Experience, awareness and consciousness:

suggestions for definitions as offered by an evolutionary approach.

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Abstract

It is argued that the hard problem of consciousness, i.e. the fact that we have experience, stems from a conceptual confusion between consciousness and experience. It is concluded that experience has to be considered as a basic characteristic of ongoing interactions at even the most simple level, while consciousness is better defined as reflexive awareness, possible since symbolic language was developed.

A dynamic evolutionary point of view is proposed to make more appropriate distinctions between experience, awareness and consciousness. Experience can be defined as a characteristic linked closely to specific pattern matching, a characteristic which is already apparent at the molecular level at least. Awareness then can be regarded as the special experience of one or more central, final modules in the animal neuronal brain. From evolutionary considerations, awareness can be understood functionally and physiologically. As such, awareness is what experience is to animals.

Finally, consciousness could be defined as reflexive awareness, instead of using the term as synonymous to awareness. The ability for reflexive awareness is distinctly different from animal and human awareness and depends upon the availability of a separate frame of reference, as provided by symbolic language. As such, words have made reflexive awareness - a specific and infrequent form of awareness - possible. Conciousness might be defined as the experience evoked by considering, i.e. thinking about experiences themselves.

Explaining and understanding awareness and consciousness as evolved biological characteristics of the functioning of animals and later humans, poses no philosophical problems. The nature of experience itself remains elusive, but this is not a problem specific to

awareness or consciousness. If there is a hard problem of explaining consciousness, than this actually must be considered as the hard problem of explaining experience. While the definition of experience could be broadened to include all molecular and biological pattern specific recognition events, the true nature of consciousness might be better understood when considering it as a very specific form of awareness, made possible by language.

Keywords

Experience, pattern matching, dualism, evolution, language, awareness, reflexive awareness, consciousness.

1. Introduction

1. Insightful understanding often depends on definitions, as is expressed in the following quote:

"The increase of conceptual clarity of a theory through careful clarifications and specifications is, as William Whewell observed more than a century ago, one of the most important ways in which science progresses. He called this process "the explication of conceptions" and showed how a number of theories, in the course of their temporal careers, had become increasingly precise - largely as a result of the critics of such theories emphasizing their conceptual unclarities. Many important scientific revolutions ... have depended largely on the recognition, and subsequent reduction, of the terminological ambiguity of theories." (Laudan, 1977).

Indeed, it is usually overlooked how our definitions and how the terminology we use direct our thinking, and often guide us into narrow dead end alleys obstructing what are often straightforward insights.

2. Recently, many of the discussions about consciousness have centered around the hard problem of consciousness or have dealt with the question whether there is something hard at all about consciousness to be explained. To me, as a biologist with interests in general information and evolution theory, it appears that most of these discussions actually are about the problem of explaining what experience might be. So, the usage of the terms "experience, awareness and consciousness" as synonyms, obstructs constructive discussion and leads to a confusion of what may be different concepts.

3. I will try to show that explaining experience is a more general problem, not directly linked to understanding what awareness and consciousness are about. Experience itself might be treated and better understood as a general concept already apparent at the molecular level, while one might consider awareness and consciousness then just those kinds of experiences which become possible respectively with the development of brains in animals and of symbolic language in humans. The fact that both awareness and consciousness themselves are also experiences, leads to confusion about their being hard problems to be explained, while

the eventual hard problem is already intrinsic to the 'phenomenon' of experience itself.

4. One then might accept that there is something irreducible about experience since it is an intrinsic characteristic of material interaction, of our universe, while on the other hand one can easily agree with the claim that consciousness is explained (or explainable). While this manuscript was in preparation, Griffin (1997) proposed the notion of 'panexperiental physicalism' as a third way - that is nondualistic interactionism, besides dualism and materialism - to understand what experience is about. The approach outlined here has been reached by following a different line of reasoning but is not incompatible with his hypothesis.

2. Experience

2.1. Introduction

5. In an effort to get a grasp on the concept of experience, I will adopt an informational, interactive, dynamic point of view on what chemistry and autonomously duplicating chemistry (life) are. The reader is warned that the definitions and the approach below may require some shifts in current thinking. Some patience is asked for. Again, this will be in the first place a matter of redefining terms, especially by broadening concepts like experience, interpretation, motivation, etc.

6. The use of concepts like experience and motivation (and many more) to describe processes going on at the simplest (organic) chemistry level may seem anthropomorphic. Still, I would like to remind that considering the use of these concepts for describing processes of limited complexity as being an anthropomorphically biased approach can itself be regarded as anthropocentric reasoning.

2.2. Experience at the molecular level: chemistry

7. Our use of the word 'matter' usually invokes the idea of inert pieces of substance, floating around in space. In our minds, matter is different from interaction and action because we have separate words for what is actually a continuum: no material interaction without matter, no interesting material characteristics when trying to understand matter without interaction. Dualistic reasoning is an implicit consequence of our basic terminology.

8. Indeed, only matter as in rocks or gold atoms is rather inert. These kinds of material configuration are consequently of little interest to understand chemical reactions, living processes, experience and consciousness. However, other species of atoms are naturally engaged in interatomic interactions leading to continuous molecular reconfiguration. Since this interaction occurs according to strict rules, certain atoms interact with only certain other atoms. As a matter of fact, one can speak of interpretation: atoms interact with only certain atoms out of the wide range of atoms present in the immediate environment. This means that atoms have the capacity to recognize specific patterns. It could be stated that this specific pattern recognition has to do with experience and that experience as such can be considered as a basic characteristic of material interaction.

9. One can ask why a molecule interacts with other - and only with certain other - molecules. Again, one is tempted to apply terminology we usually apply only to describe behaviour of animals and humans by asking: "What is the 'motivation' of molecules to behave in some specific manner?". I will tackle these questions by considering enzymes, those special interactive molecules which are a hallmark of living chemistry (just as much as nucleotide strands are).

2.3. Experience at the enzymatic level

2.3.1. Enzymes are repetitive processors

10. The process of inorganic chemistry is generally a once-only event. Matter (two atoms or molecules) is reconfigured and strong external forces (energy) will be necessary to let the process occur again. One could say that the initial molecules (the substrates) were also the processors, but due to their own processing activity these processors no longer exist. In the case of an enzymatic molecule we have a device which can repeat the same process several times (by the addition of a little external energy) without being changed physically. The processor still exists after the processing, and flips back so that the process can be repeated. The activity of the processor does not lead to its own destruction as is the case for inorganic chemistry. We have a true processor, repetitively switching on and off, quite well comparable to a transistor, a human made digital processor.

2.3.2. Experience as the matching of patterns

11. When the appropriate substrate is present in the immediate environment of an enzyme, it is recognized by the active site of the enzyme and this leads to action, which is the processing of the substrate into product and the subsequent release of the product. This also makes the enzyme return to its receptive state. Enzymatic substrate recognition is specific pattern recognition and - as I proposed to be the case for all other molecular interactions - one could define experience as 'having to do with specific pattern recognition'. Or one could say that experience has to do with 'the event of the matching of patterns'. This resembles strongly perceptive experience as we know it (see paragraphs 36-41). Thus, when the preformed recognition site of the enzyme meets its fitting pattern, there is experience. Experience is then described as a characteristic of the interaction between processor and substrate. Experience can be described in the same terms for e.g. cellular experience (paragraphs 19-24) and experience of multicellular organisms (paragraphs 36-41).

12. Remark that this definition of experience as already a basic characteristic of molecular interaction is in accordance with the following suggestion of Chalmers (1995):

"..., then experience must be more widespread than we might have believed, as information is everywhere. This is counterintuitive at first, but on reflection I think the position gains a certain plausibility and elegance. Where there is simple information processing, there is simple experience, and where there is complex information processing, there is complex experience. A mouse has a simpler information processing structure than a human and has

correspondingly simpler experience" (p. 217).

2.3.3. Enzymes are interpreters

13. Again, we might define another concept at this level which is usually assumed to exist only in complex organisms: interpretation. An enzyme must be able to tell at least the difference between all possibly present molecules and the one very specific substrate upon which it will act. Since enzymes pick out only one of many possible molecules, they interpret the environment.

2.3.4. Enzymes are motivated and can be in different moods

14. Besides interaction, perceptive experience and interpretation, one can try to define motivation and mood at this level of processing complexity, whereby mood could be defined as the degree of specific motivation, the degree of motivation to undertake some specific action. Being in a receptive state and having substrate in its immediate environment, an enzyme is 'forced' to be active, it has no choice. This is motivation at its most crude appearance. Remark that perception of the appropriate substrate (perceptive experience) is not sufficient to let the enzyme undertake its typical catalytic behaviour. The enzyme must also be in a given state, i.e. in the right mood. Given molecules of this type (enzyme and substrate), the motivation for the process follows only from the combination of the experience of inside drives (molecular tensions inside the molecule) and the experience of the presence of the right substrate (perception).

15. The internal drive or mood may differ. Enzymes can find themselves in an activated status (through phosphorylation by protein kinases) or in an inactivated status (through dephosphorylation by phosphatases). Also, an enzyme may be in need of a specific co-enzyme which may alter its conformation in such a way that it can exert its activity. One could say that these events induce internal experiences (in the form of altered molecular tensions) which will alter the mood of the enzyme and which will motivate or demotivate it to undertake action. Similarly, cells and multicellular organisms will be motivated by the combination of internally constructed pattern recognition demands and externally present, specifically fitting patterns. The perception of food will induce animals to eat only when they are internally motivated by a hungry mood - in other words, enzymes and animals have to be in the right mood to express certain behaviours.

2.3.5. A possible explanation for the apparent transience of experience

16. What enzymes must experience is some specific environmental change, think of changing electromagnetic fields due to the approach of an external molecule. Chemical and biological experience might be intrinsically transient because it is a characteristic for describing the dynamically, transient, temporary interaction between a specific processor and a specific environmental change (e.g. the presence of the right substrate). So there is only experience

when specific - pattern matching - conditions are met. It should be emphasized that the pattern matching itself is not the experience. All one can say about experience is that 'it has to do with' pattern recognition/matching. We will try to show below how this appears to be also the case for aware experience (e.g. paragraphs 36-41).

17. This 'definition' of experience implicitly holds that experience is transient and thus might offer a solution to the problem Chalmers had with his own suggestion (paragraph 12):

"..., then experience must be more widespread than we might have believed, as information is everywhere. This is counterintuitive at first, ... Indeed, if experience is truly a fundamental property, it would be surprising for it to arise only every now and then; most fundamental properties are more evenly spread." (Chalmers 1995, p. 217)

2.3.6. Conclusion

18. I have tried to show how several concepts which we take to be concealed to the realm of animal life could be defined already at the molecular level (anorganic and enzymatic). Certainly enzymes could be regarded as devices which interprete the environment by picking out only certain molecules and which can be in different moods, i.e. they can have different degrees of motivation to act, driven by internal experience of intramolecular tensions. For instance, when enzymes are not linked to certain co-enzymes or have not been activated, they will not experience certain molecules as their possible substrates, while these same molecules will be processed when the enzyme is in the proper mood. The kind of environmental experience they can have and their behaviour will depend on internal configurations, i.e. intramolecular tensions which we can consider as motivations. As such, asking: "How is it like to be an enzyme?" is more than paraphrasing Thomas Nagels' similar question about bats (Nagel, 1986).

2.4. Cellular experience

19. We can now look at the multi-enzymatic processor, the cell. It should be noted that the product(s) of one enzyme can be used as the substrate for other enzymes. Enzymes interact by means of chemical molecules, whereby the product of one enzyme serves as the substrate for another enzyme. In this manner, enzymes influence each others' behaviour, just like cells and animals do. Such a community of enzymes, interacting with each other and with the nucleotides (which are basically carriers of encoded information), embraced by a membrane, is - roughly speaking - a cell.

20. Cells, just like enzymes, can respond to specific external molecules which connect to receptors at the cell membrane. This is pattern matching between intercellular messenger molecules and cell membrane receptors and we could consider this as cellular perceptive experience. This will influence the internal behaviour of the cell, by inducing several enzymatic cascades which would not be happening without the cellular perceptive experience. The situation is comparable to enzymatic behaviour which is influenced by the matching of its active site with the appropriate substrate, or with animals which will behave differently as

influenced by different perceptions.

21. Just like enzymes, the reaction of cells depends also on their internal motivation. Cells have to be in the right mood to respond. Neurons for instance will not always fire when the same amount of dendrite neurotransmitter input is given. Much depends on which molecules are connected to their membranes. For example, serotonin receptors are present on the membrane (not in the synapses) and serotonin can enhance the responsiveness of the neuron. Endorphins and enkephalins bind to opiate receptors on the membrane and inhibit neurons that transmit pain impulses.

22. Remark that cells can also differ in their response to external stimuli depending on their developmental stage. Maturating cells will respond to other molecules than mature cells and/or activated cells, because the receptors expressed on their respective cell membranes differ. This recalls somewhat the different behaviour of activated/nonactivated enzymes (paragraph 15). Comparably, multicellular colonies like animals react differently to identical stimuli, depending on the developmental stage they are in (paragraph 39).

23. Since the messenger molecules mostly come from other cells and since the products resulting from cellular activity mostly will be recognized by other cells (to these other cells these molecules are the observable, external behaviour of the first cells), cells can interact - again reminiscent of enzymatic interaction - and may form complex ecological societies, composed of several genetically related and unrelated cells. A special form of such a community is the multicellular organism, which is composed of genetically identical cells. It is a temporarily existing colony of clones produced by duplication of a single germ cell.

24. In conclusion, it is possible to describe cellular experience in the same terms we used for enzymes, only there is more flexibility in the interactions and the whole system is somewhat more complex and flexible. Cellular experience and behavior can be regarded as simply an extension of the experiential and behavioral possibilities which exist already at the molecular level, and below I argue how animal experience, i.e. awareness, is basically only a more complex experience than that possible at the cellular level.

3. Awareness

3.1. Introduction

25. In what follows I will strictly avoid the use of the term 'consciousness'. Awareness and consciousness are largely used as synonyms, but I will argue how awareness and consciousness might be better understood by considering the latter as a special form of awareness.

26. Native English speakers reading previous drafts of this manuscript have pointed to the odd proposition that I, as a nonnative speaker, make above. Of course, one should regard this proposition within the context of the philosophical debate on how we can understand consciousness and it is not my intention to change linguistic habits - something which would be impossible anyway. However, English, by the presence of two etymologically unrelated terms, nicely offers the possibility to assign also different meanings to these words.

Interestingly, it appears that English previously made the distinctions I am advocating here as being more appropriate to structure the debate on consciousness. Indeed, 'aware' stems from the Anglo-Saxon 'gewaer' (11th century) which meant something like 'being informed', 'to know' from the 13th century onwards. I'd say the original meaning of awareness relates to the having of experiences, the experiencing itself. The etymologic origin of 'consciousness' points to a more restricted meaning. It is composed of the Latin words 'cum and sciere' and could be translated as 'to know ABOUT', which points to some reflexive properties of consciousness, that is to the considering of experiences. I will come back to this discussion after considerations about the nature of awareness (paragraphs 56-58).

3.2. Awareness is what experience is to animals

27. It is generally agreed that plants are unaware organisms. Usually this difference is explained by the fact that animals have neurons, and although neuronal circuitry is indeed essential to animal awareness, this does not explain why neuronal circuitry should lead to something like awareness. To understand what awareness is about we have to take into account the special kind of situation animals find themselves in.

28. Animals can be defined as multicellular, heterotrophic, eukaryote colonies. Being a heterotroph colony makes life rather complicated. The basic reason for the complications is that, as a heterotroph, it is evolutionarily advantageous when the colony is able to move towards the usually patchily distributed food like plants or pray. Of course, multiple sessile or almost immobile animal species and life stages occur, as is the case for parasites or as is the case in aquatic environments where food is mobile and can be filtered out of the water. This kind of animal life is usually less complex (e.g. Porifera and Coelenterata in water and the parasitic Cestoda tapeworms), which is an additional indication that the mobile animals need to resolve more problems. Sexually reproducing animal colonies have to be able to move towards potential sex partners, since these also will be moving around. Also, there are predatory heterotroph multicellular colonies dwelling around, not feeding on plants but on other animals and thus animals should be able to flee. In summary, animals have to be able to move: towards e.g. food and potential sex partners and away from e.g. danger and annoying conditions. As it turns out, the need for multicellular heterotroph colonies to be mobile is the basic reason why muscles, nerves, perception organs, emotions, brains have turned out to be advantageous characteristics during animal phylogeny. A first indication is that all of these characteristics are lacking in plants and all or most in primary or secondary immobile animals.

29. It may be useful at this stage to summarize briefly some of the characteristics which differentiate animals from most other living beings. For animals, perceptive experience - the specific recognition of environmental patterns (be it food, partners, predators or behaviours of other animals) - is of the utmost importance to optimize moving. Besides potent perception capacities, animals - being multicellular colonies - will need special internal motivations to behave as an individual organism. This could be considered as perception of the internal metabolic state of the colony. These motivations to make the colony do the genetically right things are basically hormonal or humoral in nature, i.e. emotional drives. Humours in turn are nothing but the intercellular signalling molecules we addressed earlier. Once the colony has perceived (e.g. food), and is in the right mood (for instance, being hungry) to be motivated by

this perception, it will take action.

30. Most important with respect to understanding the development of awareness is the development of neurons, which are simply cells specialized in enhancing the speed of chemically intercellular signalling transforming the chemical signal received at the dendrites into an electrical one so that intracellular transmission proceeds extremely fast, whereafter transformation into a chemical signal occurs again at the axon. Neurons - with their extraordinary number of branches and interconnections - enable the development of a nervous system and of central processing of the experiences going on in the body. It is the central processing which takes place in the brain which is crucial in understanding what awareness is about. Other multicellular beings have no central processing of experiences.

3.3 Awareness is the experience which is the result of filtering and processing the multiple possible bodily experiences

31. From neuroscientific and psycho-analytic studies it becomes clear that we are 'unconscious' about many events in our brains and bodies and this is generally called 'subconsciousness' (paragraphs 44-47). First I want to argue that what we call awareness is an end stage experience which results from the filtering and processing of the several possible experiences going on in our bodies and brains.

32. Many examples of unaware experiences can be given. Muscular proprioreception is going on all of the time. It is about monitoring the elongation of muscles in order to enable continuous muscular correction of bodily equilibrium. None of this experience (by the monitoring processors) or action (by muscular contraction and relaxation) usually reaches awareness. We are completely unaware of it. Also for perception, i.e. the capturing of information from the outer world by smell, taste, touch, sound and vision, only a limited number of the experiences of the perception cells and organs reaches the central experience (final awareness) modules. This becomes clear when we realize that 'we' only experience a limited amount of all the visual information present at each moment when our eyes are opened. When reading these lines, your brain has already filtered out many visual signals coming from the surroundings of the printed letters you look at. It is such a routine that this information cannot reach awareness (unless written words like those above tell us to attend to it). For instance, Crick & Koch (1995) suggest that most of the experience of visual signals in the V1 region of the visual field of our brain never reaches higher order processing units. See also Bridgeman (1992).

33. There may be several, mutually not exclusive reasons why we awarely experience, i.e. become aware of, only a limited amount of all the experiencing of our body and brain. First, too much information could cause chaos and costs energy and might ruin living processes by making them chaotic (Kauffman 1995). Enzymes can have only one kind of experience. They can recognize only one (combined) pattern. Cells can respond to several hundreds of different molecules docking at their membranes, and the resulting cellular experiences and activity therefore will not only be more complicated but also more flexible (more intelligent) than that of individual enzymes. Still, cells deal with very specific molecules and are unable to experience the presence of all those other molecules which do not fit their membrane

receptors. Because of this selective blindness, there is a huge filtering out of all possible information present in the environment. It can be hypothesized that the increasing problem of filtering out ever larger amounts of experience may be an evolutionary explanatory reason why filtering was a necessary development.

34. Second, only some of the experiences are of relevance to central processors. Most of the information gathered by local bodily experience is not of importance to the functioning of the animal for undertaking direct actions as a whole and therefore need not to be transmitted to higher or the highest level processing centers. For many processes going on within the colony, there is no functional reason at all why higher order processors should be informed, even when the subsystem fails. In the example of visual perception, it is clear that our retina receives all of the time environmental external information when awake, but only a very tiny amount of e.g. all of the visual information reaching our retina is really of importance (paragraphs 36-41).

3.4 How does the filtering takes place?

35. We may ask how it is decided, by which level of processing, when and which information is to be let through to higher order processors and to the final processors (the awareness modules). A good guess for routine physiological processes is to say that the higher order processing modules will be activated when the routine processors at the lower levels cannot handle things on their own and/or when action (e.g. moving) has to be taken involving the whole colony and not the subsystem alone.

36. For perception of the environment we find back in a more elaborated form the situation as explained for enzymes and cells whereby there is specific pattern matching between the active site of the enzyme (a preformed pattern recognition site) and the substrate, or between the membrane receptors of the cell and the fitting messenger molecules. Similarly, only certain patterns will attract our attention and will be experienced. They elicit perceptual awareness. Which patterns are of importance and should be reported to higher order processors, which patterns fit our matching demands, depends on several cues, which are determined by different mechanisms.

37. First, the patterns of importance may have been carved into our brains phylogenetically: When we observe a curled branch on the ground while walking in the wood, we all of a sudden may become aware of danger. It has been suggested that this experience is explainable as an ancient fear of snakes. Similarly, biologically important patterns like potential partners, food, ... will attract our attention.

38. Which patterns are of importance can also be acquired by 'education' during life. Young animals can learn from the reactions of their parents and kin, which may be important to recognize dangerous situations or to acquire social skills for instance by means of punishment and reward. Drug dogs are trained/educated to observe specific smells, while their untrained counterparts are more versatile in their smelling preferences. For humans, the pattern of importance can also be instructed by words or it can be a word itself which attracts attention because of special reminiscences.

39. There are also developmental cues. Just as cells will respond differently to certain stimuli, depending on their developmental stage (paragraph 22), so multicellular organisms respond differently during their lives because of some hormonal developments which have taken place. Think of the different developmental phases of worker bees or of the differences between pre- and postpubertal humans.

40. Finally, which experiences are of importance will depend on present other internal experiences (e.g. hungriness) which we can summarize as the mood of the colony. For example, our interests are different when angry compared to when feeling great. A cat in a lazy mood may just as well let a mouse pass by under its nose.

41. In summary, for animals, it is decided by phylogenetically given moulds (for instance snake contours or attractiveness of sexual partners), developmental stage (for instance changing interests while growing up), previous experiences (for instance habituation and education), other current experiences (for instance the current state of internal motivation, like being hungry or not) and the interaction among all of these, which pattern is to be perceived or recognized, which experience is to become what we call aware experience.

42. It is probably about this discontinuity of perceptual experience that Chalmers was thinking and not about the more fundamental discontinuity we assigned to experience as it can be described at the molecular level. Basically there is not really a difference: when we accept that experience is about pattern matching, the discontinuity of experience follows from the fact that pattern matching occurs only now and then, whatever the complexity of the pattern matching demands.

43. One might say that the distance between the first experiences which will lead to action becomes larger during evolution (molecular, cellular, animal multicellular colony), with many more possibilities for flexibility in between. The more complex the system, the more flexible it is in setting out the patterns of importance - in combining different filters, the more adaptive it is to the environment. The degree of responsive flexibility could be defined as intelligence.

3.5. Subawareness and final awareness

3.5.1. Subawareness or modular awareness

44. The model outlined above, whereby much processing and filtering of bodily and brain experiences results in some final aware experience, fits with the model of the modular brain (Gazzaniga, 1985; Gazzaniga, 1996; Bridgemann, 1992). Each of our brain modules has its own input, processing and signalling specificities, in my words: each has its own experiences and makes its own interpretations and decisions. As was the case for enzymes and cells, the behaviour of lower order modules forms the experiences of higher order modules. Thus a lot of information will be processed without the higher order processors necessarily being informed about it. Because most of what is going on in our (body and) brain remains hidden from the final awareness module(s), we would never have known about it without the knowledge gathered by e.g. psycho-analysis and neuroscience.

45. For example, in split brain patients - as studied by e.g. Gazzaniga (1985), the mute brain

hemisphere was able to answer questions by taking action, although it could not report to the speaking (aware) brain half. Obviously information had been perceived and processed, and this could activate motor modules to undertake the appropriate motoric responses. This seems to be full awareness. However, since no report to the speaking brain hemisphere could be made, the patient was unaware of this. Thus, awareness of brain modules and hemispheres, which even leads to appropriate responses, seems to be possible without the subject's awareness, in other words without final awareness.

46. Another example is the phenomenon of blindsight. Here lesions exist in certain fields of the visual cortex. Although it appears that parts of the brain of these people is aware of certain perceptions of the retina, this does not lead to awareness: people think they don't get any information from the retina, although they score about average when asked to locate objects perceived visually. The same phenomenon has been described for animals, whereby it could also be shown that these animals as subjects are not aware of what their brain knows (Cowey & Stoerig, 1995). With blindsight, it appears that there is no final or subjective awareness possible because one of the basic modules is not getting the required information, and/or cannot send through its information. Still the brain experiences, processes and takes decisions 'unconsciously' or subawarely.

47. One could describe the experiences of each brain module as its awareness, and maybe we can name this better subawareness (instead of unawareness or subconsciousness).

3.5.2. Final awareness

48. The idea that an interpreter module exists has been suggested by Gazzaniga (1985). I'd prefer to call this the final interpreter module(s), since interpretation could already be said to exist at the enzymatic level at least and it could be said that each brain module has the ability to interprete incoming signals, e.g. as whether these are to be transferred to higher order modules.

49. From the above examples, it occurs that final awareness becomes possible only when certain essential lower order inputs are provided to one or more final awareness modules. This suggests that what is usually labelled as 'consciousness' is the experience of some final interpreter module(s), i.e. final awareness. When this final interpreter module(s) lack certain information from the submodules, subjects cannot become aware of what certain modules in the brain have experienced and know.

50. Gazzaniga (1985) assumes that the 'interpreter module' has to do with language. Since animals are certainly aware organisms - also because subaware activity has been shown in animals (paragraph 46) - this seems unlikely. Still, this interpretation of Gazzanigga (1985) may be understandable: in most humans the experience of the final interpreter - the aware experience - will be automatically translated into words, such that it appears that it is in the more recently developed language centers that the final interpretation is done.

51. One could define awareness as the final experience of the brain resulting from filtering by a modular brain - by means of several strongly interacting criteria (which can be phylogenetic

or developmental and which depend on current internal motivations, previous experiences, environmental cues, etc.). From this definition it follows that for animals awareness **is** the only possible form of experience when awake (Note 1). Hence, another possible reason for the confusion between experience and awareness: experience can be understood as both a more fundamental concept of nature and as the specific animal form of it, awareness - which for animals is what experience is about.

4. Consciousness

4.1. Introduction

52. In what follows, I will consider consciousness as a specific form of awareness, just as we considered awareness as the specific animal form of experience. I will try to show how this distinction enables us to address the first person - third person problem more easily, just as we tried to show how the distinction between experience as a general concept and awareness as a specific form of experience allows us to consider the hard problem of aware experience as the hard problem of experience as a general concept. These ideas will be developed from the same evolutionary approach used above, by arguing how it is basically because of recently evolved linguistic capacitities that a new form of experience, conscious experience, became possible.

53. I should hurry to explain how ascribing consciousness - or rather, as will become clear, the possibility for conscious experience - to humans only, does not put humans on a higher ethical platform than animals. It should be clear from what precedes that animals do feel (i.e. can have different very deep emotional experiences), think (i.e. can consider different options before taking action) and know (i.e. can have the experience of certainty). They are aware emotional beings that can suffer and enjoy. As a matter of fact our ethical responsability towards their physical and psychological well being is as large as our responsability towards newborns and young children. For children as well as animals the experiences are absolute (here and now (Donaldson, 1992)) - without any possible comfort or support from relativizing considerations as they are available to grown-up humans. While we have no problems in feeling compassionate for the discomfort of children, because we realize that their experiences are absolute, it is rather strange that most of us do not recognize that for many animals these same considerations should be kept in mind: when they suffer, suffering is what they are.

4.2. Symbolic language and human awareness

54. Having said this, the argument for considering consciousness as a specific, recently evolved form of aware experience goes as follows. Awareness combined with language offers several emergent possibilities, of which "human awareness" and consciousness are some (Note 2). One could state that symbolic language is the only basic difference that science has left as a distinction between humans and animals (Note 3). Besides its role in refined communicaton and increased thinking capacities (leading to human awareness (paragraph 55), symbolic language offers the ability to store experiences in our brain in still a different code

and at a separate place from those places where experiences themselves are stored. Important here is that words provide us with an internal separate frame of reference, which enables us to take distance of what is going on and which offers the possibility of conscious experience (paragraphs 56-58).

55. Am I conscious, while I am writing this article and searching all possible corners of my mind for the right words and for useful insights by recombining information I have read, heard, stored before? I would say I am not. I am trying to solve problems in the present, using all the skills at my disposition - including my linguistic and educationally acquired skills, just as cats use all their native and learned skills when solving the problem of how to catch a mouse. Just like animals, I try to tackle current problems aided (or disturbed) by stored previous aware experiences and knowledge and by comparing different outcomes. Except for the usage of words, there is no difference with animal awareness. Humans simply can consider more possibilities because of better developed mental representation capacities and because of words. This is in my opinion human awareness, not consciousness. Both humans and animals are aware beings in these situations, neither of them is conscious.

4.3. Consciousness can be defined as reflexive awareness

56. I will argue that the concept of consciousness is better restricted to some other phenomenon, which - like human awareness - also needs both the activitity of the final interpreter module(s), leading to aware experience or awareness, and language. I suggest to define consciousness as 'reflexive awareness', i.e. some kind of experience which is possible because symbolic language enables us to take distance of the current aware experience, and to observe it as if we were a third person looking at ourselves.

57. The distinction I want to point to, may become clear when considering the kind of aware or conscious questions we can ask. I can ask about the past: 'How did I get there last time?', which is an aware practical question, BUT I also can ask: 'How did it feel like to be there two years ago?', whereby I consciously wonder about previous experiences. About the future, I can awarely ask 'Which road shall I take next time?' in an effort to prevent possible future problems, BUT I can also consciously ask 'Will I like it there just as much as last time?', reflecting upon the possible future experiences theirselves. In present time, one has to be somewhat more careful in discerning awareness from reflexive awareness. Both the expressions: 'Which is the right road now?' and 'I like driving here' are about awareness, whereby the latter is simply a linguistic translation/expression of a current experience. BUT I also can wonder: 'Isn't it strange that I am driving a car?' or 'Why do I like driving a car?', which both are reflexive activities and make me conscious of what I am doing.

58. From this it follows that we have the possibility of being conscious, but that most of the time we are not, being aware 'only'. On the contrary, most of our lives are spent while being aware of what is going on, which enables us to respond and react appropriately, but we are not conscious, since we do not use our ability to take distance.

4.4. The first person - third person problem

59. This more restricted definition of consciousness - as a language dependent possibility to consider the experience of being aware - immediately enables us to address the first person - third person problem in a rather simple manner. Having experiences, i.e. being aware, I am first person, very similar to what happens to an enzyme, a cell or a bat. Thinking about these experiences (and those of others), I am third person, I am conscious. Since this 'thinking about' is an experience itself, this puts me back in the first person. Of course, our ability to take distance can go on and this will be an experience itself each time, so we can easily imagine thinking about "the experience of thinking about an experience", i.e. thinking about conscious experience. This could be compared to a camera observing a TV and representing its recording on the same TV. The result is a TV representing its own when representing its own when representing ...

60. In both first person and third person modus we make use of words. In first person modus verbal reporting is nothing but an extension of the 'being aware' process, it is a translation in symbols of the experience itself. In third person modus, words are used differently. Now they function to take distance from the present experience and to consider it as an outside observer. Defined in this manner, first person experience is aware experience, third person experience is conscious experience.

61. Related to the first person - third person problem is the kind of experience (aware or conscious) we will be studying when asking questions to subjects. When we ask: 'Did you see object x?', we ask about retrieval of stored experience and we are studying awareness. When we ask 'How did this electric pulse feel?', we address the nature of the experience, we ask for considerations about the experience itself and are studying consciousness.

4.5. Cutting at the joints

62. I have tried to explain how experience might be described as an intrinsic characteristic of (at least) certain biochemical processes. To speak of the awareness or consciousness of an enzyme, a cell or a plant however, is something different (for a discussion of 'plant consciousness', see Nagel (1997)). Doing so, we end up with awareness and consciousness (complex higher order experiences as they became possible with ongoing evolution) as being intrinsic characteristics of the universe - some cosmic force, which leads to dualism. Recall that we opted for a nondualistic interpretation by assigning simple experiential events to simple interactive systems (paragraph 7).

63. Awareness can be restricted to organisms which rely on central neuronal processing of bodily and environmental experiences, i.e. to animals. I propose that a similar distinction is possible between animals and humans. Animals can feel and animals can know, that is they can have the aware experience of feeling certain about something. But they cannot know that they know, they cannot know that they feel. To animals 'knowing' is possible (it is an aware experience), 'knowing of' (conciousness) is not, because an independent frame of reference is lacking.

64. Although we propose that a clear cut is possible between consciousness and awareness, cutting at the joints is not always easy. After all, complexity increase is mostly a rather gradual development - think of brain development and intelligence increase during animal phylogeny from snails and worms to dolphins, magpies, ... and humans. Still, it is now widely accepted that, besides gradual evolution, 'symbiosis' - the merging of two unrelated lineages of doing things -, like that between protein and DNA (leading to the genetically encoded cell), or between the 'urkaryote' and the bacterial ancestors of the mitochondria (leading to the eukaryote cell) or between animal emotional awareness and symbolic sounds (leading to human awareness and the possibility for consciousness) can cause sudden jumps in evolution, and cause clearcut differences (see also Note 2).

5. Mystic experience

65. Besides aware experience, conscious experience, dream experience (see Note 1), there is also something like mystic experience. Mystic experience has been described as a purely emotional manner of experiencing and furthermore as an experience whereby there is no 'locus of concern' within space/time, that is that there are no 'here and/or now', 'there and/or then', 'somewhere and/or sometime' experiences, but only 'out of space-time' experience (Donaldson, 1992).

66. I think that mystic experience actually boils down for the most part to some kind of animal experience of direct intensive total mental joy, an experience to which we have had no access for a long time, because of the immediate interference of mental representation and words when we do have aware experience. Except for mystic experience, wordless enjoyment seems an impossibility to us because we will feel the need to express our joy ("Isn't this beautiful?") and/or try to explain why the 'I' enjoys ("I especially like the way this artist does x, because y and z"), forgetting to 'just' enjoy. This coincides with the point of view of William James, who: "... a century ago, pointed out that mystical experience is not so much invoking higher powers or other realms but losing, albeit briefly, one's own identity." (citation taken from Blackmore (1994)).

67. It is therefore maybe not coincidental that inadvertent spontaneous mystic experience such as is occasionally possible to Westerners seems to occur most frequently (which probably means 'most easily') when people are subject to deeply emotional and direct experience of nature itself, when nothing really important is bothering their mind (my interpretation of examples given by Donaldson (1992)). Eastern cultures have developed numerous techniques - basically aimed at stopping thinking and stopping thinking in words - to evoke mystic experience more easily. There is a more original typically human manner to evoke mystic experience. It is dancing and trancing, which appears to be a standard part of rituals and social behaviour in most native cultures.

6. Zombie experience and artificial consciousness

68. Can computers have experience? When we defined experience as being apparent at

already the level of simple matter (paragraph 8) and enzymes (paragraph 11), we should state that transistors (on/off devices) can have experience as well. It appears that besides electromagnetic experience as it occurs in biochemical and neuronal processes, a new kind of experience, electronic experience, has been developed by the scientific activity of humanity. Yes, computers have experience.

69. Since a computer responds to input and gives as the output what appears to be a centralized final calculation of all submodular calculations, the computer is aware when we apply the above definition of awareness. Computer awareness evolves rapidly: pocket calculators have the experiential complexity of a snail compared to current computers which can talk to us. Similarly, growing complexity of brains made increase aware experiential flexibility. Especially now that we start equipping computers with the possibility of coping with visual and auditory input, the resemblance to awareness of living organisms increases. According to the definitions given, computers or AI machines do experience and - since there is central processing - have aware experience when sufficiently complex.

70. Are computers conscious? No doubt we can program computers to consider not the result of the input and the calculation, in other words to consider the knowledge, the information which results from experience, but also the event of the input - the experience - itself. This must not be that difficult since computers use language and thus have the ability for reflexiveness. When they are able to consider the experiences themselves or the fact that they have experiences, computers are conscious according to the above definitions. Will computers one day be aware and conscious? According to the definitions I suggest here, they are already or will be no doubt.

71. Is claiming that machines have or can have experience, awareness and consciousness the same as claiming that there is no difference between computers and living beings? I think that again the distinction we tried to make between experience on the one hand and awareness/consciousness on the other hand enables us to explain where the difference really lies. The discussion is not about whether processors, organisms or systems can become aware or conscious, but whether the underlying experience is comparable. Although computers can be aware and conscious, this experience will compare in no way to the aware and conscious experience which is possible in animals and humans respectively.

72. The most probable reason for this difference is that the basic experiences in bodies and brains (hormonal and interneuronal signalling) are of a different nature than the basic experiences of computers (signalling between transistors). Maybe the most important reason is something which has been clear to many students of living organisms for a long time, but which has always been overlooked, avoided or denied by science: animals and humans are emotional organisms in the first place (Vaneechoutte, 1993). This trivial insight is fortunately and finally finding more and more acceptance. According to the hypothesis of Antonio Damasio (1994), emotion pervades and underlies aware reactions even more deeply than was believed by those of us who were already convinced of its importance.

73. So, we might also get a grip on the zombie discussion by stating that zombies and computers can indeed be defined as aware and possibly conscious 'beings', but that their awareness and consciousness is of a different kind from ours, because they deal with a different kind of experiencing, that is insentient or nonemotional experiencing. Only in the

case that we could program emotionality into computer brains might it be possible that one day computers might have aware and conscious experiences comparable to ours. Theoretical work on how 'appraisive knowledge' could be programmed into computers so as to lead to 'emotional' behaviour has already been formulated (Gudwin & Gomide 1997). Others say that the objectives of an AI system could be put to 'please human beings' or to 'pay attention to approval and disapproval of human beings' (Walter Fritz, personal communication).

7. Experience and experiences

74. We end up with many classes of experience: molecular biochemical experience, cellular experience, subaware brain module experience, final aware experience, language dependent conscious experience, dream experience, mystic experience and AI or zombie experience.

75. Just as mystic experience might be understood as pure direct emotional animal experience, so we can understand zombie experience as the experience which is possible for emotionless, insentient machines. They are just different experiences, by definition. We cannot know what the world of AI experience is like, just like most of us cannot imagine what mystic experience is about. The experiences of a bat, for which the world is composed of sonar images in air, will be different from the experiences of a dolphin, for which the world is 'seen' as sonar images in water, or from those of land animals which use vision and sound in air, etc. And all of these will be impossible to imagine to a human mind. We may come closest to understanding how it must be to be some other human being, simply because we are most alike. Still, all of this can be considered as aware experience, while no one can really understand how it must be like to be another being. This coincides with the vision of the mind as the product of the interaction of brain, body and environment, whereby there is not really a mind-body duality. As such, the world view of a mind is a specific reflection of the very specific combination of physical and environmental present and past experiences of an individual colony or system.

8. Summary

76. In summary, experience can be considered as a basic characteristic of material interaction starting (at least) at the level of enzymatic processes. Understanding what experience is about is a hard problem. All I can offer as a way to an answer is that it has to do with pattern recognition or pattern matching, which explains the transiency of experience. The essence of animal awareness is that it is the final experience possible when experiences are first processed in a central brain, and as such awareness is the most frequent experience possible at the animal level. On this view, in nature only animals can be regarded as possibly aware beings.

77. Human awareness is an extension of animal awareness by the possibility of storing information in an independent manner, by means of words (linked to mental representations). It makes us much better able to retrieve events in the past, it offers the new possibility to consider events in the future and it enables us to consider many more possible outcomes of

present events. It also enables us to translate present experiences into words. Words also may be used to construct imaginary (virtual) situations in which we can have vivid (as if) aware experiences.

78. This is not to be confused with the use of words for imagining how experiences were, are or could be and which I suggest to define as having to do with consciousness. Consciousness then is the ability, again offered by language, to consider the experiences themselves: how were events experienced in the past, what will events feel like in the future, how do others experience things. In the present tense we can wonder about the experiences we are having or wonder about the fact that we have experiences - which again should not be confused with the aware activity of reporting present experience. For example, saying 'I like this' is aware activity, while saying 'Quite surprising that I like this' is conscious activity.

79. While awareness **is** (animal) experience, conciousness can be defined as the experience which stems from considering experiences, or as reflexive awareness (third person activity). Conscious activity itself is awarely experienced, which puts us back in first person modus. Besides these pitfalls, I think the basic confusion in many discussions on consciousness stems from taking these specific animal and human experiences to be the only kind of experience possible, overlooking that experience is an intrinsic feature of the interaction between matter.

80. I have tried to argue how evolutionary, dynamic reductionism may enable us to some degree to distinguish between experience, awareness and consciousness. I conclude for myself that there are no philosophical problems about awareness and consciousness. Mechanistically, aware and conscious activity can indeed be considered as explained (Dennett 1991). However, I think that explaining how these experiences feel like and why it should feel like something, is not within the realm of our methods of understanding. To me this comes as no surprise, since I consider our lack of understanding of the nature of experience as a consequence of the evolutionary limitations of our individual animal minds, developed to think in terms of cause and consequence. We should adopt some modesty in these matters. After all, also our basic laws are merely descriptive: they enable prediction, but they do not explain why things are the way they are. The physical laws which science has revealed, give us a false impression of basic understanding, while these laws only reflect some generalities, without explaining why these generalities are the way they are. We can describe under what conditions two molecules will interact and predict to which new molecule this will lead. We describe how it happens, but we do not understand why this happens.

81. I hope that this approach may provide a manner for making elementary distinctions between experience, awareness and conciousness and that it may offer a way to a renewed constructive debate between those researchers and philosophers who find themselves at present in opposite camps. Possibly the ideas of D.R. Griffin (1997) offer a way out in the same direction.

9. Notes

82. Note 1. Of course there is also dreaming experience during sleep. One could say that dreaming activity occurs during every normal sleep, but that we experience dreams only

sporadically (some even report to have never dream experiences). My guess is that this dream experience stems from 'partial awakeness', i.e. a state of being whereby some of the modules which are otherwise inactivated during sleep regain activity. This might occur because of environmental conditions (think of noises), because of malfunctioning of some organs during sleep (think of apnoea) or because of the emotional impact of the dreams themselves, which alert some modules otherwise 'asleep'. At those moments we are able to witness the complexity and the seeming chaos of the interpretation processes of lower order modules in the absence of our final interpretation capacities. (To humans there is also conscious experience and mystic/religious/hallucination experience. For a preliminary attempt at classification, see paragraphs 54-61, 85 and 65-67).

83. Note 2. As a matter of fact, there is nothing nondeterministic about the enigmatic word 'emergence' (Nagel 1961) - also 'supervenience'. Instead of stating that the sum is more than the parts (a quantititave approach, which is not applicable), we might better understand emergence by saying that the qualities of the combination are different from the qualities of its constituent parts (a qualitative approach).

84. Combining two different processes, like i) being an emotional animal and ii) speaking - can lead to predictable emergent outcomes. i) An animal has emotions which have been naturally selected because they enable appropriate behaviour needed to survive and reproduce (paragraph 29). ii) A certain animal species (the human animal) is able to speak and thus to think about future possible events (like death) and future possible emotional experiences (like how it will feel to be dead). An almost inevitable outcome of i) and ii) together is that these animals will develop behaviour which is meant to influence the assumed afterdeath events and emotional experiences. As such, one could say that the worldwide occurrence of independently developed burial rituals is a predictable emergent outcome of the combining of emotion and speech in a single organism.

85. The recurrent need throughout our history and at present of most humans to believe in the existence of divine powers (religiosity) can be explained starting from the same considerations (Vaneechoutte 1993) and as such religiosity becomes a subject for scientific studies, pace those who claim that science has nothing to say about religion. While science cannot proof or disproof the nonexistence of deity, it can wonder what it is in the human mind that makes so many of these minds convinced of something for which absolutely no trace can be found when applying the otherwise very efficient scientific methods.

86. Note 3. However, even the exclusivity of symbolic language for humans may be questionable, since we still have very little idea of the degree of symbolisation of the sonar languages of e.g. dolphins and bats or of the infrasound language of elephants.

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