



LANGUAGE AS EMBODIED INFORMATION

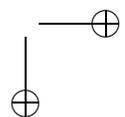
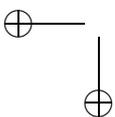
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1. *Introduction: The Life of the Sign*

In his *Philosophical Investigations*, Wittgenstein presents us with the following observation and puzzle: “Every sign by itself is dead. What gives it life? In *use* it is alive. Is life breathed into it or is the *use* its life?” [Wittgenstein 1988, §432]. Wittgenstein’s question points immediately to one of the central problems in the philosophy of language and of philosophy in general which is the problem of how (linguistic) signs can somehow ‘signify’. This problem was also very much in the focus of Ladrière’s philosophical interests as was the investigation into the so-called limitative theorems in logic, such as Gödel’s Incompleteness Theorems [Ladrière 1957]. In a paper published in the journal *Synthese*, Ladrière writes the following:

“le problème que l’on peut considérer comme central dans la philosophie du langage est celui de la signifiante: comment peut-on expliquer que les signes aient la capacité de faire signe, par quel mécanisme les phénomènes physiques qui sous-tendent l’usage du langage et les actes du langage sont-ils revêtus de signification, ou encore comment s’effectue la transposition de l’ordre des purs arrangements extérieurs régis par des règles combinatoires dont les contraintes sont purement formelles, à l’ordre du langage, envisagé comme ce milieu en et par lequel des sujets parlants prennent position à l’égard du monde en même temps qu’ à l’égard les uns des autres?” [Ladrière 1984, p. 59]

One possible answer to this question is that words and sentences are the linguistic expressions of human mental states and as such are characterized by ‘intentionality’, being that property of mental states by which they can be said to be ‘about’ states of affairs and things in the world. Giving an account of this intentionality which is characteristic of human language is considered to be an important problem in any philosophy of language and mind. D. Dennett [Dennett 1987] considers in this respect three different ‘stances’ all useful in predicting the behavior of certain systems.



In the *Design Stance* one predicts the behavior of a system by assuming that it has a certain design, that it is composed of certain elements with certain functions and that it will behave as it is designed to behave under certain circumstances. In so doing the design stance can safely ignore details of the physical implementation of the various imputed functions.

In the *Physical Stance* one predicts the behavior of physical systems by exploiting information about the physical constituents of the system and the laws of physics.

Finally, there is the *Intentional Stance* in which the systems whose behavior one wants to predict are treated as rational agents. They are attributed the beliefs and desires they ought to have given their place in the world and their purpose, and subsequently one predicts that they will act to further their goals in the light of their beliefs. As such, these different stances present some kind of cumulative hierarchy in which one level builds upon the other, thus presenting a picture of intertwined relations that together explain the behavior of complex systems such as also the human being.

In this paper, we will discuss an approach to the aforementioned problem of the production of significance in which Dennett's different stances are taken into account in order to elucidate this relation. The starting point will be an analysis of the qualia debate in contemporary philosophy of mind and the functionalist answer to Chomsky's Competence Model in Devitt and Sterelny's 'Martian Argument', an argument comparable to Dennett's *Design Stance*. Biological models of the mind, as implementations of the *Physical Stance*, on the other hand, show recursivity to be present on the level of brain processes, consciousness and language but it would seem that looking at language in relation to qualia and the question whether these can be causally active requires us to introduce 'emergence' and 'downward causation'. In a final part, which highlights the *Intentional Stance*, as natural language is not only characterised by recursion but also by 'aboutness' or Intentionality, we will show how there might be a reason to speculate about a non-computable or non-recursive element 'that lies beneath' and may account for the connection between consciousness and the intentionality of language.

2. *Qualia, Functionalism, and the Martian Argument*

In recent discussions in the Philosophy of Mind the nature of phenomenal states or qualia — also called 'raw feels', 'conscious sensations', or the feel of '*what it is like to be*' — and of consciousness in general have been an important focus of research. Qualia, then, are (first order) properties of mental states as e.g. 'seeing red', 'feeling pain' and the concept is sometimes used more broadly to indicate conscious experience in general. Explaining these

qualia has been called 'the hard problem of consciousness': David Chalmers, e.g., writes:

"If any problem qualifies as *the* problem of consciousness, it is this one. In this central sense of 'consciousness', an organism is conscious if there is something it is like to be that organism, and a mental state is conscious if there is something it is like to be in that state. Sometimes terms such as 'phenomenal consciousness' and 'qualia' are also used here." [Chalmers 1995, p. 201]

Proponents of Mind-Body identity theories [Macdonald 1989] claim that, in fact, there is no problem since it is perfectly possible to reduce these states and their properties to neurophysiological properties. In the case of Functionalism, mental states are claimed to be reducible to functional or computational properties of the organism concerned. Others claim that a reduction is impossible and that, therefore, there remains an 'explanatory gap' [Levine 1983]. So, while some consider consciousness and qualia as some kind of epiphenomena with no real existence in their own right, others want to say that there is a fact of the matter with respect to these phenomena and that therefore they should be given a separate ontological status and that also we should be philosophical realists about the things in question. The first group, let us call them reductionist, are antirealists in the sense that they believe that there is no fact of the matter as to the existence of the aforementioned phenomena or entities unless maybe with respect to a certain background theory but not as something existing in a mind-independent way [Vergauwen 2000, p. 366].

Functionalists hold that mental states, qualia, and cognitive states in general can be viewed as the functional states of a machine or, rather, of a Turing-machine. In this view, the explanation of cognitive functions has to be done in terms of a causal-functional description of these functions. So, e.g., a typical functional explanation of 'pain' would imply that pain is a functional state and as such, therefore, functions as the detection of tissue-damage. Of course, such a causal-functional state or role may cause the production of a certain behavior or of another functional state which is the result of the first state. In functionalism, a mental state is defined in terms of three elements which are causally related: the input — the stimulation which causes the mental state — the causal interaction with other mental states, and the output which is behavioral. In this sense mental states are defined by means of a job description. Reductive explanations in science usually work this way. It is, e.g., known that organisms are able to transmit hereditary

information. This was known even before the gene was discovered. Subsequent scientific investigations showed that in fact DNA was responsible for this transmission and that therefore did the job that was required.

This kind of explanation of mental states is underpinned by a principle which is shared by many functionalists and non-functionalists, which is the principle of mind-body supervenience [Kim 1998, p. 10].

(a) Principle of Mind-Body Supervenience.

The mental supervenes on the physical in that any two things (objects, events, organisms, persons...) exactly alike in all physical properties cannot differ in respect of mental properties. That is, physical indiscernibility entails psychological indiscernibility or, as it is sometimes put, 'no mental difference without a physical difference'.

The principle of supervenience is combined in functionalism with another principle which is the principle of multiple realizability [Kim 1998, p. 70–71].

(b) Principle of Multiple Realizability.

Mental states are multiply realizable: any given mental state can be instantiated in (infinitely) many physical states.

It is within such a functionalist framework that some have argued that Chomsky's approach, who considers linguistics to be part of cognitive psychology, is misguided. Michael Devitt and Kim Sterelny [Devitt, Sterelny 1989] have presented an argument — dubbed the Martian argument by Stephen Laurence — intended to show why this is so. Linguistics, according to Chomsky, deals with human knowledge and understanding of language, linguistic competence, and is therefore concerned with questions about the cognitive skills of human beings and thus in the end ultimately about the specific human neural setup. The psychological mechanisms for language acquisition are instantiated into the mind/brains of the human language users.

Since grammars are about such instantiations, the instantiation of English grammar in humans is indeed English according to this conception. This we may call the competence thesis, the thesis that grammars are about human linguistic competence.

The Martian argument, now, runs as follows. Let us assume that Martians, whose psycholinguistic processes *ex hypothesi* differ from human ones nevertheless manage to produce a set of sentences that are extensionally equivalent to the set of sentences in human English. This implies that the sentences that are grammatical in Martian English are also grammatical in regular English.

However, since by hypothesis Martians have a different neural organization, they really have a different language competence and now the question arises whether they should count as speaking English. On an account of what it is to speak English the Martian speakers should indeed count as speaking English. On the level of linguistic symbols everything they say is indistinguishable from us and they also seem to be able to communicate via a seemingly shared language. They are, therefore, on the face of it, competent in English. We can, then, nevertheless study the shared language that we both use on the linguistic level without having to appeal to differences in competence.

"According to the transformationalists, English competence consists in internalizing a grammar. They go further: all English speakers have internalized near enough the one grammar; competence has a uniform structure across the linguistic community. Even if this is so, it is not necessarily so. Many other grammars could agree on the meaning-relevant structures they assign to the sentences of English. Suppose that Martians became competent in English by internalizing one of these other grammars. The theory of Martian competence would have to be different from the theory of ours. Yet the theory of symbols would be the same, for it would still be English that they spoke. Returning to earth, it would not matter a jot to the theory of symbols if competence among actual English speakers was entirely idiosyncratic." [Devitt, Sterelny 1989, p. 514]

This argument has caused a lot of discussion which we do not want to go into here, but we want to maintain that this functionalist approach, which is in fact nothing but a variant of the Turing test, neglects an hitherto not enough noticed fact, namely that 'there is something it is like to use (speak and understand) a (specific) language' which in turn means that in fact the ability to use a language turns out to be some kind of a quale. Moreover, functionalism at best does not believe that qualia can be fully functionalized and because of the supervenience principle, according to Kim and others, in combination with certain intuitively plausible assumptions (causal exclusion principles) it implies a kind of epiphenomenalism, the view that every mental event is caused by a physical event in the brain but that mental events have no causal powers of their own.

They are powerless to cause anything else, not even other mental events and are therefore almost literally 'non-existent'.

In our view, language and consciousness are intimately related and have a 'phenomenal' ('qualia-like') aspect. A further investigation into the nature of these qualia may, therefore, then reveal something of the true nature of



the mental and of language. It would seem that such an investigation has to concentrate on the embodiment of the mental and the linguistic.

3. *Biology, Recursion and Language*

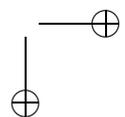
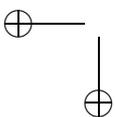
An initial proposal can be found in the neurobiological model proposed by Gerald Edelman, more specifically, in his theory of Neuronal Group Selection where he uses the concept of a Dynamic Core [Edelman, Tononi 2000; Vergauwen 2010, pp. 1258–1260]. Edelman explicitly aims at constructing a naturalized theory of consciousness, in which properties such as intentionality — the fact that conscious mental states are characterized by “aboutness” — and qualia — the subjective “raw feels” are accounted for in a neural framework. He begins by stressing that, though it is sometimes claimed that any attempt to reduce phenomenal or subjective experience (qualia) to neural activities leads to an explanatory gap which constitutes ‘the hard problem of consciousness’ [Chalmers 1995], this need not be a problem because in a certain sense a reduction is possible:

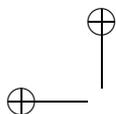
“the neural systems underlying consciousness arose to enable high-order discriminations in a multidimensional space of signals [and] qualia are those discriminations. Differences in qualia correlate with differences in the neural structure and the dynamics that underlie them... and I have stressed that it is the distinctions among the entire set of experienced qualia that allow the specific defining property of each quale to appear.” [Edelman 2003, p. 5521]

However, a scientific account of the individual experiences of these qualia is not to be expected since:

“a scientific theory cannot presume to replicate the experience that it describes or explains: a theory to account for a hurricane is not a hurricane. A third-person description by a theorist of the qualia associated with wine tasting can, for example, take detailed account of the reported personal experiences of that theorist and his human subjects. It cannot, however, directly convey or induce qualia by description: to experience the discriminations of an individual it is necessary to be that individual.” [Edelman 2003, p. 2251]

In other words simulation is not duplication. Here, a distinction is made between primary consciousness and higher-order consciousness [Murphy, Brown 2007, pp. 141–144]. Primary consciousness involves the ability to

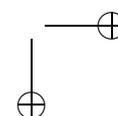
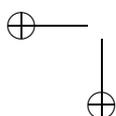




construct “mental scenes” with limited informational or symbolic content, such as may be found in an animal’s ability to learn and adapt its behaviour and which is more or less immediate. Higher-order consciousness evolves later and is related to semantic capabilities, as is found in its fully developed form in human beings who have a fully fledged language with syntax and semantics. Edelman’s theory further provides a neurophysiological description of the likely mechanism at the basis of conscious awareness. It is argued that a conscious state is a dynamical process within the cerebral cortex in which functional interconnectedness is created by rapid, two-way (re-entrant), neural interactions. Such a functional integration is called a “dynamic core”. This core is itself, then, a group of neurons — a neural state — and it is the sets of neurons involved in the (functional) relations between them that constitute the nature and content of consciousness at any given moment. Such dynamic core(s) may be sensitive to further bodily (sensory) inputs or from other brain systems with which they interact, as well as with itself. This gives rise to extremely complicated patterns of interactions, but what is also important is that the whole system is embodied, especially with respect to the subjectivity of experience. The activity of the dynamic core leads to successive discriminatory states which entail sets of phenomenal experiences. Consciousness in this view arises from re-entrant interactions among neural populations and the causal activity is produced by the dynamic core; so, the qualia emerging from this core are caused by it, and according to Edelman this does not necessarily lead to epiphenomenalism because these emerging qualia are informational structures even if they are not causal and it may sometimes be useful to talk about these qualitative informational states “as-if” they are causal depending on the level of description. This does not however, according to Edelman, imply epiphenomenalism, since

“There is, however, no need to conclude that C [quale] is therefore meaningless and unnecessary. C states [qualia-states] are informational even if not causal. C states are the discriminations entailed by causal transactions among C’ [neural states].” [Edelman 2003, p. 5523]

The qualia, then, are the reflections of the permanent causal interactions in the (complex) dynamic core, but are themselves not causally active: “underlying each quale are distinct neuroanatomical structures and neural dynamics that together account for the specific and distinctive phenomenal property of that quale” [Edelman 2003, p. 5523]. As for the phenomenal experience of the quale itself, the theory holds that it is no problem — and that therefore the “hard problem” and the problem of the “explanatory gap” [Levine 1983] are ill posed — because the need for a phenotype experiencing and giving



rise to the qualia is no hindrance for a scientific theory of consciousness and, moreover,

“if the phenomenal part of conscious experience that constitutes its entailed distinctions is irreducible, so is the fact that physics has not explained why there is something rather than nothing.” [Edelman 2003, p. 5524]

Let us notice right away that the reentrant activity of the dynamic core which causes the qualia has a recursive nature. Indeed, a main tenet of Edelman’s thesis is the existence of reentrant signalling between neuronal groups. He defines reentry as the ongoing recursive dynamic interchange of signals that occurs in parallel between brain maps, and which continuously interrelates these maps to each other in time and space. Reentry depends for its operations on the intricate networks of massively parallel reciprocal connections within and between neuronal groups, which arise through processes of developmental and experiential selection. Edelman describes reentry as “a form of ongoing higher-order selection... that appears to be unique to animal brains” [Edelman 1998, p. 46] and claims that “there is no other object in the known universe so completely distinguished by reentrant circuitry as the human brain” [Edelman, Tononi 2000, p. 49]. So, in fact the human brain is a massively recursive machine.

It should, then, come as no surprise in this view that human language indeed inherits this recursion. Indeed, in a *Science* article Hauser, Chomsky and Fitch [Hauser, Chomsky, Fitch 2002] have suggested that recursion is a basic characteristic that distinguishes human language from all other forms of animal communication. They make a distinction between a faculty of language in the broad sense and a faculty of language in the narrow sense [Hauser, Chomsky, Fitch 2002, p. 1570–1571]. The first of these faculties contains an internal computational system in combination with at least two other organism-internal systems which they call the “sensory-motor” and the “conceptual-intentional”. The second faculty is the abstract linguistic computational system by itself which is contained in the first faculty but which is independent of the other systems with which it nevertheless interacts. As such, then, the second faculty is a component of the first one and the mechanisms that underlie the one are a subset of the ones that underlie the other. It is in this process that they see a central place for recursion:

“We assume, putting aside the precise mechanisms, that a key component of FLN (faculty of language in the narrow sense) is a computational system (narrow syntax) that generates internal representations and maps them into the sensory-motor interface by the phonological system, and into the conceptual-intentional interface by the (formal) semantic system... All approaches agree that a core property of FLN is recursion, attributed to narrow syntax in the conception just outlined.” [Hauser, Chomsky, Fitch 2002, p. 1571]

However, a problem remains. The discussion of Edelman’s neurobiological model has shown that at first sight, though qualia — including the understanding and use of a language — are real as informational states, in this approach they seem to be doomed to causal impotency. But if this is the case one may say that they might as well not exist and that therefore the functionalist threat as present in the Martian argument has not been removed.

If Chomsky is right, then in our view there is indeed something it is like to have a language and the corresponding quale is also a consequence of the recursive activity in the brain but this is apparently not enough, even though recursion is hardwired in the brain. So it would seem that we need a means of making explicit how causal activity is somehow inherent in the activity of qualia. We suggest that recursion can only be a partial support of this thesis if we go one step further by appealing to the concepts of downward causation and third-order-emergence.

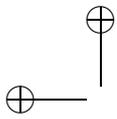
4. *Embodiment and Causation*

Edelman, again, notices that qualia emerge from their physical substrate and, as informational structures, reflect the causal transactions between the successive stages in the dynamic core. They constitute a “phenomenal transform”. While in themselves they are not causally active, they are nevertheless entities in their own right. If we want to make sense of the causal nature of qualia it is important, first, to notice that qualia *emerge* from their neural substrates. They are, therefore, as we will see, a direct consequence of the embodiment of the mental and at the same time the expression of the dual nature of physically embodied information. The concept of emergence has a rich history [Murphy, Brown 2007, pp. 78–80] and it comes in several variations. It was especially rife in the philosophy of biology throughout the 20th century where it was proposed as an alternative to vitalist accounts of the origins of life. Gradually, the concept came to be applied to the emergence of consciousness.

The concept itself is by no means easy to define but there are some useful characteristics that it may be said to have: according to Kim [Kim 1998, pp. 226–229], emergentism implies the view, first, that all that exists in the space-time world are the basic particles recognized in physics and their aggregates. It further entails that when aggregates and their particles attain an appropriate level of structural complexity, genuinely new (higher-order) properties emerge to characterize these structured systems and that these emergent properties are irreducible to, and unpredictable from, the lower-level phenomena from which they emerge. Finally, once these higher-level properties (e.g. mental states or qualia) emerge, they are able to manifest causal powers in their own right, thus affecting the lower-level phenomena (“downward causation”). Our approach intends to show that causal efficacy and downward causation are intimately related to emergence and more specifically to what Terence Deacon has called ‘Third-Order-Emergence’ [Vergauwen 2010, pp. 1265–1266].

Deacon [Deacon 2007] has offered an account of emergence which sheds light on this. In general, the emergentist’s aim might be said to show how, within complex systems, new entities emerge that exhibit novel causal powers. Deacon starts from the assumption, as e.g. also R. Van Gulick [Van Gulick 1993] and A. Juarrero [Juarrero 1999], that in emergent phenomena the physical laws governing the constituents of a system should not be violated and that an additional account should be given of the configurational regularities affecting constituent interactions. Furthermore, the relative autonomy and causal efficacy of such “holistic” emergent phenomena should be accounted for. Instead of making a commonly held distinction between “strong” and “weak” emergence, Deacon makes a threefold distinction between different kinds of emergent systems. In doing so, three interconnected hierarchical levels of emergence can be described. A first kind of emergence is “first-order emergence” or “supervenient emergence”. This happens in systems in which relational properties determine the emergent higher-order properties, e.g. such as in the case of the liquidity of water as determined by the aggregation of water molecules [Deacon 2007, pp. 97–98]. A second kind of emergence, “second-order emergence”, is present in diachronic symmetry-breaking typically also found in living systems and mental processes:

“in contrast, there is a self-differentiating feature to living and mental processes, which retains and undermines aspects of self-similarity. This characteristic breakdown of self-similarity or symmetry-breaking is now recognized in numerous kinds of complex phenomena, including systems far simpler than living systems. These complex emergent phenomena share this characteristic change of



ensemble properties *across time*, and are often computationally unpredictable.” [Deacon 2007, p. 99]

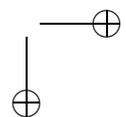
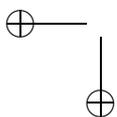
Third-order emergence involves in addition information or memory. It is the kind of higher-order regularity which can additionally exert a cumulative influence over the entire causal future of the system, thus encompassing the evolution of second-order processes. According to Deacon this involves an additional leap of recursive causality:

“the relationship implicit in third-order phenomena demands a combination of multi-scale, historical, and semiotic analyses. Thus, living and cognitive processes require introducing concepts such as representation... information and function in order to capture the logic of the most salient emergent phenomena.” [Deacon 2007, pp. 106–107]

The level of third-order emergence, therefore, is “the point where physical causality constitutes significance” [Murphy, Brown 2007, p. 83]. Among the processes emerging here we surmise that linguistic competence considered as a quale with a recursive basis also belongs. Indeed, in our view, qualia or phenomenal states can be described in terms of emergent processes of information which can have downward causation but arise only when the information is physically embodied.

Certain proposals by E. Thompson and F. Varela can be used to illustrate this. In a framework describing the relationships between neural dynamics, consciousness and embodiment, they propose to investigate the neural correlates of consciousness. In doing so, they do not assume only a one-way (upward) causal relationship between neural systems and the contents of consciousness but also the possibility of a two-way (downward) causal relationship between embodied conscious states and neuronal activity [Thompson, Varela 2001, p. 418]. They suggest that as a result of emergence in complex systems it is to be expected that in such systems there is both upward causation and downward causation implied in the relationship between neural activity and conscious activity. Since specific cognitive acts demand the integration of distributed and interacting areas of the brain, the search for a neural correlate of consciousness must account for these large-scale integrations of brain activity.

The mechanism they suggest for this integration is the formation of dynamic links mediated by synchronization of neuronal discharges over multiple frequency bands.





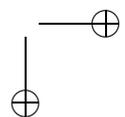
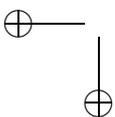
“Given that the coupled dynamics of brain, body and environment exhibit self-organization and emergent processes at multiple levels and that emergence involves both upward and downward causation, it seems legitimate to conjecture that downward causation occurs at multiple levels in these systems, including that of conscious cognitive acts in relation to local neural activity.” [Thompson, Varela 2010, p. 421]

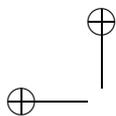
An important consequence of this is that these processes can be studied empirically. Thompson and Varela mention as examples of this the study of human epileptic activity and voluntary perceptual reversal. Human epileptic activity freely modifies the subject’s mental competencies but the converse would also seem to be the case. The subject can voluntarily affect his or her electrical condition that normally would lead to an epileptic seizure [Thompson, Varela 2002, pp. 421–422]. Furthermore, models of the visual perception of multi-stable or ambiguous figures suggest that such perception is based on generic properties of coupled non-linear oscillators and their phase relationships which might show “that different ‘cognitive’ interpretations of ambiguous figures initiated by the subject might shift the neuronal bias that defines the perceptual reversal” [Thompson, Varela 2002, p. 421].

Emergence and downward causation, therefore, can account for the causal activity of qualia as embodied and that this activity does in fact involve not only an upward part but also a downward one. Our approach shows that embodiment is essential to consciousness and also to language, by extension thereby partly rebutting the Martian argument since it clearly shows that the specific neural setup of the mind is responsible for the specific result, i.e. human natural languages, and that recursion is present both on the neurophysiological and the linguistic level. But at the same time it seems that something else also has to be taken into account which points in a very different direction.

5. *What lies Beneath: From Computability to non-Computability*

The theory we have presented here is to a certain extent tributary to David Chalmers’ so called ‘Double-Aspect theory of Information’: his hypothesis is that information has two fundamental aspects, a physical one and an experiential or phenomenal one, and that, furthermore, phenomenal consciousness by virtue of its status is one aspect of information where the other aspect is found embodied in physical processing. Physical information is, as embodied information, then, “a difference that makes a difference”:





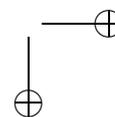
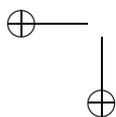
“The basic principle that I suggest centrally involves the notion of *information*. I understand information in more or less the sense of Shannon (1948). Where there is information, there are *information states* embedded in an *information space*. An information space has a basic structure of difference relations between its elements, characterizing the ways in which different elements in a space are similar or different, possibly in complex ways. An information space is an abstract object, but following Shannon we can see information as *physically embodied* when there is a space of distinct physical states, the differences between which can be transmitted down some causal pathway. The states that are transmitted can be seen as themselves constituting an information space. To borrow a phrase from Bateson (1972), physical information is *a difference that makes a difference*.” [Chalmers 1995, p. 216]

We have seen how qualia can be causally active entities, whence they emerge and why the kind of downward causality they exhibit is not in contradiction to the physical closure of the world. Chalmers notes that there are certain structural analogies between the physical and the phenomenal aspects of information:

“there is a direct isomorphism between certain physically embodied information spaces and certain phenomenal (or experiential) information spaces... That is, we can find the same abstract information space embedded in physical processing and in conscious experience.” [Chalmers 1995, p. 21]

Inevitably, at this moment questions of computability of this kind of information show up.

Dynamical systems such as brain processes can be simulated by appropriate computational systems but this does not mean computability in every case. Klaus Mainzer [Mainzer 2009, p. 299] distinguishes three reasons for the computational limits of a system. First, a system may be undecidable in a strict logical sense. Second, a system can be deterministic but nonlinear and chaotic which implies that the system depends for its outcomes on very tiny variations in the initial data making it practically nearly impossible to predict its behavior. Finally, a system can be stochastic and nonlinear which implies that its behavior can only be predicted probabilistically. One of the limits on the computability of a system is that it may be undecidable in a strict logical sense. Roger Penrose, for one, has suggested how quantum mechanics may help to explain how the human mind goes beyond Turing Computability [Penrose 1994]. He does not talk explicitly about qualia but, rather, about



mathematical creativity and he uses Gödel's famous Incompleteness Theorems to show how human beings can "see" the truth of certain mathematical propositions even though within an axiomatic system these propositions are undecidable, i.e. neither the propositions themselves nor their negations can be proven. This makes the system *incomplete*. Though one may say here, as Chalmers does, that this non-algorithmic processing is another example of an "extra ingredient" which may tell us something about the physical role that conscious experience plays but not how it arises [Chalmers 1995, p. 207–208], the point I want to raise here is a different one.

If Chalmers is right in saying that phenomenal properties constitute the internal aspect of information, then a *metalogical property such as incompleteness* which is definitely a property of (complex) formalized mathematical systems is also a property of the information the system contains. Mental states and natural language are usually characterized as being "intentional". Intentionality or "aboutness" is a term coined by the Austrian philosopher Franz Brentano and it points towards the directedness upon the world of mental states in general and of language in particular, their content, or their (possibly non-existing) reference.

John Searle has argued that intentionality is a biological property of the brain and cannot be simulated by any computer program [Searle 1980]. According to Searle, Intentionality represents the semantic side of the brain and of the language it generates and can never be duplicated by any computer program which is merely syntactic. There is some discussion on whether qualia exhibit intentionality [Northoff 2003]. Some have argued that qualia are primary and that intentionality can be inferred from them. Others consider intentionality as a necessary condition for qualia:

"without qualia, which reflect the experience of perceptions and actions, a direction towards "observable and to-be effectuated events within the environment" would remain meaningless i.e. superfluous since it could no longer be experienced as such. Such a 'hollow' intentionality, i.e. intentionality without experience, remains naturally impossible... qualia without intentionality would remain "empty"..." [Northoff 2003, p. 136–137]

However this may be, what we can say is that in as far as some complex physical systems, such as the human brain, are able to refer to things they exhibit genuine intentionality and that therefore "intentionality is at least a sufficient condition for mentality" [Kim 1998, p. 23].

In view of the theory presented here we suggest that there is a close relationship between intentionality and logical incompleteness. If a system is logically incomplete it means that it has non-isomorphic models, also called

non-standard models, which is for instance the case with the models of formalized arithmetic in Gödel's incompleteness theorems. This comes down to the fact that the information in the axioms of the theory is in a sense insufficient to uniquely determine what they are "about". Incompleteness may, then, be seen as a logical analogon of intentionality in the following sense.

In the Correspondence Theory of Meaning and Truth the property of truth expresses the "aboutness" of propositions in the sense that true propositions are "true of" or "about" true states of affairs. The property of truth, therefore, expresses the "reference-relation" for such propositions. If truth is non-computable or non-algorithmic, then so is intentionality. If Penrose is right, human beings are able to "see" the truth of certain mathematical statements and are therefore able to perform non-computable operations which Penrose thinks are a consequence of non-computable elements in the physical laws which the brain exploits when it performs this task. One need not agree with Penrose's idea of performing non-computable tasks to see that the general phenomenon of incompleteness might epistemologically indicate that the "aboutness" is a consequence of a tension between the inside ("information") of the system and the outside of the world, which is what the information is supposed to be about, a tension which in its turn is a consequence of the embodiment of the (linguistic) information processed by the mind. The intentionality of (phenomenal) consciousness and of language might, then, be said to derive from the same source: the incompleteness of the information processed. Assuming, as we do, that using a language has a 'qualitative' aspect entails the embodiment of linguistic competence. If this system would be complete in the logical sense, the system itself would be *categorical* so that all of its models would be isomorphic. But that would at the same time imply that the 'tension' between the information and what it is about would disappear. The feeling of "aboutness" might then, somewhat speculatively, be defined as a the reflection of the difference between language and "the world".

6. Conclusion

Let us return to the question put forward in the beginning. If intentionality is at least part of the explanation of what gives a (linguistic) sign its life, what is the mechanism that gives it its life?

Terence Deacon has expressed some pessimism as to whether such an explanation is possible:

"We still do not understand fully the basis of the relationship that invests words with their meanings and referential capacity. To be

blunt, we do not really understand one of our most commonplace experiences. We know how to use a word to mean something and to refer to something. We know how to coin new words and to assign new meanings to them... Yet we do not know how we know how to do this, nor what we are doing when we do. Or rather, we know on the surface, but we do not know what mental processes underlie these activities, much less what neural processes are involved." [Deacon 1997, p. 51]

It may be useful to compare our approach with the view of intentionality put forward by Fred Dretske [Dretske 1988]. Dretske's goal is to explain how events that take place in the brain can be understood as intentional even though they are physical events. He distinguishes three types of representational systems. The first type is a purely conventional one in which the relation between a sign and its referent is established solely by the user's intent. The second type of representational systems contains conventions and natural signs. So, e.g. humans use natural signs for conventional purposes. In such a way, a physical entity or event can acquire intentionality. Type three Systems of representation are those in which the signs exhibit intentionality because of the function they serve in an animal's behavior:

"the elements of a representational system, then, have a content or a meaning, a content or meaning defined by what it is their function to indicate... These meanings display many of the intentional properties of genuine thought and belief. If, then, there are systems of type III, and these are located in the heads of some animals, then there is, in the heads of some animals (1) something that is about various parts of this world...; (2) something capable of representing and, just as important, misrepresenting those parts of the world it is about; and (3) something that has, thereby a content or meaning (not in itself in the head, of course) that is individuated in something like the way we individuate thoughts and beliefs." [Dretske 1988, p. 77]

Notice here that, although Dretske emphasizes the role of a function in constituting intentionality, he is not a functionalist. He does not want to identify mental properties with functional properties. He wishes to stress that for a state of the organism to exhibit intentionality, the state must not only provide information, but its purpose must be to provide information. There always has to be a teleological element which may be provided by evolutionary mechanisms. However, the capacity for natural language to refer to things in the world is much more difficult to explain given both its complexity and

the mechanisms that underlie it. That is why some, such as e.g. Daniel Dennett, who, incidentally, does not even believe in the existence of qualia, have claimed that it is not so much the case that humans ‘really’ have beliefs or intentions but that we are pragmatically justified to use the intentional stance there. Since we cannot understand human behavior from what goes on in the brain and the ascription of beliefs or desires or intentions permits us to predict behavior we can use the intentional stance vis-à-vis other humans. Our view differs from both Dretske’s and Dennett’s. We do consider intentionality as real and as a consequence of the qualitative nature of language and language understanding. In that sense, our proposal presents a ‘realistic’ reinterpretation of Dennett’s *Intentional Stance*, since in it mental states and qualia do not receive an ‘as-if treatment’ but are taken as full blown elements in the ontology of our theory. Moreover, the source of this intentionality is to be looked for in relation to the logical nature of the information that qualia contain. In that sense, intentionality is a consequence of the information processing that goes on in the brain. It is, however, not in itself a biological phenomenon but rather due to the embodied nature of this information.

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