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What Does the Mind Do That the Brain Does Not?

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1. Introduction

The purpose of this article is to discuss various issues relevant to the nature of independent action by consciousness. Two forms of independent action by consciousness have been proposed by various researchers: free will and holistic processing, and both will be discussed. (Holistic processing contributes to the formation of behavior through the holistic use of brain programs and encoding.) An experiment by Libet et al. [1] has shown that if free will exists, it must act as a selection process, and this result will be taken into account. We will also draw upon the findings of a number of other contemporary researchers, and originate some ideas herein, in discussing these issues. We will see that the effect of any independent action of consciousness on the brain/nervous system must be very small, that holistic processing must be a selection effect, that versatility of response to varying conditions can indicate the possible presence of consciousness in an animal, and that because locomotion involves varying conditions, simple forms of conscious experience are likely to occur very early in the evolutionary line of animals.

There is wide variation in the meaning of terms such as consciousness, awareness and free will, so the meaning of these words herein will be given next. The term *consciousness* refers herein to that group of phenomena which can be described in terms of conscious awareness. This term is meant to contrast with *physical world*, which comprises phenomena that are not described in terms of conscious awareness. (No ontological difference is meant by this distinction, but only a difference in description.) Some discussions of consciousness limit this term to certain facets of the above phenomena, such as the ability to hold mental images different from perception, or to have reflective thought and/or self consciousness [2]. However, no such restriction is meant herein. The terms *mind* and *consciousness* are used synonymously herein.

The terms *conscious awareness* and *conscious experience* are used throughout to refer to the experiential aspect of consciousness. The adjective *conscious* may seem redundant to some. But in some usages the terms awareness and experience do not necessarily imply a conscious phenomenon, so this word is added for clarity.

We are going to consider the possibility of independent action by consciousness (with two examples – free will and holistic processing), so this term will be explained next. By *independent action* is meant the ability to make a change in the physical world (more specifically, in the brain/nervous system), with this change not being random or completely determined by physical conditions. The terms *independent function*, *independent processing*, and *mental influence* are synonymous with independent action.

Free will is a form of independent action in which alternative possibilities are present in conscious experience, and is the ability to select between these possibilities.[1] In some usages this term is used solely for actions in which there is rational consideration of the choices involved, but no such restriction is implied herein. *Holistic processing* refers to the selection and activation of motor programs and/or other encoding in the brain in service of a goal which is held in conscious awareness.

We should note that there is no term for consciousness in any presently known physical laws. Put another way, consciousness is not explained by presently known physics. The ontological relationship between consciousness and the physical world – whether consciousness emerges from the physical world, or whether dualism, panpsychism or some other ontological relationship obtains – is also unknown.

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[1] Free will as a form of independent action is sometimes referred to as *libertarian free will* [3,4].

It is not known whether free will or any other sort of independent action exists. Given the complexity of the brain, with a large number of factors contributing at the molecular level to the neural processes involved in encoding and motor programs [5], it would probably be very difficult to establish experimentally whether or not it does exist.

As said above, independent action by consciousness involves physical change in the brain/nervous system, with this change being neither random nor completely determined by physical conditions. Therefore, if independent action occurs, the description of this physical change would be part of the description of the physical world. But presently known physics only offers determinism and randomness. Therefore, any addition corresponding to free will or any other independent action would constitute a radical addition to presently known physical laws [6].

It is probably because independent action would be a radical addition to physics that relatively few contemporary scientists and philosophers have proposed the existence of free will. However, philosophers making such proposals include Griffin [7], Kane [3,4], and Searle [8]. Neuroscientists making such proposals include Eccles [9, 10], Libet [11,12], and Sperry [13,14]. And physicists making such proposals include Burns [6,15,16], Goswami [17], Mohrhoff [18], Mould [19,20], Sirag [21,22], Stapp [23], and Walker [24,25,26]. (For further discussion of contemporary proposals, see Burns [6,27].)

2. Proposals for Free Will Can Be Made in a Variety of Ontological Contexts

The proposal that free will exists has been made in the context of many ontological models, i.e. models which seek to characterize the nature of the relationship between consciousness and the physical world. For example, in emergent physicalism it is considered that consciousness emerges out of some special conditions in matter. Consciousness, which has to do with such things as awareness and qualia, is quite unlike any of the quantities involved with presently known physical laws. So if consciousness can arise from these, one can reasonably suppose that free will can also arise as an emergent property. Thus Sperry [13,14] has suggested this possibility in the context of emergent physicalism, which he called mentalism. Similarly, Searle's proposal [8] that free will exists is made in the context of emergent physicalism.

Alternatively, in dualism it is considered that consciousness and the physical world exist independently, but interact. This ontology has been proposed by Popper and Eccles [10] and Sirag [21,22]. The latter has shown how these very different entities can interact. He points out that the properties of unified field theory, which describes all of physics, can be described by a certain type of mathematical space. It is known, by a mathematical theorem, that this space has an intersection with another space of different type. Since all properties of the physical world are described by the first space, the second space must be something different. Sirag proposes that the second space corresponds to a generalized version of consciousness which he calls Universal Mind, and that the intersection of the two spaces corresponds to consciousness as we experience it. In this way consciousness would have some, but not all, properties of the physical world, and would additionally have some properties from Universal Mind. Interaction via an independent function of consciousness would be possible through the properties which are common to both spaces.

Free will is also proposed in the context of other ontologies. For instance, Griffin [7] places free will within the ontology of panexperientialism, in which all matter is conscious. Goswami [17] places it in the context of idealism, in which pure consciousness is the ground of being, and mind and matter emerge from this common ground.

It should be noted that some proponents of free will (e.g., Stapp [23]) make no proposal regarding ontology. However, the above examples show that one can propose the existence of free will within the context of most ontologies.

3. Relationship of Free Will to Presently Known Physical Laws

Let us first ask the relationship of free will to conservation of energy. In order for free will to affect the brain, it must be able to make changes in physical conditions. Yet, by definition of what we mean by free will, these changes cannot be determined by physical conditions. Because energy is defined in terms of physical conditions, these two statements taken together mean that the action of free will would violate conservation of energy in the physical world, and it is often argued that free will could not exist for that reason.

However, the requirement that energy be conserved derives from an underlying principle in physics, called Noether's theorem, that all physical laws have the same mathematical form at all times. Therefore, as Mohrhoff [18] has pointed out, if the action of free will cannot be specified by mathematical prescription, there is no requirement that it

must conserve energy.[2] So the situation is this: Suppose there is an action, such as free will, which can change physical conditions in the brain, with this change not determined by any physical conditions. If the change can be specified by mathematical law, such action cannot occur because it would then violate the law of conservation of energy. But if the action is genuinely free, i.e., cannot be mathematically specified, it can occur because it is not then subject to that law. It is exactly its freedom, in the sense of the result not being pre-determined, that allows free will to occur.

Presumably free will would produce its physical effects in some characteristic way – for instance, effects may be limited to certain types of function or certain types of interactions in the brain. Also, the magnitude of its effects may be limited. Such characteristics are presently unknown. However, in that they would involve consciousness, any theoretical description would constitute a radical addition to presently known physical laws [6]. On the other hand, such description is apt to be an extension of known laws, or at least have some point of commonality with them, and several proposals have been made in this regard.

A number of physicists have proposed that free will produces its physical effects via collapse of the wave function, such as Goswami [17], Mould [19,20], Stapp [23], and Walker [24,25,26]. There are two central ideas involved: (a) Most physicists believe there is a phenomenon in quantum mechanics called "collapse of the wave function," in which the wave function, previously in an indefinite state, changes to one of its possible definite states.[3] Physicists disagree about what causes collapse, but some maintain that consciousness must be present in order for it to occur. (b) In the collapse process, as this concept is ordinarily applied in quantum mechanics, the selection of a definite state is inherently random. Free will, as discussed above, must be something other than a random process, so presently known quantum mechanics cannot account for it. However, one can conceive that free will could use a non-random version of collapse to produce its physical effects, in an extension of quantum mechanics.

Another point must be taken into account with regard to the collapse hypothesis. In order for free will to act on neurochemical processes in the brain, the wave function must be able to act at the cellular level. It is often argued that because the brain is warm and wet, thermal conditions would prevent quantum mechanical effects from being important at the relatively large scale of cellular structure [31]. However, Stapp [23] has replied that even if quantum properties are partially lost, some effects, such as collapse, may still be important.

In another type of theory, Burns [32], Eccles [9] and Walker [24] have proposed that the action of free will takes place within the limits of the uncertainty principle. We should note that Wilson [33] has shown that if changes within these limits are made to a biochemical process at the cellular level, the effect of such changes would be too small to make any significant difference to brain functioning. However, Burns [32] has shown that biochemical processes can be affected if changes within these limits are made to individual molecules, rather than to cellular components. The reason is that individual molecules have a very small mass, so changes in velocity within these limits are sufficiently large that with magnification by molecular interaction, the direction of a small molecule can be changed to any other direction in one mean free path of travel.[4] In this way, if a sufficient number of individual molecules can be simultaneously affected, processes at the cellular level can be initiated and/or modified.

Specifically, the impact of about 80 ordered water molecules, traveling at thermal energy in the intercellular medium, is sufficient to break a chemical bond. Estimating that several bonds must be broken to open an ion gate to a sodium channel, that several sodium channels must be opened to initiate an action potential, and that several action potentials must be initiated to produce a physical action yields the result that several thousand water molecules must be ordered to initiate a physical action [32]. Thus if free will can act to simultaneously order several thousand molecules, it can initiate a physical action in this way.

In presently known physics fluctuations within the limits of uncertainty principle would be considered random. So the above proposal also involves an extension of quantum mechanics to include, in this case, the ordering of quantum fluctuations.

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[2] Similarly, conservation of momentum derives from the principle that all physical laws have the same mathematical form at all points in space. It follows that if free will is genuinely free and cannot be specified by mathematical law, conservation of momentum does not apply.

[3] We should note that collapse of the wave function is not part of the dynamical equations of quantum mechanics [28], but the concept of collapse helps us to understand these equations. On the other hand, some interpretations of quantum mechanics do not invoke the idea of collapse in explaining these equations [29,30].

[4] Changes in individual coordinates are specified according to the stochastic interpretation of quantum mechanics [34,35].

Alternatively, it may be that the physical effects of free will are produced by some other means, not presently known. For instance, perhaps it can effect a change – small, but not necessarily constrained by the uncertainty principle – under certain conditions, such as complexity or computational function of the brain processes involved [36]. Such a possibility would also be an extension to presently known physics [6], although of a different type than the above two proposals.

4. Free Will as a Selection Process

In order for a choice to be made, a person must be simultaneously aware of two or more possibilities – otherwise no choice is available. The choice might be made between taking an action and not taking it, or it might be between two (or more) different actions. However, to make any sort of choice, a person must have conscious thoughts that describe the possibilities available. Once aware of them, he can select among them.

There are two points of view which can be taken about the origination of these thoughts. We will see that one idea is supported by theoretical considerations and experiment, whereas the other is not. But let's lay out the two perspectives first. In the first view, the free will process includes not only selection among the possibilities, but also origination of the thoughts describing them. After all, if the selection takes place through free will, which by definition is different from brain processes, the thoughts which describe the possibilities might originate independently also. There are several possible versions of this view. One might conceive that mind is able to hold thoughts independently of brain, so that the thoughts about the choices need never be encoded in the brain. Or one might conceive that as mind originates the thoughts, it encodes them in the brain. But in either case, in this view, the conscious thoughts which describe the possible choices originate in mind.

In the second view, the possibilities one is aware of are originated by the brain, and the free will process simply acts as a switch to select among them. In this view mind can only produce a very small effect on the brain, such that it can activate a motor program the brain has already presented, but cannot originate motor programs or encoding for an entire thought.

The latter view is supported by the following theoretical consideration. A great deal of data makes it evident that the content of conscious experience is ordinarily determined by the brain – for instance, if a brain area which processes some feature of conscious experience becomes damaged, a person then has a deficit or disorder in that feature. One might conceive that mind can originate the content of entire thoughts, as in the first view above. But if mind can produce content to that degree, why would we need the brain? Why should evolution set up an elaborate system for coding in the brain, which is subject to damage, if mind can determine content to that extent? So the second view seems more likely. In that case, free will would act as a switch to select among choices, with both the choices and the motor programs to carry them out supplied by the brain [15,16,27].

Let us now ask about the relative timing of the conscious experience of choices and the brain's action in initiating motor programs for physical actions, according to these two perspectives. In the first view, thoughts about the choices originate in mind, so one would expect the brain to initiate the motor program *after* these thoughts are experienced. (Haggard and Libet [36] refer to a view which implies this timing sequence as the "traditional" view of free will.) In the second perspective, the brain is producing both the motor programs and the thoughts about them, so it seems likely that the motor programs would be prepared and ready *before* the thoughts are presented to conscious awareness.

A well-known experiment by Libet et al. [1] and its extension by Haggard and Eimer [37] support the second view, but not the first. In these experiments the subject was asked to move his hand or wrist at a time of his choosing and to report the time he decided to carry out the action. In order to perform an action the brain must use a motor program. A readiness potential is present in the brain while a motor program is being processed, so it can be learned whether the brain prepares the motor program before the decision is made or after.

In the experiment of Libet et al. [1] subjects were instructed to flex their wrist at a time of their choosing. The results were that the readiness potential began several hundred msec *before* the intention was consciously experienced, and the movement commenced about 200 msec after the intention. In the experiment of Haggard and Eimer [37] subjects were asked to move either the right or left hand in an irregular sequence of their choice. This experiment estimated the time of onset of the lateralised readiness potential, which can only begin when the motor program is specific as to whether the right or left side of the body is to be moved. Similarly to the results of Libet et al., the potential began several hundred msec *before* the subject's report of conscious intent to move, and movement began 200 msec or more after conscious intention.

As Haggard and Libet [36] point out in summarizing these experiments, the results show that brain processing begins before conscious experience of intention. They also point out that because the experience of intention occurs before movement begins, the data allow the possibility that free will can act to veto an action or select between alternative actions.

The above experiments do not show whether free will exists. As we noted earlier, given the complexity of the brain, it would be very difficult to establish that experimentally. However, their outcome is consistent with the second view above that if mind can produce changes in the brain, such changes are very small. Combining this idea with the conclusions of the above experiments, free will can be described in the following way. It can activate a motor program (or veto it by lack of action). However, it can only produce a small effect on the brain – too small to generate an entire motor program or an entire thought. Thus the basic motor programs involved are generated by the brain. Furthermore, the possibilities presented to conscious awareness are generated by the brain, and the free will process consists of a selection among these possibilities.

5. Independent Processing Additional to Free Will

If the independent action of consciousness can select among motor programs, it seems reasonable that it can make selections not only when a conscious choice is made, but also at other times. Many actions involve dealing with varied and unpredictable conditions, such as when walking over very irregular terrain. What is needed here is not conscious choice about the various details of the action, but simply to accomplish the goal – in this case, traversing the terrain. In this case, instead of presenting alternatives, the brain could simply present the goal to conscious awareness. The independent function could then contribute to the formation of motor programs by selection among patterns the brain has available in order to respond to conditions at hand [15,27]. In this way the independent function could help provide versatility to actions.

Such action by consciousness could save a considerable amount of neural programming that the brain would have to provide if it had to entirely determine responses to all of the large number of unpredictable conditions which are encountered in different situations.

6. Independent Processing and Evolution

If the presence of consciousness is to be selected for in evolution, then consciousness must be able to contribute to behavior in some function that can act independently of the brain (or nervous system, in simple animals). Otherwise, evolution would select for brain processes only, and the presence of consciousness would be coincidental. In that case, the fact that consciousness is associated with some brain processes would make no difference to our functioning, nor would it matter which brain processes it is associated with. For instance, consciousness is especially associated with actions involving novel events, but habitual actions can be performed with little or no awareness [38,39]. If consciousness is an epiphenomenon, its association with novel events is merely a coincidence, and we could carry out our response to such events just as well without it.

Also, much sensory processing, especially for vision, is lengthy and involves many steps, but consciousness is associated only with the end stage, which describes the outside world, not with earlier stages. In an intermediate stage of vision processing, the world is described in terms of lines and bars, with no distinction made between objects and shadows [40]. If consciousness is an epiphenomenon, we would be able to carry out our daily activities just as well if our visual experience was of this intermediate stage, and it would be only an amazing coincidence that consciousness happens to be associated with the end stage of processing [16].

In a similar vein, Mould [19] points out that if conscious experience does not act on biological mechanisms, there would be no reason for emotional life to be relevant to what is happening. If an organism is starving, it could just as well feel glorious fulfillment as desperate hunger. He adds that if conscious experience is an epiphenomenon, there is no reason why it should have any connection at all with the brain's sensory processing – we might instead just experience a meaningless blur of irrelevant sensations.

The fact that conscious experience is not irrelevant to behavior therefore suggests that consciousness does perform a function independently of the brain. Such a function would reduce the amount of brain processing necessary to produce behavior, and the presence of consciousness would thereby confer an evolutionary advantage. In that case it would not

be surprising to find use of such a function beginning early in the evolutionary line, with more complex use occurring in more complex animals.

As suggested earlier, if an independent function can help produce a versatile response to a varying environment, this might especially save neural processing. So we will consider versatility of behavior as a possible indicator of the presence of consciousness on that grounds.

We should note that, in fact, many of the current proposals made for consciousness in the animal kingdom do involve versatility, although such proposals are usually made on an intuitive basis and without discussing whether an independent function of consciousness might be involved (proposals reviewed by Griffin [2]). For instance, Griffin [2, Ch. 13] especially emphasizes versatility as being associated with consciousness.

Some proposals about the presence of consciousness in the animal kingdom suggest that it is associated with locomotion, and inasmuch as locomotion over varying terrain would require versatility of response, these would imply that consciousness is associated with versatility. For instance, Sheets-Johnstone [41] proposes that consciousness is associated with the ability to traverse the environment, such that brain programs for motor action and proprioception (which specifies the relative positions of moving appendages) are used. In that case, consciousness would appear at early stages in the animal kingdom, both for vertebrates and invertebrates. In a similar vein, Meijsing [42] notes that creatures which can travel fast enough that they could injure themselves on colliding with an obstacle also have vision sufficiently developed to detect distant objects. She proposes that consciousness was first used in evolution in the earliest animals with both locomotion and vision for distant objects. She contrasts these with bacteria, which can propel themselves and can sense their immediate surroundings through chemoreception, but would not be considered conscious under those criteria.

If use of the independent action of consciousness appears early in the animal kingdom, then choice, i.e., selection between alternative behaviors, may occur at a relatively early stage. In that case, feelings such as pleasure and pain in simpler animals and emotions in more complex ones could act as choice guiders [15,16]. The content of such an experience – the urge for a certain type of action and the intensity of that urge – is, as for any experience, specified by the brain. However, there could be a savings in neural programming, particularly when a choice must be made between conflicting actions which respond to different sorts of needs, if the brain can simply present choice guiders, rather than prescribing such behavior in advance. Thus such feelings can be supportive of independent action and therefore would also be an indication of the presence of consciousness.

Relevant to this, a variety of proposals have been made that the presence of emotions, as indicated by behavior and/or neurophysiology, shows the presence of consciousness in animals (although without these proposals discussing any connection to an independent function of consciousness). For instance, Panksepp [43] points out that the basic neurophysiology associated with emotions in humans is also found in mammals and has suggested on that grounds that mammals also experience emotions, albeit perhaps in a simpler form than humans. Dawkins [44] proposes that various objective signs, such as physiological and behavioral parallels to human emotional capacity, can suggest the presence of consciousness in an animal. Bekoff [45] suggests that systematic studies of behavior which appears to express emotion, drawing on both ethology and neurobiology, can shed light on the distribution of conscious experience in the animal kingdom. Finally, Cabanac [46] points out that several physiological correlates to emotion in mammals are present in reptiles, but not amphibians, which would suggest that the conscious experience of emotion also began development in reptiles.

Relevant to other aspects of conscious experience which might appear early in the evolutionary line, several proposals have been made that a simple form of self awareness is a necessary part of the locomotion process. Sheets-Johnstone [41] points out that in order to know the relative positions of its appendages in locomotion, an animal would need to know the distinction between parts of its body and the environment, and such could thereby constitute a primitive sense of self. She suggests that along with the experience of locomotion, this sense of self or agency is also experienced consciously. Similarly, Meijsing [42] proposes that when an animal has the capacity for both locomotion and perception of a distant environment, perception must involve an awareness of the body/self going somewhere. In that case even the earliest forms of conscious perception would also involve a simple form of self awareness.

Also, Panksepp [47] proposes that the roots of the self in mammals are in the areas of the brain (diencephalon and mesencephalon) in which sensory mappings, coordinates for motor actions, and affective motivations meet, and that both affective value coding and representation of self play an important part in the formation of motor actions. He proposes that a conscious sense of self appears in the evolutionary line along with affective experiences in mammals, or perhaps

arises even earlier in simpler vertebrates and other creatures which have more primitive versions of the comparable neural architecture.

So far we have considered flexibility of behavior and feelings which could help choose between alternative behaviors as indicators of the presence of consciousness. However, one could also ask whether there is some particular behavior which can indicate the presence of consciousness. For instance, a well-known proposal has been made by Gallup [48] that if an animal can recognize its reflection in a mirror, it must be self aware and therefore conscious.[5]

The question of which species can recognize themselves in a mirror has been investigated experimentally. Most animals treat the reflection as a conspecific, and attempt to attack it, court it, or otherwise interact with it [48]. However, among primates, chimpanzees, orangutans and bonabos have this ability [49].[6] In addition, dolphins appear to be able to recognize themselves in a mirror [51,52]. No other animals have been found that can do this.

However, the problem with using the ability to recognize oneself as an indicator of the presence of consciousness is the following. As discussed earlier, the experiments of Libet and others show that specific behaviors are always supplied by the brain; and that if there is an independent function of consciousness, its action is simply to select among them. Therefore, even if a behavior includes some feature, such as the ability to recognize oneself, that humans associate with consciousness, the fact that an animal has that behavior shows only that its brain is able to produce it. Rather, one must look for flexibility in selection of behavior as an indicator of consciousness. Using this criterion, higher cognitive ability, with its weighing of alternatives and ability to modify behavior, implies a substantial flexibility of behavior and therefore is itself an indicator of consciousness. But it is the flexibility in selecting behaviors, rather than any particular behavior, that produces this conclusion.

As another example, it has been proposed that episodic memory (ability to remember a sequence of events) implies the presence of conscious experience [2]. An animal with episodic memory presumably would also have other cognitive abilities, and by the above criterion would therefore probably be conscious. On the other hand, lack of any particular cognitive ability, or of cognitive ability in general, does not necessarily mean lack of consciousness. For instance, lack of episodic memory does not necessarily imply a lack of conscious experience. A very simple animal might use the independent function of consciousness to help it move over varying terrain, yet have no need to know what it was doing yesterday or even two minutes ago [15].

7. Holistic Actions of Consciousness

Researchers have made two sorts of proposals about the way consciousness may act holistically. First, proposals have been made that consciousness can access various feature processors in the brain and represent their contents in a unified qualia display. And second, proposals have been made that consciousness can select among programs and/or other encoding in the brain to help carry out a goal which is held in conscious awareness. The first action can be regarded as holistic because it produces a unified qualia display. However, it does not involve any physical changes in the brain, but merely a representation of its contents. The second action is holistic because it selects and activates brain programs and/or encoding in the service of a goal. Because the latter involves activation of programs and/or encoding (i.e., physical changes in the brain), it is a form of independent processing, and we refer to it herein as *holistic processing*.[7]

Let us now review some of the above proposals, including the first type, so as to increase our overview of the holistic action of consciousness. (A few additional proposals about holistic action are reviewed by Burns [27].)

Eccles [53, §8.3; 10, p.270] was among the early contemporary researchers to propose that consciousness acts holistically, and he has undoubtedly contributed more to the discussion of this topic than anyone else. For instance, he proposed that holistic action by consciousness can integrate the results of various aspects of vision processing, which are done in different parts of the brain, to give us a unified visual experience.

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[5] Gallup [48, p. 490] uses a somewhat different terminology than herein. He says that an animal which can recognize itself in a mirror must be aware of itself and therefore must be aware of its own mental states. He makes it clear that by *mental states* he means what is referred to herein as *conscious experience*.

[6] Also, a gorilla, Koko, who was reared by humans during much of her early years, showed this ability [50]. But no other gorillas have been found to recognize themselves in a mirror [49].

[7] Both forms of the holistic use of consciousness have been jointly referred to as *active gestalt* [15], *holistic information processing* [27], and *activity of the self-conscious mind* [10].

Since Eccles' original proposal about this, an analysis of the computation which must be used to process visual information has been developed, and it can be helpful in understanding what consciousness may contribute to vision processing to know something of the components of this computation. Visual information is initially simply a pattern of light and dark on the retina, and it is this pattern which must be converted into a representation of identifiable objects. In the first stage the boundaries of objects must be distinguished from shadows. These distinctions cannot be made simply on the basis of a two-dimensional pattern, and the brain must incorporate various rules – for instance, areas with different textures are apt to correspond to different objects – in order to determine these boundaries. This stage produces a two-dimensional sketch of the objects in the visual field, which is called the "primal sketch". In the next stage, these outlines are combined with further details of visual information (color, movement, etc.) to describe three-dimensional objects which can be compared with the contents of memory and identified [40].

This computational analysis can give us an answer to the question, if consciousness can represent encoding in the brain as a conscious experience, couldn't it simply convert the encoding at the retina into visual experience, so that the extensive brain processing of visual cortex would not be needed? The answer is that the pattern on the retina is not sufficient to determine what we see, and various rules must be used to determine the outlines of objects. We concluded in Section 4 that mind can originate or hold separately only a very small amount of the information which contributes to the contents of conscious experience, not even enough for a single thought. Rather, such encoding must be done by the brain. Therefore, mind cannot provide the above rules for vision processing. The brain must provide them implicitly in its neural circuitry, and whatever consciousness does must occur after these rules are incorporated into the vision computation. So any action by consciousness must occur after the stage of the primal sketch. At this point consciousness could then act holistically to integrate the further details of visual information scattered among various feature detectors and material from memory which identifies the objects, and present all this to conscious experience in a unified way [15,16].

In an additional proposal, Eccles [10, p.364] has pointed out that different sensory stimuli can take different amounts of time to come to conscious experience, depending on their intensity, yet we experience these stimuli in the proper temporal order. He proposed that holistic action by consciousness provides the coordination to present these in the proper order.

With respect to the second type of holistic action by consciousness, Eccles [10, p.552] has proposed that independent processing ("self-conscious mind") provides creative imagination. In a similar vein, Penrose [28,31] has suggested that mathematical insight comes from independent processing. By extension, such processing could also play a part in insight in general. Also, Goswami [17,54] has proposed that independent processing plays a part in creativity in cases in which an insight not only is new, but uses a new context to view the situation.

As previously noted, we have concluded that any effect of the mind on the brain is too small to present an entire idea to conscious awareness. However, just as mind could activate a motor program, it could activate a stored thought and present it to conscious awareness for consideration with regard to a current problem. Similarly, it could link a thought already in conscious awareness to a new context, so that the thought could be viewed in a new light. In this way independent processing could present new insight, even though its effect on the brain is very small. Because such a process would select among stored material in the brain, it would be a selection process.

Hodgson [55, §6.3] has proposed that independent processing by consciousness can be used to compare incommensurate properties. For instance, an organism might encounter a potential food which is somewhat like previous foods, but resembles a previously encountered noxious substance in some respects. The characteristics of the new substance may not be entirely commensurate with those previously encountered. Nevertheless, if the organism can make some sort of comparison, it can better select a behavior – in this case, eating or avoidance – for dealing with the new substance. Hodgson has suggested that experiencing substances by their qualia gives a better way to make such comparisons than if the brain had to do it mechanistically. Although a simple comparison of qualia would describe the basic ability, as it would be found in primitive animals, in humans, who have considerable cognitive ability, this basic process would enable the "informal plausible reasoning" by which humans customarily deal with incommensurate factors.

We can see in the above proposals that holistic action by consciousness involves several differing aspects. First, there is an ability to read an extremely large amount of information which is represented in the brain by a variety of electrochemical processes. Second, a large amount of this encoding is represented in a new medium, conscious experience, by qualia. Third, there is an ability to select and activate programs and/or encoding in the brain, with these

selections based on the contents of conscious experience. It would seem that far more information can be read than is presented to conscious experience. For instance, in the case of insight, it would seem that a large amount of unconsciously held information must be surveyed, in order to find the relevant idea to be directed to conscious experience. Also, in order to use a motor program, the function it would carry out must be known.

Finally, in characterizing holistic processing, we should return to Mohrhoff's conclusion that the action of free will cannot be mathematically pre-determined, in order that it not be in conflict with the law of conservation of energy [18]. The arguments by which this conclusion is derived apply to any sort of mental influence, not only free will. Therefore, any action by holistic processing must have a degree of arbitrariness to it, such that it cannot be pre-specified.[8] This arbitrariness, then, is the hallmark of action by consciousness – it acts in response to the contents of conscious experience, but in an *ad hoc*, rather than deterministic fashion, and must act in this way in order not to violate the law of conservation of energy.

8. Alternative Views of the Self

The differing positions people hold on the nature of the self are exemplified by the views of Sperry and Eccles. Sperry [14, p.78] said, "I have always favored monism .... Monism ... says no to an independent existence of conscious mind apart from the functioning brain."

On the other hand, Eccles [10, p. 557] said, "The self-conscious mind ... may rise superior to the brain .... Thus there may be some central core, the inmost self, that survives the death of the brain to achieve some other existence which is quite beyond anything we can imagine."

Either view is consistent with the ideas herein. Clearly, they involve differing conceptions of whether all aspects of the self are defined in the brain or whether it has a transcendental core. Also, as we will see, they involve differing conceptions of whether independent processing is an impersonal principle or whether it is carried out by a transcendental self.

The first view assumes that all aspects of the self are defined by the brain. So free will and holistic processing presumably are carried out by some sort of impersonal principle that the brain can use when it is sufficiently complex or carries out certain functions or uses certain biochemical processes. In this view, the idea that there is a core self, transcendent to the brain, which carries out this processing is evidently just a confusion in which the brain-generated traits defining the self are mistakenly felt to have something to do with the action of the impersonal principle.

The second view assumes there is a core of self-awareness – some central essence – which is something additional to what the brain determines. Conscious experience is a unified whole, and perhaps this core self-awareness produces the unification. In that case one could reasonably suppose that the core self also carries out independent processing.

Not all aspects of independent processing are carried out at the level of conscious experience, and this brings added complexity to the question of the nature of the self. Encoding has to be read at the cellular level – this is not done by conscious experience. This coding has to be translated into the qualia display – this is not done by conscious experience. A selection is then made between alternatives, or a goal the brain has presented is assented to and held in consciousness – this part of the process is done in conscious awareness. But changes then are made in the brain at the cellular level, in response to what happened at the conscious level, and this is not done by conscious experience.

If independent processing is done by an impersonal principle, we can simply conclude that the principle must act at several levels – the cellular/physical level and the qualia display – with different types of activity taking place at different levels. On the other hand, if independent processing is done by a transcendental self, it must include not only a conscious self, but also an unconscious self which can read brain encoding and does the work of translating back and forth between the brain and the qualia display. Therefore, if there is a transcendental self, it must be a compound self which comprises considerably more than the conscious self.

Clearly, the question of the nature of the self cannot be separated from the question of the ultimate nature of independent processing - impersonal principle or the action of a compound self.

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[8] An arbitrary event differs from a random one in that a sequence of random events must follow a pre-specified probability distribution, whereas a sequence of arbitrary events does not have this restriction.

9. Overview of Conclusions About the Nature of Independent Processing

We have now reviewed a number of issues relevant to the nature of independent action by consciousness. As said at the beginning, we have taken into account the experiments of Libet and others, and the results of these experiments have led to the conclusions that the physical effect of mind on brain must be very small and that holistic processing, as well as free will, must be a selection effect. A number of relevant findings from other researchers have also been summarized herein, and all these conclusions, taken together, suggest a reasonable overview of the possible nature of independent processing. A summary of these findings follows.

* It is not known whether free will exists. However, if it does, it would (by definition of free will) produce physical changes in the brain without these changes being either random or determined by physical conditions. This means that the description of these physical changes would require a radical addition to presently known physical laws.

* Even though the description of such changes would require a radical addition to physical laws, it is likely there is some common ground between it and presently known laws. Present proposals include the ordering of quantum randomness – either via collapse of the wave function or the ordering of quantum fluctuations – or that the capacity for independent action arises when special conditions – such as complexity or carrying out certain functions – obtain in the brain.

* The experiment of Libet et al. [1] and its extension by Haggard and Eimer [37] show that if free will exists, it can choose between different motor actions (or whether to carry out an action or not), but that mind does not produce the thoughts that describe these choices. Instead, the thoughts describing choices are produced by the brain, and free will must act as a switch to choose between them. We concluded herein that this means that mind can only produce a very small physical effect on the brain.

* We concluded herein that if mind can produce a small physical effect during the action of free will, it can also produce a small physical effect at other times. It was proposed that if an ongoing action is being carried out for which there are varying and unpredictable conditions (as in traveling over uneven terrain), mind can contribute by selecting appropriate motor programs from the repertoire the brain has available. In that case the brain would present the goal (in the above example, navigating the terrain), and mind would select motor patterns for that goal while the goal is held in conscious experience.

* If the presence of conscious experience is to be selected for in evolution, mind must produce physical changes in the brain/nervous system, with these changes able to influence the behavior of an animal. If it could not, there would be no reason for the qualia of conscious experience to be related to environment or behavior, and the fact that our qualia are so related suggests that mind indeed can produce physical effects in the brain.

* If consciousness has the ability to select motor programs in response to varying conditions, this ability could be used in locomotion. Such use could save neural programming because the brain/nervous system would then not have to determine responses to all of the many combinations of conditions, some of them opposing, which could affect the movement of an animal. If consciousness has this ability, its use would probably begin very early in the evolutionary line of the animal kingdom, although the conscious experience of such animals would undoubtedly be very simple.

* Choice, i.e., selection between alternatives presented by the brain to conscious awareness, may also begin early in the evolutionary line. In that case, conscious experience of pleasure and pain could act as choice guiders, and might occur in the earliest examples of animals which use this function. Emotions could also act as choice guiders and would occur in animals with more advanced nervous systems.

* According to the above lines of thought, a behavior would indicate the possible presence of consciousness if it showed one of the following characteristics: (a) flexibility of behavior in response to varying and unpredictable conditions, or (b) behavior indicating the experience of pleasure/pain and/or emotions. Because cognitive ability enables flexibility of response, its presence would always indicate the presence of consciousness. On the other hand, behaviors which are rule-based, with little flexibility, would not carry any indication of the presence of conscious awareness, even if such behaviors are very complex or are similar to behaviors associated with consciousness in humans.

* A number of proposals have been made about holistic actions consciousness might perform. Such proposed actions are of two types: (a) the production of holistic conscious experience based on the contents of a large number of feature detectors and other processing units in the brain, and (b) the independent action of mind to select among behaviors and ideas in the brain. (We have referred to the latter herein as *holistic processing*.) Creative insight would be

an example of the latter and would be produced by bringing thoughts already stored in the brain to conscious awareness and/or by activating a new context so that thoughts already held are looked at in a new way.

* As Hodgson [55] has pointed out, an important feature of consciousness may be the ability to weigh incommensurate factors. In a primitive organism this ability could be used simply to select a suitable behavior from different, perhaps opposing, behaviors suggested by various factors in the environment. In humans, who have substantial cognitive abilities, this ability would be at the core of the informal plausible reasoning we commonly use when weighing incommensurate matters.

* As Mohrhoff [18] has shown, if a mental influence can produce physical changes, then it must have some degree of arbitrariness in the changes it produces. The reason is that if such changes could be mathematically predetermined, they would then be subject to the law of conservation of energy, which a mental influence cannot fulfill. If, on the other hand, the changes produced by mental influence cannot be mathematically specified, they are not subject to that law. Therefore, it is the hallmark of mental influence that its action always has a degree of arbitrariness in it.

* The ultimate nature of independent processing depends on whether its arbitrary selections are carried out as an impersonal principle or by a transcendental self. If the latter, the self must be compound in nature, with both a conscious self which experiences the qualia display and an unconscious self which can read brain encoding and select motor programs, and therefore carries out most of the work of independent processing.

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