Commentary

Inner Speech, Self-Regulation, and the Modular-with-Feedback Theory of Free Will

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This paper demonstrates a synergy between the Inner Speech model of free will and the Modular-with-Feedback Theory. The first section examines determinism and causation to argue that free will requires the ability of an agent to make a non-deterministic choice, which could have been decided otherwise. This in spite of physical, hereditary and environmental ad hoc factors which inevitably influence choice. Section two introduces the Modular-with-Feedback Theory which proposes free will to be compatible, not with determinism, but with chance. It provides a model of how free will emerges from oscillating neuronal activity in neural modules. These, representing ideas, oscillate subconsciously, competing for conscious attention. Although the choice between them is partly random the modules are able to maintain a sense of context and consistency; leading to a conscious desire for a sense of character. Learning from experience, we use feedback to rebalance. Conscious decisions, using inner speech, train the subconscious to advance, in the future, options better conforming to our desired will. Section three discusses how consciousness emerges non-deterministically in a manner consistent with a causally interactive dualism that is, at a hidden level, monist. Section four explains how inner speech self-regulates our behavior by talking us through free, usually consistent choices, conferring moral responsibility. Some abnormalities of inner speech diminishing free will are discussed, and further research programs proposed.

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 doi.org/10.32388/7XGJTM

Section 1. Free will, determinism and causation

This paper presents the Inner Speech theory of free will as being synergistic with the Modular-with-Feedback theory of the existence of free will. Neither is compatible with our being predetermined. Section 1 will clarify the meaning of predetermined. To some, it means that since the first particles emerged from the violence of the inchoate Universe, some superintelligence could theoretically have tracked each one's trajectory to know exactly where it would be right now, and could continue thus on into the future. Under this conception, if a stranger were to phone you as a wrong number, and your phone began to ring at the exact moment that your tea-kettle began to boil, this coincidence would have been preordained as inevitable. There are many reasons to deny that this is so, which have been discussed in Lugten[1]. Suffice it to say that in a deterministic Universe, everything would have to be, in its most fundamental sense, entirely predictable to an intelligence that had complete knowledge of the particles in it. There could be nothing fundamentally *un*predictable in this Universe, such as emergent phenomena, which, by definition, are those which cannot be predicted given a complete understanding of their underlying level of composition. If consciousness is such an emergent phenomenon, and we are conscious, we cannot be predetermined.

But even while denying the hard determinism of the “random phone call/ tea kettle boiling coincidence”, we could acknowledge a certain validity to the softer, or “ad hoc” determinism of the “I was raised by abusive parents in a crime-ridden neighborhood; therefore my tragic circumstances made me do it” defense. Studies have reported heritable components influencing a number of character traits including intelligence, novelty seeking, fearfulness, aggression and violence, amounting to more or less 50% of the influence on our behavior[2]. In studies of intelligence, at least in the United States, the genetic potential for achieving a high IQ is typically stunted by a child’s upbringing in an impoverished environment, while in affluent families, the full impact of genetic inheritance is exposed, with environmental impact falling from 60% (impoverished upbringing) to none at all[3]. We are also influenced by our epigenetic family history[4], and by physical limitations associated with our sex, stature and any disabilities we might have. Accordingly, men don’t make decisions about becoming pregnant, and tall people don’t decide to become professional jockeys. We observe that children of very rich families will likely decide to go to Ivy-League schools. They are unlikely to sell crack on street corners. But children from poor neighborhoods can over-perform their genetic and environmental heritage, resist the lure of gang membership, study hard, and win a scholarship. What counts is determination, not determinism.

In fact, lately, physicists and philosophers have been more concerned with the nature of causation, as to whether it occurs at the fundamentally small levels of physics, if at all, or whether it occurs at the level of consciousness (e.g., [5]). This can lead to a stance, basically deterministic from an outsider's point of view, that being part of the causal flow (i.e., not random) is necessary for freedom, if you think that freedom is wanting to do what you had to do anyway. But if causation occurs at the level of human consciousness, we can also be free in the sense of "I made this as a genuine choice, and I could have chosen otherwise". Others, including Lavazza[6], propose that Free Will, like causation, isn't binary but comes in degrees. The percentage that isn't predetermined by our circumstances could perhaps be measured based on the mental integration of our personality, and would be equivalent to our agency. The integration of our personality, psychologically, has been defined as "the gradual bringing together of constituent traits, behavioral patterns, motives, and so forth to form an organized whole that functions effectively and with minimal effort or without conflict"[7]. Cognitive scientists have suggested a "Free Will index" to assess people's capacity to rethink their actions. This could be used to ascertain if a perpetrator is less than free in an *ad hoc* sort of way that might respond to rehabilitation.

Section 2. Consciousness, decision-making, and the Modular-with-Feedback Theory

This section introduces the Modular with Feedback Theory as a counter to those who argue that our personal genetic and environmental determinism renders us bereft of free will. We will argue free will can have a neurological basis which is able to surmount both determinism and chance through the emergent process of consciousness. Although subconscious processes are involved in decision-making, in our theory, consciousness is not an epiphenomenon, indeed, our theory depends on consciousness being able to direct these subconscious processes. We propose what is effectively an inversion of compatibilism, compatible not with determinism but with random chance. We need to consider neuroplasticity, consciousness, character, and free will.

First of all, conscious decisions can neuroplastically alter brain structures. For instance, any new experience, learning or memorization changes synaptic organization, and this neuroplasticity is ongoing, day and night. It can lead to dramatic structural changes in the size of brain structures. This was demonstrated by Maguire and colleagues who used structural MRI scans on the brains of London taxi drivers[8]. They showed the effect that an intensive process of memorization had on the posterior

hippocampus, which correlates with the storage of spatial representations. This structure, they found, could expand plastically in adults in response to the consciously driven demand to pass the required licensing examination for London cab drivers, while the anterior hippocampus actually shrank. Aspiring cabbies who were not willing to memorize “the knowledge” of the streets of London showed no change to their hippocampus, and they did not pass the exam. The effect of consciousness on neuroplasticity was also investigated by Schwartz who was able to demonstrate that Obsessive Compulsive Disorder (OCD) patients could consciously learn to reduce their symptoms. This produced physical changes to the basal ganglia of their brains which could be viewed on a PET scan. “The results achieved with OCD supported the notion that conscious and wilful mind differs from the brain and cannot be explained solely and completely by the matter, by the material substance, of the brain... self-directed brain changes - neuroplasticity - are a genuine reality”[9]. The studies of Davidson corroborate those of Schwartz. Using fMRI, he demonstrated that the mental process of long-term meditation caused changes to patterns of brain function, such as changes in the cortical evoked response to visual stimuli, reflection impact on attention, and altered amplitudes and synchrony of high frequency oscillations that probably play a role in the connectivity between distant neural circuits[10]. He concluded that, based on neuroplasticity, we can learn happiness and compassion the same as any other skill. More recently, Kempermann’s group studied genetically identical mice in an enriched enclosure as they engaged in self-paced, monitored learning tasks, finding they developed growing, increasingly stable interindividual differences in learning trajectories[11]. Their adult hippocampal neurogenesis and connectivity was positively correlated with variations in their exploration and learning efficiency. However, they noted, during some tasks, divergence transiently collapsed, highlighting the sustained significance of context for individualization. They concluded that individual choices shape life course trajectories of brain structure and function beyond genes and the environment. Based on these experiments and others like them, it would seem that consciousness can change the material brain and be the cause of our actions, as is required for us to have free will.

Secondly, we consider that an “extended form” of consciousness relates awareness of our environment to our self-awareness through patterns of thoughts and expectations based on subconscious processing. This has been described by Damasio[12]. In addition to containing a sensory model of the external world, the brain maps each body region such that perturbations register as sensations or feelings, and then trigger homeostatic corrections. These activities then generate their own map, which enables the individual to feel how it has been affected by the changes. This ability to feel the changes provoked by our

minds allows the brain to logically infer that it is the cause, creator and owner of the body tissues, its mental feelings about those tissues, and all the activities it directs involving those tissues. The conjunction of these maps results in a “core” consciousness which is recognized as a property of the individual and which creates the “autobiographical self”. This stream of thoughts depends on a subconscious that perceives, solves and acts on problems, and, with a brief delay, conveys to consciousness the minimum amount of information necessary to understand the situation.

This brief delay has been studied by Libet[13] who demonstrated that voluntary movements are initiated in the cerebral cortex 1/3rd of a second before we become aware of making a decision to act. He also concluded that during the final 150 milliseconds of this period, subjects could consciously veto a decision that had already been triggered by a wave of cortical activity. Libet wrote “Apparently, the conscious mind could intervene, in the final stages of heightened neurological activity, either to block the already initiated movement or let it pass”(p. 35). But to freely decide whether to veto a planned action would itself require antecedent brain activity, modifying the signal for the initiated movement, and this antecedent brain activity then influences our “free choices”[14]. Furthermore, failed attempts at veto can be consciously recast as deliberate decisions to act, meaning that our conscious understanding of our decision process blends neural activity from both before and after the decision would appear, experimentally, to have been made[15]. Some researchers, including Greene and Cohen[16], Soon et al.[17], Cashmore[18], and Harris[19] have argued that Libet’s and subsequent experiments measuring “readiness potentials” imply that we are subconsciously governed “zombies”, possessing a mere overlay of consciousness. These experiments have been reviewed in depth by Dennett[20], Klemm[21], Lavazza[6] and Tse[22], who deny the pertinence of Libet’s experiment to the consideration of actual free will. Maoz et al[23] found readiness potentials involved only in meaningless, arbitrary decisions, but “strikingly absent” in meaningful decisions. Klemm[21] decisively argued that the subconscious can only initiate action with which it is already familiar. No one, he noted, has ever subconsciously learned to ride a bicycle or play the piano; both the choice to do so, and the accomplishment of it, are painstakingly conscious examples of the exercise of free will.

Consciousness is directed. A directed consciousness is necessary to have goals the achievement of which necessitate making free choices. Usually, it is concerned with solving some type of problem, often abstract. There may be an immediate problem, such as how to safely cross the street, or abstractly, how to solve a math problem, or write a story. Meanwhile, the subconscious may be busy performing another

task, and as long as sensory input matches expectations, the task will not intrude. When the subconscious perceives a discrepancy, it jolts the consciousness to attention.

Conscious inner speech is almost always left sided[24][25][26]. In patients with surgically “split brains”, the left hemisphere, which contains the language centers, has the conscious ability to word our “inner voice”, and it is quite happy to invent lies. The left side of a “split brain” patient will communicate a false rationale for thoughts based on an unknown input provided to the right side. The necessity to create a coherent narrative was discovered by Gazzaniga[26]. He named the network in the left hemisphere responsible for narration “the interpreter”. However, we propose that the deterministic belief of Gazzaniga is wrong.

When we make a decision, either consciously or subconsciously, there are, we believe, three reasons why we bother to verbalize it consciously. 1) In order to justify our decisions to others, they have to be understandable in words to ourselves. 2) In order for us to be able to remember the detailed reasons for a decision, we need to store worded memories. 3) In order for the decision to be a recognizably personal one for which we accept responsibility, it must be articulated verbally, balancing pros and cons, assessing consequences and mentally preparing for them. The successful adoption of responsibility for the decision reinforces the subconscious decision-making process so that it will be more likely to make decisions in keeping with our character in the future. For instance, Bode et al[27] proposed an evidence accumulator model of free will, whereby activation patterns predictive of each decision become increasingly similar to the pattern detected when the conscious experience of the decision is triggered. They reported that in free decision tasks, where decisions must be made in the absence of useful external information, such as in guessing, fluctuating intention for one or another option may result from active competition between their neural representations, embodied in the dynamic states of decision networks, including the random activity associated with the brain’s average configuration and a default position tending to repeat the same decisions as made in the past. A mathematical model by Gold and Shadlen[28] and Wong et al[29] suggests a race between neural circuits representing “hypotheses”, the firing rates of which are tied to environmental stimuli, towards a critical threshold for the decision. Andrea Lavazza[6] wrote that Executive control functions organize everyday behavior, which is not the instant behavior found in Libet’s experiments. “They allow us to modulate our behavior, control its development and change it according to environmental stimuli (...physical and social). Also, Executive functions allow us to change our behavior based on its effects, with sophisticated feedback mechanisms; finally, they are also necessary for tasks of abstraction, inventiveness and judgment”. She proposes an Index of Free Will as a

measure of individual capacity, or internal control, “understood as the agent’s ‘ownership’ of the mechanism that triggers relevant behavior and the reasons-responsiveness of that mechanism”. This would allow for the search for the underlying neural correlates of the capacity exhibited by people and limits in capacity exhibited by each individual. Studies have regionalized various character building functions to infoldings of the Frontal Cortex, for instance as described by Minxha et al[30] “Decision making in complex environments relies on flexibly combining stimulus representatives with context, goals and memories...This work reveals a neuronal mechanism in the human brain whereby oscillation mediated coordination of activity between distant brain regions and accompanying changes in strength of representation and/or geometry implements task-dependant retrieval of memory”. This is an example of how task-dependent retrieval of memory, necessary for making choices about those tasks, results from oscillations linking distant brain regions to the human medial frontal cortex. Free will also involves risk assessment, and one’s personal willingness to take risks. Stuphorn[31] described how newly published studies in macaques by Ryo Sasaki et al showed that “two neighboring regions in the frontal cortex together regulate risk attitude in a competitive push-pull-like fashion and can both increase and decrease risk seeking”. Also, that this could be modified by inputs from other regions of the cortex.[14] Klemm wrote[21] of Circuit Impulse Patterns: “In the brain, the oscillation frequency and phase relations of electrical activity shift within and among oscillating circuits. I contend that such changes will change the nature of the thought, and, indeed, are a key component of thought itself”. This is consistent with neural processing that makes decisions by using oscillating neural circuits to stabilize our responses to the world, thus maintaining mental homeostasis. This is performed without a central vantage point, such as a conceptual “homunculus”, or “little man”, surrounded by the metaphoric “Cartesian theater”, popularized by Dennett[32]. This theater is a putative location in the brain where all our separate internal and external sensory inputs are seamlessly blended to create a unified phenomenal experience, which is then, also seamlessly, able to instruct our bodies to act in certain ways, and experience the actions of the body as it responds. Should such a privileged viewing point exist within the brain, any homunculus viewing the scene would have to answer to its own homunculus, and so on.

The urge to act in a certain way is best explained by assuming a “modular theory” for problem solving, including a Character module. It could be consistent with the “pandemonium of demons”, coordinated by a “Joycean (stream of consciousness) machine” proposed by Dennett[32], if the Joycean machine were conscious. It is consistent with the Avatar of Klemm[21], which creates a sense of self able to interact with the outside world through its integration with the subconscious. It is consistent with the circus

"Ringmaster" proposed by Stewart and Cohen[33], the "executive system" of Tse[22] and the "core" consciousness of Damasio[12]. According to modular theories, each potential solution to a problem or decision on how to behave next is represented by a module, or specific pattern of neural oscillations. In choosing between them, the homeostatic function of the brain responsible for our sense of self is likely to be as finicky about maintaining a consistency of self-recognition, or personality, as it is about maintaining a steady blood pressure. Therefore, our choices will be constrained but not determined by a sense of context and consistency, and a conscious desire to maintain a sense of character and responsibility. People are conscious of the need to maintain this, as it is necessary for the trust that maintains business dealings, friendships, and partnerships that lead to the beginnings of families. The subconscious can choose from among several contenders what it expects to be an appropriate course, but just before acting, we become conscious of approving or vetoing it. This theory also accounts for our ability to make surprising decisions, meaning decisions that in the past, even moments before, we would not have considered making, and which those who know us would consider "out of character".

The Modular-with-Feedback theory works in the following way. The conscious mind is a problem solving device, forever seeking answers. A common problem is "What shall I do now?" In the mind of any individual, different options will compete for enactment. Ideas that are out of keeping with character will not recur with great frequency. That I could run down the street singing "Hallelujah!" will not get very far. But ideas in keeping with character, such as putting on the kettle, or phoning so-and-so, will compete with repetitive excitation of oscillating modular nerve patterns until the pattern representing one idea is able to inhibit the other, expand to dominate the cortex, and exceed the threshold for implementation. This idea is consistent with the integrated theory of attention proposed by Buschman and Kastner[34], whereby inhibitory neurons create lateral inhibition of neighboring neurons and increase the synchrony of high frequency oscillating modules. This increases synchrony between regions, and by inhibiting the neurons of competing modules, reinforces the module as a local attractor. Thus we can see that our likely behavior is predetermined by our history, which will cause some neural circuits to oscillate more strongly than others. But in their competition, each must be assigned a probability, and our actual behavior will depend on the dominance of that probability at any moment. Similarly, it is unlikely that England will lose a soccer match to San Marino, but the possibility can't be ruled out, such as occurred when England lost to the USA in the famous 1950 World Cup match at Belo Horizonte. (see [35])

In order for the Modular theory to generate free will, we propose a dynamic version involving feedback loops. Consider the problem of crossing a busy street. If we assume both a degree of urgency, and an

approaching vehicle, we can suppose that the person of reckless character would dash right out, while a timid personality would wait for the vehicle to pass. In the reckless person, the “Go” module would oscillate with greater strength than the “Wait”, and quickly cross the threshold to action. In the timid person, vice versa. A third, indecisive person, might have oscillations of equal strength, and be unable to decide until changing sensory input renders dashing out to be untenable. Feedback can occur if our impetuous road-crosser is nearly run over, with a screech of brakes and a loud cursing from the vehicle’s driver. The reckless character, now chastised, may consciously reset the oscillation amplitudes of the modules to be more cautious next time. The same feedback applies not only to snap decisions, but also to decisions emanating from our moral core. Consider Artie, who has found a wallet containing $500 on the back seat of a taxi. Having turned it in, Artie is rewarded with only a thank-you, but has a good feeling about it. Coincidently, 3 months later, in another cab, the same thing happened. At this point, Artie is unemployed, and would have really appreciated a cash reward. The good feeling has evaporated. A month later, facing eviction and now unable to afford a cab, Artie sees a man up ahead drop his wallet on the sidewalk. On inspection, it also contains $500. This time, the module suggesting that Artie pockets the wallet overwhelms the module for crying “Hey, Mister, you dropped your wallet!”, and, whether or not the decision is subconsciously made, Artie declines a veto and walks away with the wallet. Artie recognises that her character has changed, even if only temporarily, as a result of feedback from experience.

The Modular-with-Feedback Theory predicts that, through a consideration of the state of being undecided, we can show that the modular mechanism cannot possibly be predetermined. You are sure the answer to the last multiple choice question in the exam must be either (a) or (d), and the neural modules for each oscillate at about equal strength without reaching the threshold to decide on the answer. Suddenly the docent says to put all pencils down, and your “hurry up and decide” module supervenes to choose whichever pattern was dominating at that moment. Unless one holds to the determinism of the “random phone call/ kettle boiling coincidence” variety, the choice of either (a) or (d) could not be foreseeable even in principle. It seems possible that advances in technology may enable experiments to look for this taking place. An experimental setup might be able to “watch” the competing modules as they arrive at their unforeseeable decision, as a way to test this theory. It would require a device with sensors that could discriminate modular brain activity with sufficient resolution to distinguish between two modules representing competing ideas, so that their interaction could be followed as the decision is made.

This section advances the theory that inner speech occurs at the level of mind rather than at the material level of neuronal interactions, which take place in the subconscious. At the subconscious level, a module of activity representing a problem is matched with multiple modules representing possible solutions, and various possible matches are forwarded to the stream of consciousness. The mind's inner speech then may reject the proposal, and send it back. If this happens, the subconscious downgrades the proposed solution in terms of future reference, and looks for a better match. A better match may be found, or, at some point, the search may encounter a seemingly unrelated information module which the stream of consciousness is able to seize upon as providing a surprising and innovative solution. The stream of consciousness then approves the best solution and inner speech conveys it into spoken word, action and memory. The conscious inner speech directs the subconscious as to which facts or events should be deliberately, with effort, learned, remembered and retrieved when needed. It also directs the subconscious as to what behaviors to try and perform more skillfully, and which to avoid in future. We can say, with a nod to Libet, that even if our subconscious was deciding for us half a second before we became aware of the decision, our subconscious decisions are trained by our conscious Free Will.

Section 3. Monism, dualism and the emergence of free will

As indicated in the first paragraph, this is a theory in which free will depends on consciousness being an emergent phenomenon, such that we cannot be predetermined. This section elaborates on how we can suppose that this is so.

Although this model may seem like a dualist proposal to the problem of free will, with respect to the mind/ body problem, inner speech can be tied to the material brain through the Entropic Theory of the Emergence of Consciousness[36]. This paper claims that we are fated to remain ignorant of the mechanism of emergent properties such as consciousness. The reason is found in a seeming contradiction in the behavior of information with respect to the first two laws of Thermodynamics. It is said that Information, considered as the microstate of the particles within an isolated system's macrostate, can, like First Law energy, neither be created nor destroyed, yet the information in that system, like Second Law entropy, will inevitably increase. To explain how information can increase without being created, it is supposed that a superintelligence, knowing the complete microstate of the system before the entropy-increasing event, would be able to predict where each particle would go, after the event. While this works as an explanation for routine events, it does not work for emergent events such as consciousness. These events, by definition of the term "emergent", are features of a system which

cannot be predicted by a complete understanding of its underlying level of composition. It is proposed that events like this must be considered as irreversible computations, to which Landauer's Principle applies. Irreversible computations are cycles in which bits of information, temporarily stored, are then destroyed. This destruction represents work, and results in a measurable heat loss, increasing entropy. Although Landauer's bound has been challenged, at a deeper level, an objective reduction theory of quantum mechanics, the Relativistic Transactional Interpretation, explains how entropy, and all classical physics, emerges from symmetry breaking and the deletion of information at the quantum level during the absorption of photons[37]. During computations, tryptophan amino acids in neural microtubules absorb uv photons, and a non-deterministic, non-unitary evolution occurs with destruction of any computation involved in the symmetry breaking. Consciousness involves the irretrievable destruction of microscopic information and the resultant uncertainty is due to entropy. From this, it is reasonable to propose that the increase in entropy in a time-irreversible, unpredictable (emergent) system requires the simultaneous permanent deletion of information concerning the steps, or computations, involved. From this it follows that the steps being sought in the quest for the understanding of consciousness are destroyed as a result of entropy, and will therefore always remain a mystery. (and, likewise, the process whereby the conscious mind directs the brain to act must be an information deleting reversal of the process of emergence). However, we can say that the situation is inconsistent with simple dualism, but is an emergent dualism, specifically, a causally interactive dualism that is, at a hidden level, monist. It is described by the "mentalism" of Sperry[38]: neither dualistic nor identical to brain states. "The difference between mental states and brain processes is the difference between an emergent property or quality and its infrastructure. The subjective quality of mental states as consciously experienced is retained but in a form that is not separable from the brain activity".

From this, it follows that free will can be tied to our functioning brain structures, and their development and evolution, in an emergent manner that cannot be predetermined, or even analyzed and understood.

Section 4. Inner speech, free will, and individual variations

This section deals with the importance of inner speech to self-regulation of our behavior through an ability to freely make choices that are usually consistent with our character. Free will involves conscious decisions, although a well-trained subconscious may often be able to make the same choice that we would consciously decide on. Our conscious choices, as we have seen, are framed in language, and it is our "stream of consciousness" inner speech that weighs the options before making and memorizing the

decision, and signaling for action. Inner speech, silent and self-directed, is involved in self-reflection, attention, learning, memory - short and long term, creativity, problem solving, monitoring progress, motivation, action planning, task-switching, emotions and inhibitions, plus communicative competence[39]. It is important in facilitating delayed gratification and resisting temptation. This gives us control over our volitional agency, and is hence a critical component of our self-regulation. Free will is accomplished through the behavior of self-debate. We recruit our inner voice when we act according to our free will, so as to render our behavior, otherwise mysterious, explicable and rational. This gives us ownership of our behavior, making us morally responsible.

Agency entails formulating a choice before choosing it, and this can be impaired in patients with Attention Deficit/Hyperactivity Disorder, Autism, addictions or Traumatic Brain Injury. More commonly, it may be weakened by hunger, tiredness, and emotional states, leading to "ego-depletion"[40]. Individual differences in self-reported use of inner speech (e.g., [41]) may affect the enactment of free will choice. Simple acts of self-control can occur without self-directed speech, or if the speech was all done in the recent past.

The extent to which people experience inner speech varies greatly, from an almost constant patter to a virtual absence of self-talk, and the differences matter for performing certain cognitive tasks[42]. Nedergaard and Lupyan[43] found that, given an Internal Representations Questionnaire, study participants with less frequent inner voices did worse on psychological tasks that measure verbal memory, and gave a name to the condition - "anendophasia". Some researchers have even suggested that lack of an inner voice may impact other areas important for sense of self, though inner speech seems not to be necessary for task switching and visual similarity judgements. Still others do not experience any auditory or visual imagination in addition to lacking an inner voice, a condition called "deep aphantasia"[44]. Although compared to having a "blind mind", it may also include having a deaf, touchless or tasteless mind as well. Deep aphantasics may have abnormalities of actual visual processing as well. Most of the operations of the brains of these individuals are subconscious. They may have to speak without being able to rehearse the speech aforehand, and may write without having any pre-experience of the written content, or surety as to the entire content of the message, interrupted by pauses until prepared to write more. Planning may be possible through a combination of imagined textures, bodily movements and states of mind, leading to a feeling of completion when the plan has been formed.

Briefly going back to anendophasia, it should be acknowledged that some individuals who claim that they exhibit this condition might rather be unaware of their inner speech or understand it differently. But

let's assume that anendophasia is real. One striking possible consequence of the analysis put forward in this paper is that infrequent or inexistent inner speech could be associated with lower levels of free will[45].

If this is the case, then the legal system would be faced with questions such as brought forward by proponents of an "Index of Free Will" when presented with defendants claiming to have anendophasia, as well as the problem of how to determine whether the claim is genuine.

Considerably more study needs to be done, including correlation between inner speech and brain waves and activity. But it seems plausible that free will in individuals with weak or absent inner speech rely almost entirely on the conscious training of the subconscious, through projected actions that are accepted or rejected, such that it is able to make appropriate selections without the benefit of internal verbal debates. And yet, people with inner speech deficits may benefit from training exercises. Morin[39] cites a number of studies where this approach has helped, for instance, hyperactive children reduce impulsive behaviors[46][47], and schizophrenia patients to improve self-reflective skills (see [48]). Morin notes that Autism Spectrum Disorder may possibly be caused by inner speech underutilization, and that design of an inner speech training protocol could be a promising avenue. Such an approach may also help strengthen the free will of those whose free will is thought to be neurologically compromised.

In conclusion, the Inner Speech Model and the Modular-with-Feedback Theory exhibit synergy in their explanation of how a genuine free will results from the interaction of our consciousness with our subconscious level, with corresponding philosophical and legal implications. This paper highlights the need for a theoretical and research program into the mechanisms by which anendophasic people may perform the inner computations that engender free will.

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Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.