The Extraordinary Ordinary Powers of Abductive Reasoning

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ABSTRACT. The psychology of cognition has been influenced by semiotic models of representation, but little work has been done relating semiotics and the process of cognition proper. In this paper, I argue that the semiotically relevant concept of abduction is crucial for this effort. Abduction is identified as the ground-state, or default, mode of cognition. As such, it deals with the issue of reasoning toward meaning and away from what Peirce called 'genuine doubt'. In this fashion, abduction is shifted from being solely a logical and semiotic concept to a psychological concept. Abduction is first examined historically, and then further compared to the more traditional reasoning modes of deduction and induction to show how all three are necessary for any complete model of cognition and research into cognition. Different modes of abduction, including detection, diagnosis and divination, and different directions of abductive research in psychology are detailed.

KEY WORDS: abduction, abductive reasoning, cognition, logic

Monster Movies, Mad Scientists and Meaning: An Introduction

I grew up watching and loving old horror movies on late night TV. When I was a preteen in Charleston, Channel 3 out of Huntington, West Virginia, presented a double feature every Saturday night after the late news. DJ, the weather lady, went straight from her perky weather wardrobe to a cheesy black cape and heavy black mascara, since she had the dubious honor of being a rather lackluster mistress of ceremonies for the horror movies. Some of these movies were recent (for the time) American International clinkers such as *The Monolith Monsters* and *The Brain That Wouldn't Die* to the older classics such as *The Wolf Man*, *The Black Cat* and *Donovan's Brain*.

There were also a variety of standard venues for these films: dark and ominous cemeteries, creepy bayous, haunted houses, desolate moors, decrepit castles, and the like. One of my favorite locales was the Laboratory of the Mad Scientist. In these labs, various demented geniuses attempted to

push back the veil of the Ordinary, in order to expose and gain access to those Extraordinary Powers that only a few people have been privileged to possess. And in the end, the poor scientists would fall prey to the results of their efforts, since all Mad Scientist movies seemed to have the same theme: there are things that humans are not Meant To Know, and there is a horrendous price to pay if we try to pursue Forbidden Knowledge. But the Mad Scientists were propelled nonetheless toward their doom because the lure of gaining such Extraordinary Powers was just too strong. And as an impressionable child, I felt that lure as well. I wanted those Extraordinary Powers myself, regardless perhaps even of the Price Too Horrible To Pay.

Now that I am an official adult and no longer an impressionable child, I look at the world much differently. I have come to learn that Extraordinary Powers and Marvelous Circumstances are not nearly as interesting as the Extraordinary Ordinary Powers that we have, and the Marvelous Ordinary Circumstances we find around ourselves. This paper is based on one of the most basic Extraordinary Ordinary Powers we possess—the ability to think abductively.

The work I have pursued in abduction and abductive reasoning over the last two decades or so is motivated by a desire to be able to craft new tools for understanding how human beings learn in ordinary settings, and to apply those tools to research in my area of educational psychology (Shank, 1994, 1996; Shank, Ross, Covalt, Terry, & Weiss, 1994). When I began to look at issues like ordinary meaning and day-to-day learning, I eventually realized that I needed to turn away from the sorts of models of information processing which continue to dominate cognitive psychology to this day (see Bransford, 1979, and Driscoll, 1994, for reviews of these models). Why did I need to make such a drastic move? Simply put, information-processing models were dedicated to the notion that such complex phenomena as ordinary meaning and day-to-day learning could only be understood when broken down into their more abstract, and context-free, factors and studied at that level. Even such apparent advances and changes as connectionism (Bereiter, 1991), situated cognition (Brown, Collins, & Duguid, 1989) and constructivism (Bruner, 1986) nevertheless are best understood as applied developments of basic insights generated by the original information-processing model, rather than being qualitatively distinct departures from the ontological assumptions of the more abstract earlier models. In other words, these later advances changed the thrust and content, but not the foundational assumptions, of the cognitive psychological world. They looked at more complex phenomena, but ultimately only by breaking them down in similar fashion to the earlier methods derived from earlier more abstract models.

I came to the conclusion that, instead of 'fixing' the basic model with constructivist, connectionist or situated cognitional ideas, we needed to turn in a fundamentally new direction. As an outgrowth in my lifelong interest in

language and its use, I made the choice of looking at semiotic theory as a possible replacement for information processing as a foundation for a new approach to empirical inquiry in educational psychology (Shank, in press; Shank & Cunningham, 1996; Skaggs & Shank, 1998). While I am certainly no philosopher, I did have an intuitive sense that such a shift would lead us into different ontological assumptions about the workings and practice of the human mind. Rather than talking about those assumptions directly, I would instead like to illustrate how they function implicitly in a semiotic model for the study of human cognition and learning. Just as a brief marker to this point, though, I would like to go on record as stating that a semiotic model of research in the human sciences, grounded in Peircean thought, represents a shift from nominalist models to semiotic realist models (see Fisch, 1986, for an extended discussion of this development in Peirce himself).

My work is very much in process, and much of what I detail here is nothing more than notes on issues that need much fuller development. I can, however, bring to the table an idea that I have developed and fostered over the last 10 years or so. It concerns a radical departure in our practice of studying how the human mind works. Its message is a simple one: Human learning is first of all much more a matter of reconciling (or 'fixing') meaning (cf. Peirce, 1955, pp. 5ff.) than it is an effort to learn verifiable meaning. In other words, the pursuit of learning begins, and is driven by, ordinary meaning rather than theory testing. We need to rethink our methods of fostering and implementing learning, based on the fact that we have not understood the dynamics of ordinary meaning.

What I propose is a new perspective of learning based on ordinary meaning, and what I call ground-state (or default) thinking. Ground-state thinking, which leads to ordinary unreflective meaning, is the base on which all sound learning is built. It provides the immediate and strongly felt 'known' that serves as the foundation point for creating the reflective and highly inferential process that we call learning. In order to understand this process, though, we need to go back and briefly review the history of the development of inquiry.

A Brief Non-scholarly History of Empirical Inquiry

When we look at the history of empirical research, regardless of the field, we are actually looking at a history of inquiry (see Haack, 1993, for an overview of the various manifestations of the logic of empirical inquiry; also see Crosby, 1997, for a picture of the historical implications of modern inquiry). The earliest task for empirical research was to sort out what is true from what is false. To do this, researchers such as Aristotle (Adler, 1978; Parry & Hacker, 1991) developed modes of inquiry to build new truths from existing truths. These existing truths were based either on what anyone could

obviously see was true, such as the fact that the sun was shining or that grass is green (cf. Adler, 1978), or else on facts that were logically self-evident (Maritain, 1937). By self-evident, it was meant that the fact had to be true, or else our whole way of looking at the world becomes inconsistent or even incoherent. For example, one self-evident truth is the fact that two objects cannot occupy the same space at the same time. This is self-evidently true, because if it were not true, then we have no coherent way to talk about what we mean by objects occupying space (Parry & Hacker, 1991).

Once the questions of truth were settled using this method, there remained a need to find a systematic way to draw further truths from these initial, non-problematic truths. From this procedural need was derived the principle of deductive inference (Tarski, 1941). One of the basic tools of deductive reasoning is the Aristotelian categorical syllogism (Parry & Hacker, 1991). By using the categorical syllogism, the inquirer could take any claim that was certainly true, either by virtue of experience or self-evidence, apply it to another claim that was also certain, and derive a conclusion that, by its nature, most certainly had to be true (Longley, 1981). The initial growth and development of western philosophy is based, in part, on the methodological acquisition of the deductive categorical syllogism. So far as empirical inquiry is concerned, such a tool helped allow for the development of natural history as an empirical look at how the world of experience operates, and the self-evident foundations of such a world. Starting with Aristotle himself and his empirical works on, for example, the nature and parts of animals, natural history continued well into the medieval world as the basic strategy for understanding the empirical nature of the world of experience.

For centuries, all empirical reasoning in the western world was ruled by deduction. That is, the domain of reasoning was divided into deductive reasoning or invalid reasoning (Broadie, 1993). But the act of limiting inquiry to procedures of deductive reasoning had the further impact of limiting inquiry to the examination of those instances where truth could be rendered non-problematic at the outset. This had the effect of rendering all questions that we know now as empirical questions into naïve observational or self-evident questions. The growth of scientific inquiry, which we consider to be the settling of the truth of empirical questions and claims, had to await the development of other logical tools (Boehner, 1952; Broadie, 1993; Holland, Holyoak, Nisbett, & Thagard, 1986; Leonard, 1957).

One can legitimately argue that the real beginning of the scientific revolution came from the 13th to the 14th centuries, when Roger Bacon, Ockham and others first demonstrated the validity and range of inductive reasoning (Deely, 1992). Of course, inductive reasoning was finally linked more explicitly to actual scientific method by such later thinkers as Francis Bacon and John Stuart Mill. However, this later work could not have existed without the foundational work on inductive reasoning proper, which was laid out several centuries earlier. Over time, inductive reasoning eventually

developed into the inference tool that launched scientific inquiry. Specifi-cally, induction allowed for the systematic accumulation of specific informa-tion to build probable generalizations, which is at the heart of all scientific inquiry (Holland et al., 1986).

The legacy of inductive reasoning is much greater than just the field of scientific inquiry. This logic of science has pervaded our ways of under-standing at all levels. Our views of culture, human institutions, including schools, and the process of capitalism have all been shaped and imbued with inductively based quantifiable scientific concepts (see Crosby, 1997). This is not as bad as some would have it, but it makes for less than an ideal society. This is due to the fact that inductive methods have a crucial drawback, over and above the well-known drawback that induction leads to probable, instead of certain, conclusions. Briefly, inductive methods are only useful in settling issues of empirical truth when the meanings of these empirical phenomena are first rendered non-problematic. That is, in order to use inductive methods, we first have to make sure that we know what all of our phenomena mean, and that there is general agreement on these meanings. In science, the question of prior meaning is most often resolved by the use of theory. The whole purpose of theory, in relation to empirical inquiry, is to settle at the outset what our concepts mean, so that we can decide empirically what is probably true about them (Hempel, 1965). Definitions then derived from theory (in the human sciences, operational definitions are a subset of this category) can create conceptual limitations when we try to understand the physical world; those same types of drawbacks can be crippling in our attempt to understand our cultural worlds.

Inductive reasoning, for whatever political and cultural reasons involved, was also used to 'replace' deductive reasoning as the starting point for appropriate empirical inquiry. This led to the ascendance of the scientific method (itself grounded in inquiry) as the primary valid mode of inquiry in our culture. This then led to the subsequent devaluing of earlier modes of deductive inquiry per se. Deduction no longer stood on its own as a mode for resolving empirical issues, but was instead incorporated within the hypothetico-deductive model of empirical inquiry (Hempel, 1965). Scientific claims were sought to replace all earlier forms of understanding. It became the role of the theorist, guided by probabilistic findings, to make issues of meaning non-problematic so that these issues would not subsequently interfere with hypothesis testing. By virtue of this sleight of hand, meaning per se vanished from the practice of empirical observation and testing.

Today, I think it is safe to say that our culture is looking for new ways to understand the world. I agree: Matters of meaning cannot be explained away ahead of time. They must be allowed to 'float free', so that we can understand how our precepts and practices relate to the ordinary meanings that we bring into everyday settings. Furthermore, we need to be able to synthesize patterns of ordinary meaning; not to create new truth claims, but

to generate new insights that then lead to more sophisticated levels of meaningful understanding (Shank, 1994). But, in order to do these things, we need new logical tools. In fact, we need to be able to turn to new approaches to logic itself, much as researchers turned to induction to forge the scientific method and the scientific process of research. Fortunately, there is one mode of logic left. And even more fortunately, it seems to be perfectly adapted to addressing those issues of meaning that are the crux of the crisis. This mode of logic is little known and poorly understood, but its promise is substantial. It is called abduction.

Abduction in General

The version of abduction that we will use in this paper was first systematized by C.S. Peirce (1955). There has been a great deal of recent interest in the topic (e.g. Engel-Tiercelin, 1991), particularly by those who are exploring computational implications of Harman's (1965) notion of 'inference to the best explanation' (e.g. Josephson & Josephson, 1994; O'Rorke, 1990). The ideas behind abduction, though, are much older. We will start with the more formal explanation, and then move backwards to place this idea within a historical context.

   Peirce (1955) thought of abduction in terms of the concept of hypothesis, as reflected in the following passage: 'Any proposition added to observed facts, tending to make them applicable in any way to other circumstances than those under which they were observed, may be called a hypothesis' (p. 150). It is important for us to see at the outset that Peirce links the idea of hypothesis to ordinary experience and not to theory testing per se. Therefore, a hypothesis is ultimately an explanation of how ordinary circumstances are the way they are. The end product of such an account is an intuitive 'guess' as to the reason that a certain pattern of experience was found, and that 'guess' can then serve as the basis for empirical test.

   At first glance, there does not appear to be much difference between Peirce's account and the project of modern psychological research. We make theoretical guesses that are then tested. Where Peirce advances the project is in the area of moving from the ordinary experience to the hypothesis without the strict dependence on theory that characterizes contemporary science. This systematic effort was labeled by Hanson (1958) as 'the logic of discovery'. Such a logic attempts to unify the process of hypothesis formation with those of deduction and induction. At various places, Peirce calls the logic of hypothesis formation and discovery by various names, including hypothetic inference, hypothesis and retroduction. His most common coinage, and the one we will use, is that of abduction (Fann, 1970).

   The best way to see the formal nature of abduction is by comparing it to deduction and induction. Peirce (1992, p. 188) used the following sequence

of syllogisms to help illustrate what he meant by abduction. With these
examples, he seeks to show how a single set of claims can be moved
logically from one form to the next:

DEDUCTION
Rule. – All the beans from this bag are white.
Case. – These beans are from this bag.
Result. – These beans are white.

INDUCTION
Case. – These beans are from this bag.
Result. – These beans are white.
Rule. – All the beans from this bag are white.

ABDUCTION
Rule. – All the beans from this bag are white.
Result. – These beans are white.
Case. – These beans are from this bag.

While Peirce's set of syllogisms do in fact begin to help us to understand
the relation of abduction to deduction and induction, they are not framed in
such a way as to really show us how they function within a practice of
empirical inquiry. Therefore, we will expand them to illustrate the more
general points we need for an abductively based model of empirical inquiry.
I have added phrases parenthetically to emphasize and explain key points,
while rearranging the syllogism related to abduction. First is our deductive
expansion:

Rule. – [It is true that] All the beans from this bag are white.
Case. – [We know that] These beans are from this bag.
Result. – [Certainly, it is true that] These beans are white.

Our inductive expansion is as follows:

Case. – [We know that] These beans are from this bag.
Result. – [We have observed that] These beans are white.
Rule. – [Probably, then] All the beans from this bag are white.

Finally, our abductive expansion is as follows:

Result. – [We have the experience that] These beans are white [but this
experience lacks any real meaning for us].
Rule. – [The claim that] All the beans from this bag are white [is
meaningful in this setting].
Case. – [Therefore, it is both plausible and meaningful to hypothesize that]
These beans are from this bag.

Abduction, then, is the act of reasoning from the experience to the case.
That is, it is the act of using some sort of hypothetical rule or claim in order
to render what might be a unique experience into a commonplace example

of some more general phenomenon. Peirce (1955, p. 151) illustrates this point with yet another general configuration of the abductive syllogism:

> The surprising fact, C, is observed;
> But if A were true, C would be a matter of course,
> Hence, there is reason to suspect that A is true.

In other words, Peirce is saying that that we are led from such surprises to what is ordinarily the case. However, abduction can be applied in a more global way. Such an understanding leads us to realize that Peirce's 'surprise' is a specific example of the more general case that we do not know what something, C, means. But the subsequent rendering of the meaning of C as a case of A is often so automatic that we are not even aware that we are making an inference. For example, when we walk into a room, we do not experience uniqueness. Instead, we 'see' chairs and tables and rugs and so on. All of these 'perceptions' of 'ordinary objects' are actually inferences based on the idea that we expect to see certain objects in certain places. It is our ordinary, unreflective way of rendering meaning non-problematic, and it occurs before any theoretically grounded definitions are formed.

If abductive inference is behind our ordinary and unreflective perception of the world, then we must assume that it is actually the default, or ground-state, mode of cognition. That is, we must say that abductive inference is present any time we find ourselves in an ordinary situation where we know what to expect, and we are operating based on our understanding that the present situation makes perfectly good sense to us (cf. Holland et al., 1986, for a very brief attempt to link the concept of abduction with their fascinating interdisciplinary exploration of the role of induction in theory and inquiry).

Given the notion of abduction, and its potential scope, why has it not played a major role in inquiry before now? The answer is that it has, but under different names. Let us examine some of these historical uses of abduction.

Historical Models of Abduction in Empirical Research

Recent research on my part, based on an analysis of Peirce's 10 classes of signs, has argued for six distinct modes of abductive reasoning that constitute a major part of the repertoire of reasoning used by empirical researchers (Shank & Cunningham, 1996). It is beyond the scope of this paper to do more than list these modes of reasoning: they are (a) reasoning to the omen (or hunch); (b) reasoning to the clue; (c) reasoning to the metaphor or analogy; (d) reasoning to the symptom; (e) reasoning to

the pattern; and (f) reasoning to the explanation. Three of these modes of abductive reasoning, however, have played such an important historical role in the history of empirical inquiry that they can be identified as the basis of three venerable models of abductively guided empirical inquiry. All three share the distinction of having been considered more as processes based on skill and/or experience than as acts of reasoning. These so-called 'skills' are detection, diagnosis and divination. Let us consider each in turn.

Ginzburg (1989) argues that abduction can be traced back to the kind of knowledge needed by hunters. Hunters are keen observers, but they observe certain kinds of things. They need to be able to identify certain types of droppings and hoof marks and they need to be sensitive to certain smells and patterns of broken brush. All these things that hunters observe are results; they are the results of the past presence of certain animals.

Occasionally, a hunter might come across, for example, a unique scent. This observation can no longer be considered as the consequence of the presence of a particular type of hunted animal. It is a source of what Peirce called 'genuine doubt'. The hunter cannot identify the type of animal by this new and unusual scent. However, if a certain familiar animal should happen to give off this scent during its mating ritual, then it would follow that this unique scent is no longer unique, but is simply a case of a different rule yielding a different result.

Two questions come to mind: How did the hunter come up with this particular guess, and is he correct? First of all, the abductive researcher does not consider anything as being unique; instead, the basic unit of observation is the *clue*. By this, I mean that the hunter is less interested in the smell as a unique part of the world than he is of its status of pointing out, or indicating, some other state of affairs. In other words, the hunter is interested in the smell as a sign of some animal, and if the smell is unique, then he cannot know what type of animal the smell is a sign of. At this point, the hunter must bring to mind his knowledge of animals, and the likelihood of certain occurrences within the realm of his experience. He uses the pattern of his experiences to reject, at least implicitly, certain possible objects of the unique smell-sign. For instance, the idea that the smell is from an extra-terrestrial animal is implicitly rejected by virtue of the fact that the hunter never even bothers to consider it in the first place. There is no basis in the experience of the hunter for such a consideration, even if it should be correct. Likewise, the hunter considers the possibility of a new animal, but rejects that idea because he has hunted the forest for years without encountering any new animals. He then considers the case whereby familiar animals might hypothetically exude unfamiliar smells. He knows that mating causes olfactory changes, and this idea seems fruitful to him. He also knows that mating rituals of prey are rarely experienced by hunters, so that he might not have encountered them before. His formal abduction could be:

Result. – This is an unusual smell.
Rule. – It is reasonable to suppose that animals exude unusual smells during their mating season.
Case. – This quite possibly is the smell of a common animal during mating season.

Our hunter is now armed with a hypothesis which he then proceeds to test by stalking his prey via the odor. The question of whether he is correct or not depends entirely upon what he finds at the end of the trail. Once he actually finds the animal, though, he is at the first stage of an inductive sequence regarding mating scents and the animal that he has found. In the case of hunting, abduction is often verified in practice. This form of abduction, which we can also identify as reasoning to the clue, is the most historically primitive example of what we know as detection.

A number of other authors have pointed out the relation between abduction and detection in more sophisticated cultural contexts. Studies of Sherlock Holmes (Bonfantini & Proni, 1983; Caprettini, 1983; Sebeok & Umiker-Sebeok, 1983), and Eco's (1983) famous novel *The Name of the Rose*, with its master of abduction, William of Baskerville, all point out the necessity of keen intelligence and skill in abductive reasoning. In fact, the brilliant 'deductions' of Holmes, and the conclusions of William of Baskerville, are both examples of abduction.

There are two other famous historical models of abduction, which we know as diagnosis and divination. Unlike detection, which is oriented to understanding what has happened in the past, diagnosis orients us toward the present, and divination orients us toward the future.

In diagnosis, and particularly in symptomatology, we attempt to ascertain the nature of some disease by the presence of overt signs, which we call *symptoms*. Sebeok (1979) points out that the entire semiotic approach as a technique draws one of its major historical directions from symptomatology. Quite often, these networks of signs are complex, with much overlap and much room for error. The diagnosis of disease from patterns of symptoms is clearly abductive in structure; in fact, it is an outstanding example of reasoning to the symptom. We start by considering the symptoms as results of some unknown disease. By virtue of knowledge, experience and further gathering of symptoms, we decide that the symptoms are the result of a certain disease, and that the patient is a case of a person with this disease. Again, there is no guarantee short of test. In this case, the test is in terms of some prescribed medication or treatment, which serves as an indirect verification at best. Suppose we have a patient with red blotchy spots. We claim that the patient has a case of measles, and give her antibiotics. In fact, the patient has pneumonia, which responds to the antibiotics and leads to a cure. We may never know that our diagnosis was wrong, since our treatment was correct. If we expand our ideas of symptoms beyond disease, we can include the practices of mechanics, engineers and trouble-shooters of all

forms here. All of these practitioners share the circumstance that abductive skills increase with accumulation of experience. We trust the old doctor and the old mechanic more than the young fellow just out of medical school or automotive training. Furthermore, we are willing to allow for one or two misdiagnoses if their results are not too serious, since we know how deceptive symptoms of any kind can be. This is because all symptoms are understood abductively, with the resultant lack of certainty. This is due to the fact that signs, whatever their nature, can be deceptive as well as plausible. In fact, Eco (1976) is so bold as to define a sign as something that can be used to tell a lie.

Finally, we reach the last historical root of abduction, or that of divination. It was the job of the diviner to treat the signs of experience as special types of signs known as *omens*. Careful procedures were maintained for discerning the presence of omens. One culture might depend upon the patterns of entrails, while another culture might turn to the stars. Our culture turns primarily to the predictions of scientific theories. It is also important to remember that less systematic and more personal and idiosyncratic omens also exist; we call these *hunches*. Therefore, divination is a type of reasoning to the hunch.

As with the other historical models already discussed, the ability to verify one's divinations is limited, since there is no direct link in experience between the presence of omens and the occurrence of future events. Divination as a general area has received blanket discrediting in our modern scientific era, precisely because its hypotheses are so resistant to scientific verification. Given that omens are types of hunches, and hunches deal only with possibilities, then any attempt to go beyond possibility empirically when using omens is particularly vulnerable to discrediting. Such a blanket discrediting does a disservice to two important ideas, however. First of all, divination is an economical strategy for gathering experiences into some coherent unity. These coherences might themselves be the basis for further assumptions and scientific testing. For example, the human race might not have paid so careful attention to the movements of the stars had we not thought that there was a need to consider the role of these movements as omens about our lives. Finally, the act of divination represents a fundamental human need to inscribe our experiences with meaning and purpose. For example, when some camps of scientific practitioners embraced the idea of 'value-free' research, they lost touch with this basic need. This loss was to the detriment of science as a human project. An informed and self-conscious form of omen-reading, as a disciplined and domesticated form of making hunches, seems to be necessary for any type of human information-gathering system.

Abduction has occurred throughout history as a means for detection, diagnosis and divination. A systematic understanding of each of these skills is needed for us to improve and transform psychological research.

Abduction and Psychological Research

One of the consequences of postmodern theory (Lyotard, 1979) is an awareness that no form of inquiry can continue to proceed as if it were based on some 'Grand Narrative' that explains and defines the entire field. For empirical psychological research, that Grand Narrative has been a model of applying a strictly scientific model to understanding basic human phenomena (Driscoll, 1994, p. 12). With the loss of Grand Narratives in many fields, there has been a 'balkanization' of disciplines into 'camps' and other ideologically based units (Kuhn, 1970, observes this with a certain degree of distress). A number of major research camps in the human sciences have recently been enamored, generally as a result of misunderstanding Kuhn (1970), with the idea of championing new paradigms and paradigm shifting. I feel that the concept of abduction and its subsequent use in building new models of psychological research has the most immediate promise in replacing this desire to keep looking for newer paradigms and paradigm shifts in order to help the research process as a whole evolve. In other words, what we need are not new models, but new tools for research that allow us to progress abductively. In the face of numerous possibilities, I offer three directions which we can incorporate easily into our current human science research practices.

   The first direction is the strategy of looking upon abduction as a type of 'cultural reading'. This notion has a venerable history. Scholars in the Middle Ages often referred to the world as 'the book of God' (Curley, 1979). By this, they meant that observations are related to each other, and we can learn to read those observations and draw lessons from them. A particularly good example of this is the medieval bestiary (see Shank, 1987a, for an extended semiotic analysis of the bestiary). In a bestiary, all sorts of plants, animals and minerals were described (Curley, 1979; White, 1954). The chronicler went beyond the act of description to draw some lesson of moral and religious significance from the characteristics of the thing described. For example, the hippopotamus was held up as an example of the undesirability of sloth, while the lion was championed for his courage, and was compared to Christ.

   When we consider the world not as a compendium of facts but as a web of meanings (Deely, 1982, 1990), then we go beyond concepts like environments and settings, to concepts like the world as an *Umwelt* (von Uexküll, 1982). An *Umwelt* is a 'lived world', where the things we observe take on significance. It is our job to read those observations in order to determine their significances. This act of reading consists of treating observations not for themselves, but as signs of other things. Since we don't know for sure what they signify, we can only guess. Therefore, if we do indeed live in a world of signs, our most basic actions consist in reading those signs. Consequently, the process of abduction runs through our very act of living in

a world that makes sense. Where that sense breaks down, our abductions need to become explicit and reflective.

How could such 'cultural readings' advance psychological research? One immediate direction is to build upon the ongoing work on cultural psychology built around Vygotsky and pioneered by Cole (1996), Rogoff and Lave (1984), Scribner and Cole (1973), Wertsch (1991) and others. These theorists and researchers have long argued that sociocultural and historical issues play a crucial role in understanding fundamental psychological phenomena. Currently, these views are contrasted with more general models of cognition, which attempt to describe principles that cut across sociocultural boundaries. An abductively informed research agenda can be used to bridge the gulf between these two approaches. A field-based and meaning-based 'reading' strategy can be used to satisfy the need (laid out in general cognitive models) for finding and using general research techniques that are not dependent on particular sociocultural manifestations, while at the same time foregrounding the realization that different sociocultural frames will instantiate meanings-in-use in different ways. In other words, a semiotic strategy that uses an abductive focus is general enough to address basic issues, while being sensitive to the complex and manifold issues of meaning that are inevitably present.

The second direction involves the act of extending another of the six modes of abductive reasoning into a model of research much like the three historical models of detection, diagnosis and divination described above. In this case, the new model is based on a deliberate and reflective extension of the notion of reasoning to a metaphor. Metaphor currently plays an important role in psychology. Lakoff and Johnson (1980), for instance, have argued that all human conceptual systems are metaphorical at heart. Given the inherent human need for understanding via metaphor, it is possible to channel that need into a method that creates new and unusual metaphors and analogies strictly to expand the domain of understanding on the original topic itself. I have called this method elsewhere the Law of Juxtaposition (Shank, 1988), and I see it as one of the most interesting models of abductive inquiry to implement. This law simply states, in its general form, that human beings will inevitably be drawn to attempt to reconcile, by abduction, any two juxtaposed items into a meaningful, conclusive third.

The Law of Juxtaposition has both theoretical and practical implications for psychology and psychological research. From a theoretical perspective, it provides an important link between cognitive scientific models and meaning-oriented models in psychology like Gestalt theory (Kohler, 1970; Perls, 1973) and logotherapy (Frankl, 1984). The meaning-oriented models have focused primarily (though, especially in Kohler's case, far from exclusively) on therapeutic and clinical issues. The Law of Juxtaposition shares this emphasis on the priority of meaning with these models, but is focused on cognitive processes like the more abstract information-

processing models. The Law of Juxtaposition thereby brings this emphasis on the priority of meaning to the forefront of methods to study human understanding processes from a cognitive perspective. It does so by an emphasis on the reconciliation of meaning, not in therapeutic settings, but in situations and areas where ordinary meaning prevails. That is, the 'fixation of belief' (Peirce, 1955, pp. 5ff.) that allows us to label objects in the world as ordinary chairs and tables and ashtrays is the same process that Gestalt therapists and logotherapists utilize with clients who suffer crises of meaning. In other words, unreflective reconciliation of meaning in an almost or quasi-automatic fashion is just as important theoretically as crisis-driven meaning making, and deserves to be explored and studied just as thoroughly as its more dramatic and reflective therapeutic 'cousins'. But how can we systematically look at such nearly automatic processes of meaning? By using the Law of Juxtaposition, we can deliberately orchestrate reconciliations that either mimic or move systematically away from ordinary and nearly automatic reconciliation processes. As the orchestrations grow more arbitrary, they function more and more metaphorically. Fortunately, metaphoric thinking is already a key component of this ordinary meaning reconciliation. By the careful selection and study of such metaphors and metaphoric domains, the psychological researcher can explore boundaries of meaning making previously inaccessible to the cognitively oriented theorist and researcher.

From a practical standpoint, the Law of Juxtaposition offers the psychological researcher the chance to explore meaning threads and dynamics outside the boundaries of psychological theories. Since abductively oriented research deals with meaning *qua* meaning, it is imperative to be able to step outside of our existing frameworks of presuppositions and expectations (which serve to channel and limit meanings). Peirce's emphasis on 'surprise' in abductive inquiry is based, in part, on the realization that when we are surprised, we are now outside our prevailing presuppositions and expectations. The Law of Juxtaposition says that we do not have to wait until the world surprises us (although we should treasure and use such surprises when the world gives them to us!). By deliberately juxtaposing one area of study with some other area almost (if not totally) outside of the area of foregrounding by which we have framed our understanding of the first area, new paths of insight and discovery should almost inevitably arise.

To illustrate, let me return to the topic of medieval bestiaries raised earlier (Shank, 1987a). I was intrigued by bestiaries for years before I decided to do a systematic study of how they could be used to enhance our contemporary understanding of research methodology. I began my study, finally, with the following question: In what way (or ways) is a bestiary like a contemporary scientific report such that, by juxtaposing these two entities, we can derive non-obvious, rich and qualitatively distinct insights into the nature and potential of the latter entity?

Such inquiry must begin with patience and trust. I realized that, in order to do justice to the question, I had to learn a lot about both areas. I already had a fair knowledge of how scientific reports come to be written and are meant to be read, but I knew almost nothing about bestiaries. So I began an 18-month session of research and reading into bestiaries, with no assurance that this effort would lead to anything useful. Simply using the Law of Juxtaposition, after all, does not remove the risk inherent in all empirical inquiry that the processes and entities being studied will end up being insightful, non-trivial or true.

To make a long story short, I was able to discover complementary hidden strengths and weaknesses when juxtaposing the bestiary and the contemporary scientific report. The key strength of the bestiary, as contrasted to the scientific report, is that the bestiary is able to deal with a variety of ways of knowing (e.g. natural historical, descriptive, moral, religious, allegorical, etc.) in a cooperative fashion, while various modes of knowing (e.g. scientific, artistic, etc.) in the scientific report are more often than not competitive (i.e. scientific vs artistic, objective vs allegorical). On the other hand, the scientific report is an exemplary example within empirical inquiry of an open system, whereby new knowledge and even new theoretical orientations can be assimilated into an existing report on a particular phenomenon. The bestiary, on the other hand, by being foundationally an expression of a Christian worldview, can only function as a closed system. In fact, the wealth of new observational and scientific data that emerged in the early decades of the modern era overwhelmed the neat and closed system of the bestiary, thereby rendering it no longer functional. Even more important is the finding that the structural relations of these strengths and weaknesses map out a complementary binary oppositional structure between the bestiary and the scientific report. Such a system then allows us to envision some synthesis beyond this opposition; namely, an empirical report strategy that uses modes of knowing cooperatively (the strength of the bestiary) within an open and growing framework of knowledge and meaning (the strength of the scientific report).

Let me add, as an important aside, that I am not claiming that juxtapositioning per se is anything new in inquiry. In fact, according to current postmodern thinkers (e.g. Firat, 1989), the essence of all postmodern thought is to move beyond theoretical analytic thinking, and to juxtapose strange and arbitrary ideas together, to yield exciting cognitive syntheses. The advertising world, and MTV, have practiced these techniques for years. With the Law of Juxtaposition, though, I seek to treat this technique as a more precise and reflective empirical method, which I feel is truly a novel use of an existing technique.

The third, and final, direction deals with the notion that psychological inquiry needs to be based not on scientific principles as we understand them, but on its own principles. Let us return to the idea that abduction is the

ground-state of cognition. If this notion is true, then we tend to see the world not in terms of truth, but in terms of significance. That means that we experience not a world of facts, but a world of signs (Deely, 1990; Eco, 1976; Leonard, 1957; Peirce, 1955). Therefore, if we accept the role of abduction in understanding the world, we need to pursue the notion of a psychological semiotic, or a doctrine of signs that informs our understanding of psychology as a mode of inquiry on its own terms.

In actuality, such tools and techniques as the Law of Juxtaposition are a special case for this much larger process, one that we could call the use of the 'effort after meaning'. Effort after meaning is a fundamental human process, and the principal way that we as humans understand our world. I am suggesting that we stop trying to understand that effort exclusively in a scientific fashion, and use the effort itself as a rich and complex tool of inquiry to help us understand the world as a whole. As a result, we are then free to use all trappings of meaning as research tools. For instance, we have striven for a century to attempt to understand culture using the tools of scientific inquiry. What about using culture itself as a tool for inquiry? That is, what about using culture as a metaphor for human cognition, and seeing how we can understand different ways of being human by using different cultural 'metrics'? What about using such aspects of culture as metaphor and literature and praxis as touchstones for illuminating the human experience? And finally, what about the idea of treating any connection we can draw, no matter how arbitrarily, as a source of insight, and that the basis for inquiry into the human condition is not a search for truth per se, but an evolving of a continually growing basis of insight into what it means to be a human being?

Several centuries ago, we moved as a culture from the Age of Faith to the Age of Science. Psychology as we know it was formed in the Age of Science. But we are on the verge of a new era, and that major change will affect the way we do empirical inquiry. I have been talking about what I think is the path of inquiry that psychology needs to take, here at the end of the Age of Science and at the beginning of the Age of Meaning. We are currently doing research and building models by using methods that are not so much wrong as they are 'played out'. By this, I mean that they have grown stale from decades of constant use, and the time has come to invigorate both fields by applying ideas and techniques that are truly new. We are lucky to be at such a point, since the first applications of new ideas and methods are always the most exciting. How this era will develop is anyone's guess. Perhaps, as Tursman (1987) suggests, Peirce's ideas will lead us to a genuine science of discovery. Perhaps Kapitan (1990) is correct in his view that abduction will play less of a role in inquiry than we currently expect. Whatever the result, the real adventure is in the trying. What more could any self-respecting inquirer want?

Back to the Lab; or, Some Concluding Thoughts

Finally, we return to the Mad Scientist's Lab. The credits are rolling on the screen, and DJ has already shed her cape and is scrubbing the mascara from her face. The equipment stands isolated and empty, since the scientist who breathed life into the process is with us no more. He has fallen before the inexorable weight of the meaning of his acts. We stare at the ruins of his dream with fascination and dread. Is this the way of all inquiry?

We get up from the sofa, and walk to the kitchen to make ourselves a midnight snack before turning in. We navigate the space between living room and kitchen effortlessly. On our way, we pass the TV, a floor lamp and a chair. A gas heater burns steadily, and warm air wafts from it steadily outward. The walls are green. The baseboard is white. In spite of the heater, the air is chilly. We open the refrigerator. The light comes on. Inside, we find leftover roast beef and bread and pickles. The roast beef is on a yellow plate with light green trim, the bread is in a plastic sack, and the pickles are in a jar with a picture of a pickle on the label. We work quietly so as not to wake my father (who is now dead) and my mother (who is now elderly and lives alone) who are sleeping in the next room. We work by the glow of the tiny refrigerator light. The sandwich is delicious, and we savor its texture and taste as we chew it slowly and deliberately. All the time, we think about the fate of the Mad Scientist, and mourn the loss of the world that was almost to be, but did not come to pass. The world of the Extraordinary.

Ironic, isn't it?

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