectives on color theory (Goethe, 1840/1970), electromagnetic field theory (Faraday, 1839/1965), and quantum theory (Einstein, 1950/2011; Schrodinger, 1944/1992). In addition, character education could suffer in a decreased appreciation of *social diversity* resulting in lesser awareness of the 'other' in education (Dewey, 1910; Freire, 2000), less sensitivity to sustainability of the environment (Senge & Barker, 2008), and decreased attention to family and community (Bruner, 1960; Foucault, 1971). We are already seeing these changes.

Personal Experience with Intuitive Instruction

Teaching intuitively means listening for inspiration to arrive in your mind in the form of an idea to integrate into a lesson, even though it was not in your planning. Many students appreciate it when the teacher models being open to inspiration. I remember one high school class where I was suddenly inspired to use an analogy to explain the way a physics phenomenon works. The analogy was about a father and a son and the deeply caring relationship that they can have. I remember distinctly feeling that this idea came out of the blue, yet I felt it was important in some way that I could not explain to myself. I looked up to see tears in the eyes of one of my students. With an exchange of glances, we communicated to each other that he related to the analogy and it relieved him of some heavy burden.

Where did the father and son analogy come from? I call it *my idea*, yet it never occurred consciously to me until that moment. Was it a product of previous experiences, a combination of other thoughts already inside me; or was it an entirely new idea that just arrived from an outside source, like a phone call coming to my mind as if my mind were

a cell phone? These are interesting questions that press the boundaries of current research into brain activity and they are outside the scope of this study to try to answer them. The relevance to this study is that an idea arrived (the father and son analogy), but its source was not known. Yet, the idea seemed appropriate to use, even though it was not in the plan for the lesson I had to teach. This is the essence of teaching intuitively; to live as if everything and everyone around you is a live source of inputs that may change your next move. The intuitive teacher listens for new ideas as well as planned ones. This teacher therefore, also listens for intuitions to arrive in the students, ready to respect that there may be constructive use of ideas they come up with, even if the teacher cannot imagine what they are. The intuitive teacher is open to inspiration.

Teaching intuitively also means listening for a student's intuition or at least respecting that someone who cannot articulate an idea may still have a good idea, nevertheless. This was evident in the findings of this study, where Whorf (1964) described how many Hopi individuals could not articulate the physical phenomenon of a light flashing, because the Western language required that this communication employ an agent doing the flashing (the light) as the subject of a sentence and a separate verb performing the action (the flashing). To the Hopi however, a *flash* is an inseparable entity; there is no light that does the flash, the light and flash are one.

Although no lack of intelligence or comprehension existed with the Hopi, the Westerners, in Whorf's observation, disrespected the lack of the Hopi to communicate. Just as a teacher might treat the intuitive student, they saw the lack of articulation as a deficiency, rather than a viable use of an alternate set of epistemic beliefs that describe nature. As the quantum Physicist, Schrodinger (1944/1992) points out, the student must

reduce what he or she wishes to tell you in order to put it into language. For example, the child in the findings who said that the origin of the wind is *somebody who blew*, may be expressing the connection between a conscious intent behind physical events that are an inseparable whole. Piaget's interpretation fits with the positivist view that the child is not up to the task of carrying the weight of meaning in a metaphor, because the child lacks the range of life experiences to do so (Piaget, 1929/2007). But this form of analytical explanation needs to settle on a singular answer, because it needs rationality. What Schrodinger (1944/1992) understands from the physics of complementarity and Nisbett (2003) understands from the Chinese middle way is that both things can be true at the same time - the child may lack life experience while also being constrained by language to express concepts that go beyond rationality.

When put into our Western language, the explanation of the wind must be reduced to assigning an agent (*somebody*) to the blowing of the wind, whereas the larger idea the child may be trying to communicate is the wholeness of intention becoming a physical reality. This was in agreement with the way the Hopi speak of the *manifestation* of ideas becoming physical things or events. They describe manifestations that do not have tenses like past, present, and future; rather, they see one whole process of as the wind or the flower or the person as coming into being from an inseparable string of intention leading into fact (Whorf & Carroll, 1964).

Another way to see in the findings where Western thought has disrespected intuition in articulating notions about time is in the way quantum physicists spoke of *entanglement* and the *observer effect* as introducing questions to our concept of physical events perhaps not being caused in linear time (Bohr, 1949). Ideas in their holistic or

intuitive form are too large for words. Einstein (1920/2010, 1950/2011) underscores this sentiment, having experienced being the student who was misunderstood and then being the intellectual scientist that very few could understand. Maxwell (1856/2010, 1873/2010; 1864/1982) also speaks of this in describing how he valued Faraday's remarkable verbal descriptions as a supplement to his mathematical descriptions of electromagnetic fields.

Holdrege and Talbot (2008) describe in depth how a student must by definition always be seeing more than can be described. Goethe argues that a direct perception of nature is real and whole, and we must realize that with a descriptive explanation, we "kill it with the word" (Goethe, 1840/1970, p. 302). This is not to say that the act of putting ideas into words is bad. It is one of the highest acts of the human being. The accomplishments of human beings have reached astounding heights through our ability to communicate with each other and build upon each other's ideas. Our technological achievements stagger the mind, and in many cases truly have the power to help all of us. Nevertheless, intuitive education, if it is to restore balance to these analytic accomplishments, must constantly seek to honor that for every idea that can be articulated and communicated in words or mathematical symbols, there was probably a larger idea. It is probable that we can only bring the tip of the iceberg of what we conceive or receive as ideas to consciousness (Einstein, 1920/2010, 1950/2011; Goethe, 1840/1970; Newton, 1730/1974; Newton & Einstein, 1979). So, it is a balancing act to recognize an idea that has been reduced in order to articulate it.

Reduction need not diminish writing and mathematics; it can even enhance appreciation of the beauty and wonder of all of the intangible aspects of an idea that

remain outside of the conscious purview. In a school setting, this means that the teacher must be ever vigilant to respect the unseen meaning of the students, the literature, the historical vignette. In short, intuitive teaching is the act of being ready to include more than what you see at first, in case more of the unseen parts of the idea surface.

Teaching Intuitively

According to Goethe (1840/1970), naming and labeling, while a mainstay of the rational process, can also have a deleterious effect if left unchecked, in that it can cause imbalance between the intuitive and analytic parts of the mind. As an example, consider the intuitive teacher who wishes to avoid imbalance in order to support students who know intuitively that putting labels on human beings is harmful, but who do not make the leap to see that our analytical way of thinking has taught us to name, categorize, and label everything as a matter of course. For this example lesson, start by demonstrating how light passes through a prism making a rainbow (this works just as well with a lesson in history, literature, etc.). Then ask the class to name the parts of the rainbow. As they categorize it and classify the parts as red, orange, and so on, stop the class abruptly. Walk over to a single student and name some sociological category to which that student belongs.

If the class is open minded enough, make the category somewhat disrespectful, like, "How would you categorize yourself? Are you *merely* a _____ (male, female, gay, minority, etc.)?" Before pursuing this line of analysis of the student's sociology, ask the class if this process of labeling the student limits and detracts from the individual. Then, ask if it would be better, perhaps not limiting, if we were to give the student a complimentary label. Presumably, the class will see that, with any type of label, you

somehow reduce the student to less than she or he really is.

Then, turn back to the act of naming the parts of light. Ask if light is perhaps more than its parts - more than words can describe. The point is that naming can kill, if you ask Goethe (1840/1970). It must at least limit, so although it is helpful to name the parts of a thing, it must always be recalled that the thing itself is always more than the description that we can put into words.

Another way an intuitive teacher can practice the art of giving respect to the idea that a person, a science phenomenon, a historical vignette, or a work of literature or art is more than any words can describe is as follows. Teachers always need to look for alternative views that the lateral thinker or intuitive student might sense. For example, when teaching Darwin's theory of evolution, mention the alternative view of Lamarck. A teacher must not say that science is absolutely certain about one or the other, show the openness to not place ideas into set categories and place limits on them. Here is a good test: Newton's theory of color was challenged by Goethe. But the positivist mood of that time passed over Goethe's ideas much the same as Piaget passed over the use of the intuitive children's ideas.

As a test, see if you can find value in Goethe's alternative view. Newton closed off all light coming into a room except for a small swatch of white light coming through a slit. He passed this through a prism and got the colors of the rainbow and claimed that white light is made of red, orange, yellow, green, blue, indigo, and violet. Goethe, on the other hand, said that Newton only saw a partial view of light. He performed an opposite experiment. Goethe replicated Newton's experiment by opening the room to white light except for a swatch of black, by placing a black strip in a white background. He looked

through the prism and saw an eighth color, magenta. He concluded that Newton had prematurely drawn a quantitative conclusion from partial evidence and that many more qualitative experiments were needed to investigate the relationships of white and black, or light and dark.

The ancient Chinese proponents of the principle of the middle way might say that Goethe brought out opposites in order to find the middle way (Nisbett, 2003). Goethe's original writings on this subject specifically claim that it is not enough to say that colors are merely parts of white light. He makes the qualitative statement that color is born through the interaction of light and dark (Goethe, 1840/1970). This qualitative view, and the significant way in which it is different from the view that *colors come from taking white light apart,* escapes most scientists to this day. This is a prime example of the subtlety we miss if we do not balance intuitive epistemic beliefs with analytic ones. The intuitive teacher here would not only see that the students need to see opposites in order to find a middle way, he or she would also see that the students must see explanations of nature that do not immediately assume everything must be taken apart in order to understand it. To separate light into its colored parts is a valid act; but it is not a full explanation. The Goethean act of making the room light, then looking through the prism at the single, black strip causes an inverted rainbow, the opposite to the one we normally see. Goethe shows the rest of the picture. And in seeing the inverted rainbow, the red from the beginning of the normal rainbow and the violet from the end converge. In their synthesis is the birth of magenta, the elusive eighth color. So, not only has Goethe shown an opposite way, he has produced color by bringing the whole together instead of taking it apart.

The predominant view we teach to children lines up with many lessons we tell them - to break things down into parts in order to understand them. This is a true and valid way to teach. But the opposite needs to be taught, also. Sometimes, we need to bring things together, or better, leave nature in its whole, original state for understanding. This form of understanding and learning is the foundation of the epistemic belief system in intuitive teaching. The intuitive teacher seeks longer connection time to events, but she or he also seeks additional answers. Deborah Ball encourages alternative answers through community in the classroom so that she can "aim to develop the children's appreciation for and engagement with others different from themselves" (Ball et al., 1990, p. 388). I find that when I give such alternative explanations, students are freed by the openness and completeness to learn. It frees them to learn because they do not have to have an inner dialogue that infers that *this teacher is not allowing for the rest of my knowledge, which I cannot explain*. Students who seem to be more intuitive are especially affected by such a balanced approach, so that their ability to learn increases even more dramatically. Giving alternate explanations is not simply about choosing the right metaphors. It is also about leaving room in what I do not say, for students to receive a level of learning from their inner voice, that is larger than I can put into language. My other choice would be to assume the arrogant position that everything the students need, can be articulated in a metaphor by their teacher. This posture is something my students sense - it is not in my language so much as it is in my respect for the unseen and the unspoken. The challenge here would be to generate evidence to support these claims. This is a call for research that can be sensitive enough to see the delicate flower of a student's desire to learn opening in response to the teacher's respect for the unspoken metaphor.

Another negative consequence of the analytical act of naming versus the intuitive act of just observing is that students stop looking once they have successfully named something. It is not that we should not engage in the act of naming, the point is that we should also continue being in connection with that which we have just named. For example, I observed a first grade class doing a science lesson on dirt samples. The children were noticing the colors and textures of red clay, tan sand, and brown hummus. Soon after they gave the right answers as to what color and texture the samples were, the teacher moved on. I know that the teacher was pressured to cover enough information. The school is tested, as so many schools are, and these students would some day be second graders, with teachers who would pass the pressures they feel onto the first grade teacher. The students were still quite interested in the soil however, and the teacher's actions of getting a right answer, then turning away from the soil sends a strong signal to the students. Magdalene Lampert, in her article, *When the Problem Is Not the Question and the Solution Is Not the Answer: Mathematical Knowing and Teaching* (1990), describes successful ways that a fifth grade teacher of mathematics has developed to avoid training children to seek the *right answer* only. In doing so, Lampert claims to foster independent thinking, autonomy, and personal fortitude of character. Getting the right answer can get in the way of staying connected to the subject matter in a deep and meaningful way.

Education's drive to get the right answer can send a harmful message. Many adults come out of the U.S. educational system with a vague thought buried in the back of the mind that there is one right answer for a problem (Wagner, 2008). One thing intuitive teaching does, as described earlier, and more fully in Appendix E, is to keep aware of

alternate answers by preserving a sense of the whole through connection to others and connection to the lesson at hand. This is disrupted necessarily by the exigencies of life: testing, time constraints, unforeseen events; but the aim of the intuitive teacher is a balance, as much as possible, between analytic right answers, memorized information, and names of things and the intuitive experience of being with the whole idea, the phenomenon, the community.

Wagner (2008) made a survey of CEOs in the U.S., asking what they are looking for as they hire new employees. The overwhelming response was that in order to compete in the increasingly global arena, they need young people who can problem-solve. Their biggest complaint was that the college graduates were looking for the right answers; they wanted to be told what to do and to have a set of conditions for which there was one correct answer, then move on. Other countries are turning these kinds of students out onto the marketplace (Darling-Hammond, 2010), but the U.S. is so bent on testing scores, that we are stressing information and analysis over intuitive, creative problem solving. In order to prepare for tests, as Darling-Hammond (2010) claims, we memorize answers, while other countries like Japan, Singapore, and Finland stress more open ended experiential learning in schools.

Therefore, if attention is turned back to the first grade class, you can see that it might be better to follow the natural inclination of the children to stay connected with the science experiment. In this connected mode, the children cannot yet articulate what the parts of the science experiment are, and they cannot memorize information for a test. They can, however, stay in the creative, holistic state of being one with the actual phenomena in front of them and thus let their imaginations run. This is the birth of the

problem solving that the CEOs need in the workplace later in life. Letting children stay in a state of observation is not a non-productive activity. It is replete with active inner mind work that crosses the boundary between ideas that are too big to articulate and those that can be put into practice. True problem solvers use this deeper form of thinking. A great scientist like Schrodinger is not just a head person, analyzing his world into parts; he is also holistic, simultaneously leaving relationships whole. Intuitive teaching does not just put parts together - it leaves large, whole ideas untouched by the analytical mind, and respected in their wholeness for attributes that can only be gained in this way (Arnheim, 1986b). Every human relationship is an example of this. Once taken apart and analyzed, is somehow lessened. But kept whole, the relationship is somehow, as the saying goes, more than the sum of the parts.

Lesson from Pat

Perhaps this is similar to the teacher's work with students who tend to make comments that are off point or only tangentially related to a class lesson. I had a high school student that I will call Pat, who I taught in three different courses: geometry, physics, and an advanced science seminar. Pat could be counted on to join a discussion with a view that was in from left field. Almost every time Pat did this, the class was stopped. None of us could make the connection to what Pat was saying, and if asked, he usually could not explain himself. I came to know Pat quite well because he was in three of my classes. It turns out that he was a very intelligent, creative thinker. But he was in touch with larger ideas than he could express, so in touch with these ideas that he was compelled to share them. Here was another chance to honor intuition! On the one hand, even when I came to respect that Pat had something of value, I could not entertain every

one of his comments. I could however, outwardly demonstrate my respect. Perhaps this act of respecting Pat may be form of what Dan Goleman (2005) claims is using emotional intelligence. In another book about working with presence, Goleman and Senge (2007) recommend a stronger form of listening, where the teacher leaves room for the possible wisdom that Pat might be seeing, even if it could not be fully brought up to the conscious discussion level. So, what could I do as an intuitive teacher? I could tell him and the class that there must be something interesting in what Pat is seeing, but we will not be able to follow it right now. Again, in a book on social intelligence (2006) Goleman asserts that it may be validating to Pat to see his contribution used, even if it is simply noted, so that the class can move on. Sometimes, I would stop and the class and I would try to help Pat bring out his ideas. In these cases we were almost always rewarded for the cleverness or refreshing effect his ideas had in showing the class a view that no one had thought of.

The result of handling Pat's ideas this way was validating for the whole class. They saw that there are always many ways to look at a problem. This is building creative problem solving. They also saw a respect for diversity and appreciation of multiple intelligences as Howard Gardner recommends (1993, 2008). In addition, they saw a tolerance for multiple world views (Hutchison, 2005, 2010), even in the face of some world views being at odds or slowing down the predominate one, namely, the teacher's agenda for the class that day. A possible objection to this example might be that teachers do not often have time to stop and entertain ideas that are tangential to the lesson. This is true. We must work within the constraints of keeping to state and national curricular mandates. That is why it is so important to see the value in teaching intuitively. If we see that not only Pat and the class become validated, but that their thinking becomes more

productive for later problem solving in real life problems, then perhaps we can afford to lessen the need to stay within the curriculum so strictly and to test the information so extensively. According to Einstein, Michael Faraday rose to be one of the most articulate scientists in history on field theory. Einstein felt that the Faraday-Maxwell field descriptions were "probably the most profound transformation which has been experienced by the foundations of physics since Newton's time" (Einstein, 1950/2011, p. 33). Yet, Faraday, like Einstein had trouble in school. He begged his parents to let him learn at home because his teacher constantly reprimanded him for not conforming to his classmates. Faraday had a speech impediment. This deviation from the norm was something the teacher could not get past, so a brilliant learner was driven from school. As Faraday began an apprenticeship with a book binder he read the equivalent of an entire set of encyclopedias he was binding. If his teacher had been open to alternate forms of expression, he might have been spared extreme emotional and social difficulties.

Lesson from Doug

The intuitive teaching example above cannot be done superficially, however, because it will then simply become an outer act of saying that Pat's ideas are valued, when in reality they are not. Treating children in school with respect, as if their ideas matter, cannot be done in a perfunctory manner. If the teacher does not believe that the student may truly have a valuable addition to a discussion, then the exercise of respect is a sham. The intuitive teacher must be on the lookout at all times for a way to use what the student brings to the class. The teacher must truly receive value from the student. If the student senses that he or she is not needed; if the basis for respect of a student is not really because he or she is helpful, then the teacher is not saying what he or she really

means. I learned this lesson the hard way with my own son, Doug. He and I could not work together on his rehab program, even when he was ready to get his life on track on his own. I often gave what he considered to be good advice, and he felt that my intentions were all in favor of him. Nevertheless, we could not work in close proximity without an argument. I think the missing ingredient to our relationship was that I was doing him a favor - in his mind and in my own. And as long as we both felt that, there was an element of disrespect. I felt a little superior and he felt like a charity case. Then I realized that I had to find how my relationship with Doug made me a better man. I found it. Doug taught me how to hit a wall and keep on going anyway. He showed me how to access strength and find the way to solve a problem, when you think you are empty. Once I realized this and told him, we began to have longer conversations and truly listen to each other. Instead of arguing, we could deconstruct past problems and move on.

I believe that this is another example of the intuitive mind at work. Looking at the whole picture, intuitively, I saw that Doug - like any student or friend - needed a truer relationship with me in order to use me as a teacher. The intuitive teacher seeks this relationship. If a teacher looks at a student expecting to see someone who has less, and the teacher is the provider of more - there is only a relationship of superior and inferior. But if a teacher sees the student as a whole person already, perhaps not yet able to use words to articulate the wisdom she or he has, then relationship and learning can take place. Dewey advocates such a relationship:

> Our tendency to take immaturity as mere lack, and growth as something which fills up the gap between the immature and the mature is due to regarding childhood comparatively, instead of intrinsically. We treat it simply as a privation because we are measuring it by adulthood as a fixed standard. This fixes attention upon what the child has not, and will not have till he becomes a man. This comparative standpoint is legitimate enough for some purposes, but if we make it

> final, the question arises whether we are not guilty of an overweening presumption. Children, if they could express themselves articulately and sincerely, would tell a different tale; and there is excellent adult authority for the conviction that for certain moral and intellectual purposes adults must become as little children. (Dewey, 1916/2005, pp. 49-50)

In this assertion that Dewey makes are actually two separate recommendations for the intuitive teacher. One is to respect the child. The other is to avoid seeing childhood as a deficit. For although it is true that the child is only partially full of the ability to articulate ideas and also partially full of information, childhood is closer to the early intuitive period of thinking. In many cases, this gives the child a greater ability than the adult to see ideas in a context that relates separate ideas to large holistic ones. Let us then examine further how an intuitive teacher can use contextual wisdom.

Lesson from Kindergarten Children

I have done a simple science demonstration with kindergarten children through twelfth graders. It appears in most physical science and physics textbooks. I believe that it is analyzed incorrectly because the textbook writers are lacking context. The science demonstration consists of three bowls of water. One is hot, one is room temperature, and one is cold. Each student is asked to put one hand in the hot bowl and one hand in the cold bowl and hold them there for about 30 seconds. Then the student is asked put both hands into the room temperature bowl of water, and report aloud what each hand feels. Invariably the student reports that the formerly hot hand feels cold and the formerly cold hand feels the water to be hot. Here, note that the student in the demonstration and the textbook in its description are dealing purely with observation, which is an intuitive act (Arnheim, 1986b). The perception that the water in the middle bowl feels warmer to one hand and cooler to the other is a purely intuitive perception. The body receives the

physical sensation and the mind notes the observation of the two hands. Up to this point I have no disagreement with the textbooks. Next comes the analysis - and here is where the textbooks and I part. One physics textbook, which is typical of many in this demonstration, questions, "Can we trust our sense of hot and cold" (L. Thomas, 1974, p. 291)? The untrustworthiness is based on the expectation that the body should act like a thermometer and tell us the temperature of the water. But this analysis has arbitrarily assigned this task to the body, then condemned it for not doing its job. This is like projecting an adult's consciousness onto a child, then condemning the child for coming up short. If we instead listen to what the body is saying, we see that our hands are telling us where the relative difference in heat is. The cold hand senses that the water is warmer than itself; and the hot hand senses that the water is cooler than itself. If our body is asked to perform this function, the function of detecting relative temperature difference, it turns out to be extremely accurate. The body has many such temperature difference sensors, the lips being extreme in this ability. This is why sometimes an adult holding a baby will feel the baby's temperature by pressing the adult's lips to the baby's forehead.

My problem with this science textbook suggestion is not that it is incorrect. It is correct to say that we cannot trust our senses to mimic the workings of a thermometer. My problem is that the example degrades the human body by arbitrarily projecting the function of a thermometer onto the body - a function which it simply is not made to do. This act of projection, without giving respect to the body is accomplished by analysis that is done by itself without context. If the analysis were done in context of what the body does do - not what it does not do, the science student would learn the incredible sensitivity our bodies do have and how to use them and respect them a little more.

Further, the science student would learn to ask what a natural object is - not what the student *thought it was* in some arbitrary notion that the student might have formed before truly meeting the natural object. As Goethe recommends:

> He should form to himself a method in accordance with observation, but he should take heed not to reduce observation to mere notion, to substitute words for this notion, and to use and deal with these words as if they were things. (Goethe, 1840/1970, p. 283)

The respect of context can be an act of intuition. By looking at an object or a person and staying in the mode of observation, without judging, naming, categorizing, or in any other way thinking analytically about that person or object, one can stay in the predominantly intuitive mode. This act is very respectful of that which we are observing. It is like the silence that can follow the statement of a great person - many people will not be quick to presume to add to or manipulate a wise or great utterance; they will let it stand. In the same way, an intuitive teacher may let a phenomenon of nature speak for itself. Also, in the same way, a teacher will sense when to be analytic and when to use this intuitive respect to let a student's utterances stand, without touching them.

Lesson from Michael

Another example of context comes from an alternative high school that deals mostly with students who are emotionally disturbed. I taught science and mathematics there for ten years. The principal was extremely aware of and respectful of the context in which each student exhibited emotions. He knew every student's name and spoke to each as an individual, different from every other. During my ten years in this school I came to know that I was watching one of the finest educators I would ever see in my 40 years of professional life. On one occasion a new student, I will call him Michael, was brought to the principal's office with a police escort and the student's parents. The student had

refused to go to school for some time, so the police were deemed necessary to see to it that the boy would enter the building and not run away. It was clear that this was his last chance, he would go to juvenile detention if this school did not work out for him. The principal spoke to Michael with true respect. He asked him to try one class. After a standoff and then continued discussion, the principal masterfully got Michael to agree to try out a class, if he would be allowed to leave school right after this class. The principal agreed and brought him to my class. In the hall, the principal explained the situation to me. I welcomed Michael, showed him to a seat, and continued my lesson in physical science.

Something clicked for Michael. He spoke up and asked some challenging questions. I cannot remember the exact questions, but I remember thinking how odd they were, as if he were testing whether or not he would be discriminated against for being different. I stopped my train of thought completely when he spoke and answered him directly without letting myself judge why he was asking these questions - or what context they came from. I did not know the context, so I made sure to keep myself from assuming anything, and just answered him with respect that there was a good reason for his strange questions. I watched as Michael looked around the room. I think he was checking if he would be accepted or rejected. I remember making a use of one of his questions and referring to it later in the lesson. By the end of the 45 minute period, Michael decided to stay the day. He told the principal that he would stay in school if he could be in my class. For a long time his questions in class remained somewhat disrespectful and challenging, but gradually his contributions became more constructive, rather than menacing. Michael's way of testing me was clearly the most persistent I have ever seen. For the next

few months however, he followed me to the cafeteria at lunchtime and stopped by my class often. Soon, he began to make friends and find his own interests apart from me.

Michael's case is quite interesting to me because I feel that he taught the principal and me how to reach a new level of respect for the context from which a student can be speaking. For me, I learned that I may not be able to understand the context from which a person is speaking - yet my job as an intuitive teacher remains to respect that it must have value to that person. For some reason, Michael needed to test me and the class and the principal and the school more than any student I have ever met. But whatever that reason was, whatever the context, it had meaning and use to Michael. So, if I had projected some analysis of why Michael was testing us so much in the menacing way he was doing it, I might have lost Michael's confidence and he might be incarcerated for refusing to attend school. Instead, I believe that I grew from this experience, the principal said that he grew from it, and I think the class had an overall benefit from Michael's interruptions. They saw a case where it was worth waiting to see where Michael was coming from, the context from which he was speaking and acting. Michael became a valuable friend to other students and a loyal student to my science class. He could always be counted on to stand up and say what others might be shy to admit.

In Michael's case, context is composed of an intricate set of factors that are entangled within its environment, as Steve Talbot points out in his and Craig Holdrege's book, *Beyond Biotechnology* (2008). Talbot compares context to the concept of entanglement in quantum physics, where the parts of the physical world seem to actually be interconnected in subtle ways. Students are connected to many contextual parts of their past, their family, their friends, their school, and many subtle factors that are not

always able to be uncovered. It is in respect of this subtle, yet very real context that the intuitive teacher operates. My motivation as an intuitive teacher is to suspend analysis of context, yet give it my utmost respect and my careful observation.

Conclusion

The intuitive act of listening to someone without constantly forming final opinions of the context can help bridge the communication gap between my self and the other. For example, indigenous peoples are often assumed to be unintelligent because the translator projected his or her own culture onto that of the indigenous speaker. Donaldson tells a story "of the Indian who said that he could not translate ‘The white man shot six bears today’ because no white could do so” (1989, pp. 57-58). Whorf (1964) writes of miscommunications with the Hopi because the interviewer required a subject and predicate to sentence structure in order to translate meaning – but the Hopi do not always separate whole concepts into parts. To the predominantly analytical mind, this could make the Hopi seem less capable than the Eurocentric thinker. Nevertheless, Whorf describes how the Hopi are quite intelligent. Like the children in the intuitive stage, the Hopi use a non-linear set of epistemic beliefs to learn and communicate in a way that speaks in wholes that are outside of the temporal use of verb tenses, and outside of the spatial separation of a subject and predicate:

> The thoughts of a Hopi about events always include *both* space and time, for neither is found alone in his world view. Thus his language gets along adequately without tenses for its verbs, and permits him to think habitually in terms of space-time. Properly to understand Einstein's relativity a Westerner must abandon his spoken tongue and take to the language of calculus. But a Hopi, Whorf implies, has a sort of calculus built into him. (Whorf & Carroll, 1964, p. viii)

One can find a similar respect for an intuitive intelligence in indigenous peoples of ancient cultures in the historical writings of Stone (1976) and Diop (1974). Teresi (2003)

tells a story of the earliest known discovery of rubber by Aztecs that predates the Western discovery of the vulcanization of rubber by Charles Goodyear by a thousand years. Teresi spent his life uncovering lost discoveries such as the true origin of such things as: steel, robotics, the printing press, and antibiotics. What is noteworthy to this discussion is that many of the discoveries that we normally attribute to the analytic mind of the post Greco-Roman era actually were made by ancient, intuitive cultures that more closely map to children and quantum physics thinkers, than the formal reasoning thinkers of modern Western cultures. The famous quantum physicist Erwin Schrodinger (1944/1992) lamented that the science of his time (mid 1900s) could not rid itself of dilemmas from formal reasoning that could not accept contradiction and paradox. These however are elements of the intuitive thinking of the indigenous, the ancient, the East, the Afrocentric thinker, South American epistemic beliefs, many current third world ideologies, and the child. According to Nisbett (2003), studies of the thought of the ancient East reveal that even today, as analytic, formal reasoning has flourished in modern society there, the Eastern culture can still use the ancient intuitive modes of thought that contend that "Change produces contradiction and contradiction causes change; constant change and contradiction imply that it is meaningless to discuss the individual part without considering its relationships with other parts and prior states." (Nisbett, 2003, p. 200). This also implies the tenet of the middle way; that there is a choice between two opposite views that includes and transcends both. Therefore, context is important to intuitive education and the analytic part of each one of us needs the intuitive part in order to complete itself.

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APPENDIX A: INTUITIVE EDUCATION

What would intuitive education enable for the child as she/he navigates the world?

Intuitive Education versus Analytic Education - we need both in balance.

Intuitive	Analytic
predominantly right-brain	predominantly left-brain
holistic, undivided	separated in parts
collaborative, group thinking	isolated, individual accomplishment
animated	inanimate
circle thinking in holistic concepts	linear thought in abstract concepts
descriptive, lateral language	articulate, didactic language
relationships, complexity	positivistic, fixed hierarchy
BEAUTY, qualities	MEASUREMENTS, quantifiable
hard to assess, hard to communicate, poetic	more easily tested meanings
necessary for: unanimity, union, solidarity, harmony, meditation	necessary for: reading, writing, building, categorizing, judging
wonder and awe	naming, then moving on

APPENDIX B: HOLISTIC INTUITIVE EPISTEMIC BELIEFS

How would holistic intuitive epistemic beliefs work for a child?

School Activities: Intuition versus Analysis - a balance of each in every day.

School Activity	Intuition	Analysis
Science	observe, wonder, be with	name, explain, measure
Reading	stay in the story, feel, be inspired	retell, analyze, talk about
History	identify with people, situated context	record facts, learn from scrutiny
Mathematics	appreciate: beauty, elegance, pattern, universal (Bortoft, 1996)	perform: calculation, precision, abstraction, generalization

APPENDIX C: PRAMLING STUDY EXCERPTS

The following are excerpts from a study that re-analyzes Piagetian interviews Pramling (2006). It has examples of child interviews from *The Child's Conception of the World* (Piaget, 1929/2007) with accompanying re-analyses by Niklas Pramling. The adult examiner's questions and parenthetical notes are in normal text and the child's reactions are in italics (as are subtitles). For each of the children's responses a re-analysis by Pramling is included.

Piaget outlines his technique for interviewing children as follows. "The child is asked: 'Do you know what it means to think of something?'" (p. 37). This is in my view an incredibly difficult question for anyone to answer, not just for a young child. However, "[w]hatever the answer may be, the meaning behind the words is what matters" (p. 38), Piaget continues. So what do the children reply to such a question? The following is one example:

> TANN (8) thinks with his *"mind"*. "What is the mind? — It *is someone who isn't like we are, who hasn't skin and hasn't bones, and who is like air which we can't see",* (p. 53)

The child speaks about the phenomenon of mind in anthropomorphic terms ('it is *someone'),* and *'who is like'* (air), but *'isn't like we are'*. Thus it is like something else (a person; air) but unlike in other respects. In this way, 'mind' is spoken about in terms of its likeness and differences to something else that is familiar. By using meta-communicative markers (such as, 'is like'), the child qualifies his own reasoning. He thereby clarifies that he communicates about something in terms of something else. This is a very impressive undertaking, in this case, for a child of eight years. However, this excerpt is interpreted by Piaget as a case of the child identifying thought with air. In Piaget's interpretation the child therefore makes a reality claim about thought. In the analysis there is no evidence that this feature of using markers in the children's reasoning are considered.

...

In the chapter on 'meteorology' the following two explanations of children in terms of 'is like' or is 'as if' take place:

> DUCR (8 1/2): [...] the clouds are alive *"because they fly in the air as*

if they were birds, but they go very fast", (p. 302f.)

This excerpt is rather ambiguous if seen in the terms of the present analysis, in both 'because' and 'as if being used by the child. In my view, 'because' could be seen as motivating how the clouds could be spoken of as alive, while 'as if clarifies that they are in fact not so. However, neither of these words is attended to in the analysis. The excerpt is not interpreted by Piaget at all. It only appears in a section of the book on 'artificialism' in the child's thinking.

> CEN (8; 6): "Do you know where clouds come from? - *Steam.* - What is steam? - *It's like smoke.* — Where does steam come from? — *From water when it's boiling or nearly boiling".* "Where does the steam of the clouds come from? - *When you cook the soup.* - Does cooking the soup make the clouds? - *The steam goes out and it takes water with it",* (p. 303)

The child says about steam, that *'it's like* smoke'. From a rather concrete experience, the cooking of a soup, and a simple observation, he talks about where clouds come from. The child is thus able to get these two domains of experience (cooking a soup, and that the sky is sometimes filled with clouds) together in a single explanation. Departing from something familiar and observed, the child could from the analyst's point of view be seen as expanding his knowledge to begin to make sense of or speak about other phenomena. At the same time, he meta-communicates that he does so, and that his saying therefore is not by himself, nor should it by the communicative partner be taken literally. In Piaget's analysis the qualification that the child in my reading makes with the word 'like' is not attended to. Instead the excerpt is interpreted by Piaget in terms of 'artificialism'. Hence, as can be seen throughout the analysis, these qualifications that the children do in their answers tend to be disregarded. The children are understood as making reality claims. However, these markers are in a communicative perspective of significant Importance, as will be argued in the discussion.

I interpret the markers that the children use as communicating a meta-understanding. Behind this lays a more general issue, if children also in other cases may be using language non-literally, even if they do not mark it.

Reasoning by analogy, or using language non-literally

In the chapter on 'the child's notion of thought', Piaget argues that for the child thought is material, that it is 'air', and "that it also is regarded as actually a part of the external world" (p. 46):

> RON (7 *'A):* "Can one see thought? - *Yes.* - How? - *In front of you.* - Where? There (50 cms away) or right over there? - *It doesn't make any*

> *difference. The wind makes the grass move and you see it moving. That is thinking",* (p. 46)

In my view, two things are here worth considering. First, that the child says that 'it doesn't make any difference' where thought is, could be understood as he does not intend what he says to be taken literally but only as a matter of speaking. Second, saying that thinking is 'the wind in the grass' need not be interpreted as the child actually thinking that thought is material and external. It could alternatively be interpreted as the child reasoning by analogy (i.e., thinking is like the wind in being transient and difficult to 'get hold of') . However, in the interpretation neither of these possibilities are considered. The answer by the child is interpreted as showing what the child really thinks is the case.

Interesting to note is also how the interviewer uses analogy to explain the question to the child. For example, if having asked the child "Do you know what it means to think of some- thing?" (p. 37), the child "has not grasped the idea", then, Piaget explains, "the matter must be further explained" (loc. cit.). He does this by saying to the child that "'When you walk, you walk with the feet; well then, when you think, what do you think with?'" (p. 37f.). In communicating with the child the interviewer shows an awareness of making something understandable by speaking of it analogically in terms of something else. That children may also reply in this manner tends not to be considered in the analyses.

In the chapter on 'the notion of thought', the following exchange takes place:

> RATT (8; 10) [...] "Have words got strength? - *Yes.* - Tell me a word which has strength? - *The wind.* - Why has the word 'wind' got strength? - *Because it goes quickly.* - Is it the word or the wind which goes quickly? — *The wind.* — Tell the a word which has strength. — *When you give something a kick.* - Is that a word? - *No.* - Tell me a word which has strength- ". (p.45)

According to the interpretation, "Ratt was unable to understand that it is things and not words that have strength" (p. 45). However, to ask a child whether 'words have got strength' is, in my view, a rather strange question. The child's use of 'because' could be seen as an indication of the child trying to motivate how one could speak of words in terms of strength, rather than the child being unable to make the distinction between words and things. Read in this way, 'because' could signal an 'as if' mode of reasoning. However, the reasoning is ambiguous. As Aronsson and Hundeide (2002, p. 179; see also their example 2 where the child actually uses 'because') among others have observed, "children willingly tend to answer bizarre questions". To qualify these answers by using 'because' may be one way of doing this without actually believing that things really are in the way one speaks. Hence, 'because' may be used as a way of making sense of these questions, of making the questions sensible. I will return to this issue in a later section of this

article.

Thinking and knowing, saying and meaning

Closely related to the theme of the present article is the distinction between saying and meaning. To make this distinction is a way of marking out a 'gap' between how one speaks and what is claimed. In this sense it is relevant to the present analysis and will therefore here in all brevity be considered.

The following example is, in my view, illustrative of the child using language non-literally, but also seems to imply the child managing the distinction between saying and meaning. The exchange is taken from the chapter on meteorology. More specifically, the formation of rain is spoken about:

> MOC (8): "Where does the rain come from?- *The sky.* - What is it? - *Water.* - How is it made? - *The clouds.* - How? — *Because they jump. The clouds jump and then the rain comes.* - What do you mean by saying they jump? - / *mean that they burst",* (p. 314)

In my view, the child here makes clear that he is aware that he uses language non-literally ('jump', 'I mean that...'). He also shows that he manages the distinction between what he says and what he means. If he did not realise this difference, he would reasonably reply by repeating what he already said, or said that this is what they do. That the child manages this distinction is not commented upon in the analysis. Instead, for Moc and the other children cited in this case, "therefore the clouds move about intentionally to wherever rain is necessary and transform themselves into water" (p. 314).

Consider also the following example from the chapter on 'the notion of thought':

> SCHI (6) [...] "What is memory? - *When you remember something.* - How do you remember? - It suddenly *comes into the mind (revient dans notre ame). When you've been told something it comes into your mind, then it goes out and then it comes back.* — It goes out? Where does it go to? - *Into the sky.* - Do you really believe that? - *Yes. I don't know, but it's what I think (ce queje crois)".* (p. 45)

That memories 'go out' and 'come back' is interpreted literally. However, I would like to argue the possibility of an alternative interpretation. That the child in his answer contrasts the two words 'know' and 'think' may be significant as a marker to how the child understands his own utterance. Writing on this very distinction, Dewey (1910/1997, p. 9) argues that: "To say '1 think so' implies that I do not as yet *know* so". Hence, to say that 'I think so' implies a tentativeness. It could be read as a marker pointing out that the child

is unsure, that the child has difficulties with coming to terms with what is being asked of him. So whether the child actually claims that memory is an entity 'coming' and 'going' is open to debate.

What is it, or what is it like?

In writing about how to understand the children's answers that thought is air, wind, etc., Piaget considers adult influence. Maybe the "children have been told of a soul or a mind which is invisible *like* the air, and they have concluded that thinking is by means of the air" (p. 47; my italics). Some of the children's answers could probably be understood in this way, he concludes. But why not conclude that the child likewise as the adult considers or speaks of, for example, thought, as being *like,* for example, air? This question re-emerges in the interviews with the children. In the same chapter on the notion of thought, this example is found:

> KAUF (8; 8, a girl) thinks with her memory. *"Memory is something in the head which makes us think.* - What do you think this memory is like? - *It is a little square of skin, rather oval, and inside there are stories {tes histoires).* - What are they like? - *They are written on the flesh.* - What with? - *Pencil.* - Who wrote them? - *God. before I was born, he put them there",* (p. 52)

The interviewer asks the child what she 'thinks memory is like'. The child's answer however is treated as claiming what memory 'is', which, in my view, is a rather different matter. It is possible that the child notes the 'like' of the question and consequently compares it to something else, concrete, in making a narrative (of an agent, in this case God, doing something). In the analysis in the book, two points are made: (1) that the child does not distinguish between thought and matter, and (2) that the child is mistaken as to the origin of her knowledge in thinking that her knowledge is innate.

Consider in addition one more brief example of the use of the word 'like', taken from the chapter on the child's notion of dreams:

> HORN (5; 3): "You know what it is to dream? - *Yes. It's when you see people.* - Where is the dream? — *In the smoke (la fumee).* — What smoke? - *The smoke that comes from the bedclothes.* - Where do the dreams come from? - *From here* (pointing to his stomach). - Then how is it that they are in the bedclothes while you are dreaming? - *Because you know it's like that". (p.* 106)

This example is interpreted as illustrating a child being intermediate between two stages of development in starting to cast off the idea of an external origin for dreams. In my view, the child's last phrase could be of significant importance in understanding what the child is saying. To say that

'it's like that' is qualitatively different from saying that 'it is so' or 'that's how it is.'

On the formation of rain, the following exchange occurs, illustrative of the child reasoning in terms of 'likeness':

> SCHI (7; 4) said that the clouds come from mist: "What is the mist made of? — *Water.* — Like the water in the tap? - *No, it's water like when you perspire. It's not quite water when you perspire, it's like water.* — Where does this water come from? — / *think it comes from being hot. So that it ought to be heat that makes the clouds come...* - How is that? What heat does it come from? - *It comes from the sun.* — Where does the water come from that is heated by the sun? - *From the sun itself.* — What is the sun made of? - *Fire, I think. When it's too hot, it's tike when your hands are too hot, the sun perspires, and that makes the clouds cover it",* (p. 316)

The children, as here exemplified by Schi, "seem spontaneously to regard the clouds as 'heat' or 'wetness' or 'perspiration', and the rain" consequently "explains itself (p. 316), according to the interpretation. What is not considered in the interpretation is the abundance of markers used not only by the interviewer but also, and especially, by the child. Note, for example, how the child answers that 'it's not quite' but that 'it's like'. The child also says that 'I think' twice, which could signal an uncertainty (i.e., marking out that this is not necessarily how things are), not a simple claim of a fact (see further on the use of the word 'think' above).

Because and as if

In the chapter on the child's notion of dreams, some, for the present analysis, interesting exchanges can be found. For example:

> KENN (7 1/2): [...] "When you dream of school, where is the dream? - *At school. because it's as if you were at school.* — Is the dream really at school or is it only as if it were at school? - *It is at school.* - Really and truly? - *No*". (p. 114)

This is interpreted as the child actually thinking that the dream of school is at school, and also showing that the child understands dreams as external to him. The markers used by the child are not considered in the interpretation. However, 'because' and 'it's as if' could be seen as marking out that this is not really the case, but it could be seen in this way 'because' it is as if it were so. However, neither interpretation is entirely convincing and the child is self- contradictory in his answers. Also to question the child's answer ('really and truly?') disqualifies the previous answer given by the child,

making it necessary to change the answer (cf. Aronsson & Hundeide, 2002).

...

Reasoning through and about the metaphors of language

This section will look at the use of the metaphors that are inscribed(!) in our language and how the children (as well as the rest of us) speak about certain phenomena in these terms.

In the chapter on 'the origins of child animism', the following reasoning is reported:

> HAD (6): "Can the sun do whatever it likes? - *Yes. because it's alone with the moon.* - And the clouds? - *Yes. because they are alone with the other clouds",* etc. The meaning of these words is sufficiently clear from the following answer: "Can you do whatever you like? — *Yes, because my mother sometimes lets me",* (p. 227)

In Piaget's terms, the excerpt illustrates how the child "endows all objects with freedom of movement for the reason that they are 'alone', that is to say that no one commands them nor supervises what they do" (p. 227). This may be, but notice how the initial question is phrased. It implies that the sun is an agent, capable of 'doing' something; and consequently, the child's answer may be seen as only following in line, or with the by the questioner established frame of reference, of how to talk about these phenomena. Thus, the child also animates. But once again, this makes it problematic to take the child's answer as an indication of what the child thinks is the case. (Pramling, 2006, pp. 456-461)

APPENDIX D: DATA ANALYSIS CODING TABLE

Following is a detailed account of the code assignments with long descriptions of the analysis of the 42 child interviews, Piaget's discourse analysis of them, and the re-analysis that this study has contributed. The interview excerpts are all from *The Child's Conception of the* World (Piaget, 1929/2007).

Coding Scheme

Child Epistemic Belief	Quantum Theoretical Construct	**Code**
INTERCONNECTEDNESS: egocentrism, participation, artificialism	**E**NTANGLEMENT	I/E
PARADOX: contradiction, animism, purpose, intention	**C**OMPLEMENTARITY	P/C
CONSCIOUSNESS: intention, purpose, participation, animism, artificialism, egocentrism	**O**BSERVER EFFECT	C/O

Frequency Distribution

Code	**# Codes**	**# Children**
I/E	36	30
P/C	14	12
C/O	36	31

Chapters / Pages	TRANSCRIPTS

In the following, Piaget introduced perhaps the most important point for the research in this study. It comes from Part I. REALISM: Chapter I. The Notion of Thought (Piaget, 1929/2007). There, he clearly described the child as treating the mind and body as interconnected. The re-analysis of this study agreed with that description but it disagreed with the way Piaget did not value the child's sense of

interconnectedness as a learning tool.	
Chapter I. The Notion of Thought	Let us imagine a being, knowing nothing of the distinction between mind and body. Such a being would be aware of his desires and feelings but his notions of self would undoubtedly be much less clear than ours. Compared with us he would experience much less the sensation of the thinking self within him, the feeling of a being independent of the external world. The knowledge that we are thinking of things severs us in fact from the actual things. (Piaget, 1929/2007, p. 37)

Re-analysis: Piaget describes here the intuitive child as being embedded in the world and not experiencing disconnection. He clearly describes how an adult can separate the thinking self from the world and that this "severs us" from the actual things. This study agrees with this analysis of Piaget. The disagreement lies in the fact that Piaget does not mention the value of being able to be embedded in the phenomenon you are observing. It is precisely this ability that has made some scientists great.

Einstein (1920/2010, 1950/2011) speaks of this interconnectedness that the ancients hypothesized (Diop, 1974; Stone, 1976), but was all but forgotten by Newton's (1730/1974; 1979) time. He recaps a portion of scientific history much like Kuhn's analysis of paradigmatic revolutions (2004), whereby scientists had a conflicting dual set of notions in the belief in action at a distance versus the connectedness of fields – but in many cases, he concludes that allegiance to Newton's doctrine was stronger than reasoning:

> Newton's theory is probably the greatest stride ever made in the effort towards the causal nexus of natural phenomena. And yet this theory evoked a lively sense of discomfort among Newton's contemporaries, because it seemed to be in conflict with the principle springing from the rest of experience, that there can be reciprocal action only through contact, and not through immediate action at a distance. It is only with reluctance that man's desire for knowledge endures a dualism of this kind. How was unity to be preserved in his

> comprehension of the forces of nature? Either by trying to look upon contact forces as being themselves distant forces which admittedly are observable only at a very small distance--and this was the road which Newton's followers, who were entirely under the spell of his doctrine, mostly preferred to take; or by assuming that the Newtonian action at a distance is only _apparently_ immediate action at a distance, but in truth is conveyed by a medium permeating space, whether by movements or by elastic deformation of this medium. Thus the endeavour toward a unified view of the nature of forces leads to the hypothesis of an ether. (Einstein, 1920/2010, p. 3)

Following are excerpts from the Piagetian interviews describing the child's notion of thought (Piaget, 1929/2007).

p. 39 C/O I/E P/C	Mont. (7; 0): "You know what it means to think? —Yes.—Then think of your house. What do you think with?—The mouth.—Can you think with the mouth shut?—No.—With the eyes shut?—Yes.—With the ears stopped up?—Yes.—Now shut your mouth and think of your house. Are you thinking?—Yes.—What did you think with?—The mouth."
C/O I/E P/C P/C	Acker (7; 7): "What do you think with?—The mouth." This statement was reiterated four times in the course of an examination on dreams which appears later. After the questions on animism we added: "Can a dog think?—Yes, it listens.—Can a bird think?—No, it hasn't any ears.—What does a dog think with?—Its ears.—Does a fish think?—No.—A snail?—No.—A horse? —Yes, with its ears.—A hen?—Yes, with its mouth."
C/O I/E	Schmi (5 1/2): "What do people think with?—The mouth."
C/O I/E	Muy (6): "What do you think with?—With something, with my mouth."
   P/C	Barb (5 1/2): "You know what it means to think?—When you can't remember something, you think.—What do you think with?—The ears.—If you were to stop them up, could you think?—Yes . . . no. . . ."
  I/E C/O	Rehm (5; 11): "You know what it means to think of something?—Yes.—Think of your house.—Yes.—What do you think with?—With the ears.—When you think of your house, you think with the ears?—Yes."
I/E C/O	Ceres (7): "What do we think with?—I don't know. —Where do we think?—In the head.—Where?—In the mouth, inside the head."
p. 41 I/E C/O	Kenn (7 1/2): "What do you think with?—Inside my head.—Is the head empty or full?—Full.—If someone

P/C	opened your head, would they see when you were thinking?—No, because they couldn't see.—If they could look inside your head without your dying, would they see your thought?—You can't hear it when you speak gently.— What do you think with?—The head.—With what part of the head?—The mouth.—What is inside the head? Is thought inside?—Yes, when you are thinking of something. —What is inside the head?—When you speak.—Can you think when your mouth is shut?—Yes, without speaking. —What do you think with when you don't speak?—The mouth.—What is there inside the head when you think? —Nothing.—Can you see thought?—No.—Could I hear it? —No.—Could I feel it if I put my finger there?—Yes."
C/O I/E	Metr (5; 9): "When you think, what do you think with?—I don't know.—With your hands?—No.—With your head?—No. You can't ever see thinking.—What do you read with?—The eyes.—Can you think with your eyes shut?—Yes.—With your mouth shut?—No, I can't. —With your ears stopped up?—Yes.—Do babies think? —No, they don't know how. They are too little.—What do we think with?—I don't know. I've never seen thinking.— Do we think with the head?—No—What then?—With the mouth."
p. 44 C/O I/E I/E I/E	Acker (7; 7) told us four times, as we have already seen, that thinking is with the mouth. "When you think with the mouth, where does the thought come from?— From the eyes, from outside. You see, then you think.— Then when you don't speak, are you thinking?—Yes. —What with?—The mouth."—A moment later: "When you don't say anything what do you think with?—The stomach." As he said this Acker pointed to the larynx in explanation, showing that he was thinking all the time of voice.
p. 45 I/E	Schi (6) gave the word "memory" spontaneously. "What is memory?—When you remember something.— How do you remember?—It suddenly comes into the mind (revient dans notre dme). When you've been told something it comes into your mind, then it goes out and then it comes back.—It goes out? Where does it go to?—Into the sky. —Do you really believe that?—Yes, I don't know, but it's what I think (ce que je crois)."
p. 46 I/E	Ron (7 1/2): "Can one see thought?—Yes.—How?— In front of you.—Where? There (50 cms away) or right over there?—It doesn't make any difference. The wind makes the grass move and you see it moving. That is

I/E P/C C/O	thinking. —Is it in front of you or in the brain?—Both, you can think anyhow.—Can one touch thought?—Sometimes, when the thoughts are real."
p. 48 C/O	Duc (6 1/2): also stated that the light cannot see through a hand, alike confusing "seeing" with "giving light."
C/O	Sci (6) said that dreams come "with the light."—"How?—You are in the street. The lights (street-lamps) can see there . . . they see on the ground." "Tell me some things that give light.—Lights, candles, matches, thunder, fire, cigarettes.—Do eyes give light or not?—Yes, they give light.—Do they give light at night?—No?—Why not? Because they are shut.—When they are open do they give light?—Yes.—Do they give light like lamps?—Yes, a little bit."
p. 49 C/O I/E P/C	Falq (7; 3): "You know what it means to think?— You think of things you want to do.—What do you think with?—With something.—What with?—A little voice.— Where is it?—There (he points to the forehead)." "Where does the little voice come from?—The head.—How does it happen.—By itself.—Does a horse think?—Yes.—What with?—A little voice in the head.—And dogs?—Yes.— Does the little voice say words ?—Yes.—Why? Dogs can't talk.—They talk, then they listen.—Where ?—There (pointing to the forehead).—Why?—There is something there.—What?—A little ball." In the head is also "a little mouth.—Is it there now?—Yes.—You really believe that?—Yes."—A few moments later Falq speaks of memory. "Where is it?—Inside there (showing his forehead) .—What is there?—A little ball.—What is inside it?—Thoughts.—What would one see inside if one looked? Smoke.—Where does it come from?—From the head." "Where does the smoke come from?—From the thoughts. —Is thought smoke?—Yes." "Why is thought inside the ball?—It is a little air and smoke that has come.—Where from?—From outside.—Where?—The air outside and the smoke from the chimney.—Is the air alive?—No, it is because it is the air, and when you think of something it comes into the ball. When you've thought of something the thought comes with the air and the smoke." "How?—The thought makes the air and the smoke come in and they mix." "What is the smoke?—Breath.—And the air?—The same." "Is there breath in you?—No . . . yes, when we breathe.—When you breathe what comes in and goes out?—Wind.—Does breathing make air?—Yes.—And smoke?—No . . . yes,

	steam."
p. 51 C/O I/E	E. Kun (7; 4) and his sister M. Kun (8; 4) were questioned one after the other without being given time to compare. Both stated that thought is in the head and that it is "white" and "round." M. Kun said it was "as big as a large apple"; E. Kun that it was "little." This would seem to suggest traces of adult teaching on the brain. However, E. Kun at other times maintained that one thinks "with the mouth.—Where is the thought?— In the middle of the mouth.—Can one see it?—Yes.— Touch it?—No.—Why not?—Because it is too far away. —Where?—In the neck." The combination of spontaneous convictions with instruction received is evident.
p. 52 C/O	Im (6): Thought is "my intelligence." It is "what makes us think and try and find out.—Who told you that?—I wasn't told, but I know." This "intelligence" cannot be touched "because it is full of blood."
p. 57 I/E	Bourg (6): "Can a word have strength?—No . . . yes.—Tell me a word which has strength.—Daddy, because he's a daddy and he's strong.—When I say 'cloud,' is the word 'cloud' strong?—Yes, because it gives light at night (the idea that clouds give light when there is no sun appears to be fairly general).—The word 'umbrella' only the word, not the 'umbrella' itself, is that strong?—A bit, because someone might poke it in your eyes and that would kill you."
	Bow (6; 5): "When I say 'umbrella' I'm saying a word, or 'drawer' that's another word, there isn't really a drawer, they are just words. If I didn't say words to you, you wouldn't know what I wanted to say. Say a word. . . ." "The word 'sun' is it strong?—No, because it doesn't weigh much (the sun).—Is the word 'hit' strong?—No, fairly strong.—Why?—Because sometimes it hurts.—Is it the word 'hit' which is strong? When I say the word 'hit' with the mouth, only the word, is it strong?—No, because the mouth can't shout it.—Tell me a word which is strong.—When a horse runs away."
	Cam (6): "If I say the word 'run,' I don't run. I say the word with the mouth. Is a word strong?—Yes.—Why?—Because you say it.—If I say the word 'jump' is it strong?—Yes, because children jump with a skipping-rope."
p. 58	Krug (6): "Is a word strong?—No, it can't do anything at all.—Are any words strong?—Some words are strong.—Which?—The word 'strong' because you are saying it's strong.—Is the word 'elephant' strong?—Yes, because an

	elephant can carry people.—An elephant can, but simply the word?—No, it isn't strong.—Why not?— Because it doesn't do anything.—What?—The word.—Is the word 'sleep' strong?—It is weak, because when you sleep, you're tired.—Is the word 'run' strong?—Yes, if the person's strong . . . it is strong the word 'run.'"
	Words would be bound up with things and to speak would mean to act directly on things. Inversely, external things would be less material and would be endowed with intentions and will. (Piaget, 1929/2007, p. 37)

Re-analysis: Einstein describes how the Newtonian view that the world was a like machine, made of separate physical parts is not a complete description. He asserts that the interconnectedness of Faraday's and Schrodinger's field view, where everything is touching, is needed, also. This is just like the child's intuitive view that supplements the later, formal reasoning view.

Einstein exhibits a Non-Newtonian – or intuitive – sense of wholeness when he claims that notions of classical mechanics (Newtonian physics) like the materiality of the world and the mechanistic view that nature is a machine will not be able to completely describe the objects that our senses perceive in this world:

> First we try to get clearly in our minds how far the system of classical mechanics has shown itself adequate to serve as a basis for the whole of physics. Since we are dealing here only with the foundations of physics and with its development, we need not concern ourselves with the purely formal progresses of mechanics (equation of Lagrange, canonical equations, etc.). One remark, however, appears indispensable. The notion "material point" is fundamental for mechanics. If now we seek the mechanics of a bodily object which itself can not be treated as a material point—and strictly speaking every object "perceptible to our senses" is of this category—then the question arises: How shall we imagine the object to be built up out of material points, and what forces must we assume as acting between them? The formulation of this question is indispensable, if mechanics is to pretend to describe the object *completely*. (Einstein, 1950/2011, pp. 28-29)

Thus Einstein underscores the fact that science cannot fully describe the world if it conceives of matter as broken up into separate points. More interconnectedness is

necessary. Einstein refers to Newton's mechanistic view of matter – classical mechanics - as believing that matter is made of "material points" (Einstein, 1950/2011, p. 29). He describes how this view leads to an atomistic materiality. Further, Einstein claims that the pairing of a mechanistic predisposition and an atomistic conclusion leads Newton – and those theorists who inductively build the Newtonian view of the whole of nature from the parts - to see atoms as separate and particulate – as opposed to the Non-Newtonian view of Faraday (1839/1965) and Schrodinger (1944/1992) that sees them as force fields that spread to infinity and touch everything else:

> It is natural to the tendency of mechanics to assume these material points, and the laws of forces acting between them, as invariable, since time alterations would lie outside of the scope of mechanical explanation. From this we can see that classical mechanics must lead us to an atomistic construction of matter. We now realize, with special clarity, how much in error are those theorists who believe that theory comes inductively from experience. Even the great Newton could not free himself from this error ("Hypotheses non fingo"). (Einstein, 1950/2011, p. 29)

In the following, Piaget describes how children attributed consciousness to things. Where the science of his time saw physical objects of the external world as completely separate from each other and from the mind of the human being, the children did not see these boundaries. This comes from Part II. ANIMISM: Chapter V. Consciousness Attributed to Things (Piaget, 1929/2007).

Chapter V. Consciousness Attributed to Things	Since the child does not distinguish the psychical from the physical world, since in the early stages of his development he does not even recognize any definite limits between his self and the external world, it is to be expected that he will regard as living and conscious a large number of objects which for us are inert. This is the phenomenon we propose to study and we shall describe it by the current word "animism." (Piaget, 1929/2007, p. 169)

Re-analysis: Piaget lived in a time before science had embraced Einstein's theory of relativity and quantum physics. In order to communicate these theories to oneself and to the world, notions of continuity among the separate parts of the physical world were useful. So, Piaget merely mentioned the intuitive child's tendency to not distinguish between the parts of the world, but Einstein found use for these ways of thinking. Einstein - and actually, Faraday before him – conceived of the world in a significantly different way than did Isaac Newton (Kuhn, 2004; Schrodinger, 1944/1992). Newton's written descriptions often had an analytical, rational, mechanistic view (Newton, 1730/1974; Newton & Einstein, 1979). He wrote of nature as being composed of separated physical particles that interacted through forces like gravity to cause the workings of the objects in the world. Thus, a phrase Newton often used in his paradigm of epistemology and in his scientific description of the world often pictured separate physical objects causing "action at a distance" (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965; Kuhn, 2004; Maxwell, 1856/2010). This concept of action-at-a-distance serves well in this comparative scientist study, because it appeared prominently in the writings of all six of the selected scientists. Since the concept may be foreign, as it comes more from the interior of the physicist's vocabulary, let it suffice to say that it is a pivotal concept on which the analytical versus the intuitive mind divide (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965; Goethe, 1840/1970; Kuhn, 2004; Maxwell, 1856/2010). Unlike Newton's use of the concept of action-at-a-distance, the scientific writing of Faraday, Goethe, Einstein, and Schrodinger is different in describing causality of action that occurs at a distance from a localized, apparent source. Their

writing used the conceptual construct of a "field" as instrumental in causing or aiding action in many of the cases where Newton referred to action-at-a-distance being caused by separated particles or material objects (Einstein, 1920/2010, 1950/2011; Faraday, 1839/1965, 1860/2012; Goethe, 1840/1970). Thus their Non-Newtonian writings spoke less of a world composed of Newton's mechanistic parts that had absolute, separate presence in time and space - and more of the interconnectedness of all things through the concepts of fields. Einstein based the special theory of relativity precisely on this difference:

> The special theory of relativity has led to a clear understanding of the physical concepts of space and time and in connection with this to a recognition of the behavior of moving measuring rods and clocks. It has in principle removed the concept of absolute simultaneity and thereby also that of instantaneous action at a distance in the sense of Newton. It has shown how the law of motion must be modified in dealing with motions that are not negligibly small as compared with the velocity of light. It has led to a formal clarification of Maxwell's equations of the electromagnetic field; in particular it has led to an understanding of the essential oneness of the electric and the magnetic field. It has unified the laws of conservation of momentum and of energy into one single law and has demonstrated the equivalence of mass and energy. (Einstein, 1950/2011, pp. 4-5)

This study is not a discussion of the validity of any of these theories; rather, it is a demonstration of the scientific use of the epistemic beliefs of the intuitive child. The scientists described in this study had epistemic beliefs that were successful enough to communicate their ideas to many people of their time and beyond.

In this next set of excerpts from the Piagetian child interviews, the way children attributed consciousness to things will be addressed (Piaget, 1929/2007).

p. 176 C/O I/E	Kenn (7 1/2): "If you pricked this stone, would it feel it?—No.—Why not?—Because it is hard.—If you put it in the fire, would it feel it?—Yes.—Why?—Because it would get burnt.—Can it feel the cold or not?—Yes.—Can a boat feel it is on the water?—Yes.—Why?—

	Because it is heavy when you are on it (= it feels the weight of the people on board).—Does water feel if you prick it? —No.—Why not?—Because it is thin (= not solid).— Does it feel the heat of the fire or doesn't it feel anything? —Yes (it feels it).—Would the sun feel it if some one pricked it?—Yes, because it is big." "Does the grass feel when you prick it?—Yes, because you pull it." "If this table were carried to the other end of the room, would it feel it?—No, because it is light (= it would offer no resistance, because it weighs so little).—If some one broke it?—It would feel that."
C/O I/E P/C C/O	Juill (7 1/2): A stone feels neither heat nor cold. "Would it feel if it was dropped on the ground?—Yes.—Why?—Because it would break." "Can a table feel anything?—No.—Would it feel if it were broken?—Oh, yes." "Does the wind feel when it blows against a house?—Yes.—Does it feel it or not?—It feels it.—Why?—Because it is in its way. It can't pass. It can't go any further." "Tell me some things- which don't feel anything. . . . Do walls feel?—No.—Why not?—Because they can't move (this answer announces the second stage).—Would they feel anything if they were knocked down?—Yes.- Does the wall know it is in a house?—No.—Does it know it's tall?—Yes.—Why?—Because it goes right up, it knows it goes right up!"
p. 179 C/O I/E P/C	Mont (7; 0): "Does the sun know it gives light?—Yes. —Why?—Because it is made of fire.—Does it know that we are here?—No.—Does it know it is fine weather?—Yes." So, too, the wind, the clouds, the rivers, the rain are regarded as conscious. "Does the wind feel anything when it blows against a house?—Yes, it feels it can't go any further." "Does a bicycle know when it is going?—Yes.—Does it know it is going quickly?—Yes.—Can it go by itself?—No," etc. On the contrary, benches, walls, stones, flowers, etc., can neither know nor feel. "Does this bench know it is in this room?—No.—Why not?—It can't speak.—Does it know you are sitting on it?—No.—Why not?—. . .—Would it know if you hit it or broke it?—No," etc.
p. 180 C/O I/E P/C P/C C/O	Pug (7; 2): "Does the sun know when it sets?— Yes.—Does it know it gives light?—No.—Why not?—Because it hasn't any eyes, it can't feel it." "Does a bicycle know anything?—No.—Why not?—I meant it knows when it goes fast and when it goes slowly.—Why do you think it knows?—I don't know, but I think it knows.— Does a motor know when it's going?—Yes.—

	Is it alive? —No, but it knows.—Is it the driver who knows or the motor?—The driver.—And the motor?—It knows too." Benches, tables, stones, walks, etc., neither feel nor know anything.
p. 183 C/O I/E	Schi (6, advanced): "Do the clouds feel that they are moving?—They can feel because it's they that make the wind." This is Card's theory again and the same argument. Schi also speaks thus concerning flowers: "Do they know when you tread on them?—They ought to know," and then explains: "They must be alive, because they grow."
p. 184 C/O I/E	Imh (6, advanced) attributes consciousness to the sun, the clouds, etc., but refuses it to water, because water cannot move of its own accord: "It can flow faster, but only when it's sloping." Imh thus belongs to an advanced stage (the third; see Causality Physique) as regards the explanation of the movement of rivers.
p. 186 C/O I/E	Gol (6, very advanced) restricts consciousness to animals and the moon "because, at night, it always goes to the same place." Fire, on the other hand, is not conscious "because it always stays in the same place," neither are clouds because "the wind drives them" (les fait pousser).
C/O I/E	Reh (6 1/2) resists all suggestion concerning clouds, the wind, water, etc., but claims also that the sun doesn't feel. "Can the sun feel anything?—No —Why not?—Because it isn't alive." But when the sun's movements are recalled more definitely he shows a latent animism: "Why does the sun rise? So that the sun will shine (pour faire du soleit).—Why?—I don't know.—What does the sun do when there are clouds and it rains?—It goes away because it's bad weather.—Why?—Because it doesn't want to be rained on," etc.
p. 187	Falq (7; 3) gives as proof each time the matter of which the object is made; thus fire can't feel "because it's burnt wood," clouds "because they're made of rain," the sun "because it's made of fire," the moon "because it is a little cloud" (this is the spontaneous expression of a conviction to be studied in Chapter IX, § 3), the wind "because it hasn't got a head," etc.
	In simpler language, it means that, in speaking, the child does not succeed any more than we do - in expressing his thought really accurately; he is continually straining it, through inability to recollect every shade of meaning. (Piaget, 1929/2007, p. 192)
Re-analysis: In many instances, Piaget projects adult tendencies onto	

children, thus missing alternative benefits of child-like intuition. In the case above, he does not mention the possibility that the child is not trying to express thought by continually straining it, but perhaps by another method altogether. Perhaps the intuitive child is trying to describe ideas in ways that have already been constrained by the language and the expectation of the questioner. It is this way with qualitative versus quantitative descriptions. While they may sound quite different, they may be approaches to the same end. But a listener expecting a quantitative answer may easily miss the value of a qualitative response.

The quantitative approach of Maxwell is useful and necessary to the progress humankind has made in manipulating electricity and magnetism. It also gives a way of understanding the electromagnetic field that is common to many cultures – as mathematics seems to transcend language – though this is a fervent debate in its own right (Kuhn, 2004; Nisbett, 2003; Whorf & Carroll, 1964). The way Faraday describes phenomena by closely tying his language to the sense perceptions – and winding his way toward theory from a comprehension of the whole set of experiments – is useful as an alternative approach.

Some students of the electromagnetic field theory of light can learn from the epistemic belief system of Maxwell's communications, while others come to an understanding more easily through Faraday's approach. Maxwell uses a more analytical, quantitative approach and Faraday uses a more intuitive, qualitative approach. There are many times that Faraday uses analysis and Maxwell uses intuition – there is no black and white scenario where one finds either person thinking and learning completely from one epistemic belief. This is how Maxwell used

Faraday's observations to corroborate his own findings. Maxwell induced conclusions analytically from parts, but then he followed Faraday's thinking that proceeded from the whole, by a deductive method, to the parts. Maxwell, therefore used the exercise of following Faraday's path to triangulate his own findings for confirmation and verification:

> When I had translated what I considered to be Faraday's ideas into a mathematical form, I found that in general the results of the two methods coincided, so that the same phenomena were accounted for, and the same laws of action deduced by both methods, but that Faraday's methods resembled those in which we begin with the whole and arrive at the parts by analysis, while the ordinary mathematical methods were founded on the principle of beginning with the parts and building up the whole by synthesis. (Maxwell, 1873/2010, pp. x-xi)

Maxwell, in the above quotation, describes Faraday as starting from whole ideas and moving to parts. This is an intuitive act followed by an analytic act.

Following are excerpts from the Piagetian interviews and analysis from Part III. ARTIFICIALISM: Chapter VIII. The Origin of the Sun and Moon (Piaget, 1929/2007) where children described interconnectedness of the sun and the moon with the affairs of human beings. It must be recalled that the purpose of this study was not to judge the validity of the scientific content of the children's statements; rather it was to judge the value of these modes of thinking as ways of learning and knowing.

Chapter VIII. The Origin of the Sun and Moon p. 258 C/O	One of the most illuminating cases that we have obtained is that of Roy, in which certain primitive characteristics show well the original connection between animism and artificialism. We quote it almost in its entirety:— Roy (6; 0): "How did the sun begin?—It was when life began.—Has there always been a sun?—No.— How did it begin?—Because it knew that life had begun.—What is it made of?—Of fire.—But how?—Because

- child: egocentric I/E - child: purpose/participations I/E C/O - child: animism I/E C/O I/E C/O P/C - child: artificial - child: egocentric - child: purpose/participations - child: consciousness - child: purpose/participations - analysis: primitive - analysis: interpreting child as if child is reasoning	there was fire up there.—Where did the fire come from?—From the sky.—How was the fire made in the sky?—It was lighted with a match.—Where did it come from, this match? —God threw it away." After a moment's pause: "What is life?—It is when one is alive.—What made life begin? —We did, when we started living." Then after another interval and in connection with the four quarters of the moon, Roy said: "The moon has become a whole one.—How?—Because it's grown.—How does the moon grow?—Because it gets bigger.—How does that come about?—Because we get bigger (Parce que nous on grandit).—What makes it get bigger?—It's the clouds. (Roy said a little earlier that it is the clouds which cut the moon and make it into a crescent: "It is the clouds which have cut it.")—What do they do?—They help it to grow." "How did the moon begin?—Because we began to be alive.—What did that do?— It made the moon get bigger.—Is the moon alive?—No . . . Yes.—Why?— Because we are alive.—How was it made?—Because we were made.—And that makes the moon get bigger?—Yes. —How? . . . Why?—It is the clouds that have made it get bigger.—Is the sun alive?—Yes.—Why?—Because we are alive.—Does it know when it's day?—Yes.—How? —It can see that it's day." Three weeks later we saw Roy again and made sure that he had forgotten what we had previously talked about. "How did the sun begin?—With fire.—Where did it come from?—From a match.—How did the sun get big?—Because we get big.—Who makes the sun get big?—The clouds.—And we?—It's because we eat.—Does the sun eat?—No.—How do the clouds make the sun bigger?—Because the clouds get bigger too."1 "And how did the moon begin?—With fire too.—How did it get bigger?—Just like we get bigger.—Why did it get bigger? —Because the clouds made it get bigger.—How?—Because they get bigger too.—If there were no clouds would the moon get bigger then?—No . . . Yes. All the same it would be able to, just like we do." This case is worth studying closely, because it shows extremely clearly how artificialism and animism arise simultaneously out of the primitive participations that the child establishes between things and man. There are, in fact, three tendencies in Roy's thought: (1) An artificialist tendency; the sun and moon have been

	made by man. Their origin lies in the flame of a match. (2) An animist tendency; the sun and the moon are alive, they know when it is day-time, and what we are doing, etc. (3) A tendency to establish participations between them and ourselves; they grow because we grow, they began to live "because we were made" ("parce que nous, on s'est fait"), etc. Let us try to determine how far these three tendencies are primitive and what are the relations existing between them.
	1 In order to understand Roy's statements it should be noted that in other conversations Roy has said :—
- analysis: that Roy supports a system of participations is fair - it does not presume Roy to be reasoning, nor does it discard his idea	(a) It is the clouds which make the wind and vice versa (Chap. IX, § 7, and Causalite Physique, Chap. I).
	(b) We are ourselves full of wind, which has at the same time something to do with the clouds; it is this wind which makes us get bigger (Causalite Physique, Chap. II).
- "myth" assumes there is no paradigm where this can be true - assumption that child is deriving/inventing by reason	(c) In its origin the wind has come from men: it is "somebody who blew" (Causalite Physique, Chap. II).
	One can distinguish here a system of participations.
- projecting adult thinking onto child	First of all, it is clear that the artificialist myth according to which the sun and moon come from the flame of a match, is not so primitive as the feelings of participation between the sun and moon and human beings; it is the myth which is derived from these feelings and not the inverse. The myth is, in fact, more or less an effort of invention. Roy made up the myth when pressed to define the origins but his spontaneous thought was satisfied with a much vaguer relation between the sun and man. This relation amounted to no more than this, that man in coming to life thereby provoked the same sort of activity in the sun and moon. This does not constitute an idea that the sun was actually made by man, it simply indicates a participation between them and it was only when Roy was asked to define this participation more exactly that he had recourse to frank artificialism, that is to the myth of their origin in human construction.
- Roy may be intuitively preserving whole situation: mood, conversation - pleasing interviewer, not analyzing - seems to be no projection apparent, here	The same is true with animism. In Roy's view the sun and moon "grow," they are conscious, alive, etc. But there are no grounds for supposing that this animism is prior to the feelings of participation. Roy experiences; the sun and moon grow because we grow, they are alive because we are alive, etc. The relations between animism
- a deduction that would follow if the child was	

analyzing like an adult - seems to respect intuitive thinking to say child is not concerned with causal - jumping to a conclusion that Roy is using a habit of speech because he assigns relationship to sun and wind activity to be similar to human - assuming child is reasoning in a linear way - confused by children - or just not used by them? - yes logical and moral are mixed - but how do we know this is confusion - could it be a different way of thinking? - projection - Roy may be seeing a holistic feeling of interconnectedness of sun, moon, and human in eternity - interconnectedness of all things may lie behind artificialism - one may not be reasoned from the other - invention may be product of adult questions as if they can reason	and participation have been sufficiently discussed in earlier chapters and it is not necessary to return to them here. The notion of participation leads to that of animism and by nature precedes it, though animism may subsequently react on participation by confirming and consolidating it. It seems then that the impressions of participation that Roy experiences are at the root of the other manifestations of his thought. But what are these participations? To say that the moon grows bigger "because we get bigger," that it is alive "because we are alive", is to use formulae which, in the first instance, express simple images or comparisons, without concern as to a causal explanation. As far as Roy is concerned it is also a habit of speech which he used to reply to other questions; as for example, the wind goes along "because we go along," and the sun does not try to go away "because sometimes we don't try to." But the study we have made of the belief that the sun and moon follow our movements has shown clearly enough (Chapter VII, § 2) that a heavenly body which moves "when we move" moves as a result of our movement. Still further, when Roy claims that the moon came into being "because we began to live" and that "that made the moon grow bigger," or again when Roy affirms that even without the help of the clouds, the moon would have grown because of us, it seems that he has in view not merely analogy but genuine causality. Analogy may enter into Roy's reasoning, but only inasmuch as analogy and causality are always confused by children still in the stage of "precausality," that is to say where the logical or the moral is confused with the physical. It may be that the impressions of participation to which the question of the origins of the sun and moon give rise are to be explained as follows. When Roy said that they began to exist "when life began" and "because we began to be alive" it seems that he might have been thinking in more or less vague terms of the origin of babies and that his ideas on the origin of things might be a function of his ideas on the birth of human beings. Roy, like many children, has perhaps begun to wonder where babies come from, and from that to ask himself questions as to the origins of things, with the implicit tendency to relate the birth of things to that of men. We shall see subsequently some examples of artificialist interests originating and developing along these lines.

- perhaps, but child's process of systematizing is intuitive and holistic, not analytical and isolated	We must first inquire what are the ideas of children on the origin of babies. Their first impression is of a connection between babies and parents: they feel that the latter play an essential part in the arrival of the baby—either that they have bought, found or otherwise obtained it. Finally, they invent an explanation for their conviction, namely, that the parents have made it. In this case the feeling of a connection precedes the myth and actually gives rise to it.
- child: purpose/participations - child: animism	Whatever may be thought of this particular proposition, whose accuracy may be judged by what follows, we can understand the true relations existing between Roy's feelings of participation, animism and artificialism; the foundation of them is in the feelings of participation, and it is when the child seeks to systematise these feelings that he has recourse to animistic and artificialist myths.
- exactly, he is being made to speak in a way that is not his native epistemology	Thus, on the one hand, Roy, when urged to define the contents of his participations which seem to partake of the character both of analogy and of causality, fell back on animist explanations. For example, speaking of the clouds, he replied :— "Can we make the clouds grow bigger?—No.—Why do they grow bigger?—Because we grow bigger (Roy admits thus what he has just denied).—Why do you grow bigger?—Because I eat.—Does that make the clouds bigger too?—No, they grow because they know that we do." And after a moment: "How did the clouds start?— Because we were growing.—Is it we who make them grow bigger?—No, it isn't us, but the clouds know we are growing." In other words, the universe is a society of like beings living according to a well-ordered code of rules; every analogy is at the same time a logical relationship since analogy signifies common or interacting purposes and every purpose is a cause. One even feels that, for Roy, the members of this universe necessarily imitate each other so that when we grow the moon and the clouds are forced to follow suit. Clearly, when Roy is made to define his ideas his participations develop into animistic explanations. But, on the other hand, in this universe consisting of a society of living beings, Roy gives the first place to man (or alternatively to God, which amounts to the same since he conceives God as a "gentleman" who lights matches and throws them away).

Re-analysis: Consider the paragraph where Piaget analyzes that when the child invents a myth that the sun comes from a match, the child had an earlier thought that the sun, moon, and humans are connected by the participations in intentions and therefore, "it is the myth which is derived from these feelings and not the inverse. The myth is, in fact, more or less an effort of invention" (Piaget, 1929/2007, p. 260). And couple this example with the one a little further down where Piaget states, "This relation amounted to no more than this, that man in coming to life thereby provoked the same sort of activity in the sun and moon" (Piaget, 1929/2007, p. 260). So Piaget's analysis is that the child makes up myths by deriving or reasoning from fictitious premises of the connectedness of nature and then the child invents other ideas because the child is fixated on presumptions that humans coming to life had an effect on the sun and moon.

It must be recalled that this re-analysis is not based on the truth or positivistic inquiry into the child's statements; rather it is based on the usefulness of the way the child is thinking and learning, the epistemology of the child. The child starts from a premise that all is connected (Piaget, 1929/2007). This includes the objects of the world: the sun, the moon, the child, and the like. But it also includes the processes of life and nature, like our intentions and desires and purposes. Further, it not only connects things, it also connects times. Thus, the child hears the question basically as something that presumes separateness in the way it is asked. Therefore the child must begin to please the adult by considering something the adult presumes to be a fair question as, to the child, a question which has no clear answer. When the child is answering the adult, the child is using a different thought paradigm and therefore a

different language (Donaldson, 1989). The child's language does not simply have word meanings that differ, more importantly it has different grammar. Whorf (1964) compares statements of process of the child to those of indigenous peoples like the Hopi and Aztecs. He points out that the Hopi often do not conjugate verbs because of the connection of a thing to where it was and how it is manifesting in the present and future. Roy may very well be teaching the adult interviewer a wise lesson when he refuses to separate the intentions of the sun and moon from his own, much like the Hopi expresses a flash of light. The Hopi says "flash" for the event. There is no subject, such as light, as in "the light flashes". If the Hopi used a subject it would require a predicate with a verb that does the flashing. To the Hopi, this is an assumption that some separate object is doing the flashing. This to the Hopi would be a projection of the observer onto the phenomenon - to assume that something performed the act of the flash - and it would be a further assumption to assign a verb tense to this act since no one knows when and where it came from, nor where it is going. Like the child speaking of the sun and moon as participating with the human, the Hopi uses the epistemology that starts from connectedness and must be proven otherwise. In the modern, technological west we start from the assumption that all things are separate and must be proven to be connected (Kuhn, 2004). It must be recalled that this discussion is not a venue to decide on the truth or falsehood of these assumptions, but rather on their usefulness. Whorf has stated that this connectedness of a child is extremely useful:

> The thoughts of a Hopi about events always include *both* space and time, for neither is found alone in his world view. Thus his language gets along adequately without tenses for its verbs, and permits him to think habitually in terms of space-time. Properly to understand Einstein's relativity a Westerner

> must abandon his spoken tongue and take to the language of calculus. But a Hopi, Whorf implies, has a sort of calculus built into him. (Whorf & Carroll, 1964, p. viii)

Thus, Piaget may be projecting a reasoning, analytical process of thought onto the child in the very way he asks the question. Then, when he interprets the child he may be missing that the child is simply saying that he cannot conceive of separateness, so mythical answers for impossible conjectures must be invented.

In Piaget's time, society in the modern technological West was in an extremely positivistic, scientific mindset. Kuhn (2004) might say that the prevailing paradigm of thought in this society was that there was one way of finding things out, of learning. And the rational, analytical way of science of that day was the way. And education in the U.S. was built on pillars of Piagetian and scientific, positivistic thought paradigms (Bruner, 1986). Re-analysis like the samples above need to be done because society has learned to entertain multiple modes of thought as it has learned to globalize its appreciation of multiple cultures. Science is also coming to deal with multiple, even paradoxical, parts of theories of light, electromagnetic fields, and quantum theory. Education needs to catch up.

Following are continued excerpts from the Piagetian interviews from Part III. ARTIFICIALISM: Chapter VIII. The Origin of the Sun and Moon (Piaget, 1929/2007).

p. 264 I/E C/O P/C	Jacot (6 1/2) believes that the sun is of fire: "How did it begin?—It was quite tiny.—Where does it come from?—From Heaven.—How did it begin in the sky?—Always getting bigger." Jacot says that the sun is alive and conscious. It has grown like a living thing. It was made by human beings.
	Gaud (6; 8): "What is the moon like?—Round. Sometimes there is only half of it.—Why is there only

I/E C/O	half of it?—Because that is how it starts.—Why?—Because there is a lot of daylight (he means that the moon remains small during the day and only grows at night).—Where is the other half?—That's because it's not finished, not absolutely finished.—What does it make itself like?— Round.—How does it begin?—Quite small; then it keeps on getting bigger.—Where does it come from?—From Heaven.—How does it make itself?—Quite tiny.—Does it make itself all alone?—No, God does it.—How?— With his hands." Gaud adds that the moon is alive and conscious. It deliberately follows us about, etc. The sun is equally alive and has been made.
p. 266	Gall (5) was born in 1918, which perhaps has some bearings on his cosmogony: "Where did the sun come from?—It came in the war.—How did it begin?—When the war ended.—Has there always been a sun?—No.—How did it begin?—A little ball came.—And then?—It grew big.—Where did this little ball come from?—From the fire."
I/E C/O	Hub (6 1/2): "Has the sun always been there?—No, it began.—How?—With fire. . . .—How did that start?—With a match.—How?—It was lighted.—How did that happen?—By striking the match.—Who struck it?—A man.—What was his name?—I don't know." The moon was made "in Heaven" that is to say "in the clouds.—How were the clouds able to make the moon?—Because it is lighted.—What is?—The cloud.—-How?—With fire. —Where does this fire come from?—From the match." "What lit it?—A bit of stick with a red thing at the end." Hub is thinking here of the rockets sold on gala nights; the moon for him is a cloud set alight by rockets fired off by people. The origin of the clouds also is artificial: "Where do the clouds come from?—From the sky.— How did they start?—In smoke.—Where does the smoke come from?—From stoves,—Does smoke make the moons then?—Yes."
p. 267 I/E C/O	Jac (6 1/2) supposes that the stars are on fire and that they are made by people.
I/E C/O	Grang (7 1/2): "What are the stars?—Round things.—Made of what?—Made of fire." It is God who made them. The reason for this artificialism lies evidently in the finalistic attitude which makes all children believe that the function of the stars is to indicate the weather. They serve "to show if it will be fine to-morrow" (Caud, 9; 4).

	"What are the stars?—They are to show if the next day will be fine" (Ceres, 9).
p. 273 I/E C/O P/C	Font (6; 9) says that the sun is conscious, it is made of fire and it comes "from the mountain.—Where from?—From the mines.—What is it?—People go looking for coal in the ground." As to the moon: "It was made by the sun. —How?—With the fire from the mountain.—Where does the moon come from?—From the mountain.—What was there in the mountain?—The sun—Where does the sun come from?—From the mountain.—How did it begin? —With fire.—And how did this fire begin?—With matches. —And how did the mountain begin?—With the earth . . . It was people who made it."
p. 281 I/E C/O	Bul (7 1/2): "It was cut up by people to make half a moon."
	Dou (5; 0) : "It must have been cut in two."
	Hub (6 1/2): "Is the moon always round?—No.— What's it like?—Sometimes a crescent, it is very worn out. —Why?—Because it has done a lot of lighting.—How does it come round again?—Because it is made again.—How?— In the sky."

Re-analysis: When the child reaches Piaget's formal reasoning stage, causal effects can be logically deduced. The child can perceive mechanistic order. According to Schrodinger (a foremost spokesman for quantum theory), however, science had to move past thinking in deterministic ways. Science had to move past regarding the human as a machine. In order to embrace quantum physics, science had to re-embrace some historically earlier ways of thinking. These are ways that the intuitive child thinks - ways that assume a certain amount of order and conscious intention. Schrodinger used the thinking style of the intuitive child as he posited the physical interactions of the world:

> For it is simply a fact of observation that the guiding principle in every cell is embodied in a single atomic association existing only in one copy (or sometimes two) — and a fact of observation that it results in producing events which are a paragon of orderliness. Whether we find it astonishing or whether we find it quite plausible that a small but highly organized group of atoms be capable of acting in this manner, the situation is unprecedented, it is unknown

> anywhere else except in living matter. The physicist and the chemist, investigating inanimate matter, have never witnessed phenomena which they had to interpret in this way. (Schrodinger, 1944/1992, pp. 77-79)

Later, he concludes that the human controls matter. The point here is not to agree or disagree with Schrodinger's theoretical assertions. It is to note his method of thinking and see how closely it resembles that of the intuitive child:

> But immediate experiences in themselves, however various and disparate they be, are logically incapable of contradicting each other. So let us see whether we cannot draw the correct, non-contradictory conclusion from the following two premises:
>
> (i) My body functions as a pure mechanism according to the Laws of Nature.
>
> (ii) Yet I know, by incontrovertible direct experience, that I am directing its motions, of which I foresee the effects, that may be fateful and all-important, in which case I feel and take full responsibility for them.
>
> The only possible inference from these two facts is, I think, that I — I in the widest meaning of the word, that is to say, every conscious mind that has ever said or felt 'I' — am the person, if any, who controls the 'motion of the atoms' according to the Laws of Nature. (Schrodinger, 1944/1992, pp. 86-87)

APPENDIX E: 40 TEACHER PRIVILEGES OF THE INTUITIVE TEACHER

Below is a table of the 40 teacher privileges, followed by a narrative description.

40 Teacher Privileges of the Intuitive Teacher
The Role of the Experiment 1. *I may be permitted to observe an experiment without thinking of what it means.* 2. *I am allowed to receive what may be valid, scientific impressions from an experiment that are too large or complex to articulate.* 3. *I may perform an experiment and allow that it was designed to research the wrong question.* 4. *I may be aware of the danger to constrain what my students see by describing my analysis before the student is done observing.* 5. *I may be aware of the danger to hurt nature by experimenting.* 6. *I am allowed to end a lesson knowing I may never understand it because the full explanation is too large for my conscious mind.* 7. *I am allowed to listen to my students as if their commentary is sometimes revealing deeper truth than mine.* 8. *I am allowed to watch for the effect I may have on an experiment, just by observing it.* 9. *I am allowed to talk about the chance that there are non-physical causes to physical effects.* 10. *I am allowed to accept both research-based, physical effects – as well as – intuitively-based, whole ideas – and test them out scientifically as equally possible sources of evidence.*
Ways of Knowing 11. *I am allowed to not know – often.* 12. *I may keep the ability to generalize commonality (I learned as an adult), separate from the ability to synthesize universality (I knew as a child).* 13. *I am allowed to receive new ideas while speaking – and note how they are better than what I was going to say.* 14. *I may look at the same person or event and see NO connections one*

time – and NECESSARY connections by looking once again.

15. *I am allowed to rate my own impressions on an equal basis with research evidence, until proven wrong.*
16. *I may be inspired by a belief prior to its arrival in my conscious mind where I check it out analytically to see if it makes sense.*
17. *I am allowed to hear a student and believe in her or him, before actual understanding takes place.*
18. *I may connect to my student on a level that is deeper than analytic comprehension.*
19. *I am allowed to expect wisdom from myself, my student, or the next unexpected event in my classroom.*
20. *I am allowed to be turned in a new, useful direction at any moment.*

Measurability and Mechanical Thinking

21. *I may love and respect technology, instrumentation, and mechanized measurement without disrespecting the unseen, immeasurable, and non-physical.*
22. *I may assign as much importance to immeasurable patterns of similarity in the human – as I assign to the measurable.*
23. *I may assign as much importance to immeasurable patterns of similarity in nature – as I assign to the measurable.*
24. *I am allowed to make assumptions based on synthesis of diverse aspects of nature – before I measure them to verify my assertions.*
25. *I may judge the book of nature by her cover – or even a single page – then, at a later time, investigate her many parts to verify my argument, in other words I may seek scientific truth of the whole in one part.*
26. *I am allowed to state that I cannot measure – and do not understand – how the light coming from innumerable stars in the sky can simultaneously occupy the tiny space of the iris of my eye – and then separate into distinct images of the stars.*
27. *I may seek new ways to know about space and time – infinity and eternity – though they are immeasurable.*
28. *I may acknowledge evidence of a group consciousness of: bees, ants, termites, slime mold, epigenetic control of human DNA, and perhaps human beings – without being able to measure a physical component of evidence.*
29. *I am allowed to resist testing my students and suggest non-measurable, non-invasive evaluations of them.*
30. *I may acknowledge human analytical progress of the last several*

thousand years – while at the same time – acknowledging ancient intuitive abilities that have been lost, temporarily.

Pedagogy

31. *I am allowed, as a teacher, to question everything – model learning by deconstruction – for my students.*
32. *I may include every diverse natural species, diverse sociological form of expression, diverse ways of knowing.*
33. *I may aim more at the transformation of my students through the experience they have in my class - than the information they may receive.*
34. *I am allowed to integrate related subjects during my lessons – even if it strays from the curriculum.*
35. *I may accent aspects of the curriculum that I love, so that I model real connection to my material.*
36. *I am allowed to find where my students connect and have relationship to the material and modify my approach so that it respects that which is relevant to their culture.*
37. *I am allowed to have fun – and respect students for wanting to have fun.*
38. *I may let my students forget lessons, so that they pick them up later – perhaps with fresh insights.*
39. *I am allowed to forget what I am doing, or fall down on the job – then be picked up by my students – in other words, be vulnerable enough to put myself in their hands.*
40. *I am allowed to respect silence - when a student cannot or does not wish to articulate an impression – and model to the class how to leave room for possible non-language moments of higher order learning.*

The sanction of educational taboos takes many forms. Teachers in general and science teachers in specific have long been taught a certain pedagogical way. Let us take a case in point – the teaching of observation and analysis of phenomena. Often in a science class a phenomenon is demonstrated or described. The student is then directed to *observe* the phenomenon. Discussion usually follows which *analyzes* causes and

properties of the phenomenon. Science teachers have been taught this very common sequence of moving from *observation* to *analysis*. Although this may seem quite normal, there is a blind spot, here – as regards intuitive education. If we were to keep education in the U.S. the same as it has been, there would be nothing more to say. But to shine a spotlight on the point where intuition has been glossed over we would take a second look at how we handled the *observation* portion of this process. If the science teacher were taught to keep the *observation* quite separate from the *analysis*, and further – to give both a substantial level of importance – we might start moving more toward teaching science intuitively. Please note that many science teachers already do what I am about to describe. The purpose of this paper is to make it clear when we are and when we are not enhancing intuition.

To *observe* is an intuitive act. It requires no logic, no rationality. One uses senses or attention, only. To *analyze* requires no senses – just logic and rationality. These two acts are mutually exclusive and activate opposite parts of us. If a teacher stays on the *observation* of an experiment, without going on to analyze it – then notices how beautiful it is – what colors, smells, shapes are there – how it makes one feel – the intuitive capacities are being exercised. If one then speaks of causality – why the experiment happened that way – what a student might predict, conclude, think about – the analytic capacities are being exercised. Neither the *observation* nor the *analysis* is more important, just as neither intuitive nor analytical thinking is more important. And, just as both intuitive and analytical paradigms are in operation during thought – the student should be free to *observe*, then *analyze* – and move freely back and forth among these acts. The important thing is to keep them separate – mixing them is precisely the act of

jumping to a conclusion without proper foundation. And the habitual way education in the U.S. mixes them and rushes past the stage of staying with an *observation* to get to the answer – the *analysis* – cuts off further intuitions that may have been received by the student while staying still to remain with the state of *observing*. It should even be valid for a science teacher to ask for students to *observe* something, then move on, without analyzing it – though this almost never happens in the educational system in the U.S. So, let us then use this simple example where a science teacher does *observation* and *analysis* of some phenomena with a science class – and ask this question, "If some teacher education programs and some schools foster analysis over intuition, and possibly *analysis* over *observation*, why might this be so?"

Often the decision for a significant portion of the population to remain silent on a certain issue is not made consciously - it is made because society has internalized a socially constructed belief that is so subtly interwoven into the fabric of discourse and education, that alternative views are not even considered (Bell, 1994). Sometimes, the conscious effort of an elite group in power plan to cover truths about others so that a status quo may be preserved and perpetuate the superior position of the privileged few (Anderson, 1988; Lorde, 1984; Wiggan & Hutchison, 2009; Wynter, 2001). Although implied, it is not an objective of this paper to provide evidence that there exists a historical trend to suppress the purely subjective experience of observation in the study of science education and to gradually enhance the analytic acts of: naming, labeling, citing, dissecting, and the explaining of phenomena. It is, however, the purpose of this paper - regardless of the reasons that society may or may not have moved in this direction up until now – to lend voice to the latest trend which may be going quite the opposite way.

Many researchers are now arguing in favor of the swing away from the unsustainable, analytic exploitation of nature and society (Bell, 1994; Blake, Darensbourg, Butler, & Lewis, 2010; Carnoy et al., 2007; Curry, 2000; Darling-Hammond, 2010; Harry & Klingner, 2006; Hilliard, 2000; Hochschild & Machung, 2003; Ladson-Billings, 2009; Loewen, 1995; Lorde, 1984; McIntosh, 1988; Rebell & Wolff, 2008; Smith & Hungwe, 1998; Stiglitz, 2002; Wiggan, 2007, 2008; Wiggan & Hutchison, 2009). Movement in education toward a respect for processes that observe nature in unfettered operation (Boorstin et al., 1983; Bortoft, 1996; Carter, 2008; Kuhn, 2004) or society in forms that model the holistic and sustainable (Diop, 1974; Houston, 2007; Stone, 1976; Teresi, 2003) are already underway. In terms of specific pedagogical acts that teachers do or do not have as a privilege – the point of this paper is that teachers and pre-service teacher programs lag research findings in their sophistication as they communicate the art of science pedagogy. Although this list is largely subjective as it comes from my personal experience and therefore may not represent the objective mean of experiences in pre-service teacher programs and science classrooms, the research that I cite as the corresponding points to my personal observations and conjectures is mainstream and current. If I am in error, it may be in that the list of privileges sounds prescriptive or even pedantic; and for that, I apologize.

Teacher Privileges: *The Role of the Experiment*

In order to place perspective on the issue in teaching as to what role scientific experimentation plays, I need to turn to a similar sociological issue that has been breached – in the hopes of encouraging current pedagogy to breach this issue of the role of the experiment in schools, as well. In the early history of education in the U.S., issues

of fairness to styles of learning for different sociological groups came to the fore. During the controversy over the education of blacks following a long period of nationally-sanctioned slavery, W. T. DuBois openly disagreed with the way Booker T. Washington wanted industrial training to stand in the stead of higher education of the intellect. This can be compared to the grounds on which Ainsworth and Wiggan disagree with the argument whereby Ogbu recommends that blacks are considered to be educated if and when they assimilate to white culture (Horvat & O'Connor, 2006). In both of these cases, there is a question of blacks not being looked at for who they are. The complaint is that they are being looked at through the lens of the white culture. And further, it is asserted that with this lens comes a load of baggage – not the least of which is projection of a host of cultural mores onto the blacks that all but take their legs out from under them.

This first section of enumerated science teacher privileges on the role of experimentation voices a similar complaint. But in this drama, the dominant, white culture is played by analytical thinking and the blacks are played by observational, intuitive thinking. The taboo that DuBois, Ainsworth, and Wiggan had to battle was the unspoken assumption that blacks were not capable of higher intellectual activity. In science education, the taboo is the unspoken assumption that the act of receiving an intuitive idea is not a valid form of knowing and thinking. Thus, as the lens of the whites demand blacks to demonstrate intellectual prowess within a biased cultural definition almost guaranteeing lesser performance, so does the analytic way of performing experiments set up questions to nature and science that are already biased and constrained to receive only the analytic parts of the answers. It is in this way that blacks are silenced, and likewise, pure observations are reduced to “non-scientific” commentary. Thus, we

may ask, “What are these privileges science teachers may rightly demand, if we are to move toward intuitive education?”

1. *I may be permitted to observe an experiment without thinking of what it means.*
2. *I am allowed to receive what may be valid, scientific impressions from an experiment that are too large or complex to articulate.*
3. *I may perform an experiment and allow that it was designed to research the wrong question.*
4. *I may be aware of the danger to constrain what my students see by describing my analysis before the student is done observing.*
5. *I may be aware of the danger to hurt nature by experimenting.*
6. *I am allowed to end a lesson knowing I may never understand it because the full explanation is too large for my conscious mind.*
7. *I am allowed to listen to my students as if their commentary is sometimes revealing deeper truth than mine.*
8. *I am allowed to watch for the effect I may have on an experiment, just by observing it.*
9. *I am allowed to talk about the chance that there are non-physical causes to physical effects.*
10. *I am allowed to accept both research-based, physical effects – as well as – intuitively-based, whole ideas – and test them out scientifically as equally possible sources of evidence.*

Our culture has a blind spot toward finding things out while our minds are not engaged in analytical, deductive or inductive reasoning. We do not accept that our consciousness can receive impressions that are scientifically valid – and that these impressions are inextricable from every experience we have (Wynter, 2001). We try to explain scientific phenomena as if we can be totally objective – like machines. We act as if nature and society have an existence that can be seen by us through telescopes and microscopes. We want to reduce the role of our consciousness to physical, measurable workings – by projecting our current analytical, mechanical view of the world onto it, as Wynter argues in the article, *Consciousness: An Interview with Sylvia Wynter*:

> YOU CANNOT SOLVE THE ISSUE OF "CONSCIOUSNESS" IN TERMS OF THEIR BODY OF "KNOWLEDGE." You just can't. Just as within the medieval order of knowledge there was no way in which you could explain why it is that certain planets seem to be moving backwards. Because you were coming from a geocentric model, right? So you had to "know" the world in that way. Whereas from our "Man-centric" model, we cannot solve "consciousness" because "Man" is a purely ontogenetic-purely biological conception of being, who then creates "culture." So if we say "consciousness" is "constructed" who does the constructing? You see?
>
> …
>
> Obviously then, just as the medieval order could not even consider that the Earth was not the center of the universe – because they looked and saw everything "moving" and so on and so forth; also, because they don't feel the goddamn Earth move, you know! [Laughter]
>
> So that's what I mean when I say the Black situation and the homosexual situation are parallel. We are the only ones who are socialized in such a way that we cannot trust our own "consciousness." Because it's very difficult to ever contradict the norm, whatever is the norm. (G. Thomas, 2008, p. 2)

Thus, the issue of ways of knowing must be left open to culturally relevant learning and teaching that includes the human-cultural tendency to receive ideas from deductive and inductive thoughts – as well as from purely non-decipherable, intuitive sources.

Teacher Privileges: *Ways of Knowing*

11. *I am allowed to not know – often.*
12. *I may keep the ability to generalize commonality (I learned as an adult), separate from the ability to synthesize universality (I knew as a child).*
13. *I am allowed to receive new ideas while speaking – and note how they are better than what I was going to say.*
14. *I may look at the same person or event and see NO connections one time – and NECESSARY connections by looking once again.*
15. *I am allowed to rate my own impressions on an equal basis with research evidence, until proven wrong.*
16. *I may be inspired by a belief prior to its arrival in my conscious mind where I check it out analytically to see if it makes sense.*
17. *I am allowed to hear a student and believe in her or him, before actual understanding takes place.*
18. *I may connect to my student on a level that is deeper than analytic*

comprehension.

19. *I am allowed to expect wisdom from myself, my student, or the next unexpected event in my classroom.*
20. *I am allowed to be turned in a new, useful direction at any moment.*

Researchers, such as (Kumashiro, 2000), argue that there is a need for new kind of teaching; one where the teacher does not know or control how students will act, but instead, moves into unknowing, unconscious – the unthinkable – one where the teacher does not aim for students to *understand* some critical perspective, but instead, the teacher aims for *effect*, by engaging students in a relevant aspect of critical theory that students apply to their lives, use to deconstruct knowledge, and critique the unsaid. But this deconstruction is smothered by the mechanistic view that holds to the idea that facts are true if, and only if, we can measure some physical attribute of nature. Much pseudo-research has passed by the discernment of the U.S. public by quoting statistics that seem to measure the intelligence of humans in order to compare races. Often the study begins asking loaded questions – projecting an over-simplified view into the 'research' that constrains the answers that are published – like the question of a person's race. "One drop of African blood meant that a person was black, a pronouncement that carried a stigma and negative social consequences with burdens that were too heavy to bear. The irony is that all human beings share a common origin, human beings share 99.9% of the same Deoxyribonucleic acid [DNA]" (Wiggan, 2011, p. xvi).

Science Teacher Privileges: *Measurability and Mechanical Thinking*

21. *I may love and respect technology, instrumentation, and mechanized measurement without disrespecting the unseen, immeasurable, and non-physical.*
22. *I may assign as much importance to immeasurable patterns of similarity in the human – as I assign to the measurable.*
23. *I may assign as much importance to immeasurable patterns of similarity in nature*

– as I assign to the measurable.

24. *I am allowed to make assumptions based on synthesis of diverse aspects of nature – before I measure them to verify my assertions.*
25. *I may judge the book of nature by her cover – or even a single page – then, at a later time, investigate her many parts to verify my argument, in other words I may seek scientific truth of the whole in one part.*
26. *I am allowed to state that I cannot measure – and do not understand – how the light coming from innumerable stars in the sky can simultaneously occupy the tiny space of the iris of my eye – and then separate into distinct images of the stars.*
27. *I may seek new ways to know about space and time – infinity and eternity – though they are immeasurable.*
28. *I may acknowledge evidence of a group consciousness of: bees, ants, termites, slime mold, epigenetic control of human DNA, and perhaps human beings – without being able to measure a physical component of evidence.*
29. *I am allowed to resist testing my students and suggest non-measurable, non-invasive evaluations of them.*
30. *I may acknowledge human analytical progress of the last several thousand years – while at the same time – acknowledging ancient intuitive abilities that have been lost, temporarily.*

Perhaps the single, most-abused privilege of the teacher and pre-service teacher is the social construction that education is about information. It is about transformation (Darling-Hammond, 2010; Delpit, 2006; Delpit & Dowdy, 2002; Freire, 1998a, 1998b, 2000; Freire & Freire, 1994). And the role of pedagogy is to make connection above all else – relationship is paramount in teaching, otherwise the separateness of our human physicality – the fact that we live in different bodies, with different physical characteristics, and varied gender, ethnicity, sexual preference, even personality - is an unbearable hurdle to coexistence - “I must establish myself as not-you. And the road to anger is paved with our unexpressed fear of each other’s judgment” (Lorde, 1984, p. 169).

New teachers sometimes see pedagogy as an art or skill of imparting knowledge. This issue of transformation too easily slips out of sight in pre-service teacher preparation

programs because of the need to address the pressures of teaching so many facts and skills that will appear on high stakes tests (Darling-Hammond, 2010). But some experts in education feel that issues of student transformation – the path from being powerless to being empowered – will offset, and eventually set right, the political agenda of education (Apple, 2004; Delpit, 2006; Delpit & Dowdy, 2002; Freire, 1998a, 1998b, 2000; Freire & Freire, 1994). Thus it is that science education can draw on culturally relevant examples to make parallels for diverse students to relate.

> When I first heard of the term 'feminist pedagogy,' I thought it meant dealing with women, girls, etc. Now, after talking about this for the first time with the others in the group, I think it means so much more than that. I don't think of it as just a female thing. I think it concerns issues of power and how we as science teachers, and others in science, use our power and the possibilities of how we can share that power with our students. (Capobianco, 2007, p. 11)

Students can associate to parts of nature that are being passed over by comparing them to sociological movements that were ignored. And most importantly, they can be shown root causes like the ways the human mind learns best in studies that show the balanced approach to intuitive and analytical thinking (Arnheim, 1986a, 1986b; Burton, 1999b; Eisner & National Society for the Study of Education, 1985; Haskins, 2009; Kelemen & DiYanni, 2005; Krist, 2010; Pariser, 2008; Smith & Hungwe, 1998) in order to offset, and set right, the future of our world.

Teacher Privileges: *Pedagogy*

31. *I am allowed, as a teacher, to question everything – model learning by deconstruction – for my students.*
32. *I may include every diverse natural species, diverse sociological form of expression, diverse ways of knowing.*
33. *I may aim more at the transformation of my students through the experience they have in my class - than the information they may receive.*
34. *I am allowed to integrate related subjects during my lessons – even if it strays*

from the curriculum.

35. *I may accent aspects of the curriculum that I love, so that I model real connection to my material.*
36. *I am allowed to find where my students connect and have relationship to the material and modify my approach so that it respects that which is relevant to their culture.*
37. *I am allowed to have fun – and respect students for wanting to have fun.*
38. *I may let my students forget lessons, so that they pick them up later – perhaps with fresh insights.*
39. *I am allowed to forget what I am doing, or fall down on the job – then be picked up by my students – in other words, be vulnerable enough to put myself in their hands.*
40. *I am allowed to respect silence - when a student cannot or does not wish to articulate an impression – and model to the class how to leave room for possible non-language moments of higher order learning.*

Pedagogy is under siege in the U.S. – but also globally – from a bent on the measurable and mechanical, from human-directed experiments that have not been thought out, and from socially constructed beliefs that have sunken so deeply into the fabric of our thinking that we have forgotten to question them (Anderson, 1988; Rebell & Wolff, 2008; Wiggan, 2007; Wiggan & Hutchison, 2009). But if these problems sound disparate – one has only to ponder the common thread among them. They join, because unbridled, analytical, reasoning lies behind them all. They all suffer from the affliction of cold calculation without human heart. But, there is hope - we can access the opposite of our modern technological age if we look back to our roots, when we used warmer thinking - in whole terms.

Molefi Asante stresses that the Afrocentric view sees *feeling*, *knowing*, and *acting* as an inseparable whole. He contends that there are deep remnants of the process of thinking in wholes that comes from the various, ancient African cultures that facilitate learning. Like Du Bois, Asante asserts that epistemic beliefs that access the process of

thinking in wholes span many, diverse cultures. It is a principle of intellectual endeavor that a student can learn best by seeing, on the one hand, analytical parts of a whole, and on the other hand the whole in its inextricable unity. This is a pedagogical topic of conversation in the science education community at present – one which is necessary for the understanding of quantum physics (Greenstein, 1997). One study that crosses the teaching of science with African epistemic beliefs observes the need for both the analytic and holistic ways of thinking to be present to make a complete view of a scientific phenomenon (Melear & Pitchford, 1991).

> Hale-Benson reports that Black children are more feeling-oriented and people oriented and more proficient at non-verbal communication than White children. She quotes Asa Hilliard who reports that the core of the African-American cultural style is a tendency to respond to things in terms of the whole picture instead of its parts. The Euro-American, on the other hand tends to believe that anything can be divided. This is the positivistic or reductionistic view of the world, a view which drives the scientific enterprise. … So it is not without precedent that the Hale-Benson ideas are compelling, based on style alone, even without the African-American culture issue promoted by both Hale-Benson and Atwater. (Melear & Pitchford, 1991, p. 2)

This study cites the National Science Teachers Association in suggesting that more cooperative learning in science classrooms. They line up with Asante is defining cooperative as involving more talking, data gathering of real world problems and less emphasis on one right answer.

Clearly the process of thinking in wholes, when paired with the analytical process of thinking in parts, do not belong to Afrocentricity. Afrocentricity belongs to it. But pairing the fact that all records of human civilization point to the African culture as the origin of this way of learning, with the fact that modern day African-American students still tend more toward this way of learning than do Euro-centric students provides a seriously rich foundation for self-respect on the part of the African -American student.

In the end of the discussion as to a science teacher's privileges in the teaching of *observation* and *analysis*, the act of *observation* – the intuitive leap – is not a trivial matter. It is not something pre-service teachers should encounter only once or twice in a technical discussion on learning and cognition. It is important. It lies at the root cause of a new direction for pedagogy. Intuitive education has just been outlined in forty privileges – a teacher's bill of rights. Every teacher needs to be armed with a balanced method of learning and pass this on to students. The balance lies in equal respect for knowledge that arises from nonverbal, non-physical, unthinkable ideas as well as from well thought out, analyzed, conscious deductions and inductions. Audre Lorde speaks of how no one helped her to learn this way – she had to do it for herself:

> But eventually I learned how to acquire vital and protective information without words. … You always learned from observing. You have to pick things up nonverbally because people will never tell you what you're supposed to know. You have to get it for yourself, whatever it is that you need in order to survive. (Lorde, 1984, p. 83)

Intuitive education should incorporate this form of learning. Pre-service teachers need to have professors model a listening for the unsaid. In conclusion of this discussion of *observation* and *analysis,* let it be clear that the argument of this entire paper – though advocating for intuitive education – does not advocate intuition over analysis – it seeks to restore a balance of the two.

Conclusion

The existence of the intuitive trait of comprehending whole ideas of the pre-operational child can be established based on Piagetian observations of early childhood cognitive development (Piaget, 1950). An additional school of thought corroborates the existence of the child's ability to apprehend whole ideas without prior analysis from the

work of Vygotsky (1966/2002, 1979; 1978) and Bandura (1971). This argument describes how the child cannot manipulate abstract groups that are separated from a whole grouping and relates to the concept of wholeness as portrayed in the theory of Complementarity in Quantum Physics according to the work of Quantum scientists Zajonc and Greenstein (1997; 1993) among others. Since this connection shows a case where pre-operational children, who intuitively think in wholes, are not merely lacking the ability to perform formal operations, but are actually employing a useful way of knowing. I will question whether the pre-operational stage embodies ways of knowing that may be worthwhile to nurture throughout schooling. And therefore, according to the numerous studies cited above, where we established that the inquiry-based classroom as one where intuitive methods of learning need to be enhanced, we will seek to document a concrete case – a child's linguistic use of whole ideas – where intuition begins the process of knowing - followed by analysis, which completes the process.

The framework must culminate, however, in stressing that the purpose of our study is to underscore the need for intuition to be nurtured in the classroom alongside of analysis – not in any way to replace it:

> One reason why intuition has been treated with suspicion by those who believe that knowledge should be acquired only by intellectual means is, as I observed earlier, the way in which the results of intuition seem to fall from the skies like a gift of the gods or of inspiration. Add to this now the misleading belief that when a situation is apprehended as a whole it comes across as an indivisible unity, a holistic totality, an all or nothing like a flash of light or a mere feeling. According to this belief, intuitive insight is not accessible to analysis, nor does it require it. (Arnheim, 1986a, p. 26)

Although intuitive abilities are avoided in today's schools (Reuven Babai et al., 2010; Burton, 1999b; Danovitch & Keil, 2008; Haskins, 2009; Jaeger, 2007; Johansson & Kroksmark, 2004; Kelemen & DiYanni, 2005; Krist, 2010; Quale, 2011; Smith &

Hungwe, 1998; Tretter et al., 2006; Watson & Kelly, 2005; Yair & Yair, 2004), intuitively received ideas can be inspected by analysis. The mind is constantly operating with intuitive and analytic ideas working in concert, as we hope to see from the interviews that follow our research questions.