

The knowledge problem, determinism, and *The Sensory Order*

Adam Gifford Jr.

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Abstract The arguments presented in Hayek's *The Sensory Order* suggest that the mind/brain is a decentralized spontaneous order. The decentralized nature of decision-making and the central role of classification in perception, cognition, and action, are solutions to the knowledge problem that confronts the system. The nature of this decentralized complex system suggests that the ordering is deterministic and that free will in the sense of a decision-maker being able to stand outside the circle of cause and effect is an illusion. If determinism is correct, how can we hold individuals responsible for their actions? It is argued that the evolution of responsibility, blame and credit are the products of a second Hayekian spontaneous order. Responsibility and the allocation of credit and blame are part of an implicit social contract that facilitates cultural evolution, political freedom, and economic growth. It is responsibility, not the existence of free will, that makes freedom possible.

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In *The Sensory Order* (1952), Friedrich Hayek argued that the mind/brain was a spontaneous order. If he is correct, then like a market economy, the brain has no central-planner—there is no “ghost in the machine,” no utility function in the machine. In traditional economic models, choice results from conscious reason and deliberation, clearly a central-planning view of brain function. Hayek's proposal that the brain is a complex system functioning as a decentralized spontaneous order is shared today by many neuroscientists (for example, Calvin, 1996; Dennett, 1991, 1996; Edelman, 1992, Edelman and Tononi, 2000, Fuster, 1995; Franklin, 1996, Koch and Crick, 2001; Koch, 2004). However, a decentralized model leads logically to the

A. Gifford Jr. (✉)
Department of Economics, California State University, Northridge, CA 91330-8374, USA
e-mail: adam.gifford@csun.edu

question: “If the brain contains many parallel modules and relatively autonomous subsystems, how can it avoid the conflicts and discoordination typical of [many] decentralized systems?” (Donald, 1991: 57). This question is reminiscent of the socialist calculation debate and, interestingly, recent research suggests that when an individual tries to use a central-planning approach to consciously make complex decisions the outcome can be less satisfactory than decision-making that relies on nonconscious spontaneous mechanisms (Dijksterhuis et al., 2006). As with central planners in an economy, the conscious mind faces a knowledge problem, in part, because “conscious thought suffers from the low [information] capacity of consciousness. . .” Dijksterhuis et al. (2006: 1006). In the brain, specialized areas contain specialized but decentralized knowledge that is coordinated by neural mechanisms in a manner similar to that done by markets and prices in an economy.

Neuroscientist Edmond Rolls discusses the workings of some of the neural coordination mechanisms. He considers that the “[o]peration of the brain to evaluate rewards and punishers is the fundamental solution of the brain to interfacing sensory systems to action selection and execution systems. Computing the reward and punishment value of sensory stimuli, and then using selection between different rewards and avoidance of punishments in a *common reward-based currency*, appears to be the fundamental design that brains use in order to produce appropriate behavior” [emphasis added] Rolls (1999: 5). Various components of the brain’s emotional systems assign value, maintain emotional and value memory, adjust marginal value in response to current consumption, and change associated value as a result of the adaptive learning that results from the body’s interaction with the environment—all processes that facilitate the ordering of the decentralized system. “[E]motion binds together virtually every type of information that the brain can encode” Watt (1998: 5). We learn how various activities and goods satisfy basic goals, and in the process value is attached to those activities and goods. Further, the values attached to goods behave like marginal values in that, in a given period of time, they decline with consumption (Rolls, 1999; Tremblay and Schultz, 1999; Gottfried et al., 2003).

If our decisions and our behavior are the product of the neural coordination of distributed knowledge embedded in specialized areas of a physical brain, and these coordination mechanisms as well as the knowledge are products of both our ontogenetic and phylogenetic histories, then it seems that we have a deterministic system that rules out the possibility of free will.¹ Furthermore, determinism seems to rule out moral responsibility since our choices are completely predetermined. Historically, Austrians reject determinism. Popper and Mises both believed in forms of Cartesian dualism, so that the nonphysical nature of the mind breaks the physical system/determinism link. Others, such as Buchanan, also reject determinism, presumably because they see it as a necessary condition for moral responsibility, personal autonomy, and political freedom.² Here, I will argue that modern neuroscience supports determinism, but that

¹ Free will as used here is what philosophers somewhat confusingly call libertarian free will, which is a form of free will based on an assumption of indeterminism in which the decision-maker is truly free to stand outside the circle of cause and effect. Libertarianism in this sense of the word has nothing to do with political and economic libertarianism.

² See Gordon (1993); also a search for free will on the mises.org site suggests an Austrian commitment to the notion of free will.

a rejection of the standard notion of free will does not rule out personal autonomy, moral responsibility, or freedom in any meaningful sense. Interestingly, Hayek does not reject determinism. In the last section of *The Sensory Order* he states: “It may be noted in passing that these considerations also have some bearing on the age-old controversy about the ‘freedom of the will’. Even though we may know the general principle by which all human action is *causally determined by physical process*, this would not mean that to us a particular human action can ever be recognized as the necessary result of a particular set of physical circumstances” [emphasis added] Hayek (1952: 193). In other words, the fact that we live in a deterministic world does not mean we can predict human action in any finely detailed manner or that we can micromanage human behavior in a way suggested by either behavioralists or socialists.

Part of the difficulty with the idea of determinism comes from assertions such as that by Green and Cohen (2004: 1777): “Intuitively, the idea is that a deterministic universe starts however it starts and then ticks along like clockwork from there. Given a set of prior conditions in the universe and a set of physical laws that completely govern the way the universe evolves, there is only one way that things can actually proceed.” I will argue that this fairly typical approach to determinacy is misleading, but first, a brief examination of *The Sensory Order* will prove helpful to understanding the knowledge problem, determinism, and free will.

The Sensory Order

In *The Sensory Order*, Hayek pioneered ideas about the nature of and functioning of the brain. In the words of neuroscientist Joaquín Fuster,³ Hayek was:

[t]he first proponent of cortical memory networks on a major scale. . . . Hayek presents his concept of a cortical memory network in the context of the main topic, which is not memory but, significantly, perception, perception as the *source* memory and as a *product* of memory [where] perception is an *act of classification* [—furthermore] [a]ll perception is categorical in that it is an interpretation of an object or event made in the light of past experience by the network. How is the [network] formed? . . . Sensory impulses from different sources arriving simultaneously in two or more neurons will, possibly by circulating activity modify the synapse between them, such that subsequent arrival of one impulse will activate all the neurons activated together (Fuster, 1995: 87–88).

In fact, we perceive, acquire knowledge, think, and plan our actions with our memory, and importantly, though not emphasized here by Fuster, we avoid Lockeian empiricism because that memory includes not just the accumulated memory of the individual

³ Fuster, who stated in the introduction of his book *Memory in the Cerebral Cortex* (1995), that “high on the list of my sources of inspiration is the late Friedrich von Hayek (1899–1992), in my opinion the first and unrecognized pioneer of cortical network theory” (1995: x), is himself a pioneer in the development of our understanding of the nature and function of short-term memory, now often called, using computer science terminology, working memory.

but the memory of the species as well (Hayek, 1952: 53). The acquisition of new knowledge and the process of thinking and planning change the cortical networks, and this forms the basis of subsequent rounds of knowledge acquisition, thinking, and planning.

Hayek believed that *The Sensory Order* filled a major gap in our understanding of the role of knowledge in society—how it is acquired and actuated in the brain—and also that in the process of filling that gap he would consign behavioralism to the scrap heap of history⁴ (Caldwell, 2004). Furthermore, as stressed by Loasby, Hayek’s neural classification system is “‘subjective’ rather than ‘objective’.... [so that] [t]he characteristic Austrian emphasis on subjectivity therefore has a psychological, indeed biological, basis” Loasby (2004: 103). In fact, the classification system is deeply subjective—it functions at a “below conscious level.” However, two possible criticisms of Hayek’s approach are that: (1) the theory is not really about how consciousness comes about—something we still don’t know—but how the brain works, and (2) it focused primarily on perception and slighted behavior. In the intervening years since *The Sensory Order*, neuroscience has made significant progress in understanding how we perceive, think, acquire knowledge, and plan our actions with both our phylogenetic and ontogenetic memories. Additionally, progress has been made in our understanding of the division of labor between conscious and nonconscious functioning of the brain. A more complete understanding of the function and the role of classification in human action shows that the actual decision processes function at a nonconscious level.

This raises a question: If decisions are made at a nonconscious level, is consciousness entirely out-of-the-decision-making-loop? In fact, a modern understanding of classification and the spontaneous functioning of the brain suggest several things. One is that consciousness is not out-of-the-loop in the production of human action; it does not produce the actual decisions, but rather *facilitates* those decisions by way of the information that conscious processes make available to the decentralized decision-making mechanisms. Second, free-will in the sense that an agent can stand outside the circle of cause and effect does not exist. And a modern understanding of the gene/culture coevolution of human cognition suggests that, in a deterministic world, as suggested by Dennett, “holding people responsible is the best game in town” Dennett (1984: 162). Two Hayekian spontaneous orders are invoked in addressing these issues: the ordering of perception, cognition, and action planning from *The Sensory Order* and the spontaneous cultural evolutionary process of Hayek’s epilogue to *Law Legislation and Liberty, III*. But first, we will examine the limits of determinism and the role of consciousness in human action.

⁴ Interestingly, some of the arguments that actually helped to undermine behavioralism were made by Noam Chomsky with regard to language; see, for example, Chomsky (1965). These arguments were very similar to those in *The Sensory Order*. Chomsky took the position that language capacity and learnability required a built-in neural substrate of memory. Though, in Chomsky’s view, this memory was primarily phylogenetic, more recently, others (e.g., Tomesello, 1999, 2003) have shown that the necessary memory for not only language, but perceiving, learning in general, thinking, and action planning is a product of both the evolution of species and the individual. In other words, language learning or any other complex learning cannot be the result of simple stimulus and response learning as argued by behaviorists, because it involves an act of classification.

Determinism, free will, and the nature of consciousness

Although determinism implies that at any point in time all of our actions are determined by “antecedently sufficient causal conditions,” following Dennett, determinism does not imply inevitability.

First, many thinkers assume that determinism implies inevitability. It doesn't. Second, many think it is obvious that *indeterminism*—the denial of determinism—would give us agents some freedom, some maneuverability, some elbow room, that we couldn't have in a deterministic universe. It wouldn't. Third, it is commonly supposed that in a deterministic world, there are no real options, only apparent options. This is false (Dennett, 2003: 25).

Determinism does not imply inevitability because both biological and cultural evolution⁵ in addition to learning, allows agents to avoid hazards that they could not avoid without these processes. Consider, for example, individuals who have quit smoking or who never started in the first place because of research that has shown smoking to be harmful to one's health.

To understand the meaning of determinism, it is useful to consider the implications of *indeterminism*. Wegner does this by imagining what it would mean to install a mechanism that he calls a “free-willer” into an agent. “If we put a module that creates actions out of any sort of past experiences or memories, that fashions choices from habits or attitudes or inherited tendencies, we don't get freedom—we get determinism. The Free-Willer must be a mechanism that is *unresponsive to any past influence*. . . . In essence, any such system makes sense only if it inserts some fickle indeterminacy into a person's actions” Wegner (2002: 322–323). The opposite of determinism, then, is totally nonpurposeful random behavior, and according to Dennett (1984) this is not a variety of free will worth having. Finally, accepting determinism does not change the options available; in fact, ongoing cultural evolution continues to make more and more options available.

A form of libertarian⁶ free will and determinism are compatible in a type of free will that not surprisingly is called compatibilism. Compatibilists hold that free will exists as long as the agent is not subject to outside coercion. As long as our actions are a product of our own reasons for taking those actions, as long as they spring from our personal beliefs and preferences, even though those reasons, beliefs, and preferences are a product of a deterministic universe, we have free will.⁷ Compatibilism does not seem like a very robust version of free will, but when contrasted with indeterminism it is a variety worth having (Dennett, 1984).

If our decision-making processes function outside of consciousness, then it seems that the notion of conscious will is an illusion. Some investigators go so far as to deny that consciousness itself plays any causal roll in brain function or behavior, asserting

⁵ In the discussions of biological evolution, evolution is not meant to be taken as a purposeful process, but rather one that produces order from random mutation and selection.

⁶ The term libertarian is used here in the political and economic sense, not in the philosophical sense of libertarian free will, see footnote 1.

⁷ Clearly, compatibilism is consistent with prices, norms, laws, etc., affecting our behavior, but not with guns held to our head.

that consciousness is an epiphenomenon (Pockett, 2004). The decision-making process is not accessible to consciousness, but consciousness is not an epiphenomenon. Before we examine in more detail the role of consciousness in human action, it is necessary to be clear about what consciousness is not. The conscious self is not an entity. The notion of the self as an entity is incoherent, as accepting the existence of such an entity would reinsert the central-planner back into the decision-making process. The assumption that within the individual there is an additional entity, a self, would lead to a regress, and the self in this sense is an illusion.⁸ Consciousness and self-consciousness are capacities of decision-makers (Bennett and Hacker, 2003: 56). Humans possessing large brains and language have a high-level capacity—self-consciousness, a conscious awareness of being a conscious agent. At a lower level, humans and nonhuman animals have the ability to distinguish the self from the rest of the environment. These capacities coupled with consciousness make possible the monitoring of the individual's interaction with the environment.

We can now examine the role consciousness plays in human action, that is, consider what consciousness is for, or what fitness value it confers. Without going deeply into a contentious area, there is agreement that consciousness seems to be involved in the processing and integrating of complex sensory information and information from memory; in attention; in the monitoring of the results of actions resulting from decisions; and in the formation of explicit memory of the decision/action process, that is, in the learning that is an important product of the decision/action process (Dennett, 1991; Edelman, 1992; Cotterill, 1995, 1999; Fuster, 1995; Schacter, 1996; Ramachandran and Hirstein, 1997; Ramachandran and Blakeslee, 1998; Edelman and Tononi, 2000; Baars, 2002). Consciousness plays an important role in nonstereotypical, novel situations, where it is necessary to integrate, interpret, and put into context a large amount of sensory information from the environment (touch, sight, etc.), internal body states (hunger, pain, body position, etc.), and memory. Consciousness facilitates the monitoring of body/environment interactions and the facilitation of the assessment of the success or failure of those body/environment interactions, thus aiding error correction, and consciousness is necessary for the formation of explicit memories of those interactions so that knowledge of the outcomes can be used in future decision-making. It is also involved in monitoring inner speech used in deliberation that aids in formulating plans for the future in complex, novel decision-making situations and in remembering the process in the future. Consistent with determinism, the inner speech seemingly used in deliberation and the formation of plans for the future is not the decision-making process itself, which it is argued takes place at a nonconscious level; rather, inner speech provides some degree of conscious access to the products of the processing that is nonconscious deliberation. Consciousness, then, is associated with high-level processing of sensory data from both internal and external sources. This processing optimizes the information content contained in the data, in the sense that the output is in a form that is most useful for decision-making. Significantly, we are conscious of some of the output of sensory data processing, but we are not conscious of any of the processing involving the planning of action.

⁸ Bennett and Hacker (2003) spend considerable time addressing these issues.

The self is a process that facilitates keeping track of what is the agent and what is everything else. Consciousness facilitates keeping track of the interaction between the agent and everything else and as we will see, deliberation, a process facilitated by language, helps make possible the simulation of that process. Consciousness facilitates decision-making by organizing and putting into context information about the current state of the body and environment, including the options available and the constraints faced when acquiring one or more of those options.

The gap

The feeling of conscious volition or free will results when a gap exists between the reasons for action and the actions themselves, when initially there is the perception that one's current "set of beliefs and desires by itself is not causally sufficient to determine [one's] action" (Searle, 2001: 13). In economic terms, this gap exists because of the perception on the part of the decision-maker that there is not enough information to make a choice among the options available or perhaps the perception that there may be some unknown option that is preferable to those currently available.

If, as will be argued, the perception of conscious will is an illusion, why then do we have the perception that we freely choose among alternatives? Part of the reason is that the conscious feeling of will is a product of a motivational state, a state that motivates deliberation in the presence of a gap between the reasons for action and the action itself. The feeling of conscious will itself helps focus attention on the deliberation process, much like our visual attention is drawn to the source of a loud noise, so that possible outcomes can be effectively monitored. We experience the gap whenever we experience difficulty in making up our mind. The feeling of conscious will has also played an important role in the evolution of commitment. "Although the average reader probably has never had any trouble recognizing himself as the owner of his body or as the agent of his actions, this 'sense of ownership' and 'sense of agency' actually require specific brain mechanisms, which we are now beginning to understand" (Jeannerod, 2004: 422). Conscious will facilitates the recognition of ownership of our actions and allows us to recall—in the future—that those actions were "our own actions." This ability allows us to perceive and remember that we have acted and to take responsibility for those actions, all of which are important for the ability to make commitments to ourselves and others. As we will see, the feeling of conscious will is necessary for keeping track of our decisions, and though it is not the author of those decisions, it is a necessary part of the mental accounting that allows us to keep track of our obligations to others and theirs to us, as well as our commitments to ourselves. Without the illusion of conscious will, the evolution of complex human cooperation and commitment would not have been possible, and, as a result, significant cultural evolution would have been impossible as well. The perception of volition, then, is the bedrock upon which rests Hayekian spontaneous social orders.

The subconscious nature of economic choice

I want to briefly look at why our choices feel like they are the direct product of conscious decision-making. At this point, we are not addressing the ultimate purpose of

the perception of conscious will, but rather the proximate reasons for the feeling of will. The question here is “[w]hy would people mistake the experience of will for an actual [direct] causal mechanism?” (Wegner, 2002: 15). In part, it is because conscious will feels like a physical force that causes the action and because our conscious intentions to act seem to systematically precede our actions. “The illusion of conscious will may be a misapprehension of the mechanistic causal relations underlying our own behavior that comes from looking at ourselves by means of a mental explanatory system” (Wegner, 2002: 26). Wegner points to “three key sources of the experience of conscious will—*Priority, consistency, and exclusivity* of the thought about the action. For the perception of apparent mental causation, the conscious thought should occur before the action, be consistent with the action, and not be accompanied by other potential causes” (Wegner, 2002: 69). It seems that because A precedes B it “feels” like A causes B, and if there are no other apparent causes of B we conclude that, in fact, A does cause B, where A is conscious volition or feeling of the intention to act and B is the action.⁹

Economists and most others place much too much emphasis on the role of consciousness in deliberation. Wilson (2002) argues that individuals have conscious access to a great deal of information about their current memories, thoughts, and perceptions, but they are not conscious of the decision-making processes. We are conscious of “. . . mental *contents*, not mental *processes*” (Wilson, 2002: 105). Regarding speech (Velmans, 2002): “. . .there is a sense in which one is only conscious of what one wants to say *after one has already said it*. . . [Furthermore] [i]t is particularly surprising that the same may be said of *conscious verbal thoughts*” (Velmans, 2002, 8–9). Importantly, in “the production of overt and covert speech [verbal thoughts] the conscious experience that we normally associate with processing *follows* the processing to which it relates” (Velmans, 2002: 9). Some of our decision-making is associated with conscious deliberation using covert or inner speech, but the actual decision-making has occurred before we become conscious of the results by “listening” to our inner speech. Inner speech becomes part of the contents of our consciousness during the process of deliberation and in this way we become aware of at least some of the ongoing output and the final result of that process, but the process itself, the mechanisms of decision-making, are nonconscious.

The knowledge problem and more on the coordination of the system

Additional information over and above that provided by the emotional systems mentioned earlier is actually required to coordinate the system in the decision-making process, specifically, information about the direct costs associated with action. Investigators have discovered neurons called “mirror neurons” in both monkeys and humans that fire when they perform an action and when the same action is observed being per-

⁹ This discussion of the illusion of conscious causation is very similar to Hume’s (1739). Hume considers three features of our reasoning about cause and effect, including mental causation: priority—the apparent cause must precede the effect; contiguity—the apparent cause must in some way appear to be linked to the effect; and necessary connection, whereby the apparent cause is the actual cause. Hume argues that we do not actually perceive necessary connections, including in those cases where the cause appears to be conscious will.

formed by another, (for example, Gallese et al. 1996; Rizzolatti et al., 1996). Another set of neurons, called “canonical neurons,” fires when a monkey performs a particular manual action to grab an object, as well as when the monkey merely observes the object. Both sets of neurons, as well as other motor neurons, facilitate learning about the world through direct interaction with that world: learning by doing and by watching others, the brain can then use that information in decision-making. In decision-making, these neurons are active in the simulations of actions, which facilitates predictions of the possible outcomes and estimates of the direct costs of those actions and outcomes (Gallese, 2001). We acquire information about aspects of our world through interaction with that world; our brains then use simulations of those actions together with the values provided by the emotional systems when generating new plans of action, making cognition an iterative, ongoing process. Such simulations provide information about the expected net benefits of the various alternative actions as well as general information about the physical nature of world that is then used in the choice process.

The emotional value systems operate below the level of consciousness; likewise the “. . .motor simulations. . .are “*implicit, automatic, and nonconscious*” (Gallese, 2001: 41). These systems reflect the value, direct costs, and other opportunity costs of a particular action. The nonconscious nature of these systems is further evidence that conscious volition is an illusion. Finally, the emotional systems that assign value also *motivate* action, where the motive power of the system reflects the expected net benefit, about which more will be said later. We will refer to these expected net values as *decision weights*.

These nonconscious systems use fast decentralized parallel processing, unlike conscious processing, which is a serial mechanism with serious capacity limitations. These disaggregated mechanisms that are interconnected by fast parallel processes overcome the knowledge problem that would confront a centrally planned system because they facilitate processing of the multiple options and their characteristics simultaneously. To take a simple example, trying to match a name to a face, the mental search process does not involve “seeking a match [by] sorting through possibilities one at a time,” but rather it involves a global search where several possibilities are considered simultaneously with the best match being retrieved (Hills, 2006: 24). In conscious deliberation during decision-making, several non-conscious simulations take place simultaneously, where the results of the simulations are compared using the decision weights to determine a winner, which then, as when trying to match a name to a face, pops into consciousness. An important role of consciousness in the deliberation process is noticing when the simulation programs and/or the decision weighting process is “not halting,” as when I say, after examining a restaurant menu for several minutes, that I can’t decide what to order and ask my dinner partner what she is ordering in the hope of breaking the mental logjam.

Interestingly, because we don’t have direct access to the decision weights and the simulation processes, we are often, at the conscious level, unaware of the reasons for our actions. In many experiments, individuals have been shown to confabulate reasons for their behavior since they have no conscious access to the actual reasons for it. Under experimental conditions, individuals will give reasons for the choices they make in cases where the experimenter knows they do not have access to those

reasons and thus are confabulating. (Gazzaniga, 1998; LeDoux 1996, Wegner 2002, for a more complete discussion of these points, including a discussion of some of the experimental evidence.) Not only can conscious deliberation be dispensed with for many choices, but there is some evidence that it can actually make things worse. Conscious deliberation about some choices by experimental subjects is shown to result in their being less satisfied with those choices at a later date than are control groups given the same choices but that engage in no conscious deliberation prior to choosing (Wilson et al., 1993: 1995).

The simulation mechanisms and systems that provide the decision weights are part of memory systems that facilitate perceiving and planning. These systems are part of the Hayekian classification processes necessary for perception, cognition, and the planning of action. Searle (1992, 1995, 2001) has addressed this issue in, among other areas, the understanding of intentionality. Intentionality, used in the philosophical context, refers to the fact that “. . .mental states are directed at or about, or of, or refer to, or aim at, states of affairs in the world” (Searle, 1998: 64–65). Individually, the meaning of a given intentional state is radically *underdetermined*. Searle calls the phylogenetic and ontogenetic mechanisms that, among other properties, facilitate identification and understanding of intentional states, “Background,” and the emotional value and mirror systems are obviously key components of Background. “Intentional phenomena such as meanings, understandings, interpretations, beliefs, desires, and experiences only function within a set of Background capacities that are not themselves intentional” (Searle, 1992: 175). The perception, cognition, and planning are only possible within the context of a set of Background capacities (Searle, 1992: 177). These capacities are made possible by the Hayekian classification mechanisms, and it is significant that these distributed capacities are key components of the solution to the mind/brain knowledge problem.

The problem of underdetermination occurs with all representative states for human as well as nonhuman animals. The role of Background in humans can be illustrated with language. “The simplest way to see that representation presupposes a nonrepresentational Background of capacities is to examine the understanding of sentences” (Searle, 1992: 178). Take the statement: “Melissa cut the cake.” It seems unambiguous on the surface, but, in fact, its meaning is underdetermined: We understand that Melissa will use a knife, but nothing in the statement specifies that she did not use a chain saw or pair of scissors to cut the cake. We know what the statement means because we carry in our brains significant built-in capacities and knowledge about the world as components of background that enable us to make sense of sentences with underdetermined meaning.

Background can be considered memories of the individual and the species. That it is nonrepresentational implies that it functions at a nonconscious level; that it consists of memories means that it has accumulated as a result of the prior experiences of the individual and the species. Background facilitates Hayekian classification by which we perceive, think, and plan with our past. *But this restatement of a major conclusion of Hayek's theory of cortical memory networks is simply the thesis of determinism.* Now, we turn to some empirical findings on the nonconscious nature of volition.

The readiness potential

The experimental findings of Benjamin Libet and colleagues reveal the nonconscious nature of decisions. In 1965, Kornhuber and Deecke demonstrated, using surface measurement of activity in the motor cortex before, during, and after a simple voluntary action, that neuron firing started increasing up to 1 s before the actual movement. This pre-movement brain activity is called the readiness potential (RP). Libet et al. (1983) wanted to determine when, prior to the actual movement, experimental subjects became consciously aware of “deciding” to perform a movement, a simple flick of the wrist, for example. In these experiments, the RP began on average .550 s before activation of the muscles in the wrist. Participants were asked to specify exactly when they became aware of the conscious desire to move their wrists by watching a moving spot of light on a clock face. The participants were asked to report the position of the spot when they first became aware of the urge to act, which allowed Libet et al. (1983), to determine the timing of the perception of the urge. On average, the participants reported that the urge to act occurred about .200 s before the muscle activation and about .350 s after the onset of the RP. The fact that measurement of part of the subconscious preparation to act, the RP, preceded the conscious decision to act by .350 s seems to rule out conscious will as the initiator of the action. Libet (1999) points out, however, that there is enough time between the perception of the conscious will to act and the action itself to veto the action and that this veto ability leaves an opening for free will. We can’t consciously initiate action but we can consciously veto that action after it is subconsciously initiated. This has led some to suggest that though we may not have free will we do have free won’t. In fact, veto ability does not prove that we have free won’t, because the actual decision not to act will have its own nonconscious origins.

There have been critics of Libet’s results. Because of their relevance, three representative recent critiques will be discussed, those of Zhu (2003), van Duijn and Bem (2005), and Levy (2005). Zhu argues that, in fact, the conscious decision to act on the part of the participants was made when they agreed to participate in the experiment, not during the experiment itself so that Libet’s results do not rule out conscious volition. However, even conceding that the decision to act was made at the point of the agreement to participate in the experiment, that decision will have had its own subconscious origins; additionally, that prior agreement still leaves open the question of the timing of the actual act that was measured during the experiment. Voluntary actions include multiple subcomponents, including the decision to act and the timing of the action, which have their own separate volitional components.

Reviewing the Libet criticism in the literature, van Duijn and Bem (2005: 702) “question the ecological validity of the Libet-experiments.” Libet’s wrist flick is low-level behavior, whereas “...conscious will only guides behaviors in a global manner and monitors when it is time to stop or initiate unconscious ‘motor programs’” (van Duijn and Bem, 2005: 702). Van Duijn and Bem also stress the knowledge problem: “[g]iven the limited capacity of the conscious system, the bulk of processes need to be automatic and unconscious” (van Duijn and Bem, 2005: 702). They also consider a role for consciousness when confronting the halting problem: “[c]onscious control...operates at a much slower pace, but prevents us from

getting ‘stuck in set’ by solving failures that occur at the automatic levels, by creating the context for understanding an action, and by rearranging the means to achieve a certain goal if necessary” (van Duijn and Bem, 2005: 703). They are almost correct. Our conscious self monitors our interaction with the world and observes situations where deliberation or automatic habits and routines are not working or are interrupted by a novel event. They rightly view the mind/brain as a self-organized complex system that is also self-steered, but they wrongly allow the conscious self a direct role in the steering in the complex situations, rather than simply facilitating that process by providing and organizing information (van Duijn and Bem, 2005: 706).

That the brain/body is a self-organized, self-steered complex system is consistent with Hayek’s argument in *The Sensory Order*; that the self-steering is at least, in part, a direct product of the conscious self is not. The mind/brain is a complex self-steered system, but it is one without a steerer. The third critique of Libet, by Levy, helps us to see why van Duijn and Bem’s notion of a conscious entity as steerer is wrong. His approach is similar to the one taken here: he asks—when consciously deliberating—“[w]hat role does consciousness actually play? What is really happening, when you consciously weigh reasons? Each reason, in favor of or against a course of action, has a weight independent of your deliberation. . . . Where does this weight come from? It seems that it is assigned unconsciously, or at least independently of consciousness” (Levy, 2005: 72). Levy goes on to say “[w]e cannot control our decision-making, for a simple reason. It is this: decision-making is, or is an element of our control system, whereby we control our activity and thereby attempt to control our surroundings. If we were able to control our control system, we should require another, higher-order control system whereby to exert control. And if we had such a higher-order control system, the same problems would simply arise with regard to it. The demand that we exercise conscious will seems to be the demand that we control our controlling. And that demand cannot be fulfilled” (Levy, 2005: 73). This argument rules out both conscious will and conscious steering; the decision weights used in our decision-making are provided by the nonconscious mechanisms mentioned earlier. The critique denies the possibility not only of conscious will but also of conscious won’t. But, Levy then argues that this does not prove that decision-making itself is not free: free will cannot be conscious will because that would involve controlling our control system, but our nonconscious control system could itself exercise free will. Once we accept that the conscious self is not an entity, not a controller, then it makes no sense to ask if it is a free or determined system.

Taking the brain as a spontaneous order implies that the question of determinism or free will can only apply to the agent as a whole. Levy leaves open the possibility of free will, but accepts that more research will be needed to prove its existence. The necessity of Background for human action suggests that Levy’s position is consistent with compatibilism where our actions are deemed free when they are a product of our own decision weights, our own emotional value system, and our own mirror and canonical systems, that is, our own components of background and not a product of coercion, but not that our behavior can be uncaused.

The efferent copy and just-in-time production

In the cortex, the frontal motor areas that participate in formulating motor plans receive inputs (i.e., afferent, or incoming signals) from the sensory areas (vision, hearing, touch, etc.) that facilitate motor planning and they send motor commands (efferent signals) to, for example, a limb, initiating movement. A second copy of the motor command, an *efferent copy*, is sent to the sensory areas, where it facilitates the sensory monitoring of the pending body/environment interaction (Cotterill, 1995, 1999). The efferent copy primes the sensory areas for the upcoming action, facilitating both monitoring of the action and monitoring of the environment's response to that action, which helps enable the rapid determination of an appropriate response if necessary. Furthermore, the efferent copy, the plan of action, is compared to the actual action for any necessary rapid error correction.

Recall that motor simulations are used in the deliberation process. During the simulation process, the direct motor commands to the body are attenuated so that only the efferent copy is produced, which can then be combined with sensory data to reach a decision. Interestingly, the silent speech used in deliberation is evoked by speech motor memory, in a speech motor form of action simulation (Mecklinger et al., 2002). Here, an efferent copy facilitates inner speech that allows for a degree of conscious monitoring of the results of the deliberation process. Additionally, the efferent copy of the final decision facilitates the perception of conscious volition. This aspect of consciousness is consistent with Libet's results showing that the perception of conscious volition occurs after the preconscious decision, but soon enough to alter or veto the action in the case that new information indicates that a change of plan is called for or when actual actions are deviating from the planned action making error correction necessary. In other words, the consciousness perception of making a decision occurs *just-in-time* to facilitate the conscious monitoring of that decision, and that monitoring is primed by the efferent copy.

Motivation and deliberation

A primary function of the emotional systems is the motivation of action to secure rewards. The brain comes equipped with motivational systems that steer behavior toward specific goals, motivate action to secure those goals, and efficiently coordinate the behavioral components of goal-seeking actions (Kupfermann and Schwartz, 1995: 614). The process of deliberation also requires motivation. A feature necessary for deliberation is the ability to inhibit responses to current stimuli, that is, to inhibit the motive force generated by rewarding goods in the current environment, and replace it with the forward looking, more long-term deliberation process. Animals capable of planning delayed responses to secure future rewards must be able to inhibit responses to current stimuli. "Behavioral inhibition and the . . . executive functions it supports influence the motor system, wresting it from complete control by the immediate environment so as to bring it under the control of time (change) and the future and to put it in the service of goal-direct behavior" (Barkley, 1997: 156). The feeling of volition is the conscious

reflection of the motivational process that facilitates decision-making and deliberation, which necessarily involves the inhibition of prepotent¹⁰ responses to current stimuli.

The feeling of conscious volition signals the inhibition of prepotent responses and the motivation of the deliberation processes, and, importantly, it facilitates the memory of that process (Schacter, 1996; Fuster, 1999; Baars, 2002). As noted earlier, recognition of our own agency is not automatic, in that it requires cognitive mechanisms and processes. The perception of conscious will is part of the process that facilitates the recognition and memory of agency and, as such, it is a key component of the cognitive mechanisms that facilitate commitment.¹¹ The personal identification with agency, which is the ultimate or evolutionary cause of the perception of will, is the topic of the next section.

Conscious will is a feeling that is a product of the gap that signifies the need for a decision. It has been shown that consciousness and conscious feelings are necessary for formation of the long-term conscious memory of actions, facts, and events. Though conscious volition is not the initiator of actions, consciousness is necessary for the monitoring of those actions and for the formation of explicit memories of the actions. Wegner (2002: 329) calls conscious will the “emotion of authorship,” because it marks the actions themselves as “our” actions and facilitates the memory of those actions. As such, it is necessary for personal responsibility and the type of conscious mental accounts and social responsibility that facilitate complex cooperation. The feeling of authorship is what allows us to keep track of our obligations to others and theirs to us, as well as obligations to ourselves. The evolution of the perception of conscious control was a necessary component of the gene/culture coevolution of human prosociality and significant cultural evolution thereafter. The perception of conscious will facilitates our awareness of our own role in the world of cause and effect: it allows us to separate our personal actions and the effects of those actions from those that are a product of other forces, both natural and human. The perception of conscious will is a marker that allows us to recall that we performed those actions, making possible guilt, credit, and blame—desert. The next section will examine personal responsibility, commitment, and self-control.

Self-control

Self-control problems are perhaps the prime behaviors that allow us to catch a glimpse of the deterministic nature of human action. These problems are, in part, a product of the evolution of human language ability and the large brain that facilitates that ability. The abstract symbolic capability facilitated by the evolution of language not only resulted in a reduction in the human discount rate but in a divergence of the rate used by the lower-level evolutionarily older decision-making structures of the brain and the higher-level evolutionarily newer structures, including the prefrontal working

¹⁰ A prepotent response is one that yields a prepotent good or bad, defined as one for which “. . . immediate reinforcement (positive or negative) is available or with which reinforcement has been previously associated.” (Barkley, 1997: 48)

¹¹ Wegner (2002) presents many examples, in experimental settings and in others, where individuals fail to perceive their own agency in an action because it was not accompanied by a feeling of will.

memory system (Gifford, 1999, 2002a). The lower-level system operates with a higher discount rate that is a product of human biological evolution, whereas the higher-level system uses a lower language-based, culturally determined discount rate. The two systems and their divergent rates tend to conflict when choice is between a currently available good (watching TV) and an option requiring the bearing of a current cost associated with a deferred benefit (doing homework); when the choice is between two goods, where the clearly preferred good has a deferred cost (broccoli vs. chips); and finally, when considering the violation of a prior commitment (say, to have only two beers at a party). The lower-level system facilitates choice by the assignment of decision weights and action simulation, and it also motivates the decision-maker to act. Self-control is necessary to inhibit this motive force. This is a problem because motivation is strongest when a prepotent option is present, e.g., watching TV, the chips, another beer. The lower-level emotional system biases choice toward desirable alternatives that are currently present in the decision-making environment. To resist these prepotent options, the force of motivation must be inhibited; self-control, then, requires the use of inhibition, and those who have problems with self-control have problems inhibiting prepotent responses.

A recent neural imaging study examines the two systems at work during decisions involving an immediately available monetary payment and a larger payment available after a delay (e.g., 2 weeks, 1 month, McClure et al., 2004). Two results are of interest. The higher-level areas were more active when the participants selected the delayed option, but also more active were areas of the brain that are directly related to self-control—the ventromedial area of the prefrontal cortex. Patients with damage to this area have significant problems with self-control (Damasio, 1994). Further, this area is associated with emotional value—decision weight—memory and other process, as well as the mechanisms of self-control that are not amenable to conscious awareness.

The perception of the ownership of our decisions and actions allows us to make personal commitments, such as having only two beers at the party, and it also increases self-control. Psychologists call this rule-following, and though it does not eliminate all problems of self-control, commitment and rule-following make self-control easier. Barkley discusses this role of rule-following and inner speech in this capacity:

Rules are strategies that, once formulated, can be used to guide behavior more efficiently and effectively. . . .

Internalized speech, along with the sense of past and future afforded by working memory, combine to give the individual the capacity to understand and comply with commands or rules that have prolonged references. That is, such instructions or rules make reference to a behavioral performance at a place and time temporally distant from the temporal now in which the command or direction is given. (Barkely, 1997: 246–247)

Personal rule-following is a form of self-commitment that facilitates inhibition of prepotent responses and allows us to reflect on the implications of violating those commitments. Commitment and rule-following in a particular situation can eventually take the form of habits that further reduce the motive force of prepotent responses.

The evolution of responsibility

A difficult and contentious issue involving the determinism versus free will debate is the role of responsibility and morality. If determinism is true, how can anyone be held morally responsible for their actions and how can anyone take credit for their accomplishments? First of all, the allocation of credit and blame is necessary for the rational allocation of rewards and punishment, and since we have ample evidence that reward and punishment affect human behavior, the proper allocation of credit and blame are key to efficient social interaction. The successful evolution of Western norms and legal and economic systems is in large part a product of the acceptance and understanding of the allocation of credit and blame. Human biological and cultural evolution surpassed that of our closest ancestors, in part, because of the very much greater degree of cooperation that exists between humans when compared to other animals. How is this extreme prosocial behavior possible, given that survival and reproduction require self-interested agents and that cooperation with others leaves the agent open—in the terminology of game theory—to defection? It is possible because of the gene/culture coevolution of social preferences, including a willingness to cooperate in various forms of nonsimultaneous exchange coupled with the exclusion and punishment of defectors, such that long-term self-interest became aligned with cooperation, not defection (Fehr and Fischbacher, 2003; Gintis, 2003; Richerson and Boyd, 2005). This process represents the second Hayekian spontaneous order under consideration, the cultural evolution process discussed in the epilogue of *Law Legislation and Liberty V. III*.

The evolution of the feeling of authorship of our decisions was necessary for the emergence of human cultural evolution. The evolution of large brains, human symbolic capacity, and language, coupled with the feeling of authorship, are the basis for the ability to maintain complex mental accounts of direct and indirect obligations that facilitated not just reciprocity and kin selection (nepotism) but also indirect reciprocity and indirect nepotism, which are the substrate of human cultural evolution¹² (Gifford, 2002b).

The evolution of the acceptance and understanding of the implications of the allocation of credit and blame have directly facilitated the evolution of the economic and political freedoms enjoyed by many in the world today and have, as a result, been responsible for the very large expansion of options and opportunities. The illusionary feeling of free will has directly led to actual free will, if only in the compatibilism sense, and the very large expansion in the free choices and opportunities available.

¹² Indirect reciprocity involves cooperating with those that the individual has observed cooperating with others in the past. Indirect nepotism, is an extended form of kin selection that allows the individuals involved to take advantage of the fact that, among three or more siblings, for example, helping one of the siblings is a nonrival good to both of the others.

Responsibility as a social construct¹³

Does the neuroscience of determinism suggest that we must make major changes in our legal system? Neuroscientist, Blakemore (1988) claims that the idea of responsibility must be abandoned, though he accepts that criminals must be prevented from harming others. Green and Cohen (2004) argue that determinism implies that we must make fundamental changes in the way we view our criminal justice system. They maintain that the common sense view of our legal system rests on the assumption of free will because of the system's "retributivism approach" to criminal justice. In other words, the standard (layman) view is that the purpose of the criminal justice is the punishment of wrong doers, which will be seen as unfair once we understand that they have no control over their behavior, given the deterministic nature of the world. However, Green and Cohen recognize the "consequentialist approach" because it focuses on punishment's deterrent impact on criminal behavior, does not require us to "give up on moral and legal responsibility" (Green and Cohen, 2004: 1776)

I believe that Green and Cohen overemphasize the dichotomy between the retributivist and consequentialist views. Most individuals feel the emotional desire for retribution when they think that they have been wronged, however, when it comes to dispassionate rationalization of the criminal justice system, individuals are likely to argue that its primary purpose is deterrence. In fact, from an evolutionary perspective, the retributivist and consequentialist approaches are, respectively, just the proximate and ultimate products of the gene/culture coevolution of high-level human prosociality. Our motivational and value systems generate feelings of "right" and "wrong" and a willingness to bear costs to punish those who engage in "wrong" behavior. And this willingness deters potential violators—an ultimate product of our gene/culture coevolution.

Neuroscientist Michael Gazzaniga, a member of the President's Council on Bioethics, makes the point that "neuroscience can offer very little to the understanding of responsibility. Responsibility is a human construct that exists only in the social world, where there is more than one person. It is a socially constructed rule that exists only in the context of human interaction. No pixel in a brain scan will ever be able to show culpability or nonculpability" (Gazzaniga, 2005: 100).

Responsibility is a social construct that exists as a product of the collective intentionality of the individuals in society. We collectively accept responsibility as part of an implicit social contract that facilitates social interaction, and this is, in fact, possible because of determinism. In the May 15, 2004, issue of the *New York Times*, Columnist David Brooks discusses Columbine, one of the killers, and responsibility: "My instinct is that Dylan Klebold was a self-initiating moral agent who made his choices and should be condemned for them. Neither his school nor his parents determined

¹³ The term social construct is used here not in the postmodern sense of an arbitrary social structure or facts that are constructed from thin air, but in the sense used by John Searle. Searle "makes a distinction between those features of the world that we might call *intrinsic* to nature [mountains, molecules] and those features that exist *relative to the intentionality of observers, users, etc.*" (Searle, 1995: 9) The latter are social facts, which exist only relative to the attitudes of others. The human ability to create social facts allows us to create mental constructs such as promises, obligations, contracts, marriages, property, money, elections, governments, presidents, corporations, universities, and football games that exist only because their intrinsic structure resides in the brains of individuals (Searle, 1995: 97).

his behavior.” Brooks is arguing that Klebold’s possession of free will allows society to hold him responsible for his actions. This position implies that responsibility is an individual or personal phenomena, and that holding agents responsible for their actions is justified only because that behavior is free of prior causes. To see that this is false, consider what happens when we add Wegner’s free-willer module into the brain of the agent. Doing so does not provide us with an agent that we can hold responsible for his actions, nor one that will be deterred by the possibility of punishment—it gives an agent whose behavior is random. Determinism is necessary for the existence of responsibility because it facilitates behavior that is responsive to constraints. Responsibility and desert are social phenomena and the constraints of law and morality are social constructs that affect our behavior by changing the benefit–cost calculations preformed by our nonconscious decision-making mechanisms. Determinism doesn’t relieve us of responsibility, it is, in fact what makes commitment, responsibility, blame, and credit—desert—possible, by assuring that we are responsive to constraints. By this logic, those who are unable to internalize the constraints—very young children, individuals with certain types of brain damage—should not be held legally responsible for their actions, since the constraints cannot affect their behavior.

The possibility of quantum free will

The general acceptance of determinism does not imply that the brain is nonprobabilistic, only that it is statistically lawful. In fact, the release of neurotransmitters in response to an action potential is probabilistic. Furthermore, recent findings suggest that perception and cognition are probabilistic, vision, for example, uses Bayesian updating to determine the statistical structure of the environment. Perception, cognition, and the planning of behavior all can be viewed as statistical problems, and, increasingly, neuro- and cognitive scientists are finding that using a Bayesian approach to perception and cognition produces “. . .remarkable successes in generating models that predict existing empirical findings. . .” Shiffrin (2003: 342) (also see Geisler and Diehl, 2003, Sharma et al., 2003, Yang and Purves, 2003, and, for a review of the topic, Glimcher, 2003).

Because of its role in some quantum theories of free will, the focus here will be on the probabilistic nature of transmitter release. When an action potential reaches the axon terminal, it causes an influx of calcium ions into the terminal, which, in turn, initiates a cascade of events that result in the probabilistic release of the neurotransmitter from the synaptic vesicles that are bound to the face of the presynaptic membrane. If a sufficient quantity of transmitter is released into the synapses between the upstream and downstream neurons, then the downstream neuron will fire an action potential. Whether a vesicle releases its load of transmitter as a result of the calcium influx is determined by a binomial distribution—that is, release with probability p , and failure to release with probability $(1 - p)$ (Kandel, 1995: 277). So far, this randomness cannot give us free will but only adds a degree of indeterminacy to our behavior. However, the law of large numbers suggests that across all events in the neurons and synapses in the relevant areas of the brain, the degree of indeterminacy should be greatly reduced from that governing the release from any one vesicle.

According to Bourget, Stapp's (1997, 1999, 2004a) account of quantum consciousness and free will "is on the face of it the most interesting" (Bourget, 2004: 17). Stapp's account is based on idea that individual calcium ions are small enough to be entailed into a superposition of release and nonrelease states. In this situation, measurement causes the collapse of the wave function, bringing about the existence of one of the states. An aggregation of this process across synapses and many transmitter release and nonrelease events results in the superposition of alternative potential behaviors, where measurement is an act of conscious will and the collapse of the wave function brings about a specific behavior. "This means, more generally, in a situation that corresponds to a very large number of N synaptic firings, . . . [that] [d]ifferent combinations of these firings and no firings can lead to very different macroscopic behaviors of the body that is being controlled by the brain" (Stapp, 1999: 62). In order for this process to result in a form of free will, another step is required, the ability to control the timing of the collapse which can influence the probabilities assigned to the aggregates of release and nonrelease states and, as a result, possible behaviors (Bourget, 2004b: 24). "This [the timing] opens a 'dynamical gap' that allows mental effort to influence brain activity" (Stapp, 2004b: 44). According to Stapp, willful mental effort, by controlling the timing of a collapse, can influence brain activity and thus exert control over behavior.

Even if we accept that this process brings about a degree of free will without violating the laws of physics, there are several reasons why "[q]uantum theories of the mind are routinely derided as having the explanatory power of 'pixie dust in synapses'" (Bourget, 2004: 17). First, a major problem with large-scale quantum effects, such as those proposed for the brain "... is decoherence, a phenomenon that quickly destroys the superposition of large objects if they are not perfectly isolated" (Gisin, 2006: 63). If it is argued that the individual superposition events are independent and sufficiently isolated so that decoherence is not a problem, then there must be some mechanism that binds them together to produce a spontaneous order at the quantum level. We have seen that decision weights are part of the binding process at the macro level, and it seems that a separate quantum mechanism would be redundant. Furthermore, it seems likely that the binding process itself would result in decoherence. Second, "[a]lthough brains obey quantum mechanics, they do not seem to exploit any of its special features. . . . It has already been demonstrated. . . that many previously mysterious aspects of perception and action are explainable in terms of conventional neuronal processing" (Koch and Hepp, 2006: 611–612). Third, Stapp's theory, by making mental effort (i.e., conscious causal volition) the actual author of decisions and the generator of free will, results in introducing a nonspontaneous process, mental effort, which is just another form of controlling our controller. It also implies that we are consciously aware of our mental causal powers, a position shown to be logically untenable by Hume (see footnote 9) and shown to be experimentally untenable by Wegner (2002) and Wilson (2002). Fourth, a vesicle either releases or does not release its neurotransmitters as a result of an influx of calcium ions, but the vesicle or the calcium ion is not in a superposition of release and nonrelease states any more than a flipped coin is in a superposition of heads and tail states until it hits the ground or is observed by a conscious observer. Fifth, "[w]hy should evolution have turned to quantum computation, so fickle and capricious, if classical neural-network

computations are evidently entirely sufficient to deal with the problems encountered by nervous systems?" (Koch and Hepp, 2006: 612).

Conclusion

The brain is an Hayekian spontaneous order that uses distributed and parallel processing and Background/classification to solve the knowledge problem. Consistent with Hayek's notion that perception is an act of classification, it is argued that not just perception, but also cognition and planning for action, are only possible because of the existence of Background capacities that make classification possible. These Background capacities are a product of both phylogenetic and ontogenetic memories. In this system, action is determined by current states and the memories of the individual and the species—in other words, decision-making is a deterministic process and the notion of libertarian¹⁴ free will must be abandoned. If free will is an illusion, why then do we experience the feeling of conscious volition? The illusion of conscious will is the "emotion of authorship" of our actions and our agency, and as such it was necessary for the evolution of commitment. Furthermore, the feeling of conscious will signals the motivation of the act of deliberation. The perception of conscious will is the product of a gap between the reasons for action and the actions themselves. The gap occurs whenever we have trouble making up our minds. This gap implies that additional information derived from long-term memory, sensory data, and outside research can improve decision quality, and the perception of conscious will signals this process.

Problems of self-control allow us to perceive determinism in our own actions. Language, and large brains allow humans to engage in commitment and rule following that facilitates self-control. If we accept determinism, how can we hold individuals responsible for their actions? Responsibility, and the allocation of credit and blame, are part of an implicit spontaneous social contract that facilitates cultural evolution, political freedom, and economic growth. In fact, responsibility, blame, and credit are possible because of determinism and would be impossible with indeterminism. Commitment, determinism, and the feeling of conscious will facilitate the internalization and the responsiveness to the constraints that are a product of our moral, legal, and economic systems, and that responsiveness is necessary for moral, legal, and economic actions. Finally, it is commitment that creates the possibility of political freedom, not the freedom of the will.

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¹⁴ Libertarian in the philosophical sense, not in the political and economic sense of the word.

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