mon verb for the edible mushrooms. The same learning takes place for three categories of toadstools. An important aspect of such a model is that researchers do not impose a predefined lexicon. Instead, each population evolves its own set of meanings and the corresponding signals. This is achieved through the dynamic learning interactions between children and parents, and through the interdependence between the evolving behavioral abilities (e.g., categorization of mushrooms) and the learned linguistic skills.

The simulation results showed that populations evolve shared lexicons that optimally facilitate the foraging task. The majority of such languages are compositional. They contain two words to name the action (e.g., avoid/approach) and three words to name the three individual categories of mushrooms. To test whether these apparent compositional languages are actually based on real symbolic relationships, a symbol acquisition test, similar to that in Savage-Rumbaugh and Rumbaugh's (1978) chimpanzee experiments, was used. The test consisted of three learning stages. In the first stage, organisms learn to label only four foods (two edible and two poisonous mushrooms). Subsequently, they learn to associate the four names with two new verbs. In the final stage, the names of the remaining two foods are taught. The association with previous verbs is not explicitly taught because, in a real symbolic language, the logical relationship between new names and verbs is expected to be made by generalization. Data showed that the majority of populations successfully generalize the association of verbs with new names, thus demonstrating that a real symbolic language has been acquired.

This simulation shows that it is possible to build autonomous agent models that manifest behavioral, cognitive, and neural phenomena similar to those observed in experimental studies. In addition to sharing with new ape language research the benefits of a dynamical system paradigm, this modeling approach provides other advantages. This is especially true in the field of language origin research. Computational models require that language origin theories be defined in clear operational terms (necessary to implement the computer program) so that hypotheses can be verified during simulation (Cangelosi & Parisi 2002). Autonomous agent models permit the simulation of past language origin scenarios by manipulating various evolutionary, behavioral, neural, and social variables. This also helps in overcoming the limits of other computational approaches, such as classical connectionism (Rumelhart & McClelland 1986), which can only study ontogenetic changes. Finally, constraining the models to known empirical facts related to language evolution (Tomasello 2002) produces a virtuous circle. Models generate new predictions and insights, and subsequent experimental studies verify them and generate new predictions, which can be tested again in simulation.

Dynamic systems theory places the scientist in the system

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Abstract: Dynamic systems theory is a way of describing the patterns that emerge from relationships in the universe. In the study of interpersonal relationships, within and between species, the scientist is an active and engaged participant in those relationships. Separation between self and other, scientist and subject, runs counter to systems thinking and creates an unnecessary divide between humans and animals.

What does it mean to have an individual mind? One could say it means to have the ability to think and reason, to make decisions independently of others, and to have a unique point of view and the ability to formulate intentions and actions consistent with that point of view. But most human minds work along the channels of thought and reason acquired by speaking and acting with other people (Piaget 1965; Vygotsky 1978). Our "private," "original," and "independent" thoughts are always phrased in cultural lexicons of imagery, myth and story, gesture, language, or mathematical formalism. To demonstrate the independence of our minds, we say things, do things, and build things with words, gestures, and materials that are sociocultural in origin.

Being-in-relation, participating in an interpersonal relationship, is a fundamental, irreducible, primary, way of being. Individuals are born into interpersonal relationships. We never, not for a single moment of life, exist outside of relationships even when we are physically alone. Our thoughts, our movements, the artifacts carried with us are all grounded in cultural processes that were conceived, composed, and codified by individuals-in-relation (Fogel 1993).

It is ironic, then, that Western cultural and linguistic imagery gives the illusion that individual minds take precedence over being-in-relation. As scientists of mind and communication, we can use the cultural lexicon to distinguish human and animal worlds, self and other, inner and outer, emotion and cognition, and verbal and nonverbal. On the other hand, as human beings immersed in the act of communicating, such distinctions become arbitrary and meaningless. Shanker & King (S&K) suggest that we can either gain knowledge *about* the phenomenon under study or – by our own experience – gain intimate knowledge *of* the same phenomenon (James 1890). Is it possible to be a scientist while relating to our subject matter as a fully participating human being?

S&K compare and contrast two paradigms aimed at answering such scientific inquiries. They observe the behavior of individualistic world-view thinkers who come back from their solitary journeys into the mind and attempt to communicate their insights. Deacon is chosen to represent this style of science, studying phenomena from a distance, attempting to break them into independent parts, and subsequently reassembling them into a model of reality. Deacon is asking, "What are the limitations of an ape's language capacities? What abilities for communication does an ape have?"

Savage-Rumbaugh, on the other hand, was not content to approach apes from a distance. She asked, "What are the possibilities for connection between me and Kanzi? How can I change myself in order to deepen the relationship between us?" Kanzi and the other apes become active participants in a courageously alive interpersonal relationship – not separate minds contemplated from afar. Savage-Rumbaugh entered the apes' world by altering her behavior both physically and emotionally. She gave the apes the opportunity and tools to communicate, learn, and grow with a wonderfully engaged partner. By allowing herself to be moved and changed, she demonstrated the emergence of communicative capabilities in nonhuman species in ways that were heretofore unimagined.

The fundamentally different paradigms of Deacon and Savage-Rumbaugh represent different theoretical approaches: information processing versus dynamic systems. These paradigms also afford entirely different kinds of knowledge: knowledge from reason and knowledge from the fully human experience of direct engagement.

Dynamic systems perspectives assume a fundamental relatedness at the heart of the universe, implying that the scientific observer is part of this relatedness. But this raises a central question. Having gone into a direct relationship with the apes, what kind of a scientific story can be told? From a dynamic systems perspective, it is sufficient to know with whom, how, and under what conditions individuals can relate with and connect to each other. For example, Smuts (2001) described surprising and mutually enriching encounters with creatures as diverse as dogs, baboons, birds, and rodents that emerged from the scientists' "sensitivity and humility" (p. 301).

Dynamic systems is not a new behaviorism. It is not uninterested in mental and emotional processes. Rather, dynamic systems suggests that knowledge of the other can arise only in relation to the other. Acts of separation run counter to dynamic systems thinking, creating a sense of human *versus* apes rather than humans *with* apes. Thinking about the ape's mind in the absence of a close relationship is not the same as the direct experience of another mind through sharing actions and feelings, such as playing games with mutual delight or aligning intentions to achieve a common goal. These shared experiences give the observer a sense of direct certainty that she is engaging with another intentional being.

We now know that Kanzi and other bonobos can – with an engaged human partner – comprehend spoken English, produce English-based speech sounds, make stone tools, and write lexical symbols (Savage-Rumbaugh et al. 2001). It is difficult to imagine how these scientific discoveries could have been made outside of a relationship of engagement and mutual commitment between scientist and ape. The theory arises from this observation. Communicative skills like language and gesture, within and between species, can only emerge by engaging in meaningful interpersonal relationships built up over time (Bruner 1983; Fogel 1993). The telling of what happened in those remarkable relationships is all one needs to know in order to replicate the findings – that is, to recreate a similar relationship.

But this is not the whole story. As Kanzi and the other apes changed in relation to the scientists, those scientists changed in relation to the apes. Instead of being humans who viewed animals as separate and different, they became humans who changed their ways in order to invite animals into the realm of engaged, intelligent, feeling beings. This is a form of moral courage: to open our own minds to change, to expand what it means to be human by acts of love that transcend the ordinary.