ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’ USING A MODIFIED REPERTORY GRID TEST: A CASE STUDY

By

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Abstract

This paper presents a method for assessing the personal construct systems of young children (ages 4-6) regarding the notion of ‘nature,’ conducted at a Montessori Casa in Toronto, Ontario. Images from the participants’ drawings of ‘nature’ were used in a card sorting exercise and as elements in a modified repertory grid test. Member checking was conducted through recorded conversations with the children throughout the process to minimize the influence of my own construct system. I conducted content analyses of the initial drawings, and made structural measurements and statistical analyses of the card sort and repertory grid data. The limited results indicate that this modified form of repertory grid test is reliable and useful for assessing the structure of young children’s construct systems regarding ‘nature.’ Using Personal Construct Theory may facilitate the development of more participatory, engaging, and effective Environmental Education programs.

Keywords: young children, nature, environmental education, children’s drawings, personal construct theory, personal construct psychology, repertory grid test,
Dedication

This thesis is lovingly dedicated to the memory of B. Elinore Beattie (1916 – 2009), my “grammar gramma,” who loved nature and always believed in me.
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I could not have completed this journey without the emotional, financial, intellectual, and edible support of my family; thank you, Mum, Dad, Klaus, and Carol! I would also have been lost without the guidance and wisdom of my supervisors, Dr. Rick Kool and Dr. Enid Elliot; thank you both for all your hard work! I am also extremely grateful to the staff, students, and parents/guardians of Kew Park Montessori Day School, who were incredibly accommodating, friendly and generous in working with me during my research sessions. The pleasure was mine! I wouldn’t have had such an amazing research opportunity if it weren’t for the help of Dr. Jennifer Good, which I appreciate more than words can say.

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Epigraph

“If I had the power to make this will,

I would bequeath to you

A child-like sense of wonder

To last the long years through.”

-- from “Legacy to A Camper,” Mary S. Edgar (Palm, 1982, p. 122)
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Chapter 1: Introduction

Children, Nature, and Environmental Education

Many academics, naturalists, teachers and environmental organizations have documented an increasing disconnection between children and the outdoors, which Louv has called “Nature-Deficit Disorder” (Louv, 2005), as well as its detrimental effects on children’s physical and mental health (Charles & Senauer, 2010; Lester & Maudsley, 2006; Moss, 2012). Attempts at mitigation have included the proliferation of children’s books accentuating nature’s benefits, such as *What Camping Can Teach Us* (Rubo, 2005) and *Biomimicry, Inventions Inspired by Nature* (Lee, 2011), and an increase in the size and number of practical handbooks such as *Hands-On Nature* (Lingelbach & Purcell, 2000), designed for elementary-level teachers and parents trying to teach their children school subjects and a love of nature simultaneously. Professional associations, including the North American Association for Environmental Education and the Council of Outdoor Educators of Ontario, have addressed the disconnection between children and nature at their conferences; webinars on the topic have been hosted by academics and not-for-profit organizations alike. All of this action and discussion can be summed up by one conclusion: re-connecting children with the environment can be achieved through improved Environmental Education (EE).

As Environmental Educators (EErs), as adults, as a society, it is in our best interests to teach children about the earth we live on as effectively as we can. I believe that to find out how to teach children, curriculum designers and educators should ask children of all ages, as well as other professionals. The Ontario Working Group failed to speak to any Ontarian students. This situation, in which children are being taught from a curriculum into which they had no input, concerns me. I believe there is a danger that miscommunication will occur: for example, EErs may unknowingly be using terminology that has one meaning for them and a different one for the children they are speaking to (Nutting, 1988, p. 159). I have an interest in what children could contribute if they had the opportunity to participate in the EE curriculum design process. The Back to Nature Network and the Ontario Ministry for Natural Resources appear to share this goal, as they are also asking for children’s input into their latest project, an Ontario Children’s Charter defining children’s rights to outdoor experiences (Ontario Children’s Charter, 2013).

“Understanding, respecting, and working with differing conceptions of human-nature relations is part of the mandate for Environmental Educators and Communicators” (S. Dunham, personal communication, February 4, 2013). By asking children about their conceptions of common EE terms, educators can avoid talking at cross-purposes with their students. Further, EE can then be approached from the children’s point of view, taking their interests, level of understanding, and mental processes into account. My research, described in this paper, investigates a method which seeks to explore how children understand, conceive of, and find meaning in the commonly-used terms of the Environmental Education discourse, such as ‘nature’.
An Introduction to Personal Construct Theory

My research is based in Personal Construct Theory (PCT), which was first published by Kelly in 1955 (reissued as Kelly, 2002). He developed PCT after many years of work as a clinical and academic psychologist. PCT is a psychological theory, and is not interested in the neurophysiology of events or thoughts (Bannister & Mair, 1968, p. 12); it is concerned with looking in a psychological way at the meanings individuals give to events or thoughts (Kelly, 2002, p. 33). Its initial focus was “explicitly and intentionally clinical” (Bannister & Mair, 1968, p. 38); however, Kelly always recognized that PCT could be used by non-psychologists, and by any and every individual (Kelly, 1961, quoted in Bannister & Mair, 1968, p. 44). While PCT began as a tool for practice, it has grown into a theory that stands alone as an epistemological perspective (Hayhow, Lansdown, Maddick, & Ravenette, 1988, p. 200).

Kelly based PCT on the principle of ‘constructive alternativism,’ which asserts that individuals do not observe the world directly but interpret, or ‘construe,’ it: “We assume that all of our present interpretations of the universe are subject to revision or replacement” (Kelly, 2002, p. 11). There are an infinite variety of possible ways to interpret reality (Adams-Webber, 1979, p. 1), and constructive alternativism “essentially proposes that all our current perceptions, insights and understandings are open to question and reconsideration” (Butler & Green, 2007, p. 3).

Personal Construct Theory does not take a mechanistic view of the world; it acknowledges that when a researcher works with people, the people are not objects but are active agents who will also contribute something to the process (Bannister & Mair, 1968, p. 1). PCT generates “‘projective’ assessment[s], in which the [participants are] credited with having a private world of [their] own, and the [researcher] is presented with the problem of guessing what
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this world is all about” (Bannister & Mair, 1968, p. 40). A ‘projective’ approach “credits the
[participants] with having some personal vision of the universe…which constitutes the basis of
[their] actions” (Bannister & Mair, 1968, p. 40). The researchers’ “initial concern is with the
yardsticks used by [the participants]” (Bannister & Mair, 1968, p. 40). It is understood by
Personal Construct Theorists that researchers cannot remain detached from the research process
(Pope & Keen, 1981, p. 33). Their own personal construct systems will influence each aspect of
the work they undertake. Research in this context is “a dialogical adventure undertaken by both
researcher and participant” (Iantaffi, 2006, p. 223).

There is an essential reflexivity within Personal Construct Theory: “‘when we are
engaged in any task, when we commit ourselves in any way, we make changes in the world
through our actions, which in turn make changes in us’” (Radley, 1978, quoted in Edwards, 1988,
p. 233). PCT asserts “that action leads to change” (Procter, 1981, p. 350), and that change is
possible. Kelly goes so far as to suggest what action we should take: “our ever present task is to
devise ways of anticipating [events’] occurrences, and thus to prepare ourselves for assuming a
more and more responsible role in the management of the universe” (1966, quoted in Bannister
& Mair, 1968, p. 7). While ‘management’ may not be the most environmentally-friendly term,
the idea of being forward-thinking, responsible and concerned about more than just the human
species is certainly ecologically sound.

Personal constructs.

Bannister and Mair defined a construct as “a way in which some things are interpreted as
being alike and at the same time different from other things” (1968, p. 13). Kelly began
discussing constructs by describing them as “transparent patterns or [templates] which [one]
creates and then attempts to fit over the realities of which the world is composed” (Kelly, 2002, p.
Kelly stressed that a construct is not the same as a “logician’s notion of a concept” (Bannister & Mair, 1968, p. 25). Logical ‘concepts’ deal only in oppositions, such as ‘black versus not-black;’ ‘black versus white’ is unacceptable as a concept, but perfectly reasonable as a construct that applies to the colour of certain objects (Kelly, 2002, p. 74). In this construct, ‘white’ is the relevant, meaningful opposite of ‘black,’ rather than the non-specific ‘not-black’ (Bannister & Mair, 1968, p. 26), which could refer to a colour, a time of day, or a distance, and is not useful for understanding the world (Kelly, 2002, p. 74).

Kelly also stated that constructs are bipolar representations of reality “tested against…reality…in terms of [their] predictive efficiency” (Kelly, 2002, p. 9). Personal constructs are more than the words used to describe the similarities and differences between events; they are also “the underlying cognitive structures used in processing this information” (Adams-Webber, 1979, p. 31). “In our efforts to anticipate our experience each of us develops a coherent system of constructions and attempts to impose them upon the events with which he is confronted” (Adams-Webber, 1979, p. 1). An individual’s personal construct of a certain value, issue or notion will influence how she acts when facing that value, issue or notion in an actual situation (Kelly, 2003, p. 11). As individuals constantly face new situations, they will confirm or disconfirm their personal construct systems; their personal constructs will change if and when new individual or social experiences are incorporated into their systems (Kelly, 2003, p. 12).

“PCT is, thus, essentially a meta-theory in the sense of being a theory about the theories people have about themselves and the world” (Butler & Green, 2007, p. 3). PCT does not consider truth absolute, but sees all knowledge as relative (Pope & Keen, 1981, p. 30). PCT relies heavily on systems theory, as it is more concerned with processes than content (Procter, 1981, p. 352). “The psychology of personal constructs is then essentially a methodological
Repertory grids.

Repertory (rep) grid testing is a common methodology used in personal construct research. It is based on the way people use personal constructs to categorize objects that are similar but different. The test asks an individual to classify ‘elements’ according to which side of various constructs they believe best applies. Kelly defined elements as “‘the things or events which are abstracted by a construct’” (2002, p. 95). They are the people, objects or events to which construct distinctions are applied.

The researcher can then identify relationships that exist between constructs and elements within the personal construct system. A completed rep grid matrix represents “the way a person thinks about…things” (Leung, 2006, p. 275). The rep grid shows the researcher the structure of part of a person’s personal construct system, and gives insight into a person’s understanding of the world (Leung, 2006, p. 275). This is the first step in understanding how and why a person might act in certain situations. A rep grid test is not a tool for precisely mapping another person’s mind, but a method for inquiring into another’s thought processes.

Administering a rep grid test is simple in theory, although doing it well takes practice. Kelly (2002, pp. 197-200) and Bannister and Mair (1968, pp. 53-57) both gave detailed instructions for administering a Role Construct rep grid test. Fransella, Bell and Bannister have written a comprehensive book that details the administration and design processes (Fransella, Bell, & Bannister, 2004). The rep grid test allows a researcher to gather “information about an individual’s views on a particular topic” (Pope & Keen, 1981, p. 38); comparisons of two or more individuals viewpoints can then be made (Pope & Keen, 1981, p. 38). Rep grid tests, for
example, present a method for comparing the constructs of students with those of teachers, curriculum designers, other students, and so on (Pope & Keen, 1981, p. 128). Comparisons of how one individual’s personal constructs change over time can also be made (Pope & Keen, 1981, p. 74).

Repertory grid tests are well-suited to educational research as they identify the viewpoints of the people involved, which is one of the most important factors in the learning process (Pope & Keen, 1981, p. 19). The more popular, mass sampling, “‘systematic’ research designs borrowed from agricultural research” (Pope & Keen, 1981, p. 19) are unable to do this, and thus produce less meaningful results. It is important to recognize that rep grid tests are not definitive measures of individuals, personalities, or behaviours (Pope & Keen, 1981, p. 55); they are mirrors that provide “some insight into [part of the personal construct] system but [do] not capture and fully describe it” (Pope & Keen, 1981, p. 155).

**Statement of Research Problem**

I believe that Environmental Education (EE) could be improved if children’s perspectives of ‘nature’ were understood and taken into account. Personal Construct Theory supports this notion and provides a methodology for investigating children’s conceptions of ‘nature’: the repertory grid test. By assessing young children’s personal construct systems regarding ‘nature,’ Environmental Educators (EErs) might be able to understand the young children’s viewpoints in novel ways. PCT may become a foundation for the development and construction of increasingly participatory, engaging, and effective EE programs for young children. Therefore, I have developed an investigatory technique based on PCT that will enable EErs to get an improved understanding of how young children conceptualize nature.
Research Questions

How can the repertory grid method be used effectively with young children to assess their personal construct systems regarding ‘nature’?

What are the structures of young children’s personal construct systems surrounding the notion of ‘nature’?

How can the results of a rep grid test of young children’s perceptions regarding ‘nature’ be used as the basis for young children’s Environmental Education programs?

Limitations and Delimitations

Initially I planned to conduct my research at two schools, a Montessori school in Toronto, Ontario, and a Nature Kindergarten in Victoria, British Columbia, and then compare the results. As it turned out, the research schedule at the Nature Kindergarten was incompatible with my plans, so I was only able to work with the young children at the Toronto Montessori school.

The amount of time the school was able to devote to my research project was a limiting factor. The study was also limited by the availability of the children and their willingness to work with me as research participants; the children’s attention span, interest level, mood, and abilities were all limiting factors. My thesis inquiry is delimited as I only researched at one school, which means that my results are not applicable to a general population of young children. Conversely, this allowed me to study the small, specialized sample I was working with in greater depth. Another delimiting factor is the prospective non-randomness of the participating children, as they were likely those who were personally interested in the study or from families that have an interest in the topic matter.
Terms

Environmental Education.

Environment Canada’s document on Environmental Education, *A Framework for Environmental Learning and Sustainability in Canada* (Environment Canada, 2002), begins by discussing the “language of environmental learning” (p. 1); it came to the conclusion that many of the terms involved “defy clear definition” (p. 1). Like *A Framework for Environmental Learning and Sustainability in Canada*, and in an effort “to be inclusive and…offer an opportunity for all to discuss different approaches to promote lifelong learning with respect to the environment and to sustainability” (Environment Canada, 2002, p. 1), my thesis is not going to provide a specific definition of ‘Environmental Education’. Rather than getting tripped up by terminology,

learners and educators of all ages and from all sectors of society should be able to find common ground among the different concepts and their proponents as we all work together towards a more environmentally literate, competent and responsible society.

(Environment Canada, 2002, p. 1)

The Ontario Ministry of Education uses the following definition of ‘Environmental Education’:

environmental education is education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of: the Earth’s physical and biological systems; the dependency of our social and economic systems on these natural systems; the scientific and human dimensions of environmental issues; [and] the positive and negative...
consequences, both intended and unintended, of the interactions between human-created and natural systems. (The Working Group on Environmental Education, 2007, p. 6)

This is a long and confusing definition that does little to clarify how EE should be done or suggest specifically what it entails.

Finally, the United Nations Environment Programme (UNEP) stated that “education in environmental matters… is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension” (United Nations Education Programme, 2005, p. i). UNEP’s version of ‘Environmental Education’ took the form of “initiatives which are responsive, locally relevant, and aimed at transforming people's perspectives of, and aspirations for sustainable development into reality for present and future generations” (United Nations Education Programme, 2005, p. ii).

Finally, there are different types of ‘Environmental Education:’ informal, where the educator “usually approaches participants” (Canadian Tourism Human Resource Council, 2005, p. 9) and mixes with them; formal, at a “predetermined time or place” (Canadian Tourism Human Resource Council, 2005, p. 9); personal, which “involves direct interaction between interpreter and participants” (Canadian Tourism Human Resource Council, 2005, p. 9); and non-personal, which is “interactive interpretation without the presence of interpreter” (Canadian Tourism Human Resource Council, 2005, p. 9). Evidently, there are many, widely-varying definitions of ‘Environmental Education.’ It is not my goal in this thesis to dissect or choose between them.
‘Nature.’

As with Environmental Education, there are many, widely-varying definitions of ‘nature.’ The Oxford Dictionary of Current English suggests: “phenomena of physical world as a whole, physical power causing these” (Allen, 1984). Personal Construct Theory suggests that there are as many definitions as there are people to define the word. I am interested in delving into the constructs that make up young children’s concept of ‘nature’, rather than asking them for a precise definition.

Young Children.

For the purposes of my research, I defined young children as children between the ages of 4 and 6 years. I also considered young children to be children who have not yet entered Grade 1. I tried not to make assumptions about the young children I would be working with, not knowing whether they would be able to read, what level of drawing ability or skill they might have, or what kind of exposure to the outdoors they would have experienced.

Young children are active learners, and are open to receiving new information of all kinds through all their senses at any time (Cobb, 1977, pp. 29-31). They are not ‘miniature adults,’ but unique ‘little people’ with their own ways of interpreting the world, making meaning, and learning (Cobb, 1977, pp. 29-31). They are engaged in meaning-making and world-building through “unparticularized sensory experience” (Cobb, 1977, p. 45); for them, “the world is new” (Cobb, 1977, p. 48), not yet “semantically correlated with the pattern and customs of [their] culture and era” (Cobb, 1977, p. 48).
Chapter 2: Literature Review

Personal Construct Theory: The Details

The Fundamental Postulate.

Personal Construct Theory’s Fundamental Postulate is: “a person’s processes are psychologically channelized by the ways in which he anticipates events” (Kelly, 2002, p. 32). In this postulate, Kelly declared his main concern to be individual persons as wholes (Kelly, 2002, p. 33), although it is possible to view the “idiographic [individual] data…within a nomothetic [relating to larger social patterns] framework ” (Bannister & Mair, 1968, p. 12). When speaking of ‘processes,’ Kelly described the drive to action as a fundamental part of a person, a “kinetic” (Kelly, 2002, p. 33) active subject, rather than as a result of an external stimulus or a response to an internal need (Bannister & Mair, 1968, pp. 12-13). In this way, Personal Construct Psychology differs from both the behaviourist and Freudian schools of thought, as it considers the psychological processes of meaning-making, behaviour change and emotional reactions as inherently internal, rather than triggered by external stimuli (Kelly, 2003, p. 3).

‘Channel[l]ize’ is defined as “to convey in a channel, form a channel for” (The Oxford English Dictionary Compact Edition, 1971); I believe that Kelly meant the latter, since he stated that

…we conceive [of] a person’s processes as operating through a network of pathways rather than as fluttering about in a vast emptiness. The network is flexible and is frequently modified, but it is structured and it both facilitates and restricts a person’s range of action. (Kelly, 2002, p. 34)
The specific psychological channels that a person’s processes pass through depend upon what they are thinking and ‘anticipating,’ which is based upon what is currently occurring, what has happened in the past, and how these experiences are understood in the context of the person’s total life experience (Kelly, 2002, p. 34). Anticipation and channelization also depend upon and determine how individuals categorize current events and construe their anticipated outcomes.

Kelly saw scientific enterprise and the human endeavour to be much the same (Bannister & Mair, 1968, p. 2; Kelly, 2002, p. 4). Both the scientist and the average person seek the ability to predict and anticipate; both look for meaning in the world by searching for “relationships where none were ‘seen’ before” (Bannister & Mair, 1968, p. 5). To this end, individuals, both as scientists and as humans, develop theories that explain the facts around them.

A theory is a means by which its user can become involved in events and perhaps even change them…Certainly a theory aids prediction…However, in science as in daily life, a theory need not generate consistently precise predictions in order to be useful. Some theory is better than no theory at all. (Bannister & Mair, 1968, pp. 7-8)

**Personal construct systems.**

The result of individuals’ psychological processes being constantly channelized as they anticipate events and then react to the actual outcomes is the formation of personal construct systems. A system is “an interconnected set of elements that is coherently organized in a way that achieves something” (Meadows, 2008, p. 11). “There is an integrity or wholeness about a system and an active set of mechanisms to maintain that integrity” (Meadows, 2008, p. 12). Kelly recognized the universe as a system: “it is integral. By that [he] mean[s] it functions as a single unit with all its imaginable parts having an exact relationship to each other” (Kelly, 2002,
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

p. 5). People’s thoughts, theories, and constructs are seen as real (Kelly, 2002, p. 5) and should be considered part of the interrelated, universal system.

Personal Construct Theory’s 11 corollaries.

Kelly developed 11 corollaries that further explain constructs and help to refine the PCT (2002, ch. 2). He originally presented the corollaries in the order he derived them, and some authors, including Bannister and Mair (1968, ch. 1) have followed suit. Others, such as Adams-Webber (1979, ch. 1), Procter (1981, pp. 352-355), and Stojnov and Butt (2002), have presented the corollaries in the order that best helps them with their work (Adams-Webber, 1979, p. 4). I am presenting the corollaries in the order that I find makes most intuitive sense.

The individuality corollary.

Kelly explained that “persons differ from each other in their construction of events” (Kelly, 2002, p. 38). This corollary is an extension of the Fundamental Postulate’s emphasis on the individual (Bannister & Mair, 1968, p. 15). It indicates that each individual is likely to create unique personal construct systems, interpret identical events differently, and will not necessarily reach the same construct conclusions using the same logic as another (Bannister & Mair, 1968, p. 15).

The commonality corollary.

People are, in many ways, similar. Some individuals are strikingly similar to one another. Kelly explained this with the commonality corollary: “To the extent that one person employs a construction of experience which is similar to that employed by another, his processes are psychologically similar to those of the other person” (Kelly, 2003, p. 13). The crucial point is that similar individuals haven’t necessarily experienced the same events, nor did they test their predictions in similar ways; their construction systems evolved to be similar and this makes the
two individuals seem, and act, alike (Bannister & Mair, 1968, p. 23; Kelly, 2003, p. 13). This corollary is the “basis for making comparisons between individuals” (Bannister & Mair, 1968, p. 23).

**The sociality corollary.**

Moving beyond comparing individuals, Kelly considered “interpersonal understanding and interaction” (Bannister & Mair, 1968, p. 23). The sociality corollary states: “to the extent that one person construes the construction processes of another, he may play a role in a social process involving the other person” (Kelly, 2002, p. 66). Kelly first contrasted two ways that one individual might view another: one individual might watch another objectively, describing merely the observed motions and other behaviours (Kelly, 2003, p. 14); or, one individual might, while watching another, attempt to interpret why the observed individual is behaving in a certain way by “plac[ing] a construction upon the way in which [the observer] imagine[s] [the other individual] might be thinking” (Kelly, 2003, p. 15). In the second case, the observer is “construing the construction process of another person” (Bannister & Mair, 1968, p. 24), which may lead one person to understand the other and possibly play a socially significant role in relation to them (Bannister & Mair, 1968, p. 24). This relationship will not necessarily be reciprocal (Kelly, 2003, p. 69). While an individual must understand others’ construct systems to be involved or play a role in their social processes, it is not necessary for the individual to share the same construct system as the others (Kelly, 2002, p. 69). This is a particularly important point to note for Environmental Educators, especially when communicating with young children is considered.
The construction corollary.

This corollary states that “a person anticipates events by construing their replications” (Kelly, 2002, p. 35). An individual’s life experience is an “unending and undifferentiated process” (Kelly, 2002, p. 36). Interpretation cannot begin until the individual breaks this process up into discrete events, which is done on the basis of recurring themes (Bannister & Mair, 1968, p. 14); the only way to identify repetitive themes is to categorize events by both similarities and contrasts (Bannister & Mair, 1968, p. 14). For example, a person may “abstract the recurrent theme in terms of the rising and the setting of the sun” (Kelly, 2002, p. 37); the discrete length of time known as a day is identified: it is similar to all days, in that it begins with the sunrise and ends at sunset; it is different from other days because it may contain different events within it. Individuals use their knowledge of how arbitrarily-determined events tend to begin and end, the themes they have interpreted from these events, and the system of constructs they have formed, to anticipate future events (Bannister & Mair, 1968, p. 14).

The dichotomy corollary.

This corollary builds upon the bipolar nature of constructs determined by the construction corollary. The dichotomy corollary says: “A person’s construction system is composed of a finite number of dichotomous constructs” (Kelly, 2002, p. 41). It is easy to accept that a personal construct system is finite (Bannister & Mair, 1968, p. 16); the difficulty comes in accepting a theory that requires dichotomous thinking, and “deny[ing] that relativism which the sophisticated and the liberal demand” (Bannister & Mair, 1968, p. 16). Kelly recognized this problem (Bannister & Mair, 1968, p. 16); and stressed that
we cannot say that constructs are essences distilled by the mind out of available reality. They are imposed upon events, not abstracted from them. There is only one place they come from; that is, from the person who is to use them. (Kelly, 2003, p. 10)

Kelly also explained that a construct “refers to the nature of the distinction one attempts to make between events, not to the array in which [one’s] events appear to stand when [one] gets through applying the distinction between each of them and all the others” (Kelly, 2003, p. 10). While a construct stays absolute, bi-polar, and dichotomous, the events it is applied to are being judged relative to one another, and may even be seen differently depending on their specific comparisons (Kelly, 2003, p. 10). Dichotomous constructs do not require dichotomous thinking, particularly since people are constantly using more than one construct at a time.

The range corollary.

The range corollary further defines the nature of a construct. It says: “a construct is convenient for the anticipation of a finite range of events only” (Kelly, 2002, p. 48). This means that a construct is only useful in a limited number of situations (Bannister & Mair, 1968, p. 19). In those specific instances, however, it is highly meaningful, because identifying an object with one pole of a construct means that the object is similar to other objects identified with that pole, contrasts the object with the opposite pole of the construct, and excludes irrelevant data and constructs that have nothing to do with the object (Bannister & Mair, 1968, p. 19).

A construct has its focus of convenience -- a set of objects with which it works especially well. Over a somewhat larger range it may work only reasonably well; that is, its range of convenience. But beyond that it fades into uselessness. (Kelly, 2003, p. 11)
The organization corollary.

Kelly gave this corollary as: “*each person characteristically evolves, for his convenience in anticipating events, a construction system embracing ordinal relationships between constructs*” (2002, p. 39). A personal construct system is not a set of unrelated constructs; if it were, individuals would often be confused when certain constructs yielded contradictory predictions (Bannister & Mair, 1968, p. 15). Instead, individuals seem to try and create an organized, hierarchical system of related constructs which is more useful when making predictions (Bannister & Mair, 1968, p. 15). The organization and hierarchy will, with personal experience, evolve over time to become more consistent (Bannister & Mair, 1968, p. 15). For a psychologically mature and healthy individual, the keys to accurate and consistent predictions are a well-organized personal construct system and strong interrelationships between the constructs (Bannister & Mair, 1968, p. 15).

Bannister and Fransella (1971, cited in Adams-Webber, 1979, p. 8) stressed that the organization of the personal construct system requires some constructs to be included or subsumed by other constructs. Adams-Webber explained how the personal construct system can be conceptualized “in terms of Boolean set theory” (Adams-Webber, 1979, p. 8). Boolean set theory defines logical propositions for constructs that are subsets of other constructs, that are mutually exclusive, or that share an element without being a subset of another construct (Adams-Webber, 1979, p. 9). These relationships can be displayed pictorially using Venn diagrams, as shown in Figure 1 (Adams-Webber, 1979, p. 9).
When one construct is subsumed by another, the subsumed construct becomes subordinate and the subsuming construct is superordinate. The subordinate constructs become “implications for…behaviour” (Procter, 1981, p. 353). “The relationship between superordinate and subordinate constructs is dialectical. The superordinate constructs guide and govern the subordinates. The subordinates validate and maintain the superordinates” (Procter, 1981, p. 358). The subordinate constructs help to anticipate concrete, specific events.

**The choice corollary.**

In this corollary, “a person chooses for himself that alternative in a dichotomized construct through which he anticipates the greater possibility for the elaboration of his system” (Kelly, 2003, p. 11). Kelly showed how anticipation causes physical action in addition to the mental processes described by the organization corollary (Bannister & Mair, 1968, p. 18). Individuals choose to act in the ways that are most likely to improve the accuracy and
consistency of the predictions made by their personal construct systems (Bannister & Mair, 1968, p. 18).

**The fragmentation corollary.**

Individuals’ actions, which are based on anticipation via their personal construct systems, do not always appear to be internally logical (Bannister & Mair, 1968, p. 22). Kelly explained this by stating that “a person may successively employ a variety of construction subsystems which are inferentially incompatible with each other” (Kelly, 2003, p. 58); this is the fragmentation corollary. Sometimes, individuals’ actions do not appear consistent when observed, but would make sense within the context of the higher level construct or prediction at work, if it were known (Bannister & Mair, 1968, p. 22). Other times, individuals may believe that two of their constructions are consistent and can be inferred from one another, when this is not the case for an outside observer (Bannister & Mair, 1968, p. 23). The contradictions in a personal construct system may be solved as the system is refined; even if they are not, the individual’s construct system is in no way invalidated.

**The experience corollary.**

As a result of their anticipation and action, both physical and mental, people’s “construction system[s] var[y] as [they] successively construe[ ] the replications of events” (Kelly, 2002, p. 50). This is both the experience corollary and the inevitable conclusion of the Fundamental Postulate (Kelly, 2002, pp. 50-51). As previously stated, as individuals attempt to anticipate or predict events, their accuracy will depend on how well they have judged which events or objects are similar and which are not, which determines how well-organized their personal construct systems will be. When healthy individuals have experiences that indicate that their predictions are not accurate, they will often modify their personal construct systems.
accordingly. Personal constructs that are particularly difficult to change are said to be ‘impermeable’ (Kelly, 2002, p. 56). Constructs that are superordinate, that have fixed ranges of convenience, or that make up a person’s core beliefs are often not very permeable (Kelly, 2002, p. 57).

“The [e]xperience [c]orollary has profound implications for our thinking about the topic of learning” (Kelly, 2002, p. 53). In fact, this corollary essentially describes how Kelly believed learning occurs (Bannister & Mair, 1968, p. 20). A fuller discussion of PCT and its implications for learning follows further on in this paper.

**The modulation corollary.**

This corollary, “the variation in a person’s construction system is limited by the permeability of the constructs within whose range of convenience the variants lie” (Kelly, 2002, p. 54), explains how and how much individuals’ personal construct systems can be modified by their experiences (Kelly, 2003, p. 55). Changes in a construct system in response to new events require that new constructs be accepted into the system at low levels of the personal construct hierarchy (Bannister & Mair, 1968, pp. 21-22); this can only occur if the superordinate level constructions are ‘permeable,’ meaning they can be “used as reference[s]…for new events and to accept new subordinate constructions within [their] range of convenience” (Bannister & Mair, 1968, p. 21).

**Assessing and Eliciting Personal Constructs: The Repertory Grid Test**

The repertory (rep) grid test is “the most elaborate model of construct theory, and it is the technique which has received the most research attention” (Bannister & Mair, 1968, p. 48). It is technically not a test “but a methodology” (Bannister & Mair, 1968, p. 52) which is based on the nature of personal constructs, in that they recognize similarities and differences simultaneously.
It allows a researcher to investigate “both construct relationships and hierarchical status” (Bannister & Mair, 1968, p. 53) and to “study the relationships between personal constructs by analysing the way in which they are applied to the same persons or objects” (Kelly, 2002, p. 189). Rep grid testing “is basically a method of quantifying and statistically analyzing relationships between the categories used by a [person] in performing a complex sorting task” (Adams-Webber, 1979, p. 20). When properly designed and administered, the rep grid test gives the researcher a look into the structure of a participant’s personal construct system (Adams-Webber, 1979, p. 31).

The rep grid test involves filling out a matrix composed of elements along one axis and constructs along the other. The places where the constructs and elements cross are called “intersects” (Kelly, 2002, p. 190). Traditionally, the intersects are marked with an ‘X’ or a checkmark if an element is associated with the positive, or emergent, pole of the construct under consideration, and left blank if the element is associated with the other pole of the construct (Kelly, 2002, p. 190). See Figure 2 for an example.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

<table>
<thead>
<tr>
<th>Construct</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Want To Go (X)/Not Want To Go</td>
<td><img src="bear_x_trees_x_dock_x_rainforest_x_rollercoaster_x_girl_x_slide.png" alt="Image" /></td>
</tr>
<tr>
<td>Lots of Animals (X)/Few Animals</td>
<td><img src="bear_x_trees_x_dock_x_rainforest_x_rollercoaster_x_girl_x_slide.png" alt="Image" /></td>
</tr>
<tr>
<td>Lots of People (X)/Few People</td>
<td><img src="bear_x_trees_x_dock_x_rainforest_x_rollercoaster_x_girl_x_slide.png" alt="Image" /></td>
</tr>
<tr>
<td>Scary (X)/Not Scary</td>
<td><img src="bear_x_trees_x_dock_x_rainforest_x_rollercoaster_x_girl_x_slide.png" alt="Image" /></td>
</tr>
</tbody>
</table>

*Figure 2.* The repertory (rep) grid matrix used in Nature rep grid testing with the young children.

The elements were pictures cut from magazines that represented images of ‘nature’ drawn by the young children. The constructs were gleaned from the children’s drawings and my conversations with the young children during previous phases of the research. The circles in the intersects indicate which elements were shown as the initial triad for each construct. I indicated that an element was categorized by the first pole of a construct by marking an X in the intersect; if an element belonged to the second pole of a construct, I left the intersect blank. This rep grid has been randomly filled out as an example.

Kelly and many others have pointed out that the rep grid test is open to variations and extensive modifications (Adams-Webber, 1979, p. 20; Bannister & Mair, 1968, p. 72; Bell, 2003, p. 103; Kelly, 2002, ch. 6; G. J. Neimeyer, Neimeyer, Hagans, & Van Brunt, 2002, p. 161). The elements, constructs or scoring systems may be altered from Kelly’s original format (Bannister
& Mair, 1968, p. 52); “grids vary widely in their design, instructional sets, administration and analysis” (G. J. Neimeyer et al., 2002, p. 162). While this can be a boon to researchers, it also means there is the danger of creating a rep grid test which is “only remotely related to Kelly’s original instrument” (Adams-Webber, 1979, p. 32).

**Element selection.**

It is important to pay equal amounts of attention to the elements of a rep grid test as to the constructs. Neither constructs nor elements should be considered independently: Slater emphasized that “neither constructs nor [elements] are logically prior, that is, constructs can be understood in terms of [elements] just as readily as [elements] can be understood in terms of constructs” (1969, cited in Adams-Webber, 1979, p. 41). Kelly’s original design for the rep grid test centered on investigating how individuals construct the roles of other people they interact with; thus, all of the elements in Kelly’s original rep grid matrix represented actual people that the individuals knew personally (Kelly, 2002, ch. 6). In one study, Bannister varied the elements in a rep grid matrix slightly by using “sets of passport-type photographs as elements, instead of people familiar to the subjects” (Bannister & Mair, 1968, p. 66). Other rep grid test matrices have used “films, paintings, inanimate objects, emotions, [and] types of bread” (Bannister & Mair, 1968, p. 72) as elements.

Pope and Keen believed there is “no theoretical reason why the elements of grids should not include inanimate objects or even abstract ideas” (1981, p. 36). Little research has been done into rep grid tests that use elements “outside the interpersonal or clinical arenas” (G. J. Neimeyer et al., 2002, p. 177); in fact, not much research has been done into element selection at all (Fransella et al., 2004, p. 22; Hardison & Neimeyer, 2012). This has not kept personal construct theorists from being concerned about the “impact of the elements, rather than the constructs, in
determining the structural features of the personal construct system” (G. J. Neimeyer et al., 2002, p. 179).

One of the assumptions built into rep grid testing is that the elements that form one axis of the grid are “an adequate representation of the total population of the relevant elements in the person’s world” (Bannister & Mair, 1968, p. 74). Which elements are ‘relevant’ will depend upon the purpose of the rep grid testing (Pope & Keen, 1981, p. 37). Further, the elements must be representative “of those [elements] with [which] the client must interact and that the dimensions of their representation are relevant to those lines along which he has chosen to structure his life role” (Kelly, 2002, p. 191). I believe it is meeting, or failing to meet, this requirement that allows element selection to have such an impact on rep grid test matrix structure.

**Elicited and provided constructs.**

When Kelly first developed the rep grid test, he emphasized the importance of *eliciting* personal constructs rather than “testing the efficiency with which [a] person can use the [researcher’s] constructs” (Bannister & Mair, 1968, p. 43). He acknowledged, however, that this was only practical as long as the researcher’s own construct system would allow them to understand the constructs being elicited; that the elicited constructs provide information that contributes to answering the question at hand; and that the elicited constructs can be easily and accurately communicated to fellow researchers (Bannister & Mair, 1968, p. 43).

Bieri was the first to use provided instead of elicited constructs, doing so in 1955 (G. J. Neimeyer et al., 2002, p. 166). Using provided constructs “permits a higher degree of standardization in administration as a basis for ‘nomothetic’ comparisons between different populations” (Adams-Webber, 1979, p. 23) or for comparing the personal construct systems of
individuals (Pope & Keen, 1981, p. 39). When the term ‘using provided constructs’ is used, it is acting as a short-hand for what actually happens, which is that the researchers provide verbal labels that they hope will represent actual constructs used by the participants (Bannister & Mair, 1968, p. 67). The problem with using provided constructs is that the resulting rep grid tests may not reflect the individuality corollary. Interestingly, Kelly himself used provided constructs for his Situational Resources Repertory Test, although he did not phrase it that way (Kelly, 2002, pp. 233-237).

When working with young children, Edwards tried to avoid the problems associated with provided constructs by eliciting constructs from conversations that took place before the rep grid test (Edwards, 1988, p. 236). I think this requires the researcher to assume too much about the children’s construction system. Furthermore, Edwards wasn’t able to elicit very many constructs this way, and had to supplement the grid matrix with supplied constructs (1988, p. 236).

Adams-Webber has done a considerable amount of research into the differences in personal meaning and personal preference between elicited and provided constructs (1979, p. 20). Participants claim to prefer their own personal, elicited constructs (Adams-Webber, 1979, p. 24), particularly when applying them to people they know well (Adams-Webber, 1979, p. 28). In 1992, G. J. Neimeyer and Leso suggested that the “greater meaning and utility of [elicited] personal constructs” (cited in G. J. Neimeyer et al., 2002, p. 167) could be due to the reflective process that creating personal constructs requires, rather than simply the content of the personal, elicited constructs (G. J. Neimeyer et al., 2002, p. 167). Further work has shown that “anything that enhances the personal meaning of a set of constructs [will] enhance the differentiation with which that system is used” (G. J. Neimeyer et al., 2002, p. 169). Provided constructs can be as
effective as elicited ones if their personal meaning for the individuals participating in the rep grid test is increased beforehand. Young children were able to use supplied constructs meaningfully (Edwards, 1988, p. 237).

Rep grid testing assumes “that the sorting problems proposed for the client[s] are representative of those with which [they] must deal in structuring his life role” (Kelly, 2002, p. 191). Bannister and Mair state that using provided constructs ignores this assumption (1968, p. 75), but in light of the above information I conclude that this is not the case. In the case of using a modified rep grid test with young children, as long as the supplied constructs are clearly understood (Pope & Keen, 1981, p. 39), represent sorting activities that the young children perform in daily life, and fit the purpose of the rep grid test, they should be adequate (Pope & Keen, 1981, p. 38).

**Lopsided constructs.**

A lopsided construct is one in which most of the elements in the rep grid are categorized by one of the poles of a construct, resulting in a row of the grid which has most of its intersects marked or most of them left blank. See Figure 3 for an example. Lopsided constructs can occur when a rep grid test uses elicited personal constructs and participants have “the freedom to classify as many or as few of the… elements involved, as [they] saw fit, under each pole of the construct” (Bannister & Mair, 1968, p. 59), which is what Kelly recommended (Kelly, 2002, pp. 190-191). A lopsided construct can also occur when the elements in the rep grid matrix appear mostly positive or negative to the participant (G. J. Neimeyer et al., 2002, p. 178). Finally, lopsided constructs can occur when the assumption that “all the [elements] fall within the range of convenience of all the constructs” (Kelly, 2002, p. 195) is incorrect. In such a case, an individual may leave certain intersects blank because neither pole of the construct applies to the
element in question (Kelly, 2002, p. 195); these blank intersects cannot be distinguished from
blanks which represent a pole of the construct when the data analysis is being done. The
presence of a lopsided construct within a rep grid matrix can lead to false matches between
constructs (Bannister & Mair, 1968, pp. 59-60) and overall lower construct system

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct 1: Yes(X)/No</td>
<td>Element 1 Element 2 Element 3 Element 4 Element 5 Element 6 Element 7</td>
</tr>
<tr>
<td>Construct 2: Yes(X)/No</td>
<td>X X X X X</td>
</tr>
<tr>
<td>Construct 3</td>
<td></td>
</tr>
<tr>
<td>Construct 4</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 3.* A rep grid matrix in which Construct 1 appears lopsided.
It is impossible to know if the large number of blank matching intersects between Constructs 1
and 2 represent a close relationship between the two constructs, or if it is an artifact of the ‘No’
pole of Construct 1 not applying to many of the elements.

Bannister and Mair (1968, pp. 60-66) suggested several alternatives to giving the
participant complete free choice when assigning elements to the poles of a construct. These
included ranking or rating the elements along a continuum from one pole of the construct to the
other (Bannister & Mair, 1968, pp. 61-66). While this method would avoid lopsided constructs,
it is too conceptually abstract for young children to master (Edwards, 1988, p. 235; Pope & Keen,
Neimeyer et al. recommended “attend[ing] to heterogeneity in the development of element sets”
(G. J. Neimeyer et al., 2002, p. 195) to prevent lopsided constructs from presenting.

Adams-Webber has a unique perspective on lopsided constructs (1979, pp. 156-180). He
shows that there is a 62% chance that an individual will classify an element as belonging to the
positive pole of a construct (Adams-Webber, 1979, p. 158) or to the nominal pole of the construct (the pole that names the overall concept embedded within the construct) (Adams-Webber, 1979, p. 174). This is explained by the ‘golden section hypothesis’ (named for Pythagoras’ famous golden section) (Adams-Webber, 1979, p. 160): “whenever people differentiate one thing into two, they tend to do so in a way that approximates the golden section” (Benjafield & Green, 1978, quoted in Adams-Webber, 1979, p. 165). The ‘golden section’ refers to a specific ratio in which a line AB is divided by point C so that AC:CB = CB:AB (Adams-Webber, 1979, p. 160). For this equation to hold, point C must divide the line into two segments, one that is 38% of its length and one that is 62% of its length (Adams-Webber, 1979, p. 160). This ratio was thought to have great moral significance, and has been shown to be extremely visually and aesthetically pleasing (Adams-Webber, 1979, p. 160).

Young children tend to have very lopsided constructs, which grow less lopsided, meaning more balanced, as they age (Applebee, 1975, 1976; Barrat, 1977, both cited in Adams-Webber, 1979, p. 176). This may be due to the increasing number of social experiences they have had and the stronger differentiating abilities they have developed (Adams-Webber, 1979, p. 160). Healthy individuals’ personal construct systems end up being lopsided in approximately the ‘golden ratio’ by the time they are teenagers or adults (Adams Webber & Davidson, 1977, cited in Adams-Webber, 1979).

**Personal Construct Theory and Young Children**

According to PCT, there is no reason to “regard children as essentially different from adults in terms of their psychological processes” (Hayhow et al., 1988, p. 199). Young children have construct systems and use them to make choices, although the “choices are not necessarily conscious or verbalized” (Procter, 1981, p. 352). Kelly spent his first years as a researcher and
psychologist working to help and understand youth (Butler & Green, 2007, p. 3), although not necessarily young children. Despite that, I have found relatively little academic research concerning PCT and young children (ages 4-6); what work has been done mainly concerns the clinical treatment of children, and focuses on how children characterize themselves.

The personal construct system is as much a young child’s reality as an adult’s is: “not merely a passive, perceived reality, but...a dynamic, active one” (Procter, 1981, p. 359). It is fundamentally important to accept the child’s construct system and to use it as a communication tool (Procter, 1981, p. 360). Furthermore, the researcher must “develop an attitude of skeptical credulity” (Hayhow et al., 1988, p. 202), believing and caring about everything the young child says but remaining detached enough to detect patterns and draw conclusions. Seeing the world from young children’s perspectives allows the researcher to gain respect for and understanding of their experiences (Hayhow et al., 1988, p. 205). Children will behave in ways that make sense to them and reflect their personal construct systems, despite how unreasonable or antisocial the behaviour may appear to adults (Butler & Green, 2007, p. 9).

Kelly viewed ‘man-as-scientist’ (Adams-Webber, 1979, pp. 2-4), and saw humans constantly engaging in a scientific effort to “make sense out of [their] experience and anticipate events” (Adams-Webber, 1979, p. 3). Children are the embodiment of the anticipation that underlies PCT. In fact, children tend to act out a behavioural narrative rather than talking and asking questions (Butler & Green, 2007, p. 5). Their “posture and behavio[u]r are addressed to the future” (Cobb, 1977, p. 39). They are filled with wonder, which is “a kind of expectancy of fulfillment” (Cobb, 1977, p. 28), and which leads to “an appetite for exploration for which getting to know the environment is its own reward” (Cobb, 1977, p. 50). Young children can be
seen as “‘scientists holding theories about their world which provide ways of acting towards events’” (O'Reilly, 1977, quoted in Edwards, 1988, p. 232). They are constantly experimenting, pushing limits, testing boundaries and experiencing things for themselves through their actions (Butler & Green, 2007, p. 8). Often, this appears as simple play, but it is actually young children’s instinctive way of learning about their world (Lester & Maudsley, 2006, p. 4). Warren elucidated the psychological importance of play in forming a sense of self (2006, p. 28) and links play to creativity and freedom from societally-determined ways of thinking. This imaginative and creative play, so typical of young children, mirrors the psychological processes underlying Kelly’s philosophical position of constructive alternativism (Warren, 2006, p. 33).

Young children are agents “in a process of personal mutual adaptation of individual and niche” (Edwards, 1988, p. 241); they are “differentiated individual[s who are] able to react authentically to the…demands of the situation and become[] responsibly engaged in upholding [their] theories” (Edwards, 1988, p. 241). The importance of an external event is “the meaning [an individual] ascrib[es] to it” (Kelly, 2003, p. 4), not how it imposes an effect on the individual. “The child has his/her own individual meanings, and ways of making sense of themselves and the circumstances” (Ravenette, 2007, p. xiv).

Initially, many researchers had concerns about using rep grid tests with young children, as they considered it a methodology suited to adults and too linguistically and/or cognitively demanding for young children (Edwards, 1988, pp. 234-235). Subsequently, Edwards showed that “the methodology may be used with effectiveness to access even young children’s perspectives” (1988, p. 242). She used rep grid tests to access 4-year-old’s constructions of their behaviour and skills at home and at school (Edwards, 1988, p. 235). Butler and Green
demonstrated that children’s verbal ability levels need not be high for Kellian strategies to be used successfully (2007, cited in Ravenette, 2007, p. xv). Butler and Green’s descriptions of laddering, pyramiding, implication grids, dependency grids, and repertory grids indicate that rep grids are appropriate for young children (2007, pp. 64-69).

Often researchers working with young children worry that the children will “give them the answers they want to hear or that the children believe the researchers expect” (E. Elliot, personal communication, May 8, 2013). According to PCT, this should not be a problem, since the researchers’ constructs of how the children will answer are not the only way to understand the situation. By looking at the situation from the young child’s perspective, and by considering the child using their own constructs, researchers can understand that answers that seem ‘false’ to them are accurate representations of the children’s reality (S. R. Jackson, 1988, p. 224). Young children will speak “in ways relevant to them, and it is these ways which should also be relevant to [the researchers]” (S. R. Jackson, 1988, p. 225). Researchers should “appreciate and fathom young people from the inside looking out, rather than from the outside looking in” (Butler & Green, 2007, p. 5).

**Personal Construct Theory and how young children learn.**

PCT explains that individuals gain understanding, or learn, “through ‘an infinite number of successive approximations’” (Edwards, 1988, p. 234). As mentioned previously, the learning process can be described by the experience corollary: “a person’s construction system varies as he successively construes the replications of events” (Kelly, 2002, p. 50). Change or reconstruction within a personal construct system, both of which are driven by experience and anticipation, constitute learning (Adams-Webber, 1979, p. 15).
A healthy individual’s personal construct system tends to become more differentiated as more individual and elaborate constructs and subsystems form, and then more integrated as the numerous constructs and subsystems are organized into a well-functioning hierarchy (Pervin, 1975, cited in Adams-Webber, 1979, p. 42). Young children are likely to be in the differentiating stage, still adding constructs to their personal system and struggling to sort them into subsystems (Applebee, 1975, cited in Adams-Webber, 1979, p. 51). As young children have not performed much of the integration process, their superordinate constructs are likely not well developed (Adams-Webber, 1979, p. 53). This is a good condition for a learner to be in. Their constructs are likely to be quite permeable, so that novel experiences can be subsumed and the invalidation of anticipations dealt with as easily as possible (Adams-Webber, 1979, p. 12).

Young children are undergoing constant physical and mental development; they are engaged in continual exploration and discovery; their personal construct systems are always in flux, and they are always learning. Young children are perpetually acting as “taxonomist[s], for human learning requires a constant process of classification of both experience and things” (Cobb, 1977, p. 48). As young children attempt to learn and understand more, their constructs will be validated, invalidated, and re-made, and the children themselves will appear changed (Edwards, 1988, p. 232).

Traditionally, schools are institutions which promote social activities designed to meet the needs of society (Crosby & Thomas, 1988, p. 128). They are generally not places which promote the “processes of ‘natural’ learning” (Crosby & Thomas, 1988, p. 128) of young children described above. This is often due to the asymmetrical relationship between the teacher and the students (Crosby & Thomas, 1988, p. 129): the teacher has power, knowledge and
therefore control. Information is passed to the students so that they can answer test questions, and the students’ understanding of their world is not necessarily increased. This is dependent, rather than self-motivated, learning (Nutting, 1988, p. 156).

Crosby and Thomas suggested that learning should be a conversational process where students and teachers experience “‘personal construction and exchange of meaning’” (Thomas & Harri-Augstein, 1976, quoted in Crosby & Thomas, 1988, p. 129). The conversational teaching methodology also helps students become more aware of their own internal learning processes, of how their personal construct systems are structured and are changing (Nutting, 1988, p. 160). The psychological support offered by the teacher through the conversations is crucial to helping the students deal positively with the personal changes created by the learning process (Nutting, 1988, p. 160). Kelly suggested that ‘if you want to know what’s wrong, just ask’ (Butler & Green, 2007, p. 4). This can be very effective when working with young children, as long as the right questions are asked. Butler and Green (2007, p. 4) cautioned against asking questions that presume the answer or become interrogatory.
Chapter 3: Research Methodology and Method

Methodology

Overall, my research took the form of an exploratory, pilot, case study (Tellis, 1997, n.p.). A case study is consistent with Personal Construct Theory, as both recognize the relativity of truth (Baxter & Jack, 2008, p. 545). My research questions were: How can the repertory (rep) grid method be used effectively with young children to assess their personal construct systems regarding ‘nature’? What are the structures of young children’s personal construct systems surrounding the notion of ‘nature’? How can the results of a rep grid test of young children’s perceptions regarding ‘nature’ be used as the basis for young children’s Environmental Education programs?

To investigate these questions, I employed both qualitative and quantitative methodologies. Determining whether rep grid tests could be used effectively with young children required doing the rep grid testing, which meant using a quantitative method (Adams-Webber, 1979, p. 20) to make a qualitative judgment; the same was true for discussing the possibility of using young children’s rep grid test results as the basis for Environmental Education programming. Assessing young children’s personal construct systems in regards to ‘nature’ required only the quantitative rep grid test and the quantitative cluster analyses performed by FOCUS, a package that is part of RepGrid IV’s (Shaw & Gaines, 2005) rep grid analysis software.

Research Site and Participants

Kew Park Montessori Day School.

I conducted my research at Kew Park Montessori Day School (Kew Park) in Toronto, Ontario. Montessori schools use the ‘Montessori Method of Education,’ which was created by
The Montessori Method aims to help students reach their full potential through a holistic curriculum which promotes “the development of social skills, emotional growth, physical coordination, and cognitive preparation” (The Canadian Council of Montessori Administrators, n.d.). Kew Park is certified by the Canadian Council of Montessori Administrators (CCMA) (Kew Park Montessori: Our Accreditation, 2013 c). This means that all of Kew Park’s classrooms have at least one Montessori-trained teacher, have the full range of age-appropriate Montessori teaching materials, and have mixed age groups (The Canadian Council of Montessori Administrators, n.d.). The students have long periods of uninterrupted learning time (The Canadian Council of Montessori Administrators, n.d.) during which they proceed through their individualized work programs at their own pace (The Canadian Council of Montessori Administrators, n.d.). The Montessori teaching method is in line with systems thinking and can be a base for thorough and engaging Environmental Education programs (Lewis & Baudains, 2007, p. 9); I did not see much evidence of this at Kew Park, however.

In Montessori schools, children aged 3 to 5 years attend what is known as the Casa program (Kew Park Montessori: Casa, 2013 b). There are also 6-year-olds in the Casa program, children who turn 6 sometime between January and June of their final year of Casa (Kew Park Montessori: Admission Policy, 2013 a). Kew Park has three Casa classrooms; I only worked with children from two of them. The Casa classrooms contain “lightweight, proportionate, movable, child-sized furnishings,” arranged to create “space for personal, small group, and whole class learning activities” (The Canadian Council of Montessori Administrators, n.d.). All of the materials required for each activity or ‘piece of work’ are neatly stored and easily
accessible to the children, who are responsible for cleaning up after themselves when they are finished with an activity and after their lunches.

**The young children.**

I worked with 12 young children from Kew Park Montessori Day School, seven boys and five girls. All the children were between 4 and 6 years old, and all were in the Casa program. Nine of the children were in one Casa classroom and three were in a second classroom. The young children participating in my study were not selected randomly; in fact, I did not select them at all. I sent a letter home from school with the children explaining my research and asking for participants (this letter is in Appendix A). It is likely that the children who participated did so because of their parents’/guardians’ or their own interest in my study. All of the children were necessarily granted permission to participate in the study by their parents or guardians. Further, I ensured that the children were willing to undertake the tasks I asked them to engage in on the day I worked with them. All of the children were guaranteed anonymity; the names used in this paper are fictitious.

I conducted my research with the children in their classrooms. By doing this, I ensured that the children remained in an environment in which they felt comfortable and safe. Since the children were used to working independently, other events going on in the classroom during the time they were working with me did not distract them. Conducting my research in the classroom also meant that the children had a context in which they could understand the experience of working with me: I was a teacher-like figure, and we were doing an activity together. I encouraged them to treat the experience as a lesson they were teaching me, something that is common in Montessori schools, and reminded them that there were no wrong answers to any of my questions.
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Study Conduct

Pilot tests.

My initial step was to conduct three informal pilot tests with young children of my acquaintance, in order to expose potential kinks in my investigation protocol and to check the overall feasibility of my research project. Each of these pilot tests was approximately 1 hour long with a break halfway through, and involved drawing, card sorting and a form of repertory (rep) grid testing. The pilot tests were conducted in the young children’s or their relatives’ homes. These initial sessions were extremely helpful in clarifying my research method and in highlighting what sorts of tasks young children could and could not perform. They also allowed me to practice interviewing and conducting rep grid tests with young children, and to familiarise myself with my equipment and software.

Research with Kew Park Montessori Day School students.

I would have liked to spend a day, or at least an hour, with each class before I began my research. This would have demonstrated a prolonged engagement with the participants (R. Kool, personal communication, July 13, 2012), which would have increased the credibility and trustworthiness, of my findings (Golafshani, 2003, p. 600). I spent five minutes being formally introduced to each of the Casa classes that I would be working with the day before I began working with them.

Phase 1: Drawing exercise.

Data collection.

I began Phase 1 of my research on the first day I started working with the young children. Phase 1 comprised having the young children draw pictures of ‘nature.’ I asked the children to draw two pictures that would represent the concept of ‘nature,’ one of ‘anywhere outside’ and
one of ‘a forest.’ I worked one-on-one with each child, providing the children with pre-sharpened pencil crayons and blank, white, printer paper to make the drawings with. Children’s drawings are often indicators of their “active and creative response[s] towards their experiences” (Hopperstad, 2010, p. 432). Young children may use art to convey meaning about their experiences, and these meanings can be understood by listening to the children’s narratives about their drawings (Hopperstad, 2010, p. 432), which aids in conducting content analyses of the drawings themselves. The practice of using drawings to assess young children’s personal constructs has been successfully implemented by Maxwell (2006).

As the children drew, we conversed, and with their permission, these conversations were digitally recorded; I also made notes by hand. This gave me an opportunity to member-check my interpretations of the content of their drawings. All audio recordings were made with a SONY ICD-PX312 digital audio recorder (IC Recorder, 2011). The recordings of the conversations were later downloaded onto a computer and some parts were transcribed. The transcription was done on an Apple MacBook Pro, using Audacity (“Audacity,” 2013), QuickTime Player and Microsoft Word. I tried using MacSpeech Scribe (“MacSpeech Scribe,” 2011) transcription software, but found it extremely ineffective.

I made sure to ask each child about what they were drawing, so that I could be sure of understanding what it represented. I listened to the narratives they told about their drawings, and I also followed the conversational tangents the children initiated. These conversations are data, just as the children’s drawings are. The interview questions for Phase 1 are given in Appendix B. Each Phase 1 interview lasted between 10 and 35 minutes. Due to the length of the school
day, their special lessons, and other scheduling restrictions, it took two school days to conduct 12 Phase 1 interviews.

Data analysis.

I intended for the first part of my data analysis to be the complete transcription of my conversations with the children about their drawings during the Phase 1 interviews. Unfortunately, I found that the transcription process was extremely time-consuming, so I did not do this. I did listen to all of the conversations at least twice. I also made a close study of the actual drawings the young children had done. This allowed me to perform a thematic content analysis of the children’s drawings and my interviews with them, as described by Maxwell (2006, p. 22). Barazza and Robottom showed that content analysis of children’s drawings is a robust analytical tool (2008, p. 189).

The aim of the content analysis was to identify elements that would be useful for the next phases of the research. I looked for visual objects or elements in the drawings that were repeated by several children, were easy for young children to construe, and/or would increase the heterogeneity of the set of elements to be used in the repertory (rep) grid testing. I listened to the conversation for words or phrases that were repeated by several children, which indicated how the children had constructed ‘a place outside,’ or ‘a forest,’ and/or that emphasized aspects of the drawings I had already noticed. Applying these constructs to a wider range of images allowed me to understand the young children’s construct of ‘nature’ more broadly.
Phase 2: ‘Nature’ card sort exercise.

Data collection.

The second part of my research relied on the results of the first: I used images selected from the drawings the young children had done in Phase 1 to decide what the pictures on the cards for the Phase 2 ‘Nature’ card sort exercise should be. This meant that the children were sorting images of ‘nature’ that they were familiar with, and which they were more likely to find meaningful and useful than images I had selected and provided. The actual pictures on the cards were cut out of magazines (see Figures 4 and 5 for examples).

Before the young children did the ‘Nature’ card sorting exercise, I did a practice card sort exercise with them. This allowed me to make sure the young children knew how to sort pictures into two categories, and to teach them how to do it if they did not. In the practice card sort, I asked the young children to sort images cut from magazines into two categories: ‘Cars’ and ‘Not Cars.’ Descriptions and examples of the images used for this practice card sort exercise can be found in Appendix C (see Figures C1, C2, C3 and ‘Complete List of All Pictures’).
Figure 4. Picture T – clouds.
This image (Dharmasena, 2014) closely resembles the actual picture I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. The original image of clouds was used in both the ‘Nature’ card sort exercise and as an element in the rep grid test matrix. This image is courtesy of Dharmasena / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.

Figure 5. Picture L – bear.
This picture (Ratcliff, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine story about a bear, and thus is held under copyright and cannot be re-published. The original image of a bear was one of the pictures used in the ‘Nature’ card sort exercise and was an element of the rep grid test matrix. This image is courtesy of Ratcliff / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.
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For the ‘Nature’ card sort exercise, I asked the young children to sort images into two categories: ‘Nature’ and ‘Not Nature.’ The images were pictures cut from magazines (see Figures 4, 5, 6, 7, and 19 for examples, and ‘Complete List of All Pictures’ in Appendix C for a full list of images and their descriptions); as discussed, the images were based on the children’s drawings from Phase 1. I recorded the conversations I had with young children during both the practice and the ‘Nature’ card sorting exercises, asking them to describe the pictures they were looking at, and to tell me why they were categorizing them one way or another, both of which were a form of member-checking. I also took notes on how they categorized the pictures by hand. The interview questions I used can be found in Appendix B. As in Phase 1, I encouraged the young children to take conversational tangents, tell stories, as well as to answer the interview questions.

The Phase 2 card sort exercises took between 4 and 9 minutes for each young child. I conducted the card sort exercise research on the same day as the young children participated in the first part of the rep grid test Reliability check, which is discussed below. Together, these two pieces of research required me to work with each child for between 10 and 20 minutes. Due to the length of the school day, their special lessons, and other scheduling restrictions, it took two school days to conduct 12 Phase 2/first part of Reliability check interviews. The two days I did the Phase 2 interviews were one week after I did the Phase 1 interviews.

Data analysis.

Again, I would have liked to make complete transcriptions of the interviews and conversations I had with the young children; due to time restrictions, this was not possible. I listened to each entire interview once, and intend to review them in the future as I carry on this
research. I used my hand-written notes to create a table indicating which pictures each child identified as ‘Nature,’ and used these notes, with the recordings of the interviews as back-ups, to identify differences and similarities in how the young children described the pictures. I used the same process to examine the reasons the children categorized the images in certain ways.

**Phase 3: The ‘Nature’ repertory grid test.**

It was necessary for me to make several alterations (given below) to Kelly’s initial rep grid test, because my work was done with young children. As much as possible, I have tried to retain the parts of the test that are required by PCT, and to recognize the assumptions and limits inherent in the rep grid test method.

**Element selection.**

As I worked with young children who could not read, I used pictures as the elements in the rep grid matrix; this created a rep grid test modified to resemble a ‘picture sort’ (Rugg & McGeorge, 2005, p. 97). Art is one of the best communication media for young children since they tend to have less developed language and cognitive skills than adults, and using it is “consistent with the idea of social constructivism” (Barraza & Robottom, 2008, p. 189). Most children enjoy art, so data are generated in a relaxed atmosphere (Barraza & Robottom, 2008, p. 181; Ewing, 2008, p. 147).

Butler and Green showed that when children work with drawings they are enabled to describe their construing processes with more detail (Butler & Green, 2007, p. 60), as they are engaged as active agents and need not rely on their verbal or literacy skills alone (Moran, 2001, p. 600). Edwards also used pictures as elements when using rep grid testing with young children (1988, p. 235). She found that “the children coped better with simple drawings of...single
objects than they did with more complex pictures” (Edwards, 1988, p. 235). I consider the pictures I used ‘complex’ (see Figures 6 and 7 for examples), but I did not find that the children who participated in my research had trouble identifying what was in the pictures.

*Figure 6. Picture R -- boy sitting on dock looking over lake with island. This picture (artur84, 2014a) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. I would consider this picture to be fairly complex, yet all the young children I worked with were able to identify the objects it portrays. The original image was used as an element in the rep grid test matrix. This image is courtesy of artur84 / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.*
Figure 7. Picture U -- girl in field of dandelions.
This picture (Castillo, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. This is a complex picture, but all the young children I worked with were able to identify what it is an image of, and some even added their own interpretations or narratives. The original picture was one of the elements of the rep grid test matrix. This image is courtesy of Castillo / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.

When selecting elements from a pool of possibilities generated by a group, it is important that the selected elements can be identified and interpreted by all the participants (Pope & Keen, 1981, p. 39). I ensured this was the case by discussing each element picture with the young child during the rep grid test. All of the pictorial elements of the rep grid matrix were based on pictures of objects or themes that the children themselves had drawn or spoken about during a previous interview.

The actual pictures on the cards I presented as the elements of the matrix were the majority of the pictures used in the Phase 2 ‘Nature’ card sort exercise (see Figures 4, 5, 6, 7, and 19 for examples, and ‘Complete List of All Pictures’ in Appendix C for a full list of images and their descriptions). I did not include three of the images used in the Phase 2 ‘Nature’ card sort exercise because they were pictures of things, not places, and were not appropriate given the
constructs I provided in the Nature rep grid test. The images I did not include were: picture K – ladybug; picture M – girl holding frog; and picture V – bird.

Construct selection.

For my research, I used provided constructs. I employed a method for increasing the personal meaning of these constructs for the participants. First, I introduced the children to the constructs and had them use them in a different rep grid test, three weeks before participating in the Nature rep grid test I collected data from. I believe this is similar to the “‘meaning enhancement’ procedure” (G. J. Neimeyer et al., 2002, p. 169) accidentally discovered by Neimeyer, Leso, Marmarosh, Prichard and Moore in 1992 (cited in G. J. Neimeyer et al., 2002, p. 168): participants went through a construct elicitation and/or rep grid testing process using the constructs, which allowed the provided constructs to become very meaningful over the next week (G. J. Neimeyer et al., 2002, p. 168). Additionally, I could not use elicited personal constructs since that process requires a level of abstract reasoning that young children are not developmentally capable of performing.

The constructs I provided for the rep grid test matrix were also drawn from the results of the Phase 1 research. I checked the appropriateness of these constructs against the Phase 2 results and chose constructs that could be understood by all of the young children, appeared to be representative of how they already thought about ‘nature,’ and could easily be applied to the elements of the rep grid test matrix. I provided only four constructs because I did not want to exhaust the young children during the data collection process: A Place I Want To Go/A Place I Do Not Want To Go; A Place With Lots of Animals/A Place With Few Animals; A Place With Lots of People/A Place With Few People; A Place That Is Scary/A Place That Is Not Scary. I
did not use Nature/Not Nature as a construct because I believe it is superordinate to these other constructs, and it is important that a rep grid matrix contain constructs that are all on the same hierarchical level of the construct system. Figure 2 shows the blank rep grid matrix I completed for the young children.

My approach to the problem of lopsided constructs was to have as heterogeneous an element set as possible, and to specifically ask the children I worked with how they wanted to categorize each element, so that I knew whether blank intersects represented a pole of the construct or an element that was not within the construct’s range of convenience. This form of member-checking is advocated by Bannister and Mair (1968, p. 207). Considering Adams-Webber’s view of lopsidedness, I was not overly concerned by the presence of lopsided constructs.

Data collection.

In his initial description of the rep grid test, Kelly considered the possibility that participants can self-administer the test (Kelly, 2002, ch. 6); almost every researcher cited in this chapter had the participants do exactly this. Working with young children, this was not an option for me. While this meant that administering the tests took much longer, it decreased the possibility that the instructions for taking the test were not properly followed. Neimeyer et al. made clear that “even minor variations in repertory grid technique can carry significant implications for the process and outcome of the constructive process that it generates” (2002, p. 193), and it was my intention to vary from Kelly’s initial rep grid technique as little as possible.

I did not show the rep grid matrix to the young children. Instead, I asked them the questions verbally, which allowed me to control the manner in which the matrix was filled out.
A rep grid matrix can be completed many ways. Often, participants or researchers choose to proceed construct-by-construct, considering every element under one construct then moving on to the next construct; or they proceed element-by-element, considering every construct for one element then moving on to the next element (G. J. Neimeyer et al., 2002, p. 179). While Kelly suggested only the construct-by-construct method (Kelly, 2002, ch. 6), it appears that greater construct differentiation is elicited when participants complete the rep grid test matrix element-by-element (G. J. Neimeyer et al., 2002, p. 183). Neimeyer et al. caution that this result is highly dependent upon the specific conditions under which it was obtained, and do not consider it generalizable (G. J. Neimeyer et al., 2002, p. 192).

Following Kelly (2002, ch. 6), I had my participants complete their rep grid tests construct-by-construct. I was able to ensure the construct-by-construct order was followed since I asked the young children the rep grid test questions verbally, and filled out the matrix for them. Jackson (1988) claims that when working with children, writing down their answers for them “reduces threat” (p. 224) and allows them to give more meaningful answers. Having a conversation with the young children as they completed the rep grid matrix also allowed me to emphasize that I was interested in their ideas, and that whatever they thought was ‘correct’ (Pope & Keen, 1981, p. 47).

When eliciting personal constructs, a researcher initially shows the participant a number of elements (traditionally three) and asks the participant what the distinction between them is (G. J. Neimeyer et al., 2002, p. 174). When the researcher provides the constructs, the distinction between the elements is given to the participant, who then indicates which side of the distinction each element falls on. In either case, the number of elements the participant is shown initially
will have an impact on the differentiations the participant makes (G. J. Neimeyer et al., 2002, pp. 176-177). In most recent PCT research, elements are presented to the participant in triads or dyads (G. J. Neimeyer et al., 2002, p. 174). A dyad is a pair of elements while a triad is a set of three. A triad represents the

Minimum Context Card Form, in which three elements are selected for the subject’s consideration and the relevant cards separated from the pack and laid before him. Kelly has suggested that the minimum context within which a construct can be formed consists of three elements. This he considered to be the smallest number of elements from which a generalization could be made regarding similarity and relevant difference. (Bannister & Mair, 1968, p. 50)

Adams-Webber referred to this form of elicitation as “the ‘method of triads’” (1979, p. 21). Neimeyer et al. showed that presenting the elements in triads may slightly increase the resulting construct differentiation (2002, p. 172). Additionally, this is the method suggested by Kelly. For these reasons, I presented the initial elements to my participants in triads.

I proceeded construct-by-construct, considering every element on the basis of one construct then moving on to the next construct. I initially presented the young children with a triad of pictures, asked them to classify them according to the construct we were discussing, and then had them categorize the remaining images. I repeated this procedure with each construct, varying the picture triads that I began with. The initial triads were: for Want to Go/Not Want to Go, picture L – bear, picture N – road, picture Q – trees; for Lots of Animals/Few Animals, picture O – rainforest pool, picture R – boy sitting on dock looking over lake with island, picture T – clouds; for Lots of People/Few People, picture P – roller coaster, picture Q – trees, picture U
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– girl in field of dandelions; for Scary/Not Scary, picture N – road, picture O – rainforest pool, picture S – kids playing on water slide. Each image was used at least once in an initial triad.

The interview questions I used can be found in Appendix B.

As the young children and I went through the rep grid matrix, I indicated that an element was categorized by the first pole of a construct by marking an X in the intersect; if an element belonged to the second pole of a construct, I left the intersect blank. The free choice method was used, so that the young children participating could categorize as many or as few elements under each pole of each construct as they wished. By presenting the rep grid test verbally, I was able to member-check the conclusions I was drawing from the categorizations the young children were making, and ask them questions about what influenced them to characterize certain elements in specific ways. The interview conversations were recorded digitally, and I filled out the rep grid matrix by hand as the young children indicated their choices to me.

The rep grid test took between 5 and 12 minutes for each young child. I conducted the rep grid test on the same day as the second part of the rep grid test Reliability check, which is discussed below. Together, these two pieces of research took between 10 and 20 minutes for each young child. In spite of the length of the school day, their special lessons, and other scheduling restrictions, I was able to conduct all 12 Phase 3/second part of Reliability check interviews in one day. I did the Phase 3 interviews three weeks after I did the Phase 2 interviews.

Data analysis.

“In all forms of repertory grid, the unique measures provided by this technique take the form of numerical assessments of relationships between two or more construct dimensions” (Bannister & Mair, 1968, p. 67). These assessments rely on the assumption that a relationship
between constructs can be inferred from the similarity of the marked or blank intersects for each element. Further, a statistically significant relationship is assumed to reflect a “conceptual relationship for the [participant]” (Bannister & Mair, 1968, p. 67). This means that information about the structure and differentiation of the participants’ personal construct system is collected indirectly, rather than by asking the participants about their personal construct systems directly (Bannister & Mair, 1968, p. 67). I believe that this is an advantage when working with young children, as they are likely to be unable to answer such sophisticated conceptual questions directly.

To analyse the young children’s rep grid tests I used Rep IV (Shaw & Gaines, 2005) to create ‘Displays’ of the raw grid data. I also performed cluster analyses using the FOCUS package that is part of Rep IV’s (Shaw & Gaines, 2005) rep grid analysis software. The FOCUS cluster analysis reorders the elements and reverses the constructs if necessary, in order to present the cluster relationships in as visually clear a manner as possible (Shaw & Thomas, 1978, p. 152). To do this, ‘FOCUSed’ rep grids have element and cluster trees which place the most closely related elements or constructs adjacent to one another, and indicate their matching scores (Shaw & Thomas, 1978, p. 142). The FOCUS analysis allowed me to obtain an answer to one of my research questions: What are the structures of young children’s personal construct systems surrounding the notion of ‘nature’?

I used the digital recordings of the interview conversations as well as the results of the cluster analyses to answer another one of my research questions: How can the repertory grid method be used effectively with young children to assess their personal construct systems regarding ‘nature’? This data will also help me as I discuss the answers to my final research
Reliability.

As the rep grid test is so open to variation, there cannot be any such thing as “the reliability of the grid” (Bannister & Mair, 1968, p. 156). Furthermore, it does not make sense to expect the results of rep grid testing to be reliable, which is to say generally replicable and consistent over time and population, as the test is designed to measure personal construct structure, which is individual and varies over time (Bannister & Mair, 1968, p. 156). Bannister and Mair suggested the reliability of grid data is better assessed by their ability to represent “predictable stability and predictable change” (1968, p. 156).

Adams-Webber stated, however, that there are “some aspects of the issue of reliability which are common to most forms of grid test” (1979, p. 33). One of these is ‘consistency’ over time (Adams-Webber, 1979, p. 33). Consistency indicates whether an individual’s personal construct system is stable and generalizable by comparing two similar rep grid matrices that the individual has filled out over a short period of time (Bannister & Mair, 1968, p. 71).

“Consistency can be calculated with any measure of association between constructs…It is essentially a test-retest reliability for the pattern of construct relationships” (Smith, 2000, p. 223). The higher the consistency score, the more stable the construct pattern (Smith, 2000, p. 223). However, I would not expect young children to have stable construct relationships as their constructs are constantly changing as their minds develop (Edwards, 1988, p. 232).

Bell (1990) questioned the appropriateness of applying the test/retest, or consistency, method of determining reliability to rep grid tests, although he had no problem applying it to individual structural measures (p. 95). He suggested that latent trait theory, a measurement
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

paradigm which does not assign equal value to each piece of an assessment, may provide a more appropriate model for judging the reliability of rep grid tests (Bell, 1990, p. 98). The drawbacks to this approach are the large amount of data required and that latent trait theory would treat the elements and constructs of the rep grid matrix independently (Bell, 1990, p. 98). Bell saw this separate treatment as an advantage (1990, p. 98), but it is not, since it is clearly contrary to Personal Construct Theory.

A second aspect of rep grid test reliability is ‘relationship consistency,’ which refers to the consistency of “specific patterns of relationships among constructs over time” (Adams-Webber, 1979, p. 34). Relationship consistency does not depend upon the meaning of constructs or how individual elements are construed remaining static (Adams-Webber, 1979, p. 34). Rep grid tests are reliable measures of relationship consistency (Adams-Webber, 1979, p. 35), as they do not depend on the specific elements or constructs in the matrix. One concern with this conclusion is that the relationship consistency was not measured over a long period of time, so the actual stability of the construct relationships is unknown (Adams-Webber, 1979, p. 35). Personal Construct Theory holds that many personal constructs are subject to change, so overall, long-term construct stability is unlikely (Bannister & Mair, 1968, p. 156).

The best way to be sure of the reliability of the rep grid test being used is for “the individual investigator…to demonstrate the reliability of his own measurements” (Adams-Webber, 1979, p. 33). I employed a test/retest method to check for consistency, and therefore reliability, as discussed above. I compared matching scores, a measure of the relationship between constructs, in two rep grid matrices completed by the same young child. The test and retest were three weeks apart, which is not a long time, although it is much longer than the same
day test/retests discussed by Adams-Webber (1979, pp. 34-35). Due to information about how much young children’s constructs are likely to change, I predicted that the young children’s rep grid tests would not be consistent, but would reliably show some variation between the test and the retest, as Bannister and Mair suggested (1968, p. 156).

Any time the rep grid data from two or more individuals are compared, it must be remembered that construct systems are actually personal, and generalized descriptive statements cannot be drawn from the comparisons (Pope & Keen, 1981, p. 157); such comparisons are appropriate for initiating negotiations or conversations and making observations (Pope & Keen, 1981, p. 157), not drawing statistical conclusions.

*Some measures of construct structure.*

An analysis of a rep grid matrix can be done by looking at whether the blank and checked intersects match for each element between two constructs (Bannister & Mair, 1968, p. 57). A high match or highly negative match indicates a strong relationship between the two constructs (Bannister & Mair, 1968, p. 57); if half of those intersects checked for construct A are also checked for construct B, this suggests there is no relationship between the two constructs (Bannister & Mair, 1968, p. 57); if there is an “intermediate degree of congruence…the degree of association between the constructs could be calculated and the statistical significance estimated by use of the binomial expansion formula” (Bannister & Mair, 1968, pp. 57-58). This is possible because the checked intersects either match between constructs or they do not, thus are in a binomial distribution. This analysis leads to an indexed, correlational association or coefficient between constructs (Bannister & Mair, 1968, p. 67).
Rep grid matrix data can be manipulated to show the ‘cognitive complexity’ or ‘cognitive simplicity’ of an individual’s personal construct system. Cognitive complexity is based on the total number of matching intersects between constructs. “Fewer matches are interpreted as greater complexity” (Feixas, Molina, Montes, Mari, & Neimeyer, 1992, p. 27). Cognitive complexity is a measurement of construct differentiation; high complexity scores mean a high level of differentiation. High cognitive differentiation means that an individual sorts the elements in different ways for each construct in the rep grid matrix (Adams-Webber, 1979, p. 43). It is possible that individuals with high cognitive complexity will be able to see more than one point of view easily, as they have multiple sets of constructs to draw from (Adams-Webber, 1979, pp. 45-46).

Feixas et al. found cognitive complexity to be a stable, consistent, and reliable measure (1992, p. 35). Bannister and Mair felt that “untested assumptions and loose argument abound in this area of study” (1968, p. 70), and that the theory behind cognitive complexity is too far from Personal Construct Theory for this measure to be considered valid (1968, p. 70). Furthermore, this measure does not account for personal construct systems that appear complex but are in fact highly confused (Bannister & Mair, 1968, p. 72). Fransella et al. indicated that there is no consensus on the validity of cognitive complexity (Fransella et al., 2004, pp. 121-122).

Grid size.

There is no fixed standard for what size a rep grid matrix should be (Pope & Keen, 1981, p. 41). In practice, having fewer than eight elements may prevent structural details of the personal construct system from appearing, and having more than 15 elements may make filling
out the rep grid matrix a tedious process (Pope & Keen, 1981, p. 41). I found that the time and attention required to fill out my rep grid matrix, which had nine elements and four constructs, was near to the limit some of the young children were willing to participate for. Participant time and attention limits should be taken into account, rather than focusing solely on the numerical size of the grid (Pope & Keen, 1981, p. 44). Feixas et al. demonstrated that grid size can affect some structural measurements of rep grid test data (Feixas et al., 1992, pp. 33-35). As I had a particularly small grid, I avoided using any of those methods of analysis.

Factor analysis.

Kelly developed a “non-parametric, factorial method” (Bannister & Mair, 1968, p. 58) of analysis, which is described fully (Kelly, 2002, pp. 201-211). This analysis gave a simple view of an individual’s ‘psychological space,’ and is based on scanning the rep grid matrix for a few main personal reference axes (Kelly, 2002, p. 202). Factor analysis told the investigator which constructs have been used to judge elements “in a similar fashion” (Adams-Webber, 1979, p. 36); these constructs were highly related and form a factor (Adams-Webber, 1979, p. 36). The resulting factors that were extracted from this type of analysis were “empirical statements about the mathematical features of construct systems” (Bannister & Mair, 1968, p. 70) which may have been the bases for theoretical statements about personal construct systems (Bannister & Mair, 1968, p. 70).

This method of analysis was non-parametric because “it is based upon dichotomies rather than parameters or scales” (Kelly, 2002, p. 209). The advantage of Kelly’s method of factorial analysis over conventional methods was that it related “both constructs and [elements] to the same basic factors, taking into the account the interaction between them” (Adams-Webber, 1979,
Some authors (Adams-Webber, 1979; Bannister & Mair, 1968) suggested that Kelly’s method of factorial analysis was only as consistent as a conventional, computed factor analysis for the first extracted factor. The overall reliability of Kelly’s method has been questioned as well (see Adams-Webber, 1979, p. 37), as has the meaningfulness of conventional factor analysis in relation to rep grid data (Feixas et al., 1992, p. 35; Pope & Keen, 1981, p. 54).

Cluster analysis.

Most modern rep grid research includes either a computer-generated principal-component analysis or a computer-generated cluster analysis. I find cluster analyses are visually simple and easier for novice rep grid test users to understand. A cluster analysis can indicate which constructs or elements the individual filling out the rep grid matrix tends to perceive as alike or dissimilar (Pope & Keen, 1981, p. 73). A cluster analysis can be the basis for interpreting the content as well as the structure of a personal construct system (Pope & Keen, 1981, p. 73), as it clusters the elements of the rep grid matrix, which are representative of the content, not the structure, of the personal construct system.

Content analysis.

It is important to realize that there is not a clear separation between the structure and content of personal constructs, as the two constantly interact within an individual (Bannister & Mair, 1968, p. 68). Jackson (1988) suggested analyzing content in a way that acknowledged that content and construct structure are intertwined. She called on researchers to restate the participants’ constructs in terms that come from the researchers’ academic or professional discourse (S. R. Jackson, 1988, p. 225). She also prompted researchers to note if the constructs and their content are age- and developmentally-appropriate (S. R. Jackson, 1988, p. 225).
Jackson further suggested considering if any expected constructs are absent (S. R. Jackson, 1988, p. 225), but I feel it goes against PCT’s individuality corollary to make assumptions about how another person’s personal construct system should or should not be structured. Bannister and Mair claimed it is also possible to do a content analysis of a rep grid test matrix by looking at the actual constructs for their ‘meaning’ (1968, p. 68). Naturally, this type of content analysis cannot be done when the researcher has provided the constructs (Bannister & Mair, 1968, p. 68).

Data collection.

I needed to check the reliability of the constructs I provided as part of the rep grid test matrix, as well as the overall reliability of the rep grid test as a method for assessing the personal construct systems of young children. I did this using the test/retest method, administering two small, identical, rep grid tests to the young children, three weeks apart. This rep grid test was different from the ‘Nature’ rep grid test the young children completed. Figure 8 shows the blank rep grid matrix I used for the Reliability test and retest.

The elements of the Reliability repertory grid matrix were images cut from magazines. They were pictures selected from, or inspired by, objects or scenes that were present in the young children’s drawings from Phase 1, which represented a range of outdoor scenes. By selecting element images based on the drawings the young children had created, I had a grid that was more likely to be meaningful and useful than if it used images I had selected and provided. See Figures C4, C5, and ‘Complete List of All Pictures’ in Appendix C for a full list of the Reliability rep grid test element images and their descriptions.

The constructs I provided for the rep grid matrix were drawn from the results of the Phase 1 and 2 research. I chose constructs that could be understood by all of the young children, were
shown to be representative of how they already thought about ‘nature,’ and could easily be
applied to the elements I used in the rep grid matrix. I provided only four constructs because I
did not want to exhaust the young children during the data collection process. The constructs I
provided for the Reliability test/retest rep grid matrix were: A Place I Want To Go/A Place I Do
Not Want To Go; A Place With Lots of Animals/A Place With Few Animals; A Place With Lots
of People/A Place With Few People; A Place That Is Scary/A Place That Is Not Scary. These
were necessarily the same constructs as I provided for the Nature rep grid test.

I did not show the Reliability test/retest rep grid matrices to the young children. Instead, I
asked them the questions verbally, which allowed me to control the manner in which the matrix
was filled out. I proceeded construct-by construct, considering every element under one
construct, then moving on to the next construct. I did not present the element images in triads, as
there were only five total elements, and I believed the young children could handle
differentiating between them all at once.
<table>
<thead>
<tr>
<th>Construct</th>
<th>Picture</th>
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<tbody>
<tr>
<td></td>
<td>Y: townhouses</td>
</tr>
<tr>
<td></td>
<td>Z: ocean beach</td>
</tr>
<tr>
<td></td>
<td>AA: boy watering plant</td>
</tr>
<tr>
<td></td>
<td>W: man in coniferous forest</td>
</tr>
<tr>
<td>Want To Go(X)/Not Want To Go</td>
<td>X: snowy, rocky mountains</td>
</tr>
<tr>
<td>Lots of Animals(X)/Few Animals</td>
<td></td>
</tr>
<tr>
<td>Lots of People(X)/Few People</td>
<td></td>
</tr>
<tr>
<td>Scary(X)/Not Scary</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 8.* Blank example of rep grid matrix used for Reliability test and retest.

The descriptions of the element pictures are mine. These elements images were cut from magazines and are inspired by the young children’s drawings. The constructs were gleaned from conversations with the young children during previous phases of the research. I indicated that an element was categorized by the first pole of a construct by marking an X in the intersect; if an element belonged to the second pole of a construct, I left the intersect blank.

The interview questions I used can be found in Appendix B. As the young children and I went through the rep grid matrix, I indicated that an element was categorized by the first pole of a construct by marking an X in the intersect; if an element belonged to the second pole of a construct, I left the intersect blank. The free choice method was used, so that participants could categorize as many or as few elements under each pole of each construct as they wished. By presenting the rep grid test verbally, I was able to member-check the conclusions I was drawing from the categorizations the young children were making, and ask them questions about why they characterized certain elements in specific ways. The interview conversations were recorded digitally, and I filled out the rep grid matrix by hand as the young children indicated their choices to me.
The Reliability rep grid test took between 5 and 12 minutes for each young child; The Reliability rep grid retest took less time, between 4 and 10 minutes for each young child. I conducted the Reliability rep grid test on the same day as I did the Phase 2 card sort exercise research. The Reliability rep grid retest was completed on the same day as I did the Phase 3 Nature rep grid test, three weeks after the Reliability rep grid test.

Data analysis.

Traditionally, test/retest Reliability checks rely on stability to demonstrate reliability. In this case, Personal Construct Theory indicates that young children’s personal construct systems are not stable, so reliability will be demonstrated if the predicted changes over time in the young children’s personal construct systems are shown, in the form of detectable differences when the Reliability rep grid tests and retests are compared.

To see if there were structural changes in the personal construct systems between the time of the Reliability rep grid tests and the time of the retests, I compared the matching scores between constructs for each Reliability rep grid. The raw rep grids were generated using the Display option of the Rep IV software program (Shaw & Gaines, 2005). A matching scores analysis of a rep grid matrix can by done by looking at whether the blank and checked intersects match for each element between two constructs (Bannister & Mair, 1968, p. 57). I obtained the matching scores for each rep grid matrix by comparing the intersects of each construct row within the raw rep grid matrix with the intersects of every other construct row. The matching scores were calculated by visual scanning of the raw grids. The matching scores analysis is strictly structural, reflecting changes in the young children’s personal construct systems, and not concerned with the content of the rep grid matrices.
As an example, consider Nick’s Reliability rep grid test (Figure 9). First, compare ‘Want To Go/Not Want To Go’ to ‘Lots of Animals/Few Animals.’ The match score is 2, meaning there are two elements that are identically categorized for these constructs. Those elements happen to be “mountain” and “guy with sand planting a tree,” but as this is a structural analysis, it does not matter which two elements match. Only the number of matches is important.

![Figure 9](image)

*Figure 9.* The completed raw Reliability rep grid test matrix completed by Nick. The “1”s are equivalent to “X”s and represent elements that belong to the left-hand pole of the construct; the “2”s show elements that are categorized under the right-hand pole of the construct.

Then compare ‘Want To Go/Not Want To Go’ to ‘Lots of People/Few People.’ The match score is 5. Continue the comparison, considering all possible combinations. The match score for ‘Want To Go/Not Want To Go’ to ‘Scary/Not Scary’ is 1; for ‘Lots of Animals/Few Animals’ to ‘Lots of People/Few People’ it is 2; for ‘Lots of Animals/Few Animals’ to ‘Scary/Not Scary’ the match score is 4; and for ‘Lots of People/Few People’ to ‘Scary/Not Scary’ it is 1. These are the match scores for the Reliability test.

Now, consider the matching scores for the Reliability rep grid retest. Nick’s completed raw rep grid retest matrix is shown in Figure 10.
Figure 10. Nick’s completed raw Reliability rep grid retest matrix. The “1”s are equivalent to “X”s and represent elements that belong to the left-hand pole of the construct; the “2”s show elements that are categorized under the right-hand pole of the construct. Again, calculate the matching scores for all the possible construct-against-construct comparisons. The match score for ‘Want To Go/Not Want To Go’ compared to ‘Lots of Animals/Few Animals’ is 1; for ‘Want To Go/Not Want To Go’ to ‘Lots of People/Few People’ it is 5; the match score for ‘Want To Go/Not Want To Go’ to ‘Scary/Not Scary’ is 1; for ‘Lots of Animals/Few Animals’ to ‘Lots of People/Few People’ it is 1; for ‘Lots of Animals/Few Animals’ to ‘Scary/Not Scary’ the match score is 3; and for ‘Lots of People/Few People’ to ‘Scary/Not Scary’ it is 1. These are the match scores for the Reliability retest.

Finally, compare the matching scores for each construct comparison from the test to the retest. The match score for ‘Want To Go/Not Want To Go’ compared to ‘Lots of Animals/Few Animals’ in the test is 2; in the retest, it is 1. Note that the match score has changed. There are six total match scores calculated for each Reliability rep grid matrix, so the highest number of changes possible is six. As the reliability of the provided constructs and the rep grid method will be indicated by demonstrating the predicated change in personal construct system structure, I expected to see the median number of changes to the matching scores be closer to six than to zero if this is a reliable method. It would not be appropriate to calculate the mean, or average, as the match scores are discrete, not continuous, values.
It is also possible to look for differences between the Reliability rep grid tests and retests by considering differences in content. This applies to the descriptions the young children give when asked about the pictures used as elements.

**Validity.**

The validity of the rep grid test is simultaneously simple and complex. On one hand, the rep grid test is validated by Personal Construct Theory; if the theory is accepted, so must the test be. Further, use of a rep grid test is validated by the many rep grid test studies that have been conducted in the past. Within the context of PCT, the rep grid test is validated by “its capacity to enable us to elaborate our construing” (Fransella et al., 2004, p. 151).

Seelig and Radó (2006) validated the rep grid test by comparing its results with the results of a Semantic Differential test (p. 65). Bannister and Mair have made it quite clear, however, that the Semantic Differential does not have the same theoretical basis as the rep grid test (1968, p. 133) and that the two “very nearly defy comparison” (p. 133). Thus, Seelig and Radó’s method of validating the rep grid test did not appear to be successful.

Diamond discussed how to validate the results of a rep grid test, meaning the structure and/or content of the personal construct system that has been identified (1988, p. 181). He stated that merely identifying the construct system does not validate it, but that it must be further tested through member-checking (Diamond, 1988, p. 181). Diamond did this by having his participants engage in conversations to investigate if the patterns shown in the rep grid test seemed correct to them (Diamond, 1988, p. 181). These conversations appeared to be extremely beneficial to the participants, as they gained greater insight into their own psychological processes, but it is unclear if the conversations determined the validity of the rep grid test results or not (Diamond, 1988, p. 182).
Chapter 4: Results

Phase 1: Drawing exercise.

Drawings of ‘an outside place.’

While all of the young children, except for Karen, completed a drawing of ‘an outside place,’ most needed some prompting to think of something to draw; they also needed confirmation from me that the object they had thought of was appropriate. The most common item drawn by the young children was the climber in “the recess yard” that they went to most school days. Four of them drew this as ‘a place outside.’ See Figures 11 and 12 for examples. Two young boys drew their own houses. One example is shown in Figure 13.

The sun was drawn by four young children, although this was usually the only indication of the sky; only the children who drew a sun drew the ground.

*Figure 11. Houston’s drawing of the climber in the recess yard. He has drawn the slide, the steps up to the slide with a steering wheel at the top, the sand pit below the slide, and a ball (the dark, round object on the right hand side).*
Figure 12. Jane’s drawing of the recess yard. She has shown the whole climber, including the slide, as well as two buckets of toys, and a “woodchip area” off to the right. She has done her drawing from an aerial viewpoint.

Figure 13. Samuel’s drawing of his own house. He has drawn his family inside the house, and some details of his backyard on the right hand side.
All of the children who drew a sun and the ground also put people in their pictures. Figure 14 is an excellent example of how these three elements, sun, ground, and people, were combined.

![Figure 14. Nancy’s drawing of her garden.](image)

She has drawn the sun, the ground and herself, as well as several flowers, rainclouds and rain drops.

In Figure 14, Nancy has drawn plants and a person. These were the only living things that any of the children drew in the ‘outside place’ drawings. Three other young children drew plants and four others drew people, while none drew any animals. The people the young children drew were always people they knew: themselves, their family, and/or their friends.

**Drawings of ‘a forest.’**

All of the young children knew what a forest was when I asked, and they were all able to draw one. Ten out of the 12 children immediately began by drawing (a) tree(s) when asked to draw a forest. Seven of the children drew more than one tree, two of the children drew more than one kind of tree, and three children drew different sizes of trees. Five of the children drew
plants other than trees. This is well-demonstrated in Figure 15. Three of the young children specifically drew palm trees or rainforest scenes; see Figure 16 for one example.

*Figure 15.* Hank’s drawing of a forest.
He has drawn three trees on the left hand side of the page: two apple trees and one “pineapple tree.” The middle apple tree is taller than the other two trees. The object on the right hand side of the page that looks like a tree is actually a frog sticking out its “long tongue” to catch a fly. Hank has also included a fallen log, a bush, and a carrot in the lower right hand corner of his picture.

When drawing ‘a forest,’ only two children drew the sun. One child, Karen, also drew a blue sky. Three other children drew the sky, but not the sun, and not the ground. Only one child, Steve, drew both the ground and the sky, though not the sun (see Figure 17), and two children drew just the ground. Ten out of 12 children drew animals in their drawings of ‘a forest;’ nine of the ten drew multiple animals. See Figures 16 and 17 for examples. None of the children included people in their drawings of ‘a forest.’

**Element selection.**

I used the full set of 23 images created by the young children, 11 of ‘an outside place’ and 12 of ‘a forest,’ to create the set of pictures that served as images for the ‘Nature’ card sort exercise in Phase 2 and elements in the Nature rep grid matrix in Phase 3. I used images that
were common in the drawings, such as that of a slide (to represent the climber in the recess yard), a house, a rainforest, and clouds (see Figure 4).

Figure 16. Jane’s drawing of a rainforest.
She has drawn one palm tree, with roots. There is a rabbit living in the tree and a snake beside the tree. It is raining.

Figure 17. Steve’s drawing of a forest.
He has drawn the blue sky and the grass growing on the ground. The blue diamond on the left is a video game character. Next there is a yellow dog hiding behind a yellow tree, and on the right hand side there is a green squirrel being tickled by a flying dragon.
I noticed that the young children tended to draw their forest trees in a line (see Figures 18 and 19), so I chose a picture in which the trees appeared to be linear (see Figure 20). Since the young children drew so many animals, I included a ladybug, a bear (see Figure 5), a bird, and a frog.

Figure 18. Karen’s drawing of a forest. She has drawn all the trees in a straight line. There is a bird in each tree, and also a nest in the furthest left hand tree.

Figure 19. Anne’s drawing of a forest. All the trees are lined up. The brown dot on the ground is a seed.
I also needed to include some pictures that would make the set of images heterogeneous. To this end, I included a roller coaster like the one Peter had drawn, and a road similar to the one that Frank drew. I wanted to make sure that I included people in some of the pictures I chose, so when representing the flowers and other plants the young children had drawn, I used a picture of flowers that had a little girl in it (see Figure 5). Finally, I chose a picture of a boy looking out over a lake (see Figure 6). Samuel’s picture of a forest included a lake, and both Nick and Houston had drawn their forests on islands. A list of all the pictures used is in Appendix C (see ‘Complete List of All Pictures’).

![Figure 20. Picture Q – trees.](image)

This picture (prozac1, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be republished. The original image is meant to mirror the linear appearance of the trees in the young children’s drawings. I used it as an image for the ‘Nature’ card sort exercise and as an element in the rep grid test matrix. This image is courtesy of prozac1 / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licensing Agreement.

**Construct selection.**

I selected the constructs ‘Lots of Animals/Few Animals’ and ‘Lots of People/Few People’ because of the marked difference in the number of people and animals in the young
children’s pictures of ‘an outside place’ and ‘a forest.’ There were people but no animals in the ‘outside place’ drawings, and animals but no people in the ‘forest’ drawings.

I used the ‘Want To Go/Not Want To Go’ construct because I knew from some of the conversations I had with the young children that the ‘outside places’ or ‘forests’ that they drew resembled or were modeled on real places that they enjoyed going to. The construct ‘Scary/Not Scary’ was inspired by Alice’s drawing of an “evil, wicked forest” (see Figure 21).

![Figure 21. Alice’s drawing of a forest.](image)

She has drawn an “evil, wicked forest,” as evidenced by the dark sky and dying trees that have their leaves falling off. In the middle of the picture is a dragon, with a mouth full of sharp teeth, in its cave.

**Phase 2: ‘Nature’ card sort exercise.**

The young children were extremely adept at sorting the pictures into the two categories I requested them to use, ‘Nature’ and ‘Not Nature.’ The complete results of the ‘Nature’ card sort exercise are compiled in Table 1. All the young children categorized all of the animal pictures as ‘Nature,’ except for Nancy indicating the bear as being ‘Not Nature.’ The roller coaster, road, and water slide were unanimously classified as ‘Not Nature’ with two exceptions: Anne thought the road was ‘Nature,’ and Frank saw the water slide as ‘Nature.’
All of the young children used the same words to describe the pictures of the animals. This was also true of the picture of the roller coaster. For the other pictures, there was at least some variation in the language the young children used to describe the pictures, as well as which objects in the pictures they interpreted first, and therefore as most important. The pictures of the rainforest pool, the boy sitting on the dock (see Figure 6), and the kids playing on the water slide were each described 11 different ways!
Table 1.
Young Children Participants’ Categorization of Pictures As ‘Nature’ or ‘Not Nature.’

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</tbody>
</table>

Note. An “N” signifies that a picture was categorized as ‘Nature;’ a blank indicates that a picture was categorized as ‘Not Nature.’

I tried to find out from the young children why they categorized the pictures in the ways that they did, but this was largely unsuccessful. A typical answer would be: “This picture is nature, because it has plants in it, which are nature.” They could not answer the question: “what makes/why are plants ‘nature’?” They could describe what they had done, but not why they did
it. In addition, the young children’s rationale might change from picture to picture. I believe that young children are not rationally and or verbally developed enough to understand and/or articulate the answers to these kinds of questions.

**Phase 3: The ‘Nature’ repertory grid test.**

*How can the repertory (rep) grid method be used effectively with young children to assess their personal construct systems regarding ‘nature’?*

I was able to complete a ‘Nature’ rep grid test with each of the 12 young children I worked with at Kew Park Montessori Day School. The raw ‘Nature’ rep grid data, processed by Rep IV Display (Shaw & Gaines, 2005) are provided in Appendix D (Figures D1 to D12). The process of filling in the rep grid test matrix was neither confusing nor overwhelming for them. I believe this was due partly to the modifications I made to the rep grid process, using pictures that represented images and objects selected from their own drawings as elements. I think providing constructs that I knew were relevant to them and that had become familiar and meaningful also helped. Having made these considerations and modifications, I now feel that this rep grid test is an effective method for assessing young children’s personal constructs of ‘nature,’ or any other notion that a researcher might be interested in investigating.

*What are the structures of young children’s personal construct systems surrounding the notion of ‘nature’?*

To interpret the results of the Nature rep grid test, and to best assess the young children’s personal construct systems regarding ‘nature,’ the raw Nature rep grid test matrices were cluster analysed using the FOCUS program of the Rep IV software package (Shaw & Gaines, 2005). The results are shown in Figures 22 to 33. How these results may be useful to Environmental Educators will be analysed in the Discussion.
Figure 22. Nick’s FOCUSed Nature rep grid test.
The element and construct trees show which elements and constructs are more closely related to one another, by clustering them. The numbers beside the trees indicate the matching scores. “1”s indicate elements belonging to the left hand pole of the construct, while “2”s show an element belonging to the right hand pole. See Discussion for further analysis.

Figure 23. Frank’s FOCUSed Nature rep grid test.
Note how the rainforest and bear pictures are clustered together, and appear to be conceptualized quite differently from all the other elements, based on the low matching score. These are elements of ‘Nature’ that Frank finds scary because there are lots of animals in them; ‘Nature’ pictures with few animals do not scare him.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

Figure 24. Hank’s FOCUSed Nature rep grid test.
See Discussion for further analysis.

Figure 25. Jane’s FOCUSed Nature rep grid test.
I am unsure about how to interpret these results.
ASSESSING YOUNG CHILDREN'S PERSONAL CONSTRUCTS OF 'NATURE'

Figure 26. Houston's FOCUSed Nature rep grid test.
See Discussion for analysis.

Figure 27. Peter's FOCUSed Nature rep grid test.
The picture element 'trees' is categorized extremely dissimilarly to all the other elements, as indicated by the low matching score. This is because Peter did not want to go there, thought there were few people there, thought there were few animals, and did not categorize it as 'Nature.'
Karen’s main construct for differentiating between elements was ‘Lots of Animals/Few Animals.’ This was not the construct she used to categorize between ‘Nature’ and ‘Not Nature,’ however; none of the constructs I provided were.

See Discussion for analysis.
Figure 30. Samuel’s FOCUSed Nature rep grid test.
See Discussion for analysis.

Figure 31. Alice’s FOCUSed Nature rep grid test.
Alice’s understanding of what ‘nature’ means appears to be based on whether there are ‘Few People’ or ‘Lots of People.’
Interestingly, his element and construct trees are the same shape.

The element and construct trees show which elements and constructs are more closely related to one another, by clustering them. The numbers beside the trees indicate the matching scores. “1”s indicate elements as belonging to the left hand pole of the construct, while “2”s show elements belonging to the right hand pole.

Changes in matching scores.

To check the reliability of the Nature rep grid test I conducted a test/retest comparison, using a Reliability rep grid test matrix. The constructs and the elements were the same in the Reliability rep grid test and retest. The Reliability rep grid test matrix had the same constructs as the Nature rep grid test matrix, and the elements were pictures cut from magazines, as in the Nature rep grid test. See Figures C4 and C5 for examples of the element images used in the Reliability rep grid tests, and see the ‘Complete List of All Pictures’ in Appendix C for a full list of the Reliability element images and their descriptions.

I worked with the young children to complete both rep grid tests in identical settings using similar interview questions. The raw data from the Reliability rep grid tests and retests is presented in Appendix D; see Figures D13 to D36. The matching scores between each set of constructs for the Reliability rep grid tests and retests are presented in Table 2.

Young children’s personal construct systems are in a state of evolution; they are not stable. The rep grid test method should show the changes in the personal construct systems over time if it is a reliable method. To measure the structural changes, I compared the matching scores in the Reliability tests and retests. Every time the matching score for a pair of constructs differed from the Reliability test to the retest, I counted this as one change. The maximum number of possible changes was six. The number of changes in the matching scores between pairs of constructs between the Reliability test and retest for each young child is shown in Figure 34.

The median value for the number of changes in matching scores was 4. Some of the young children recognized or remembered the Reliability test element images when completing
the Reliability retest. A comparison of the descriptions of the elements between the Reliability tests and retests indicates that the young children’s perceptions and descriptions of the element images did not change.

Table 2.
All Participants’ Matching Scores Between Each Set of Constructs on the Reliability Repertory Grid Tests and Retests.

<table>
<thead>
<tr>
<th>Participant/Test</th>
<th>To Go vs. Animals</th>
<th>To Go vs. People</th>
<th>To Go vs. Scary</th>
<th>Animals vs. People</th>
<th>Animals vs. Scary</th>
<th>People vs. Scary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nick/Test</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Nick/Retest</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Frank/Test</td>
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<td>2</td>
</tr>
<tr>
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<td>1</td>
<td>1</td>
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<td>2</td>
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<tr>
<td>Hank/Test</td>
<td>1</td>
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<td>2</td>
<td>4</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Peter/Retest</td>
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<tr>
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<tr>
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<tr>
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<tr>
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<td>4</td>
<td>1</td>
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<tr>
<td>Steve/Retest</td>
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<td>4</td>
<td>1</td>
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<tr>
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<td>4</td>
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<td>3</td>
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<tr>
<td>Anne/Retest</td>
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<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
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Note. The matching score is calculated by observing the number of matching “1”s and “2”s between each set of constructs in the completed raw rep grid matrix. In this table, ‘To Go’ refers to the construct ‘Want To Go/Not Want To Go,’ ‘Animals’ refers to ‘Lots of Animals/Few Animals,’ ‘People’ refers to ‘Lots of People/Few People,’ and ‘Scary’ refers to the ‘Scary/Not Scary’ construct.
Therefore the demonstrable changes between all but two of the young children’s matching scores on the Reliability rep grid tests and retests must be due to alterations in their personal construct systems. As the rep grid test was able to indicate that this shift occurred, I conclude that my modified rep grid test is a reliable method for assessing young children’s personal construct systems, as well as any changes to their systems.

Figure 34. The number of changes in the matching score between each pair of constructs, from the Reliability rep grid test to the Reliability rep grid retest, for each participant.
Chapter 5: Discussion

How Young Children’s Personal Construct Systems Give Meaning to Their Understandings of ‘Nature’

Results of the Nature rep grid tests.

By looking at the FOCUSed results of the Nature repertory (rep) grid tests (Figures 22 to 33) and augmenting them with the results of each young child’s ‘Nature’ card sort exercise (Table 1), it is possible to start to understand how the structures of the children’s personal construct systems may contribute to what ‘nature’ means to them. I treated ‘Nature/Not Nature’ as a superordinate construct in their hierarchical systems of constructs, and I assumed there were many subordinate constructs, including ‘Want To Go/Not Want To Go,’ ‘Lots of People/Few People,’ ‘Lots of Animals/Few Animals,’ and ‘Scary/Not Scary.’

![Focus Nick “Nature rep grid test”](image)

Figure 35. Nick’s FOCUSed Nature rep grid test.
The element and construct trees show which elements and constructs are more closely related to one another, by clustering them. The numbers beside the trees indicate the matching scores. “1”s indicate elements belonging to the left hand pole of the construct, while “2”s show an element belonging to the right hand pole.
Nick.

As an example of how the FOCUSed rep grid results can indicate how young children understand ‘nature’, consider Nick’s FOCUSed Nature rep grid test (Figure 35). Two of the elements that have been categorized identically are Picture Q – trees (Figure 20) and Picture R – boy sitting on dock (Figure 6); Nick placed these elements under the construct poles ‘Few People,’ ‘Not Scary,’ ‘Lots of Animals,’ and ‘Want To Go.’ He also classified both elements as ‘Nature’ in the ‘Nature’ card sort. Picture S – kids playing on water slide and Picture U – girl in field of dandelions (Figure 7) are also categorized identically; they differ from Pictures Q and R only in that they are part of the ‘Lots of People’ construct pole. Also, Nick indicated in the ‘Nature’ card sort exercise that Picture S – kids playing on water slide was ‘Not Nature.’ It is possible to hypothesize that Nick classifies images as ‘Nature’ when they are ‘Not Scary,’ have ‘Lots of Animals,’ are places he would ‘Want To Go,’ and do not have too many people. This idea is supported by looking at Nick’s categorizations of Picture N – road, and Picture P – roller coaster. Both were classified as ‘Not Nature’ in the ‘Nature’ card sort; both fall under the construct poles ‘Few Animals,’ ‘Lots of People,’ and ‘Scary.’ The two construct poles that are most closely linked are ‘Not Scary’ and ‘Lots of Animals.’ Perhaps these are the most important aspects of what Nick understands ‘nature’ to be.

Hank.

A similar form of interpretation can be made of all of the young children’s FOCUSed Nature rep grid and ‘Nature’ card sort results. I will demonstrate four more that are of some interest. Hank’s FOCUSed Nature rep grid results (Figure 36) show three examples of multiple elements being categorized identically. First, there are Picture S – kids playing on water slide, and Picture P – roller coaster, which are categorized under the construct poles ‘Want To Go,’
‘Lots of People,’ ‘Few Animals,’ and ‘Not Scary;’ neither Pictures S nor P were sorted as ‘Nature’ in the ‘Nature’ card sort exercise (see Table 1). Second, consider Picture T – clouds (Figure 4). Picture Q – trees (Figure 20), and Picture O – rainforest pool; all are classed as ‘Want To Go,’ ‘Lots of Animals,’ ‘Few People,’ and ‘Scary;’ Hank characterized both Pictures Q and O as ‘Nature,’ although not Picture T. Finally, Hank indicated that both Picture L – bear (Figure 5) and Picture N – swamp belonged to the construct poles ‘Not Want To Go,’ ‘Lots of Animals,’ ‘Few People,’ and ‘Scary;’ he indicated that Picture L was ‘Nature’ and Picture N, most often described as a road, was not. There were also two constructs that Hank considers to be identical when it comes to classifying Nature element images: ‘Lots of Animals/Few Animals’ and ‘Scary/Not Scary.’ By taking into account the fact that Hank closely associates the construct poles ‘Few Animals’ and ‘Not Scary’ (or between ‘Lots of Animals’ and Scary’), and that he identified a relatively low number of images (50%) as ‘Nature’ during the ‘Nature’ card sort exercise (see Table 1), it is possible to surmise that Hank is creating an idea of what ‘nature’ is not, rather than what it is. This could lead to an overly negative understanding of the outdoors.

Figure 36. Hank’s FOCUSed Nature rep grid test.
Nancy.

Nancy’s FOCUSed Nature rep grid test (Figure 37) shows an unusual element tree. Each element is categorized uniquely relative to the other elements, and the matching score between them all is 75%. The construct tree and the results of the ‘Nature’ card sort exercise (Table 1) add some explanatory power. The four right hand elements, Picture S – kids playing on water slide, Picture P – roller coaster, Picture N – road, and Picture U – girl in field of dandelions (Figure 3), were all identified as ‘Not Nature.’ The remaining, left hand, elements, except for Picture L – bear (Figure 5), were all identified as ‘Nature.’ This division is mirrored by Nancy’s classification of the elements into ‘Lots of People/Few People.’ The construct pole ‘Lots of People’ is closely linked to the pole ‘Few Animals.’ It appears that this is Nancy’s quite logical way of understanding what ‘nature’ is – a place where animals are plentiful and people are not.

Figure 37. Nancy’s FOCUSed Nature rep grid test.
Houston’s FOCUSed Nature rep grid test.

See Houston’s FOCUSed Nature rep grid test in Figure 38. Houston classified Picture R – boy sitting on dock looking over lake with island and Picture T – clouds (Figure 4) identically in the Nature rep grid test, but categorized Picture R as Not Nature and Picture T as Nature. He categorized both Picture P – roller coaster and Picture S – kids playing on water slide as Not Nature, and placed them under identical construct poles in the Nature rep grid test. Three of the construct poles that Houston placed Picture P – roller coaster and Picture S – kids playing on water slide under were the opposite of the construct poles under which he classified three Nature elements, Picture Q – trees (Figure 20), Picture L – bear (Figure 5), and Picture U – girl in field of dandelions (Figure 3). The three opposing constructs were ‘Not Scary/Scary,’ ‘Few Animals/Lots of Animals,’ and ‘Lots of People/Few People.’ This indicates that Houston associates Nature with places that are ‘Scary,’ have ‘Lots of Animals’ and ‘Few People.’
Samuel.

Samuel, like Nancy, made a close connection between the construct poles ‘Few Animals’ and ‘Lots of People.’ His FOCUSed Nature rep grid test can be seen in Figure 39. ‘Lots of People,’ particularly, represented the demarcation between ‘Nature’, on the left hand side, and ‘Not Nature,’ Picture S – kids playing on water slide, Picture N – road, and Picture P – roller coaster.

I looked for patterns or themes emerging from the young children’s FOCUSed rep grid results (Figures 22 to 33) that might indicate common understandings of ‘nature,’ or repeated ways of making meaning using the personal constructs about ‘nature.’ The results from the ‘Nature’ card sort exercise (Table 1) show that Picture L – bear (Figure 5) and the other animal pictures were unanimously located on the ‘Nature’ pole of the construct, while Picture P – roller coaster was always categorized as ‘Not Nature.’ Picture N – road and Picture S – kids playing on water slide were assigned to the ‘Not Nature’ pole 11 times out of 12. I hoped that the subordinate constructs used in the Nature rep grid test would help to clarify why the young
children classified animals as ‘Nature’ and roller coasters, roads and water slides as ‘Not Nature.’ It turns out that all of the children had unique reasons for what appears, on the surface, to be an identical construct. That is to say, all of their subordinate personal construct systems were different, and they all had different relationships to the superordinate ‘Nature/Not Nature’ construct. Kelly’s individuality corollary (2002, p. 38), rather than the commonality corollary (Kelly, 2002, p. 13), was confirmed.

There was also an occasional lack of internal consistency, evidence of the fragmentation corollary (Kelly, 2002, p. 58), when the young children categorized elements identically under the subordinate construct poles, but differently when considering the construct ‘Nature/Not Nature.’ This indicates that there are other meaningful subordinate constructs that impact whether the young children consider an element as ‘Nature’ or ‘Not Nature.’ It is not surprising that young children’s personal construct systems would be somewhat fragmented, or dis-integrated, as they are in the formative stage of personal construct system development: they are accumulating, categorizing and differentiating experiences rather than organizing them into a sophisticated, integrated system.

I looked for other patterns in the relationships between the subordinate constructs ‘Want To Go/Not Want To Go,’ ‘Lots of People/Few People,’ ‘Lots of Animals/Few Animals,’ and ‘Scary/Not Scary.’ I was interested in investigating the relationship between ‘Want To Go/Not Want To Go’ and ‘Scary/Not Scary,’ and looking for any relationship those constructs had with ‘Nature/Not Nature.’ The construct poles ‘Scary’ and ‘Not Want To Go’ were on the same side of the FOCUSed Nature rep grid tests in 10 of the 12 cases, so there was often some relationship between them. When present, the degree of that relationship, indicated by the matching score,
varied from just under 60% (see Figure 29) to 90% (see Figure 31). However, neither ‘Want To Go/Not Want To Go’ nor ‘Scary/Not Scary’ appears to be closely related to ‘Nature/Not Nature.’ These young children are scared of some things that they consider ‘Nature,’ and some that they don’t; they also want to go to some places that are ‘Nature’ and some that aren’t. Again, which specific elements these are varies from child to child. Finally, ‘Want To Go/Not Want To Go’ and ‘Scary/Not Scary’ are more meaningful when looked at separately and in connection to ‘Lots of People/Few People,’ and/or ‘Lots of Animals/Few Animals,’ rather than when considered together; this is demonstrated in the interpretations of Nick’s, Hank’s, Houston’s, Samuel’s and Nancy’s personal constructs.

Overall, I found that the FOCUSed Nature rep grid tests allowed me some insight into how each individual young child understands ‘nature.’ I did not find any emergent patterns or themes among the group of young children’s personal construct systems. I am surprised but not concerned by this lack of patterns. As previously mentioned, Personal Construct Theory does focus on the individual and predicts unique construct systems. I also believe that the young children’s age contributes to the distinctly personal differences between their construct systems. These children may not be old enough for the commonality corollary (Kelly, 2002, p. 13), or the sociality corollary (Kelly, 2002, p. 66), to have affected them very much. By this, I mean they have not had enough time to share common experiences or develop similar constructions to their classmates, as they simply haven’t been anywhere in common with them for very long. Further, they may not have the cognitive skills to consciously attempt to understand someone else’s construct system, and then integrate that understanding into their own construct system. It is also possible that the young children I worked with had not had much formal or informal
Environmental Education as a group, and so had not been exposed to one version of ‘nature.’ Perhaps they were unaccustomed to thinking about ‘nature’ in the ways I was asking them to, or perhaps I provided insufficient constructs.

**How These Results May Be Useful to Environmental Educators**

The interpretations I gave above are precisely that, my interpretations. The results of the Nature rep grid tests completed by the young children at Kew Park Montessori Day School are not suitable for a researcher who wishes to compile a generalized description of how young children conceptualize ‘nature.’ The results are a snapshot of highly individualized personal construct systems that are in a constant process of evolution. I did notice that there were no animals in any of the drawings of an ‘outside place,’ and no people in any of the drawings of ‘a forest.’

For an Environmental Educator (EEr) who will be interacting with the young children in the future, however, these results are incredibly powerful and useful. They can form the basis of EE programming designed specifically to influence the known initial constructs of the students. Such EE programs can become processes of negotiation, conversations where constructs are acknowledged, discussed and observed as they shift. Instead of roughly interpreting the FOCUSed Nature rep grid results, EErrs in an ongoing relationship with the young children could continue to assess and analyse their personal construct systems as they simultaneously teach them about nature. By asking ‘laddering’ questions that move between hierarchical levels of constructs (‘why?’ to move up, ‘what?’ or ‘how?’ to move down) (Pope & Keen, 1981, p. 52), EErrs can elicit information from the young children while allowing the children to explore the limits of their own knowledge and ask questions of the EErrs and their peers.
Environmental Educators as ‘Nature Mediators’

To more easily blend PCT and EE, consider EErs as ‘nature mediators’ (see Bowling & Hoffman, 2000) who help children to reconstruct their notions of nature by forming healthy constructions of nature. ‘Reconstruction’ means changing how constructs are linked, adding constructs, and changing or elaborating ranges of convenience (Procter, 1981, p. 358); these are the same basic processes that define learning. The goal of EE, or ‘nature mediation,’ would be to change the way children conceptualize nature and, as a result, how they anticipate and interact with it. As I have outlined above, the process must begin with assessing and understanding children’s construct systems, using a modified rep grid test. This process “is not merely diagnostic” (Procter, 1981, p. 361), as it is likely to stimulate reflection and construct revision, on a conscious or unconscious level. When young children’s construct systems change, they are likely to feel an emotional shift but be unable to rationally verbalize it (Procter, 1981, p. 358), so EErs must be compassionate.

Procter (1981) listed several methods used in family construct therapy that I believe could be modified into EE teaching strategies that would help young children change their constructs of nature: indirect therapy, such as completing topical tasks and reading or telling stories (p. 362); reframing through role-playing or the use of metaphor (pp. 362-364); validation of new constructs by playing or touching with physical objects (p. 364). Hayhow et al. also emphasized the “value of story-telling and poetry in offering…alternative constructions” (1988, p. 205), while there is also a place for journaling and conversation (Pope & Keen, 1981, p. 152). The individuality corollary (Kelly, 2002, p. 38) might be understood as an argument against having any formal programming or curricula at all (Pope & Keen, 1981, p. 156). I am advocating, instead, that EErs use rep grid methodology to create programs with appropriate,
flexible content, and which can be adapted to as many individual learning and teaching styles as possible.

**Personal Construct Theory and Repertory Grids Can Improve Environmental Education (EE)**

Personal construct systems control all behaviour (Butler & Green, 2007, p. 8). “What people do is guided by their beliefs” (Leung, 2006, p. 274). “A person’s functioning can be perceived as a means of understanding the world” (Butler & Green, 2007, p. 2). How people conceptualize nature is how they will act towards, around, and within it. Kelly gave a view of conceptualization in general…Certain events in our lives may be interwoven with the construct of poverty [or of ‘nature’]…Here and there we find the good which stands out in contrast to the intervening evil. It is by such interweaving that both the events of our lives and the constructs we use for dealing with them take on meaning.

Each provides operational [referents] for the other. (Kelly, 2002, p. 218)

The construct ‘nature’ does not stand alone. It is part of a hierarchical subsystem and is related to many other subsystems within an individual’s overall personal construct system. Real events inform personal constructs on an individual basis (Kelly, 2003, p. 9).

When individuals are inundated with information, such as children being confronted with images and messages about the environment and the future of the earth, each child receives the information, interprets it, and internalizes it within their personal construct system (Adams-Webber, 1979, p. 14). The way the information is encoded in each child’s personal construct system is different, as are the results of this on the child’s future attitudes and actions (Kelly, 2003, p. 9). Since personal constructs dictate how individuals think and act in the face of real events (Kelly, 2003, p. 8), a connection will exist between what is shown to the children, what is
felt by the children, the children’s personal constructs surrounding nature, and how the children think and act in regards to nature and the environment now and in the future. “Over time a whole system of constructs evolves which the person uses to anticipate events” (Procter, 1981, p. 353).

When speaking of actions and behaviour, PCT includes all actions and behaviours: physical as well as mental processes. Personal Construct Theory considers a person to be a “whole ‘behaving organism’” (Mills, 2006, p. 304), not a living thing composed of a separated body and mind (Mills, 2006, pp. 304-305). Furthermore, PCT does not consider the mind to be separated into thinking and feeling (Pope & Keen, 1981, p. 161). Therefore, learning has intellectual and emotional aspects (Lakoff, 2010, p. 72; Pope & Keen, 1981, p. 28). It is also an embodied process, which emphasizes the importance of pluralistic pedagogies, including physically active learning (Pope & Keen, 1981, p. 162). These are common practice in Environmental Education (EE), and PCT indicates that the practice should be continued, perhaps increased.

**Education as personal construct reconstruction.**

Environmental Educators’ want to facilitate the development of eco-literate citizens who can understand and act on information about complex, intertwined, social, economic, and environmental issues, which means having an adequate set of anticipatory tools; anticipatory tools are based on personal constructs. When people’s constructs about ‘nature’ change, the way they think about ‘nature’ and act within it may also be altered, possibly creating individual relationships between humans and nature that are less harmful for all. PCT is not concerned with excusing behaviour that is harmful to the environment (Butler & Green, 2007, p. 10); rather, it is a tool for understanding children’s experiences and personal construct systems so that efforts can
be made towards reconstruction through education (Butler & Green, 2007, p. 11). Throughout the educational process it is the educators’ responsibility to understand the children’s perspective, to use words and theories from the children’s construct systems when communicating verbally, and to ensure that new information is being integrated into the children’s construct systems (Butler & Green, 2007, p. 12).

Feedback and discussion around an individual’s personal construct system is likely to bring greater personal awareness of the personal constructs and a subsequent change in some aspects of the personal construct system (Pope & Keen, 1981, p. 125). It has also been shown that educational experiences can bring about similar changes in individuals’ personal construct systems, even if there is no specific feedback or conversation about their personal constructs (Pope & Keen, 1981, p. 98).

The educational process requires communication, which means there is the potential for miscommunication. When children are better understood by their teachers, teacher-student communications improve (Nutting, 1988, p. 172). As well, learning is maximized when the material being taught is shown to have personal relevance to the learner (Canadian Tourism Human Resource Council, 2005, p. 8; Pope & Keen, 1981, p. 27). Education can be a powerful experience if it involves and accesses the ways in which personal constructs are formed. In order to tap into these meaning-making processes, it is necessary for educators to understanding them clearly.

Teachers can better help students learn if they understand how their students think about the topic being taught (Pope & Keen, 1981, p. 153). “The best way to understand people is to understand their beliefs” (Leung, 2006, p. 274). Personal Construct Theory and rep grid testing
provide a way to do just this. Research has been done where teacher-educators use rep grid tests to assess the personal construct systems of student-teachers, and both the teacher-educators and the student-teachers found it to be an enlightening process (Diamond, 1988; Leung, 2006). I am suggesting a similar approach, in which educators use rep grid testing to find out about their students’ personal construct systems; Pope and Keen also advocate such an approach (Pope & Keen, 1981, p. 2).

**Co-learning and co-creation of EE programs**

Rep grid tests also allow for comparisons between “‘the school’s official constructs’” (Pope & Keen, 1981, p. 148) and the personal versions of these constructs held by both teachers and students, who are “the active meaning makers in the classroom” (Pope & Keen, 1981, p. 148). This process creates a space for miscommunication to be identified and negotiated (Pope & Keen, 1981, p. 128). Students can take an active role, seeing themselves as more potent and involved in their own learning (Pope & Keen, 1981, p. 135). It may become a learning process in itself for all concerned, in terms of the subject material and how to understand others’ constructions of knowledge. The learning process becomes interactive and participatory, and Personal Construct Theory’s sociality corollary, “to the extent that one person construes the construction processes of another, he may play a role in a social process involving the other person” (Kelly, 2002, p. 66), applies.

Recalling PCT’s notion of the relativity of truth (Baxter & Jack, 2008, p. 545), we can see how an interdisciplinary ‘Environmental Education’ could be constructed, incorporating the way in which students understand their worlds and what will help them in their futures (Pope & Keen, 1981, pp. 31-32). EErs could ask questions that “foster a climate of shared knowledge”
I am not suggesting that all Environmental Education should be the same. Individuals, with their unique personal construct systems, are not all the same. So EE should be flexible, depending upon the personal constructs of the students and the instructor involved (Pope & Keen, 1981, p. viii). Constructive alternativism, the basis of Personal Construct Theory, requires this multiplicity. Using PCT as a pedagogical approach means that educators are not limited to one educational dogma (cultural transmission, progressivism, learner-based learning, or any other), but can adopt diverse teaching styles that adapt to the students, the material being taught, and their personal preference (Pope & Keen, 1981, p. 17).

**Further Applications and Directions for Personal Construct Theory and Education**

Wider use of the rep grid method could help teachers understand their own constructs, and how they relate to the students’ constructs. Rep grids have been used to aid teachers in self appraisal before, with the rep grid matrix results presented as bar graphs, so that teachers can easily visualize the differences between how they perceive themselves and how they conceptualize an effective teacher (Pope & Keen, 1981, p. 96). This style of self-evaluation places the teacher in the role of ‘expert,’ both as a teaching professional (Pope & Keen, 1981, p. 97) and as the person who can most accurately judge their own efforts.

Additionally, feedback and reflection on how academic information is being learned could be very useful to students (Pope & Keen, 1981, p. 126) and teachers. This processing cannot take place if the students’ personal construct systems, which change as a result of learning, are not understood by both the students and the teacher (Pope & Keen, 1981, p. 126). Feedback, reflection, and self-awareness are critical components of an effective evaluation,
which then creates opportunities for program improvement (Canadian Tourism Human Resource Council, 2005, pp. 23-24).

I believe that it is possible to develop a model for young children’s EE programming based in PCT (Viney, 2006, p. 3). This thesis is just the bare beginning of such an effort, merely scratching the surface of such an undertaking. Such a model would be useful, not just for personal construct practitioners (see Viney, 2006), but for many agents interested in EE. It would have to be an interdisciplinary, collaborative effort, similar to soft systems modeling (M. C. Jackson, 2003, ch. 10), and the personal construct systems of many stakeholders would need to be considered.

**Personal Construct Theory Relies on Relationality to Make Meanings**

As I see it, meaning is made in the ‘gaps,’ such as the gaps between two elements, in which case a construct is created to give meaning and context to the elements. Investigating the gaps between one individual’s construct system and another’s can generate a rich discussion, new understanding, and a wealth of meaning. The gap can be the time between two rep grid tests, and understanding the changes in the construct system can give meaning to the reliability of the test itself. I think the gap between the personal construct system and the world, between our predictions and what really occurs, is what creates anticipation and behaviour, and gives meaning to each action we undertake. Perhaps ‘gap,’ or even ‘opening,’ is not a good term to use for these meaning-full inter-connecting spaces or relationships. They aren’t empty at all; in fact, they contain much more spirit, or consciousness, or usefulness, than the elements they connect.

Personal Construct Theory and repertory grid testing are well positioned to help EERs start looking at the interconnections of the system, rather than the nodes or elements. I think that
is where meaning, understanding and belief are generated. And that generation begins when we are young children.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

References


ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’


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ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’


March 25, 2013
Dear Kew Park Montessori Parent/Guardian,

I would like to invite your child to participate in a research study I am conducting as part of my Royal Roads University Master’s Degree in Environmental Education and Communication. My research project is called “Kindergarten Children’s Personal Constructs of ‘Nature’.” My goal in doing this project is to find out how kindergarten children think of ‘nature’ so that environmental educators, classroom teachers and curriculum designers can incorporate what children know and think into new, and hopefully better, educational and learning opportunities for all students.

If you are willing to allow your child to participate, s/he will be involved in drawing, a card sorting exercise, and having audio-recorded conversations with me. These activities would occur over two different sessions, each lasting approximately 30 minutes. The recorded conversation will be about the child’s conception of ‘nature’, centered on the objects in their drawing and the items on the cards being sorted, which will be ‘nature’-related. All data collected will be kept as hard copies in a locked cabinet to which I have the only key and/or as data files on a computer that is backed up on a hard drive, both of which are protected by a password known only to me.

All data will be coded with a number, not the child’s name. None of the data will be stored on the internet or in the United States. All of the materials and data will be collected confidentially and anonymously; no children’s names will be used when I publish my thesis. At the conclusion of the research project, the data will be archived on a hard drive that is protected by a password known only to me, and saved for five years. After five years, all data will be deleted.

All research and data collection will occur at Kew Park Montessori School during the month of April, 2013, in your child’s classroom. You and/or your child are free to withdraw your permission to participate in the study at any time. Taking part in my project is intended to be an enjoyable experience for the children. If any child appears uncomfortable or unwilling to participate, they will be free to stop at any time.

The results of the research will be published in my thesis, and I intend to present the results at conferences and in articles. Results will be made available to you upon request.

If you have any questions, please feel free to contact me, at [ ]. You can also contact my Royal Roads University Co-Supervisors: Dr. Enid Elliot at [ ] and/or Dr. Richard Kool at [ ]. You may obtain independent verification of this project from Janine Hughes, Program Associate for the Masters of Arts in Environmental Education and Communication Program at Royal Roads University, at [ ].

Thank you,

A. Elizabeth (Liz) Beattie
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

I WILL RETURN ONE SIGNED COPY OF THIS CONSENT FORM TO YOU. PLEASE KEEP THE COMPLETED FORM FOR YOUR RECORDS.

I, __________________________________________, (parent/guardian name) give permission for _______________ (child’s name) to participate in A. Elizabeth (Liz) Beattie’s Master’s Degree thesis research project, “Kindergarten Children’s Personal Constructs of ‘Nature’,” being conducted at Kew Park Montessori Day School.

__________________________________________________________________________________________________________________________________________________________
Signature of Parent/Guardian                                      Date

Please have your child write his/her name here as an indication that he/she also consents to participate in the study. If your child is unable to do so, I will obtain verbal consent from them.

__________________________________________________________________________________________________________________________________________________________
Signature of A. Elizabeth (Liz) Beattie                                      Date

I, __________________________________________, (parent/guardian name) give permission for _______________ (child’s name) to participate in A. Elizabeth (Liz) Beattie’s Master’s Degree thesis research project, “Kindergarten Children’s Personal Constructs of ‘Nature’,” being conducted at Kew Park Montessori Day School.

__________________________________________________________________________________________________________________________________________________________
Signature of Parent/Guardian                                      Date

Please have your child write his/her name here as an indication that he/she also consents to participate in the study. If your child is unable to do so, I will obtain verbal consent from them.

__________________________________________________________________________________________________________________________________________________________
Signature of A. Elizabeth (Liz) Beattie                                      Date
Appendix B: Interview Questions

Phase 1: Drawing Exercise

Designed to obtain verbal consent and to have children draw pictures of what they think ‘nature’ is.
I will initiate some relationship-building chat first. Say hi, remind them of who I am and my name, ask them how they are, talk about a favourite thing to do at school, their family, or their favourite colour or sport.

1. This machine (indicate audio recorder) makes a copy of everything we say so that I can listen to it again later. Is that okay with you?
2. I’d like you to make a drawing for me, and I’d like to be able to keep it so I can look at it again later. Is that okay with you?
3. Here is a piece of paper and some coloured pencils. I’d like you to draw a picture of a place that is outside please.
4. Tell me about what you’re drawing…what are the objects (things/people) in the drawing? What is happening in the picture?
5. Do you know what a forest is? Can you draw me a picture of a forest?
6. Tell me about what you’re drawing…what are the objects in the drawing? What is happening in the picture?

Thank you very much for spending time drawing and talking with me. I had fun and I hope you did too!

Phase 2: Card Sorting Exercise

The pictures on the cards will be determined by the results of all the children’s drawings, so this phase cannot begin until all the children participating have gone through the Phase 1 interview. Designed to obtain verbal consent and to have children sort pictures into two categories: what they think looks like ‘nature’ and what they think doesn’t look like ‘nature’.
I will initiate some relationship-building chat first. Say hi, remind them of who I am and my name, ask them how they are, how the last few days were, what they’re working on today.
First, I will conduct a simple exercise that teaches the children how to sort picture cards into two categories. For my teaching example, I will have a set of cards in which some pictures have cars in them and some do not. I will start the sorting and explain that I am putting all the pictures with cars in one pile and all the pictures without cars in a different pile. I will encourage the children to complete the exercise, or to repeat it after I have done it, to ensure they understand the concept of card-sorting I am teaching.

1. This machine (indicate audio recorder) makes a copy of everything we say so that I can listen to it again later. Is that okay with you?
2. Do you know what the word ‘nature’ means? Here are some pictures for you to look at. Some of them will look like pictures of ‘nature’ and some of them won’t. I’d like you to put them into different piles. One pile will be pictures that look like nature and one pile
will be pictures that don’t look like nature. So I’d like you to make two different piles of pictures, one pile of nature pictures and one pile of not-nature pictures.

3. Can you tell me about the pictures you’re putting into the nature picture pile? What are they pictures of? What makes them nature pictures?

4. Can you tell me about the pictures you’re putting into the not-nature picture pile? What are they pictures of? What makes them not-nature pictures?

Phase 3: Nature Repertory Grid Test

The pictures on the cards will be determined by the results of all the children’s drawings. The constructs will be determined by the interviews and conversations taking place during Phases 1 and 2. Therefore this phase cannot begin until all the children participating have gone through the Phase 1 and 2 interviews. Some of the same pictures are used for Phase 3 as were used in Phase 2.

Designed to obtain verbal consent and to create a basic repertory grid based on pictures of ‘nature’ and constructs I provide to the children.

1. Here are three pictures, showing three different things. Can you tell me what they’re pictures of, please? Out of these three places, where would you most like to go? Least like to go? How come? And what about the remaining picture/place? Would you like to go there, or not like to go there? Why? Looking at these other pictures, can you sort them into places you’d like to go and places you would not like to go to?

2. Here are three more pictures, showing three different things. Can you tell me what they’re pictures of, please? Which of these three places do you think has the most animals? The fewest? How come? And what about the remaining picture/place? Do you think it has a lot of animals, or not very many at all? Why? Looking at these other pictures, can you tell me if there would be lots of animals or not very many animals in these places?

3. Here are three more pictures, showing three different things. Can you tell me what they’re pictures of, please? Which of these three places do you think has the most people in it? The fewest? Why? And what about the remaining picture/place? Do you think it has a lot of people, or not very many at all? Why? Looking at these other pictures, can you tell me if there would be lots of people or not very many people in these places?

4. Here are three more pictures, showing three different things. Can you tell me what they’re pictures of, please? Which of these three things seems the scariest? The least scary? Why? And what about the remaining picture/place? Does it seem scary, or not very scary at all? How come? Looking at these other pictures, can you tell me if there would be lots of animals or not very many animals in these places?

5. Have you ever seen something similar or been to any of these places before in real life?

Thank you very much for spending time sorting these pictures and talking with me. You’ve helped me out a lot. I had fun and I hope you did too!
Reliability Repertory Grid Test/Retest

The pictures on the cards will be determined by the results of all the children’s drawings. The constructs will be determined by the interviews and conversations taking place during Phase 1. Therefore this phase cannot begin until all the children participating have gone through the Phase 1 interviews. The pictures used as elements in the Reliability test/retest are different from those used in the Nature rep grid test; the constructs are identical.

Designed to obtain verbal consent and to check the reliability of the constructs being used in the Nature repertory grid test, as well as the reliability of rep grid testing as a method for assessing young children’s personal construct systems.

This interview procedure was followed for both the Reliability rep grid test and retest.

Here are three pictures, showing three different things. Can you tell me what they’re pictures of, please? Out of these three places, where would you most like to go? Least like to go? How come? And what about the remaining picture/place? Would you like to go there, or not like to go there? Why? Looking at these other pictures, can you sort them into places you’d like to go and places you would not like to go to?

1. Here are five pictures. Can you tell me what they’re pictures of, please? Out of these five places, where would you most like to go? Least like to go? How come? And what about the remaining pictures/places? Would you like to go there, or not like to go there? Why?

2. OK, looking at the same five pictures, which of these five places do you think has the most animals? The fewest? How come? And what about the remaining pictures/places? Do you think they have a lot of animals, or not very many at all? Why?

3. OK, looking at the same five pictures, which of these five places do you think has the most people in it? The fewest? Why? And what about the remaining pictures/places? Do you think they have a lot of people, or not very many at all? Why?

4. OK, looking at the same five pictures, which of these five seems the scariest? The least scary? Why? And what about the remaining pictures/places? Do they seem scary, or not very scary at all? How come?

5. Have you ever seen something similar or been to any of these places before in real life?

Thank you very much for spending time sorting these pictures and talking with me. You’ve helped me out a lot. I had fun and I hope you did too!
Appendix C: Examples and Descriptions of Pictures used in the Card Sort Exercises (Phase 2) and as Elements in Repertory Grid Testing (Phase 3)

Examples of the Pictures

Figure C1. Picture G – different white Ford SUV.
This picture (Gualberto107, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be republished. The original image was used in the practice/teaching card sort exercise, in which the young children sorted images into either the category ‘Cars’ or the category ‘Not Cars.’ All of the children easily identified this picture as part of the ‘Cars’ category. This image is courtesy of Gualberto107 / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.

Figure C2. Picture F – woman sitting by waves.
This picture (sakhorn38, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be republished. The original picture was one of the images used in the practice/teaching card sort exercise, where the young children sorted images into the two categories ‘Cars’ and ‘Not Cars.’ All of the children identified this image as belonging to the ‘Not Cars’ group. This image is courtesy of sakhorn38 / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.
Figure C3. Picture B – old car in snow.
This picture (dan, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. The original image was used in the practice card sort, ‘Cars’ or ‘Not Cars.’ The young children were able to assign it to the correct category, ‘Cars,’ despite the complexity of the image and the way the car is camouflaged by the snow. This image is courtesy of dan / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.

Figure C4. Picture AA – man or boy watering a plant, surrounded by sand.
This picture (africa, 2014) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. The original image was used as an element in the Reliability rep grid test and retest. This image is courtesy of africa / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.
Figure C5. Picture Z – person walking along ocean beach with grass on other side. This picture (artur84, 2014b) closely resembles the actual image I used in my research. The original image was cut from a magazine, and thus is held under copyright and cannot be re-published. The original image was one of the elements in the Reliability rep grid test and retest. This image is courtesy of artur84 / FreeDigitalPhotos.net, used with permission under FreeDigitalPhotos.net’s Standard Licencing Agreement.

Complete List of All Pictures

Cards for teaching card sorting (Cars/Not Cars) in Phase 2.

A – white Ford SUV
B – old car in snow
C – black Dodge truck
D – walrus
E – silver SUV
F – woman sitting by waves
G – different white Ford SUV
H – women’s athletic shoe
I – bird eating seed
J – busy street


K – ladybug
L – bear
M – girl holding frog
N – empty road going through fields
O – rainforest pool
P – roller coaster
Q – trees
R – boy sitting on dock looking over lake with island
S – kids playing on water slide
T – clouds
U – girl in field of dandelions
V – bird

**Cards used as elements in rep grid test in Phase 3.**

L – bear
N – empty road going through fields
O – rainforest pool
P – roller coaster
Q – trees
R – boy sitting on dock looking over lake with island
S – kids playing on water slide
T – clouds
U – girl in field of dandelions

**Initial triad presentation of picture cards during rep grid test in Phase 3.**

Want to Go/Not Want to Go – L, N, Q
Lots of Animals/Few Animals – O, R, T
Lots of People/Few People – P, Q, U
Scary/Not Scary – N, O, S

**Cards used in Reliability rep grid test.**

W – man in coniferous forest with deadfall
X – high, snowy, rocky mountains
Y – townhouses on leafy street
Z – person walking along ocean beach with grass on other side
AA – man or boy watering a plant, surrounded by sand
Appendix D: Raw Data from the Repertory (Rep) Grid Tests

All of the figures below were created with the Display program of the Rep IV software package (Shaw & Gaines, 2005).

Raw ‘Nature’ Rep Grid Test Matrices

**Figure D1.** Nick’s raw Nature rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D2.** Frank’s raw Nature rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
**Figure D3.** Hank’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D4.** Jane’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

Figure D5. Houston’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D6. Peter’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

*Figure D7.* Karen’s raw Nature rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

*Figure D8.* Nancy’s raw Nature rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
Figure D9. Samuel’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D10. Alice’s raw Nature rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
Figure D11. Steve’s raw Nature rep grid test. 
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D12. Anne’s raw Nature rep grid test. 
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
Raw Reliability Rep Grid Test and Retest Matrices

**Figure D13.** Nick’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D14.** Nick’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D15.** Frank’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Picture element AA was described as “somebody in Africa planting a tree to eat.”
Figure D16. Frank’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D17. Hank’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D18. Hank’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
The “1”s constitute “X”的s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Picture element AA was described as “someone watering the garden, it’s sandy.”

Figure D20. Jane’s raw Reliability rep grid retest.
The “1”s constitute “X”的s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D21. Houston’s raw Reliability rep grid test.
The “1”s constitute “X”的s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
**Figure D22.** Houston’s raw Reliability rep grid retest.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D23.** Peter’s raw Reliability rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D24.** Peter’s raw Reliability rep grid retest.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
ASSESSING YOUNG CHILDREN’S PERSONAL CONSTRUCTS OF ‘NATURE’

*Figure D25.* Karen’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

*Figure D26.* Karen’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

*Figure D27.* Nancy’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. The description of Picture element AA should have a quotation mark after ‘plants.’
Figure D28. Nancy’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

Figure D29. Samuel’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Samuel’s description of Picture element AA should have a quotation mark after ‘plant.’

Figure D30. Samuel’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Samuel’s description of Picture element X should have a quotation mark after ‘skiing.’
**Figure D31.** Alice’s raw Reliability rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D32.** Alice’s raw Reliability rep grid retest.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D33.** Steve’s raw Reliability rep grid test.
The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.
**Figure D34.** Steve’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct.

**Figure D35.** Anne’s raw Reliability rep grid test. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Picture element Z’s description should end with “‘water.’”

**Figure D36.** Anne’s raw Reliability rep grid retest. The “1”s constitute “X”s that categorize elements as belonging to the left hand pole of the construct, while the “2”s represent blanks, showing that an element belongs to the right hand pole of a construct. Picture element W’s description should end with a quotation mark.