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INNATENESS, CHOICE, AND LANGUAGE

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Throughout his writings, Chomsky raises questions about human knowledge and freedom: What do we know, and how does our knowledge arise? Why do we act as we do, and how do we choose our actions? He offers strongly contrasting views of the progress of science in answering these questions. Although linguists and other cognitive scientists have made headway in understanding human knowledge, especially knowledge of language (e.g., Chomsky 1975), we have not even begun to understand how humans choose their actions (e.g., Chomsky 1988). In Chomsky's writings, knowledge of language and freedom of action are treated as distinct and separate problems. I believe, however, that there is a thread that connects them.

There is a tension in our conceptions of human action. On the one hand, we see ourselves and others as capable of choosing our actions and therefore as accountable for the choices we make. On the other hand, we see people's actions as shaped by the past, both by evolution and by past experience. This tension raises a question: if all our actions are shaped by our individual and collective history, how can people freely choose any course of action?

Studies of human cognitive development focused on the origins and growth of human cognitive capacities seem to suggest that true choice is not possible. These studies, I hope, will help tease apart what is constant versus what is changing over human development, what is universal versus what is variable across human cultures, and what is unique to humans versus what is shared by other animals. It looks, however, as if the answers psychologists give to these questions may obscure rather than clarify our human capacity for freely chosen action.

In the early years of experimental psychology, the dominant theory of human development rooted virtually all human cognitive achievements in a single capacity to associate co-occurring experiences (see Gallistel's contribution to this volume). This general learning capacity, together with our sensory apparatus, was thought to be innate; almost everything else was thought to be learned. According to associative-learning theory, people learned everything in the same way, from elementary perceptions of depth to concepts of number and ideas of virtue. Our learning processes, moreover, were the same as those of other animals, although humans learned more. The paradigm experiments in this tradition were conducted on animals, for example Pavlov's dogs, who learned to salivate upon hearing a bell that had previously been paired with food, or Thorndike's cats, who learned to press a lever that opened a lock and released them from a cage. Experimental psychologists showed that humans sometimes exhibit the same effects, salivating to a photograph of Oreos or pushing levers that deliver candy and other rewards.

Followers of this perspective are apt to conclude that the capacity for free choice doesn't exist, because people's actions depend entirely on their learning history. We would be mistaken to think that a criminal is morally responsible for her crime, from the perspective of associative-learning theory, because her criminal actions, like all her actions, are determined by her past experience. If anyone were to blame for her crime, it would be her teachers and parents—and they didn't choose their actions either. If human thoughts, values, and actions are wholly determined by learning history, then notions of freely chosen action and personal responsibility are illusions.

Over the last fifty years, the tide has turned against this view of human development, thanks in large part to the revolution that Chomsky's work initiated. It has been supplanted, for many psychologists, by the view that perception, thought, values, and actions depend on domain-specific cognitive systems, both in humans and in other animals. Each system has its own innate foundations and evolutionary history, and each system functions to treat specific kinds of information for specific purposes. The best-known example is the language faculty: an innate, special-purpose system with a distinctive internal mode of operation and a distinctive developmental course.

The language faculty is unique to humans, but many other faculties are shared by humans and other animals. A paradigm case of a special-purpose cognitive system was discovered by John Garcia in research with rats (e.g., Garcia and Koelling 1966). Garcia allowed rats to drink a liquid with a particular flavor (say, anise), which was delivered by a flashing, buzzing tube. Drugs or x-rays, unseen by the rats, then were used to make the rats nauseated. From one such experience, the rats learned to avoid the drink with the anise flavor, but they never learned to avoid the flashing, buzzing tube.

In contrasting experiments, other rats were given a shock after drinking the same liquid from the same tube. These rats learned to avoid the tube but not to avoid the anise-flavored drink. These findings suggest that rats have one system for learning about the edible properties of substances and a second system for learning about the mechanical properties of objects. Because these systems are separate, rats cannot learn to relate a food's taste to shock or an object's behavior to nausea. Psychologists are apt to give an evolutionary explanation for these special-purpose learning systems. In the environments in which rats evolved, for example, nausea tends to be caused by substances with characteristic odors and tastes, not by objects with characteristic lights and sounds. Rats' domain-specific food learning mechanism likely was shaped by this constraint.

One interesting discovery of the last few decades is that many of the special-purpose cognitive systems found in animals exist in humans; the "Garcia effect" provides an example (Rozin, Haidt, and McCauley 2000). If you get sick after eating creamed corn in a blue dish with Dennis, who is about to succumb to an intestinal flu, Dennis is the most likely cause of your sickness. Nevertheless, you may come to feel queasy, in the future, at the thought of corn, but you are unlikely to feel queasy at the thought of Dennis or the blue dish. Like rats, humans are predisposed to learn about certain environmental relationships over others.

More recent research provides evidence for other special-purpose cognitive systems both in animals and in humans (Spelke 2003a). One system serves to represent material objects and their mechanical interactions (e.g., Scholl 2001). A second system serves to represent persons as sentient beings whose actions are directed to goals (e.g., Woodward 1998). A third system serves to represent number and the operations of arithmetic (e.g., Dehaene 1997). A fourth system, to which I will return, serves to represent spatial layout for purposes of navigation (Jeffery 2004).

These findings accord with the view that human actions depend on a collection of innate, domain-specific, core knowledge systems: systems for reasoning and learning about food, systems for perceiving and learning about objects, systems for learning and using language, and the like. Many of these systems evolved before humans did, although language clearly is an exception.

Does this view shed light on human freedom and responsibility? Apparently not. Modern evolutionary psychology seems to leave as little room for freely chosen action as associative-learning theory did. If our evolutionary history determines our actions, we would seem to be predestined to repeat the actions of our ancestors. This sense of predestination may explain why many people resist evolutionary psychology or evolutionary theory in general. If natural selection has shaped men to dominate women, shaped groups of people to be aggressive to members of other groups, or shaped step-parents to harm step-children, people would appear to have no choice but to act in these ways.

In brief, psychology and cognitive science offer two notions—general-purpose learning and innate, domain-specific faculties—that both seem to undermine notions of human freedom and responsibility. But do these notions bear that weight? To introduce my own approach to this issue, let's return to the Garcia effect and consider a gap in the preceding account.

Rats, I suggested, learn to avoid a particular flavor but not a particular feeding tube after becoming ill because they have a core cognitive system that lets them think *this food made me sick* but not *this tube made me sick*. Humans, I suggested, share this core system. It is patently *not* true, however, that humans can't think the thought *this tube* [or *person*, or *plate*] *made me sick*. Possibly in contrast to rats, we can think all these thoughts. Although the sight of a particular person may never make us feel nauseated, the thought that the person has a contagious disease may lead us to choose to keep our distance.

If human cognition depends on a collection of core knowledge systems, how can one understand this capacity for freely assembling thoughts into new combinations? Linda Hermer-Vazquez, Anna Shusterman, and I have tried to approach this question by studying the development of this capacity in children, focusing on some learning tasks that are logically similar to Garcia's, although they differ in detail. I consider one of these tasks here.

We have studied adults and children as they perform tasks developed by Ken Cheng, C. R. Gallistel, Richard Morris, and other comparative psychologists for studies of navigation in rats and other animals. Their studies have revealed two distinct core systems subserving navigation and spatial memory in nonhuman animals. First, animals can learn to locate a hidden object by searching directly at a movable, visible landmark. If food consistently is hidden next to a white cylinder that is moved around a closed chamber from trial to trial, for example, rats learn to search for the food at the cylinder (e.g., Biegler and Morris 1996). Second, animals can learn to reorient themselves and locate a hidden object by recording the position of the object within a purely geometric representation of the environment. For example, if a hungry rat is placed in a rectangular, closed chamber, sees food hidden just to the left of a long wall, and then is disoriented, the rat will reorient himself by the shape of the enclosure and search for food to the left of one of the two long walls (Cheng 1986).

Rats, however, show no ability to combine information from these two systems. If one of the two long walls in the above experiment is painted white, for example, rats will ignore this lightness cue and search equally to the left of the long black and white walls (Cheng 1986). Rats evidently can represent the location of food as "at the white cylinder" or as "left of the long wall" but not as "left of the white wall." The last thought is unthinkable, Cheng and Gallistel suggest, because it requires a combination of information stored in separate cognitive systems.

To explore the capacities that allow humans but not rats to form such combinations, we have adapted Cheng's task for children and adults. We have built human-sized rooms similar to those used with rats, in which we hide a toy in one of various locations and then disorient the child or adult by slowly turning him or her with eyes closed. When children are then asked to find the toy, those ranging in age from eighteen months to four years perform very similarly to rats (Gouteux and Spelke 2001; Hermer and Spelke 1996; Wang, Hermer, and Spelke 1999). In a rectangular environment, for example, children readily find a toy hidden directly at a blue wall or to the left of a long wall, but they show no ability to combine geometric and color information to find a toy hidden left of a blue wall. Further studies have revealed that children's performance in this task shows all the signature limits of the performance of rats. These findings suggest that homologous cognitive systems underlie reorientation in rats and human children (Wang and Spelke 2002).

Human adults, in contrast, solve all of our reorientation tasks with ease: they can quickly find an object hidden left of a blue wall or in any other relation to any arbitrary landmarks (Hermer and Spelke 1996). Developmental studies provide evidence that this ability emerges in synchrony with the development of spatial language: especially the mastery of spatial expressions involving the terms "left" and "right," which occurs at about six years of age (Hermer-Vazquez, Moffett, and Munkholm 2001).

Further studies provide more evidence that flexible navigation is linked to natural language. In one set of studies, adults were tested under conditions of verbal interference (Hermer-Vazquez, Spelke, and Katsnelson 1999). While they participated in Cheng's reorientation task, they listened to a tape-recorded prose passage and repeated it continuously, word for word. While performing this "verbal shadowing" task, adults appeared to lose the ability to combine geometric and nongeometric information, and they performed instead like rats and young children. Their performance contrasted with that of a separate group of adults, who performed a nonverbal "rhythm shadowing" task by listening to a tape-recorded percussion sequence and repeating the sequence by clapping. During rhythm shadowing, adults continued to combine geometric with nongeometric information. These findings suggest that natural language serves not only in the construction of new spatial concepts but in their active use.

Finally, training studies are beginning to suggest that the performance of four-year-old children can be enhanced by teaching them the appropriate spatial language (Shusterman and Spelke 2004; Shusterman, Lee, and Spelke forthcoming). Although children of this age typically reorient only in accord with the geometry of the surrounding layout, those who have been trained to use and understand spatial expressions such as "raise your right hand" and "give me the car on your left" are more apt to perform like adults. They combine geometric and nongeometric information to guide their search for objects.

All these findings suggest that humans come to combine together information that is represented separately in the minds of human infants and nonhuman animals and that the acquisition and use of a natural language underlies this accomplishment. Because a natural language is first and foremost a combinatorial system, it may serve as a medium for constructing new concepts once words and expressions are linked to representations from multiple core systems (Spelke 2000, 2003b). These combinations, in turn, make available a new range of potential actions.

Findings such as these suggest a different picture of human cognition and action. Indeed, humans are endowed with a set of core knowledge systems, each with its own evolutionary history. These systems may give us the building-block concepts—like *food*, *plate*, *person*, *long*, *left*, and *blue*—that we assemble into thoughts. But humans also have a further cognitive system that is unique to our species: the language faculty. As children learn a natural language, this system may allow them freely to combine their existing concepts and form new ones.

Although the concepts and thoughts provided by core knowledge systems may be limited and fixed, the concepts humans construct with our combinatorial system are more numerous and flexible, and they are not directly constrained by our evolutionary history. Concepts like *food in a blue dish* or *left of a blue wall* may have been useless to ancestral humans, and we do not appear to have evolved any domain-specific cognitive system that expresses them. Our combinatorial capacity nevertheless makes these concepts, and indefinitely many other concepts, available to us. Humans therefore can act by choosing among the options made available by the combinatorics of natural language; we are not limited either to the options expressible within one or another core knowledge system or to the combinations that we can build through slow, piecemeal associative learning. Untrained nonhuman animals and prelinguistic infants may not be able to choose to avoid food in a particular container or to find an object left of a white wall, but older children and adults can and do make these choices.

The existence of a combinatorial, natural-language faculty that serves to combine previously encapsulated representations does not explain how people choose their actions. As Chomsky has argued, free will remains a mystery (e.g., Chomsky 1988). It is even possible that the combinatorial operations of natural language provide inherently inappropriate tools for understanding our capacity to act freely (McGinn 1993). Nevertheless, the combinatorial power of natural language leaves more room for choices that are unconstrained by our history (either in evolutionary or ontogenetic time) than either associationist or evolutionary psychology would seem to grant. Even if some actions depend on automatic processes of associative learning, as traditional learning theorists proposed, people's thoughts and choices are not limited by associative processes. A child with a language faculty and a finite stock of words can produce and understand an indefinitely large set of expressions that she has never learned, by association or otherwise. And even if humans have evolved cognitive systems that predispose us to act in certain ways, as evolutionary psychologists propose, no person of normal competence is compelled to act in accord with these predispositions. Instead, people can formulate an indefinitely large number of possible courses of action, most of which are not favored by any evolved, special-purpose systems, and they can choose which course to pursue.

Of course, mature human choices are subject to bias, because our learning history and evolutionary history will tend to predispose us to certain actions over others. For example, the finding that verbal interference leads adults to navigate like children and rats suggests that the building-block concepts and behavior patterns provided by core knowledge systems are automatic and resilient, whereas the new concepts that we construct by combining core representations are tenuous, effortful, and dependent on language use. Humans nevertheless can exercise our combinatorial capacity and move beyond both our evolutionary and our learning history.

With this ability come moral obligations. The capacity of normal, mature humans to combine information in new ways that go beyond the limits both of our evolved, special-purpose cognitive systems and of our associative-learning capacities supports our sense that we are accountable for our actions. The absence of this capacity in other animals, and its limited presence in very young children, may support our sense that animals and children are not fully responsible moral agents.

In summary, the capacity to combine core concepts freely and productively may give humans a range of choice far beyond what either our learning history or our evolutionary history would seem to allow. Central to this capacity, I believe, is the faculty for natural language that Chomsky's work elucidates. If exercise of this faculty carries us beyond the limits both of innate and of learned concepts, then the study of language may speak to Chomsky's longstanding, distinct concerns for human knowledge and freedom.

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