Article

COG, A HUMANOID ROBOT, AND THE QUESTION OF THE IMAGE OF GOD

by Anne Foerst

Abstract. The general typology for the dialogue between religion and science is built on the assumption that there is an objective world, one reality that can be described. In this paper, I present an alternative epistemological framework for the dialogue that understands all descriptions of reality as symbolic. Therefore, this understanding creates a new possibility for mutual enrichment between the two dialogue partners. I demonstrate the usefulness of this framework by applying it to the dialogue between artificial intelligence (AI) and theology. I discuss an advanced AI project: Cog, a humanoid robot. After briefly describing this project, its assumptions, and the emotions it creates (mainly hope and fear), I show how the project can be enriched by theological insight. The concept of *imago Dei*—the understanding of humans created in the image of God—can be applied to the Cog project especially when it is presented in a way that takes the metaphorical character of both theological and scientific theories seriously.

Keywords: artificial intelligence; Cog; image of God; performative; robotics; symbol; theology.

A New Approach to the Dialogue between Religion and Science

The relationship between religion and science has always been difficult. Often marked by conflict and animosity, in academic circles the relationship gradually changed into one of mutual ignorance. In the 1950s, C. P. Snow coined the expression "two cultures" for the relationship between

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scientists and engineers, on the one hand, and theologians, philosophers, and artists on the other (Snow 1964).

Theologians finally were forced to recognize that, within the academic context, the acceptance of their field was diminished. Out of this position of impotence several attempts emerged which sought to bring theology[1] back into academic discourse and especially to create a framework for a dialogue between religion and science.

The literature presents four types of dialogue.[2] Even though these types have no well-defined boundaries, this typology is generally accepted within the religion and science community, with most of its members identifying themselves with one or two of these types.

Conflict. The conflict type cannot even be described as a relationship. Neither of the potential dialogue partners, theologians on the one hand and scientists on the other, is willing to listen to the other. Both are convinced that science and religion are fundamentally irreconcilable and that only their own position is correct; consequently instead of discourse, every conversation necessarily becomes an argument, each partner attempting to convince the other. The ongoing battle between evolutionists and creationists presents a good example of this kind of interaction.

Contrast. In the contrast type, science and theology conduct research independent of each other without any mutual exchange. The possibility for mutual enrichment is thwarted, because people working in the two fields hold different and mutually exclusive worldviews and are convinced that between these worldviews no contact or mutual enrichment is possible. Unlike in the conflict type, no aggression can be found here. Participants on the two sides live in peaceful coexistence without any exchange.[3]

Contact. In dialogues of the contact type, members of neither domain are willing to accept a world divided into two different realms between which no contact is possible. They accept differences between the two spheres but still desire to have a constant and challenging exchange in order to learn from each other. Their goal is to have a consonant perspective on reality in which differences can be explained in terms of different perspectives on reality and different areas of interest; the differences are not seen as the result of different and mutually exclusive realities. This position can help theologians to modify their understanding of creation according to new findings in science; conversely, it frees scientists from prejudices against religious belief and religious ideology.

Confirmation. The confirmation type of dialogue not only supports interaction and mutual enrichment between science and religion but proposes "that religion is in a very deep way supportive of the entire

scientific enterprise" (Haught 1995, 21) because it explains the human urge to know. This urge is understood to have led to science in the first place. Religion here is seen as a sphere in which faith and trust are built up, and it then enables the scientific enterprise. In practice, this type does not restrict theology to uncritically applauding anything science has to offer. Rather it distinguishes negative developments in science from the scientific enterprise itself. It may criticize some research areas and technical developments, but it deeply encourages scientists' desire for knowledge by accepting this desire as something that rose out of religious thought. In this way, theologians seek to encourage scientists to recognize the elements of trust and faith within their enterprise as necessary ingredients in any search for truth.

This typology is grounded in a particular epistemology. This epistemology, though mainstream, does not represent the only possible set of epistemological assumptions that can be held by people within the dialogue. Dialogue partners within the religion and science discourse can apply two different sets of epistemological assumptions to the dialogue.

The first set, which I call the Cartesian approach, is centered around the assumption that there is an objective world that can be analyzed, described, and understood. The other set, which I call the Symbolic approach, understands environments as socially constructed and assumes that every description of reality is metaphorical. Under the second set of assumptions, the typology is quickly challenged.

If we shift the discourse away from questions of cosmology, evolution, and creation—topics usually discussed within the religion and science community—into the realm of research in artificial intelligence (AI), the symbolic approach seems to provide a more promising means of promoting the discourse between religion and science.

The Cartesian Approach

It is generally accepted that scientific theories are shaped by their social context and that their form and content depend on the personalities of the theorizing scientists (Berger and Luckmann 1966; Kuhn [1962] 1996). However, the recognition that knowledge always includes subjective elements does not necessarily imply that the world outside of ourselves cannot be understood through empirical evidence and be described by theories.

The beginning point of the discourse between religion and science is therefore the belief of both dialogue partners that it is possible to develop a description of the existing world. I call this standpoint the Cartesian approach.[4]

If both dialogue partners assume that an objective representation of reality is possible, their research will aim toward developing theories and

world models that represent this objective description of the world. Hence, they are not willing to take into account theories and stories about reality that contradict their own model, because it is impossible to have contradictory theories within a coherent world description. Attempts to aim toward a coherent description of reality therefore often lead to dichotomies between the scientific world model and religious world descriptions.

The scientific world model today usually is centered around the generally accepted history of the universe: the Big Bang, the emergence of galaxies, our sun and our earth, the slow development of life, evolution, and finally the rise of humankind. Examples of religious world descriptions are the creation stories in Gen. 1:1–2:4, in which God creates the world in six days and the Sabbath on the seventh; and Gen. 2:4–25, in which God creates Adam and Eve.[5] If the scientific and religious world descriptions are both seen as descriptions of reality, then we have to find a way to overcome their obvious differences.

Conflict. The first type of interaction—conflict between dialogue partners from science and religion—tries to overcome the obvious differences between the two descriptions of reality by calling one right and the other wrong and playing them off against each other. Members of the two communities buy into either the scientific or the biblical world description and deny any validity to the competitor's view. When science is understood as an attempt to describe an objective reality and the Bible as another description of this very same reality, the conflict arises as a result of the need for a unifying, coherent representation of the world.

Contrast. The more subjective and partial character of any description of reality is recognized within the second type—the contrast model. Both science and religion can be seen as describing different parts of the same reality, parts that are not related to each other because they describe different realms of human existence.

Contact. The third type—the contact model—tries to establish a consonant and coherent description of reality in which both dialogue partners can play their own important roles. Only under the assumption that an objective description of reality is possible can religion and science be understood as equally important contributors to the treasure of knowledge about this reality and as cocreators in generating a complete picture of it.

Confirmation. The fourth type wants to confirm the shared fundament upon which science and religion are built: the hunger for knowledge and the search for meaning in the universe. Although religion "cannot add anything to the list of scientific discoveries" (Haught 1995, 23), it can

support the faith of scientists in a rational, ordered universe that can be explained and eventually understood. Here the relationship between religion and science is not seen as an exchange of knowledge that can lead to a discovery of all mysteries of the universe. Rather, religion is understood to provide for science a reason for its motivation and for its trust in its quest. Science, then, can search for knowledge of objective reality supported by theology.

All four types of relationship between religion and science presuppose the existence of a reality independent of humankind that can be observed, described, and understood. Scientific research is presumed to be able to uncover the secrets that still remain. Theology can either undertake the quest alone or support scientists in doing so.

The existence of a hidden competition between the two world models is shown by the fact that most research within the religion and science community is actually done on cosmology, evolution, and creation, on questions of the meaning of the universe and whether God might fit into the scientific world model. In the first type, conflict, the competition can be embodied in the religious camp by a strict denial of descriptions of reality that differ from those found in the Bible in literal form. This type depends most strongly on the Cartesian assumption. The introduction of an alternate epistemological assumption could diminish the aggression and prejudice that mar the relationship between the religious and scientific communities.

The Symbolic Approach

In 1970 Humberto R. Maturana inaugurated an interdisciplinary discourse on questions of cognition in which other biologists as well as ethologists, philosophers, and psychologists engaged (cf. Maturana 1970). By questioning the Cartesian assumption, they established a forum from which a whole new set of epistemological assumptions could emerge. Their thought was grounded in a rejection of the existence of an objective reality. In this context, all knowledge was understood as socially constructed. The movement was for that reason called *constructivism* (Maturana and Varela 1987; Schmidt 1987; Watzlawick 1984).

The symbolic approach does not go as far as constructivism in that it does not reject the Cartesian assumption; without the Cartesian assumption most scientific research would be impossible because all empirical evidence would become questionable. But in the spirit of the playfulness found at the beginnings of constructivism, I would like to set the Cartesian assumption aside. This playful reasoning is best exemplified by gestalt problems. In looking at figure 1 (Goldstein 1989), people might have endless debates about whether the figure represents two faces or a

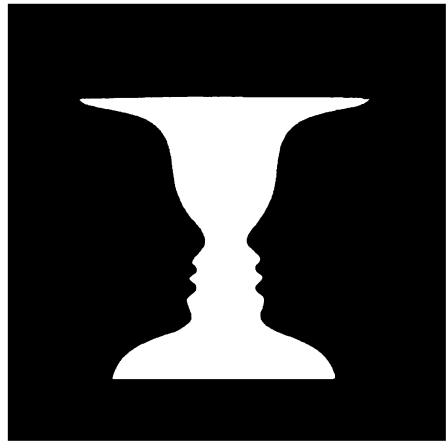

Fig. 1. Rubin's reversible face-vase figure.

Source: *Sensation and Perception* by E. B. Goldstein, 3d. ed. Belmont, Calif.: Wadsworth. Public domain.

vase. Both descriptions are equally valid, and if one mentions only the one without the other, the description of the figure is not complete.

This togetherness of equally valid but different descriptions of reality also can be found within the Cartesian approach: Under the contact model, people might argue that one interpretation represents a scientific description of reality whereas the other interpretation represents the theological approach.

The symbolic approach in learning from constructivism, however, goes one step further and introduces the element of construction. Figure 2 (Kanizsa 1979) can from a Cartesian point of view be described only as a picture of three incomplete circles. The triangle we see in the center does not exist but is constructed by our perceptual apparatus. Nevertheless, it is as valid and as real for the viewer as the circles. Any argument over its reality must come to no conclusion unless both dialogue partners perceive it. The existence of the triangle cannot be proven empirically; for those viewers who are able to perceive it, however, it is as real as the circles.

Figure 2 captures the symbolic approach for dialogue between religion and science quite well. Both scientific and theological descriptions of reality can be seen as partly constructed and dependent on our perceptual apparatus and maybe even our personality. Each description refers to parts of who we are and answers a different type of question.

This playful reasoning leads to the question, What might happen to the religion and science dialogue if its participants no longer searched for a valid description of reality but instead attempted to establish a new

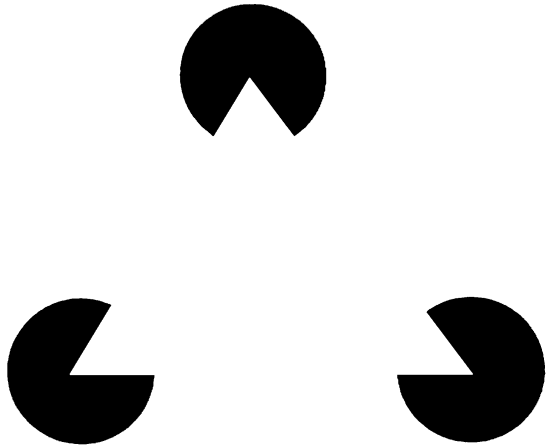

Fig. 2. The Kanizsa Triangle.

Source: *Organization in Vision: Essays on Gestalt Perception* by G. Kanizsa. Westport, Conn.: Praeger Publishers, an imprint of Greenwood Publishing Group. © 1979 by Gaetano Kanizsa. Reprinted with permission.

community that attended not only to the quest for truth but also to the fulfillment of existential needs and quests beyond scientific reasoning?

Religion has always sought to fulfill existential needs, and most descriptions of reality have been subordinated to this end; an increasing number of biblical scholars therefore interpret the Bible, not as an attempt to describe an objective reality, but as a collection of stories that reveal aspects of our existential desires and needs.[6] Religion therefore must use myths, metaphors, and symbols (Hefner 1993, 173) because it cannot express these topics properly otherwise.

In AI, the term *symbol* is used in two ways. A symbol can be a mathematical sign (e.g., $\sqrt{xy}$) which is context-free and stands for a variable, a relation, or a mathematical operation. In a broader sense, symbols are opaque and discrete entities; their meaning cannot be revealed by analyzing their structure. They get their meaning only by their relative position in a program and, hence, by the effect they have on the program's execution.

In the context of the symbolic approach, the term *symbol* is used in a transcendent sense that includes the immanent symbol understanding of AI. A symbol—etymologically συν (together) and βαλλειν (to throw)—brings together two different spheres; it points beyond itself to something else and participates in both realities. In doing so, "it opens up levels of reality which otherwise are closed for us" (Tillich 1957, 42). Symbols, then, play an important role in our construction of meaning and the reality around us.

Rather than take scientific theories and theological concepts as mere descriptions of reality, I want to understand them as symbolic hints toward something deeply connected to who we are. Science in this context can be interpreted as not simply adding to the treasure of objective knowledge about the world and ourselves under the Cartesian assumption. Rather, its description of reality "comes across to us as yet another story that tells us about ourselves" (Hefner 1993, 12). In this approach, we can recognize the universal character of metaphors; their essence "is understanding and experiencing one kind of thing in terms of another" (Lakoff and Johnson 1980, 5). Metaphors, then, can be used not only to describe something but also to create a symbolic connection between two different spheres.

Because symbolic and metaphoric language transcends reality and connects different spheres which, in the Cartesian realm, might be contradictory, it is very powerful and for existential questions might even surpass "in quality and strength the power of any nonsymbolic language. One should never say 'only a symbol,' but one should say 'not less than a symbol'" (Tillich 1957, 45).

If we can approach the dialogue between religion and science from this perspective, it gains a new gestalt, and the typology described earlier is radically challenged:

- The conflict type, as shown above, is dependent on the Cartesian assumption. It cannot emerge in a dialogue in which each partner accepts the other as someone whose story can be added to our intuitive self-understanding and our grasp of the meaning of our lives.
- Because the stories of science and religion are in many ways fundamentally different from each other, there will always be a large body of symbols that are difficult to share; most of these cannot even be communicated, because the participants in the dialogue are unlikely to have been deeply trained in both areas. However, coexistence without exchange cannot last if both partners recognize the limits of their own symbols; they will be interested in symbols that point to levels of reality different from those of their own stories.
- Contact emerges automatically, but the exchange will not be understood as a construction of a coherent and consonant description of reality. Rather it will be understood as a collection of symbols, myths, and stories that describe different facets of our daily experience and our search for meaning.
- The fourth type, confirmation, recognizes under the Cartesian assumption the need of scientists to integrate existential questions into their research and not to abstract their research from their daily life as persons. It does, however, reduce theologians to mere

> counselors who analyze scientists' motivations; it does not acknowledge that theology too can add to the treasure of stories about our human reality. Using the symbolic approach, scientists learn from theologians in both respects, whereas theologians come to understand in a much deeper way the hunger of scientists for knowledge.

I now apply this framework to dialogue between theology and AI. I first describe Cog, a humanoid robot, and briefly outline the emotions that arise when the project is understood in a Cartesian manner. I also show to what extent Cog can be understood as a metaphor that elucidates a particular perception of ourselves. Then I discuss the theological symbol of the *imago Dei*—the understanding of humans created in the image of God. Finally, I integrate both symbols into the framework of dialogue and highlight some aspects of the picture of us they create in combination.

COG, A HUMANOID ROBOT

Cog, a humanoid robot, is currently under construction at the Massachusetts Institute of Technology Artificial Intelligence Laboratory (MIT AI Lab). The project qualifies for an analysis in this paper for two reasons. First, it is a project of Embodied AI, a new camp within AI, and most of the arguments against Classical AI do not apply to this research. Therefore thinking about Cog forces one to search for new ways to criticize. Second, Cog is a realization of a very old dream of humankind: the reproduction of a human. Thus, it rouses many emotions, from fascination on the one hand to fear on the other. An analysis of these emotions leads to new insights about the possibilities for dialogue between religion and science.

I first describe the philosophy of Embodied AI and Cog as a part of this research. I then list standard arguments against AI and show that they are not valid for Cog. Finally I will develop some ideas on how to use Cog as a thinking tool to create possibilities for the mutual enrichment of AI and theology.

COG AS AN EXAMPLE FOR EMBODIED AI.

AI is a relatively new area of research. However, in its history there have been several paradigm shifts that changed not only technical applications but also AI's self-understanding (Varela 1993). All these shifts centered around the questions of what intelligence is and how one might build an intelligent machine. In the Classical AI approach, researchers seek to reconstruct and understand tasks which they believe require intelligence and to build them into machines. In all these attempts, they abstract intelligence from the hardware on which it runs. They seek to encode as much information

as possible into the machine to enable the machine to solve abstract problems, understand natural language, and navigate in the world.

This approach has always been questioned, and several attempts have been made to change the goals of AI. Currently, another shift is taking place: Some researchers are again rethinking this concept of AI and, for several reasons, question the approach of simulating human intelligence on a machine (Brooks 1990, 1991; Brooks and Steels 1995).

Embodiment. The emerging camp holds that it is impossible to abstract intelligence from bodily features and bodily conditions; consequently, the researchers call their new direction *Embodied AI*. Intelligence, so their creed states, cannot be implemented on a disembodied machine. On the contrary, intelligence emerges only in bodies and is dependent on bodily features and conditions. An ant has a different body and *lebensraum* from a horse, so they have developed different abilities and intelligent tasks which serve their respective needs.

Hence, Embodied AI researchers build robots as embodied entities that interact with their real environments; the emphasis lies in the development of hardware. According to their philosophy, human intelligence can emerge only in a body that is as humanlike as possible. For this reason any entity with humanlike intelligence must have a body that is built in analogy to a human body. Because Cog is an attempt to rebuild a humanlike creature, its shape is close to the shape of a human. To date, Cog has a head, a neck, a torso, two arms, and two hands. All these parts have degrees of freedom similar to the parts of a human body and are humanlike in shape.[7]

Interaction. A creature's body is important because it shapes the creature's intelligence, since every creature interacts with its environment. The body and the environment correlate with each other, and the body's shape evolves during evolution according to the body's environment and the need to survive in it.

Consequently, besides embodiment, the key to intelligence is interaction with the environment, and Embodied AI lets its creatures interact with real-world situations. To "build a system that is intelligent it is necessary to have its representations grounded in the physical world. . . . The key observation is that the world is its own best model. It is always exactly up to date. It always contains every detail there is to be known. The trick is to sense it appropriately and often enough" (Brooks 1990, 4).

Embodied AI systems are grounded in the world by means of multiple sensors that feel their environment, and actuators that communicate with it. This enables instantaneous reactions to sudden changes and flexible behaviors for anything the natural environment requires.

There is another reason for the emphasis on interaction, however, which is also rooted in the philosophy of Embodied AI and can be

understood as a reaction against Classical AI. Classical AI approaches try to build intelligence by implementing isolated parts of intelligence; standard topics are chess playing, theorem proving, and problem solving. Many people have criticized that approach; there has especially been a tradition of feminist critique against this selection of skills for replicating intelligence. The men who started AI were mathematicians, experts in their field, and so these skills came naturally to them. "And they said, hey, if it proves a theorem or plays chess, it must be smart" (Athanasiou 1985, 17). However, they ignored the fact that other people might select totally different skills for defining intelligence. Especially women, because of their daily experience, might chose different abilities: They often value social skills more highly than abstract, disembodied tasks. According to the feminist critique, the skills chosen by mathematicians are not only disembodied but estranged from any human's daily experiences in his or her bodily surroundings.

Embodied AI researchers take this critique seriously and redefine intelligence as the ability not only to interact with a constantly changing environment but also to act socially. The ability to act socially and form relationships is one of the most important tasks for survival. Chess and theorem proving are here seen as by-products and not as the core of intelligence.

The idea that Cog can develop similarly to humans only if it experiences similar bodily conditions is therefore another reason for the human form of Cog. Its builders hope that its outward appearance will motivate people to interact with Cog as with a human. Cog already has learned the rudiments of eye contact and grasping—both necessary abilities for nonverbal social interaction. Its builders hope that Cog will improve these abilities and develop new ones when it interacts with humans. Its body, then, can be seen as a tool for learning social skills and entering into relationships.

DISTRIBUTION. Parallel methods have already proven their usefulness, but the brain is still usually understood as the central unit of any intelligent system and the body as machinery that is controlled by the brain. In Embodied AI, new architectures are created which consist of several independent processors and units, loosely related to one another. Each single unit has many sensors and actuators to interact with its environment; the overall behavior of the whole system emerges from the simple behavior of the smaller parts. Robots with this architecture were built and were successful in many ways (Foerst 1996b). One might say in criticism that the emergence of complex behavior is usually not foreseeable, but what can be achieved with these new architectures still remains impressive. Cog for that reason does not have a central unit but is a distributed system. The distribution is twofold, involving hardware and software.

Hardware. The hardware distribution is implemented on three different levels. Every single joint has motor control primitives that run on very slow processors; these processors are built into the joints and work only locally. The slow processors are connected with brainboards that consist of faster processors and slots that can connect each of these brainboards with up to eight other ones. The brainboards run more complex behaviors and can control several parallel processes, and because they are connected they can communicate with each other and create overall behavior. The choice of these still slow processors is also rooted in the Cog philosophy because it forces the engineers to adjust their design to the processors' speed. Human neurons also are relatively slow, but because the brain has myriad connections and a complex and efficient organization, it is able to perform its incredible tasks. Only for processes such as vision and hearing, which require a huge amount of signal and information processing, do the engineers use Digital Signal Processing (DSP) chips.

Software. The distribution of the hardware is mirrored on the software level. A hardware component does not have only one correlating software entity; instead of huge and complex programs, the engineers develop small independent units. Besides its flexibility, the software architecture has the advantage that every new behavior or ability can easily be integrated into the software without interfering with the rest of the system.

DEVELOPMENT. Classical AI approaches often try to simulate the intelligence of an adult, forgetting that intelligence is a product of development. Jean Piaget and several developmental psychologists of his school have suggested that children's development is not continuous but happens in several stages; at each stage a child has different abilities which often are learned independently and later combined. With his research, Piaget showed that children are not just little adults with fewer abilities but are different and special in their own right.

The Cog researchers take this into account by understanding intelligence as a result of the development process; hence, they attempt to rebuild a newborn intelligence which develops according to the findings of developmental psychology. The tasks Cog learns to perform are those of newborns. It will learn turn taking, hand-eye coordination, grasping, face recognition, and the rules of social interaction. These skills are not very sophisticated, but they are not trivial either. They are a class of problems the Cog group tries to solve, a class that fits the philosophy that intelligence is a result of evolution in general and the phylogenesis of humans in particular. All these tasks are put together in one single robot. Instead of being developed independently—as is done in other projects —they are built together, and the tasks can use each other to learn.

COG AS A THINKING TOOL. The Cog research pursues two goals: first, to create a prototype general-purpose, flexible, and dexterous autonomous robot, and second, to study human development after birth (Brooks and Stein 1994). The second goal especially is ambiguous; we can learn something about humans from robots only if we assume that their differences are marginal and not qualitative. This apparent equality reveals the understanding of humans underlying this research: that we, like robots, can in principle be analyzed completely because we function entirely by mechanical and systematic laws which can themselves be rebuilt.

Rather than analyze the adult and disembodied intelligence and rebuild that, Embodied AI recognizes the importance of embodiment, interaction with the world, social contacts, development, and a machinery that does not center around a single agency but consists of different independent but connected modules which together contribute to the emergence of intelligence. Because of this philosophy and its realization in Cog, Embodied AI is difficult to criticize. Arguments that qualitative difference between humans and machines make Cog's success impossible seem, from the perspective of the Cog team, unfounded.

But still this understanding of humanness, the identification of humans with machines, creates fear and animosity toward the Cog project, for two reasons:

- We usually do not expect a machine to interact flexibly with us. We associate characteristics like obedience, reliability, and inflexibility with machines; characteristics which are very different from ours. The interaction with Cog, however, is unlike that with a normal machine. If one experiences Cog's sometimes anthropomorphic behavior—for example, when it makes eye contact or grasps objects with its hands—even visitors who think very positively about the project feel uncomfortable about Cog's humanlike behavior.
- These emotions might arise because in our interactions with Cog, little distinguishes us from the robot, and the differences between it as a machine and its human counterparts fade. This experience makes us aware of the human machinery and seems to diminish human uniqueness and specialness. This intuitive fear is supported by the findings of cognitive science, which reveal an increasing number of mechanisms in the human system. Even for seemingly nonrational phenomena like emotions, functionalist theories (Damasio 1994) exist. These theories will be implemented in Cog. Their successful implementation in Cog might support the main theory that we are nothing but machines.

However, perceiving ourselves as kinds of machines contradicts our intuitive self-understanding. Opponents, for that reason, try to prove this

understanding of humankind wrong by listing the differences between humans and machines. They list the things that humans can do and computers cannot do (Dreyfus 1979); they list the abilities humans have that can be neither built nor found in animals: self-consciousness, emotions, and creativity are some of the most common arguments against any potential equality of Cog and us. But the more secrets that projects like Cog seem to reveal about mechanisms that underlie certain behaviors and tasks, the farther this kind of argumentation has to retreat. And the more people still use this argument, the less they are taken seriously by AI researchers.

The argument given by Cog's builders against this type of attack is twofold. First, they say that phenomena such as consciousness are illusory (Brooks and Stein 1994, 12). Phenomena such as consciousness have no physical property and cannot be correlated with particular body parts or particular bodily procedures. These phenomena arise because our brain is complex enough to abstract and categorize certain processes and analyze them. Phenomena such as emotions arise from chemical reactions in the body and their reflections and responses in the brain (Damasio 1994, 127). Using this materialistic approach toward all complex phenomena that seem to be exclusively human, Cog's builders also can argue that Cog is built according to all these materialistic findings; as Cog becomes increasingly complex, it might develop the same complexity and hence develop the same illusions.

If we want to establish a dialogue in which the two partners exchange stories, we have to search for new ways of arguing. There is a strong need to argue with the Cog anthropology: even if the understanding of humans as machines is supported by neurological and psychological findings, we still believe intuitively that we are not like machines. However, we must recognize that the fears described above emerge under the Cartesian assumption. Only if we take Cog as a possible replica of ourselves and perceive it as a nearly objective description of a human can it create such strong emotions and lead to these fruitless arguments.

If we use the symbolic approach, we can take Cog as another story telling us something about ourselves. This enables us to free ourselves from fear and anxiety about it; if Cog is yet another story about humanity we are free to accept the mechanisms it reveals but still believe in our intuitive self-understanding.

The Image of God as Performative

The intuitive self-understanding, by which people perceive themselves as being more than machines, has its counterpart within the Judeo-Christian context in the symbol of the image of God.

> Then God said, "Let us make humankind in our image, according to our likeness; and let them have dominion over the fish in the sea, and over the birds of the air, and over the cattle, and over all the wild animals of the earth, and over every creeping thing that creeps upon the earth." So God created humankind in his image, in the image of God he created them; as male and female he created them. (Gen. 1:26–27)
>
> Whoever sheds the blood of a human, by a human shall that person's blood be shed; for in his own image God made humankind. (Gen. 9:6)

These biblical citations are the only places in the Hebrew Scriptures in which the image of God is mentioned; later, in the New Testament, some theologians, especially Paul, refer to this concept. An unequivocal definition is never found. Throughout Jewish and Christian history, various theories have been given as to its meaning. The church fathers as the central figures in early Christianity identified the image of God with νους or *mens*; both refer to the highest part of humans, the residence of reason, knowledge, understanding, cognition, freedom, love, and virtue. But these special abilities were always seen as a consequence of humans' participation in the divine. The identification of the image of God with human abilities and features is still found in many contemporary theories, from bodily descriptions to concepts of the soul. Under the Cartesian assumption, we must indeed ask for some empirical evidence for the image of God and find some univocal definition.

The symbolic approach, however, enables us to look at the concept of the image of God (*imago Dei*) differently. It does not take Genesis 1 as an abstract definition of humankind but as a story of the Creator and his creation. Martin Luther defined the theological concept of the *imago Dei* in the context of Gen. 2:7: Humans share bodily existence with animals, but the image of God distinguishes us from animals because it is an expression of God's consolation to humans; it describes the relationship between God and humans. The image of God, then, cannot be identified with particular skills and abilities but is God's promise to start and maintain a relationship with humans.

The story describing an ongoing relationship between God and humans is as valid and reasonable as the one describing humans as merely mechanical and material entities. However, it requires more of a foundation, because the assumption of God is more likely to be rejected today than is the assumption that every phenomenon can be reduced to empirical events.

With Oswald Bayer (1994), I would like to characterize God's affirmation of the image of God as *performative*. This term was introduced by the linguist and philosopher John L. Austin (1975). He defined it as a speech act which constitutes a new reality. Common examples of performatives are *Congratulations!* or *Thank you!* in which the act of congratulation or thanks is performed by the act of speech. In our context the most

important is the performative *I promise you!* which creates a new relationship between *I* and *you*, which changes and modifies the old relationship —at least for a moment.

The image of God as promise, understood as performative, is an act, a creation of something new. It creates a relationship which did not exist a moment earlier. This relationship can be destroyed only if the promise is broken. The criterion for the truth of the relationship is God's promise of faithfulness: humans can rely on it beyond their possibilities and mistakes; they can rely on it for themselves and their neighbors.

However, the performative of the image of God is different from a promise, because it can be effective only if the listener, the human, trusts the speaker, God, and God's message. The efficacy of performatives in the name of God depends on the faithful approval of the listener. They are ineffective if the listener does not have any faith. Within the Cartesian assumption, the listener might ask for evidence of the existence of God and God's reliability. But the truth of the image of God can be found only in that area which initially was constituted by the affirmation. It lies in the relationship between the *speaker*—God, who becomes known to us only with this affirmation, and who, aside from this affirmation, does not exist, because God does not want to exist for us otherwise—and the *listeners* in their situations within their personal life histories and the world's history (Bayer 1994, 447).

Every person on that ground has the freedom to believe in the image of God as just another story. If not taken literally but as a symbol, the image of God then supports our intuitive self-understanding in three main points:

Humans Are God's Partners. We experience ourselves as persons, individuals who are special. The image of God as performative supports this self-experience. However, it is not a definition of humankind. It is the symbol of God's promise to humans by which God elects us as partners. In humankind God has created beings God can talk to, beings who listen and answer (Westermann 1986, 22). The concept of the image of God is not proof of human uniqueness but tells an effective story about every person's value and dignity.

Humans and Animals Are Equal. We intuitively experience ourselves as distinct from all nonhumans and attempt to draw lines between ourselves and animals. This sense is supported in Genesis 1, where the only content of the image of God is found in its task: human dominion over the earth. This sentence has often been taken as justification for exploitation and destruction of nonhuman creation. But in the light of God's promise, we might interpret these words differently: in being created in the image of God, humans were assigned responsibility. Human

dignity and responsibility cannot be separated from each another (Westermann 1986, 22). Humans are the rulers, but only so long as their rule serves the ruled and not themselves. Dominion is understood more as an obligation and responsibility in Gen. 1:28–29: Humans and all other living beings need food and all of them get their food from God. Humans, then, play a much greater role in creation when understood as a part of creation than is allowed under a literal understanding of creation. If we interpret humans as an integrated part of creation, the nonhuman creation gets its own value and dignity. The creation of humanity "has a retroactive significance for all nonhuman creatures; it gives them a new relation to God" (von Rad 1961, 58).

Humans Need Community. The last understanding we are given of the image of God is that it was given to man *and* woman. The Hebrew text is difficult to translate into English, but it says that God creates a human (a singular form) as man *and* woman; both together are an image of God. In the creation story of Gen. 2:4–25, God says, referring to Adam, "It is not good that the man should be alone" (Gen. 2:18). Humans are consequently created as social beings.

To summarize, the biblical story of creation tells us a story about ourselves. It gives reason for our intuitive understanding of ourselves, for human dignity and personhood. It reminds us that we are part of creation and responsible not only for our neighbors but also for the nonhuman creation, which received dignity as well. We are finally reminded that only in community can we live up to these expectations, because we reach the peak of who we are only within society.

Conclusion: Humanoids as Part of God's Creation

If the Image of God is understood as a story, Embodied AI does not contradict the points revealed in the biblical story of creation. Quite the contrary: If we take both Cog and the performative of the image of God as existential stories, they are mutually enriching and together create new perspectives on human reality, human dignity, and the meaning of life.

To summarize the stories, Cog and the image of God tell us about ourselves: I have argued elsewhere (Foerst 1996a) that the mechanistic anthropology assumed in cognitive science and found in the Cog project promises to rationalize many human ambiguities and sorrows and therefore explain them away; if we could be analyzed completely and reduced to mere mechanical entities, most of the problems of humankind could be solved. All diseases could be overcome and every painful psychological problem could be treated properly. Most suffering could be resolved because the reasons could be analyzed completely and any suffering properly treated. This is the promise of cognitive science research that makes

so many people endorse this understanding of themselves. It is also the reason why so many people oppose the research, because it reduces humans to mere machines.

Although the mechanistic anthropology assumed in the Cog research seems to contradict concepts like *personhood* and *dignity*, Cog, like many other projects of cognitive science, can be understood as a story telling us something about the underlying mechanisms that make us the beings we are. It tells us the story of who we are from a functionalist point of view. Thus, it might help us to analyze our mechanisms, develop cures for diseases and mental illnesses, and create strategies for dealing with problems of human integrity and interaction. And the Cog research with its underlying anthropology might give us some consolation for suffering, because it explains it in mechanistic terms and thus explains it away.

However, the Cog research does not tell us an exclusive story but leaves room for our intuitive self-understanding. Because the image of God tells us a story about our creation and our biological system, we are free to accept its mechanisms and grateful for the gift of being created in God's image. We can see our mechanisms and our dignity at the same time.

Realizing the difficulties emerging in the construction of Cog and facing the fact that every newborn has more abilities than Cog has so far, we can gain new respect for the wonders of the complex human machinery. All the difficulties arising in the Cog project and the likelihood of its failure lead to new respect for the human being.

The image of God does not distinguish us qualitatively from animals and for that reason cannot distinguish us qualitatively from machines. Research such as that on Cog can make us modest because it demonstrates many of our features through functionalist methods and illuminates all the mechanisms we share with other biological systems. In doing so, it can teach us the right understanding of *dominion* as a caring and respectful life shared with animals in one world.

Cog is a creature, created by us. The biblical stories of creation describe us and all living beings as creatures created by God. On that ground, God's creative powers are mirrored in Cog. The Cog project also tells us a story about the human creative powers that are a part of the image of God. The Cog project does not necessarily have to be understood as a hubristic attempt to be like God but can be seen as a result of our God-given imagination and courage to create something new.

The Cog research then can explain our fascination with complex technologies and is an ambitious example of the human drive toward the impossible. It also mirrors the human desire for knowledge about ourselves, which is rooted in faith and trust. The confirmation type of dialogue between religion and science, the fourth of the types described

above, confirms this trust and might free researchers in such projects as Cog to recognize the existential stories on which their research is founded.

Finally, the Cog research can tell us something about ourselves if we analyze the emotions that emerge in its context and if we analyze people's reactions to it. Why do some people find the research fascinating and through it try to learn something about themselves? Why has it always been a dream of humankind to rebuild itself? On the other hand, why do most stories about successful attempts to create an android contain a moment in which the man-made creature rebels against its creator and often destroys him?[8] Why do we become anxious if we see a machine which looks a little bit like us and behaves anthropomorphically?

If the image of God and Cog are both taken seriously and conceived of as stories about ourselves, both reveal their symbolic character. These stories point beyond themselves and open up realms that would otherwise be closed to us. The Cog research alone could only talk about human mechanisms; in the context of creation it tells the story of the wonders of personhood and dignity and of the performative of the image of God. The image of God alone could only talk about human uniqueness and specialness; in the light of the Cog research it points to our functionalist system, to our biological dependency, and to our finiteness, which motivates us to start such ambitious projects. Together they enrich each other and create a new perspective on human reality.

NOTES

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1. It seems important to explain my use of the terms *religion* and *theology*. The word *religion* has been so broadly used that it makes the word *theology* less accessible to the discourse which has surrounded the interrelationship between the two fields. In this paper, however, I use *theology* in a more specialized sense, to represent a particular approach to the study of religion—that of the Judeo-Christian approach to religious scholarship. This reduction is not at all ideological but results from my background and education. I hope that others will broaden my quest with approaches from other religions' viewpoints.

2. Ian G. Barbour (1990) first described the four possible ways in which science and religion can be related to each other. John F. Haught (1995) later modified the typology. In the following summary I follow Haught because his alliterative names for the four types are more mnemonic.

3. Often quoted in this context is Karl Barth. He writes in the introduction to the third part of his *Church Dogmatics*—his work on creation—that he would not deal with scientific questions on creation. He says that for the understanding of creation within the context of the Bible and the Christian church, science cannot present any comments, questions, or support. Science must have its own free room beyond the Christian story of creation and creator. Theology must be free, whereas science, which wants only to be science and not to have any hidden religious doctrine, has its given boundaries (Barth 1945).

4. René Descartes (1596–1650) is usually understood as the father of the subject-object separation which initiated the rise of modern, empirical science (cf. Damasio 1994).

5. It is generally accepted within Hebrew Scripture scholarship today that the two creation stories were written about 300 years apart. Mainstream exegetic research today understands the Pentateuch as consisting mainly of three layers. J (for JHWH, the name of God), the oldest layer, was written around 800 BCE, around the time of Solomon. The J account starts in Gen. 2:4 with the story of Adam and Eve. Another layer, known as E because it uses *Elohim* for *God*, then edited J. The youngest layer is P, named after a group of priests who during, or shortly after, the Babylonian exile gave the Pentateuch its present form. They included the first creation story in Genesis 1, into which some Babylonian scientific knowledge has been integrated.

6. Rudolf Bultmann's attempt to demythologize the New Testament (Bultmann 1957, 1985) can be seen in this context. As he tried to reveal myths in the gospels, he came to an existential understanding of most texts. One example is the story of Jesus walking over the water (Mark 6: 45–51); Bultmann claimed that the water was a myth of chaos which cannot be controlled. The Gospel, then, does not describe a miracle but tells a story about Jesus conquering chaos and uncontrollable forces. The same trend can be seen in parts of Hebrew Scripture scholarship. Many theologians inquire whether the Scriptures were meant as mere descriptions of history (Gunneweg 1978, 1989) and show to what extent even genealogical texts present a specific theology (Oeming 1990).

7. The appearance of Cog and its progress can be viewed on its web page, http://www.ai.mit.edu/projects/cog/.

8. So far I have not come across any story in which the Creator is actually a woman.

REFERENCES

Athanasiou, T. 1985. "Artificial Intelligence: Cleverly Disguised Politics." In *Compulsive Technology: Computer as Culture*, ed. T. Solomonides and L. Levidow, pp. 13–35. London: Free Association Books.

Austin, John L. 1975. *How to Do Things with Words: The William James Lectures 1955*. 2d ed. Cambridge: Harvard Univ. Press.

Barbour, Ian G. 1974. *Myths, Models, and Paradigms: The Nature of Scientific and Religious Language*. London: SCM Press.

_____. 1990. *Religion in an Age of Science: The Gifford Lectures 1989–1991, Vol. One*. San Francisco: HarperCollins.

Barth, Karl. 1945. *Kirchliche Dogmatik III*. Vol. 1. Zollikon-Zürich: Evangelischer Verlag.

Bayer, O. 1994. *Theologie*. Gütersloh: Gütersloher Verlagshaus.

Berger, P. L., and T. Luckmann. 1966. *The Social Construction of Reality*. Garden City, N.Y.: Doubleday.

Brooks, R. A. 1990. "Elephants Don't Play Chess." *Robotics and Autonomous Systems* 6: 3–15.

_____. 1991. "Intelligence without Representation." *Artificial Intelligence* 47: 139–59.

Brooks, R. A., and L. A. Stein. 1994. "Building Brains for Bodies." *Autonomous Robots* 1: 7–25.

Brooks, R. A., and Luc Steels, eds. 1995. *The Artificial Life Route to Artificial Intelligence: Building Embodied, Situated Agents*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Bultmann, R. K. 1957. *The Presence of Eternity: History and Eschatology. The Gifford Lectures 1955*. New York: Harper.

_____. 1985. *Neues Testament und Mythologie: das Problem der Entmythologisierung der neutestamentlichen Verkündigung*. 2d ed. Munich: Chr. Kaiser.

Cranzel, H. "Bild Gottes." *Theologische Realenzyklopädie*, vol 6: 499–502.

Damasio, A. R. 1994. *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Avon.

Dreyfus, H. L. 1979. *What Computers Can't Do: The Limits of Artificial Intelligence*. 2d ed. New York: Harper and Row.

Feldmann, J., and E. A. Feigenbaum. 1963. *Computers and Thought*. New York: McGraw-Hill.

Foerst, Anne. 1996a. "Cog das Roboterbaby." *Wechselwirkung* 18 (August): 22–27.

_____. 1996b. "Artificial Intelligence: Walking the Boundary." *Zygon: Journal of Religion and Science* 31 (December): 681–93.

Goldstein, E. B. 1989. *Sensation and Perception*. 3d ed. Belmont, Calif.: Wadsworth.
Gunneweg, A. H. J. 1978. *Understanding the Old Testament*. London: SCM.
_____. 1989. *Geschichte Israels: Von den Anfangen bis Bar Kochba und von Theodor Herzl bis zur Geagenwart*. 6th ed. Stuttgart: Kohlhammer.
Haught, J. F. 1995. *Science and Religion: From Conflict to Conversation*. New York: Paulist Press.
Hefner, P. 1993. *The Human Factor: Evolution, Culture, and Religion*. Minneapolis: Fortress Press.
Kanizsa, G. 1979. *Organization in Vision: Essays on Gestalt Perception*. New York: Praeger.
Kuhn, T. S. [1962] 1996. *The Structure of Scientific Revolutions*. 3d ed., including Postcript. Chicago: Univ. of Chicago Press.
Lakoff, G., and M. Johnson. 1980. *Metaphors We Live By.* Chicago: Univ. of Chicago Press.
Latour, B., and S. Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton, N. J.: Princeton Univ. Press.
Maturana, H. R. 1970. *The Biology of Cognition*. BLC Report 9.0. Urbana: Univ. of Illinois Press.
Maturana, H. R., and F. J. Varela. 1987. *The Tree of Knowledge: The Biological Roots of Human Understanding*. Boston: New Science Library.
Oeming, M. 1990. *Das wahre Israel: die "genealogische Vorhalle" 1 Chronik 1–9*. Stuttgart: Kohlhammer Verlag.
Peters, A. "Bild Gottes." *Theologische Realenzyklopädie*. vol. 6: 506–15.
Scheffczyk, L. 1990. *Dualismus versus Dualität: Aspekte neuzeitlicher Weltbetrachtung*. Freiburg and Munich: Karl Alber Verlag.
Schmidt, S. J., ed. 1987. *Der Diskurs des radikalen Konstruktivismus*. Frankfurt: Suhrkamp Verlag.
Snow, C. P. 1964. *The Two Cultures and a Second Look*. Cambridge: Cambridge Univ. Press.
Tillich, P. 1957. *Dynamics of Faith*. New York: Harper.
Varela, F. J. 1993. *Kognitionswissenschaft—Kognitionstechnik: Eine Skizze aktueller Perspektiven*. Frankfurt: Suhrkamp Verlag.
von Rad, G. 1961. *Genesis: A Commentary.* Philadelphia: Westminster Press.
Watzlawick, P., ed. 1984. *The Invented Reality: How Do We Know What We Believe We Know? Contributions to Constructivism*. New York: Norton.
Westermann, C. 1986. *1 Mose.* Vol 1. Neukirchen-Vluyn: Neukirchen Verlag.