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Article

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CONSCIOUSNESS, SUBJECTIVITY, AND GRADEDNESS[1,2]

SUMMARY: The article suggests answers to the questions of how we can arrive at an unambiguous characterization of consciousness, whether conscious states are coextensive with subjective ones, and whether consciousness can be graded and multidimensional at the same time. As regards the first, it is argued that a general characterization of consciousness should be based on its four dimensions: i.e., the phenomenological, semantic, physiological and functional ones. With respect to the second, it is argued that all informational states of a given organism are subjective (as they are biologically individuated), but not all are necessarily conscious. Finally, where the third question is concerned, in each of the four dimensions of consciousness a graded element is identified: quality of information in the phenomenological one, abstractness in the semantic one, complexity in the physiological one, and usefulness in the functional one. The article also considers certain consequences of the solutions proposed, as well as some practical applications of the 4D-view of consciousness.

KEYWORDS: graded consciousness, individuated information, subjectivity, dimensions of consciousness.

1. Introduction

Contemporary consciousness studies is a field that presents us with a multiplicity of more or less fundamental problems of both an empirical and a theoreti-

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[2] The article shares its main theses with the text published in Polish in *Filozofia Nauki* (Jonkisz, 2019).

cal kind (Dehaene et al., 2017; van Gulick, 2018). Of these, the most basic concerns the lack of an unambiguous characterization of consciousness itself. There is still no universally accepted description of the phenomenon of consciousness, or general definition of it, while the operationalizations employed in particular research cases often differ significantly (Jonkisz, 2012; Pareira, Ricke, 2009; Velmans, 2009). Consciousness may be said, at the very least, to be a concept lacking in sharply defined boundaries (in that its scope has not been clearly defined to date) or an ambiguous phenomenon. (Alongside this, the possibility also persists that it could potentially refer to multiple quite distinct phenomena; see Block, 1995; Irvine, 2012; Torrance, 2009). A closely linked question concerns the relationship between consciousness and subjectivity: are the conscious states of a given organism or system coextensive with its subjective states? Such an assumption, though by no means self-evidently valid, seem to be operative in many influential conceptions and theories of consciousness today (e.g., Block, 1995; Chalmers, 1996; Searle, 1992; 2000). Another currently important issue concerns the gradability of consciousness: i.e., the question of whether consciousness emerges in steps, or with an increasing intensity/sharpness, or rather appears suddenly in an all-or-none fashion (Andersen et al., 2016; Overgaard et al., 2006; Sergent, Dehaene, 2004; Windey et al., 2013; 2014). This problem is particularly interesting, given the multi-dimensional nature of consciousness, as certain researchers insist that it is very difficult to justify ascribing such gradedness to consciousness in respect of its manifold dimensions (Bayne at al., 2016).

The paper proposes certain solutions to the three problems just mentioned: namely, that of how to give an unambiguous characterization of the phenomenon itself, that of the relationship between consciousness and subjectivity, and that of the gradability of consciousness. The aim of this article is to present and justify those solutions in a condensed form (for more details, see Jonkisz, 2015; 2016; Jonkisz et al., 2017), while at the same time pointing out their consequences and related issues worthy of further study.

2. Characterizing Consciousness

Above and beyond the operational definitions used in specific research cases, or in the common-sense description of consciousness as a state of wakefulness contrasted with deep sleep, coma or state of general anaesthesia (e.g., Damasio, 1999; Searle, 2000), formulating an unambiguous, universal characteristic of the phenomenon itself remains a difficult and problematic matter (Torrance; 2009, Velmans, 2009). As a consequence, it is possible to identify as many as several dozen different meanings for the term, together with the corresponding kinds, types or varieties of consciousness being posited, within consciousness studies (Brook, 2008; Jonkisz, 2012; Pareira, Ricke, 2009). However, amidst all this diversity, which can sometimes lead to the conclusion that we are dealing not with one but with many different phenomena (Block, 1995, p. 227), it is possible to point to a relatively small number of recurring descriptive elements. Con-

sciousness is quite often identified with a totality of subjectively experienced states or qualities (e.g., Block, 1995; Chalmers, 1995; Kriegel, 2006; Tononi, 2004). It is also claimed that consciousness consists in intentional—in the sense of being always about something (Searle, 1992; 2000)—first- or higher-order states (e.g., thoughts about thoughts, or perceptions of perceptions; see, e.g., Carruthers, 2016; Gennaro, 2005; Lycan, 1996; Rosenthal, 1986). Consciousness is also presented as a state generated by the specific brain processes—namely, widespread or more localized recurrent neuronal activity in the thalamocortical regions (e.g., Crick, Koch, 2003; Dehaene, Changeux, 2011; Edelman, 2003; Lamme, 2006). Finally, it has been characterized in terms of being a certain adaptation that allows its possessor to, among other things, more effectively adapt to new stimuli, solve problems, decide, understand and empathize (e.g., Baars, 2002; 2012; Cohen, Dennett, 2011; Damasio, 1999; Feinberg, Mallatt, 2013; 2016; Merker, 2005; Morsella, 2005). The aforementioned descriptions relate, in principle, to four different aspects or dimensions of consciousness (Jonkisz, 2012; 2015; Jonkisz et al., 2017). Firstly, they concern its phenomenological dimension, which includes the qualitative aspect of conscious states fully accessible only from the first-personal, or subjective perspective. Secondly, they relate to its semantic dimension, since the intentionality of both first- and higher-order states can be reduced to the semantic property known as referentiality (with different orders of reference; see Jonkisz, 2012; 2015; Pierre, 2003). Thirdly, they pertain to its physiological dimension, which concerns the mechanisms most likely to produce consciousness in a given organism. (In this respect, scientists like to point to specific neuronal correlates—so-called NCCs; see Metzinger, 2000). Fourthly, they concern to its functional dimension, which deals with the adaptive role of consciousness in a given organism's actions.

The vast majority of meanings, kinds, types or varieties attributed to consciousness either directly reflect one of the dimensions just mentioned or involve some sort of combination of them. Such a four-dimensional approach thus enables one to organize the different versions of the concept of consciousness into a clear taxonomy (Jonkisz, 2012; 2015). Apart from its elucidatory advantages, such an approach also has explanatory value, in that it allows us to define four distinct research problems. In relation to consciousness, one can ask: "Why and how is there something it is like to have it?" (the focus of explanation then being its qualitative characteristics, accessible from a subjective perspective); "How does it refer to anything?" (explanations thus concentrating on its semantic properties); "How does it emerge in a given organism or system?" (the aim being to understand its mechanism(s) of production); and, finally, "Why is it that these and no other states are conscious?" (the research focusing mainly on such states' pragmatic function).

If the physiological, phenomenological, semantic and functional dimensions actually exhaust the concept of consciousness as it is known to science, then they would seem to represent a reasonable starting point for an attempt at formulating

a general characterization of consciousness. Pursuing this direction, consciousness may be broadly described as a *state co-occurring or caused by specific neurophysiological processes, in which a given organism experiences certain (referential) contents related to its actions*.[3] However, even if correct, such a description is surely too general, in that it, too, allows for multiple different interpretations, where these ultimately may bear on the actual scope of applicability of the concept. Indeed, such a situation is observable at the moment in consciousness studies, where one can encounter both very narrow construals of consciousness (e.g., Carruthers, 1998; 2018—an author who holds that it is in principle only possessed by humans) and quite broad ones (Feinberg, Mallatt, 2013; 2016—authors who claim that forms of consciousness are possessed by evolutionarily very old organisms, such as, e.g., sea lampreys or insects). On an ultra-wide construal, consciousness is attributed not only to the majority of living organisms, but also to certain artificial systems, sometimes even very simple ones (e.g., Tononi, 2004; 2008; 2010—along with his integrated information theory or IIT, in which even light-sensitive diodes are claimed to have something more than a zero degree of consciousness). It therefore seems quite important to furnish grounds for accepting some reasonable limitations: limitations that may help to avoid such radical shifts in the range of what may count as instances of consciousness in the context of contemporary conceptions (Jonkisz, 2015).

Such initially imposed limitations may consist in a determination of the minimal requirements for potentially conscious organisms or systems (these are referred to as "global limitations"; see Jonkisz, 2015). In this regard, my research yielded the hypothesis that only those organisms or systems that individuate information are capable of producing subjective perspectives. This is based on two assumptions. The first is that information, as a category, is superordinate to (i.e., encompasses) consciousness, in that all states of consciousness are informational states, but not all informational states are conscious. Such an idea is by no means a one-off in contemporary research: for example, Koch and Tononi (2013) present a similar view, according to which consciousness consists in integrated informational states, as does Earl (2014), who claims that all states of consciousness are nothing more than various forms of information. The second is that, since consciousness is a phenomenon so far observed only in nature, the concept of information should also be naturalized—meaning that it will then be interpreted as a state of an organism that carries biologically justified value/meaning for that organism.[4] This assumption eventually led me to the conclusion that all information possessed by a given organism must be unique, because its form, meaning and pragmatic functions have been shaped (and continue to be

[3] Such a description presents the phenomenon of consciousness as being limited to living creatures; however, if the term "organism" is replaced with "system", and "neurophysiological process" with "mechanisms", it no longer excludes the possibility of artificial or machine consciousness (Hollande, 2003; Torrace et al., 2007).

[4] This interpretation is intended as provisional, in that it awaits further justification in separate studies.

so) by a coinciding of multiple evolutionary, developmental and environmental factors that will be distinctive for just that very creature itself. On this account, it seems that all informational states available to a given organism must have undergone a complex individuation process leading to the creation of its unique, private perspective—a process that is most probably a necessary condition for subjectivity. (This thread will be further elaborated in the next part of the present text).

Further limitations may consist in a determination of the conditions that must be met for something to count as an occurrence of consciousness in a given organism or system (local limitations). The real aim here is to find a certain contrast for consciousness: i.e., a significant difference between conscious and unconscious information processing. Such a search is indeed underway, as researchers try to spot the difference in each of the dimensions described above. As regards the physiological dimension, what we are looking for is a contrasting neuronal mechanism or activity pattern. However, despite many important discoveries, no consensus has been reached on this, either regarding an exact location or with regard to a specific, consciousness-providing activity (Hohwy, 2009; Metzinger, 2000; Noë, Thompson, 2004). The contrast between conscious and unconscious states is also not very clear in the semantic dimension. This is partly because all informational states, even unconscious ones, must refer to or mean something for the organism or system in order to count as informative at all. Admittedly, some scholars point out that the form of such a state (e.g., whether it is a thought, perception or representation) or its order of reference (first or higher-order) may be decisive (Carruthers, 2016; Kriegel, 2007), but again there is no consensus here. Neither does it seem that the phenomenological dimension brings into play any conclusive difference. Most obviously, this is because it is difficult to verify whether the organism is subjectively experiencing anything at all at a given moment. (We must rely here on behavioral measures that mostly measure reports not occurring simultaneously with the experience and so potentially influenced by many different processes; see Timmermans, Cleeremans, 2015). Yet this is also because even s u b j e c t i v e e x p e r i e n c e itself does not have a clearly identifiable set of characteristics: if we do not know exactly what it is, then we cannot be certain whether someone other than ourselves has it or not. Meanwhile, such notions as “qualia” or “phenomenological consciousness”, which are often invoked at this point, only worsen the situation (Block, 1995; Dennett, 1988,). Furthermore, it is even possible to find grounds for arguing that unconscious states are also subjective. (See the next part of this text, below, as well as Jonkisz 2009; 2016; Neisser, 2006; 2015). Partly because of these problems, the functional dimension is seen as being, at least for now, the more rational option when it comes to searching for a contrast between unconscious and conscious information processing. There is not enough room here to analyse the various conceptions and disputes that surround the function of consciousness itself. (This issue will, though, be addressed in a little more detail in the third part here; see also Baars, 2002; 2012; Cohen, Dennett, 2011; Hesselman, Moors,

2015; Morsella, 2005; Merker, 2005). Nevertheless, the assumption that conscious information processing represents an evolutionarily valuable adaptation seems self-evidently reasonable—after all, organisms must have been more efficacious and statistically more successful when acting consciously, otherwise the ability to do so probably would not have survived (Feinberg, Mallat, 2013; 2016; Griffin, 2001; Hassin, 2013; Lindahl, 1997). On the basis of just this relatively straightforward assumption, to the effect that consciousness yields a certain advantage in respect of a given organism's actions, and without specifying what the actual function in question is, the following hypothesis then seems acceptable: out of all of the informational states accessible to a given organism or system, the states that reach consciousness will most likely be those that are functionally the most useful in action at a given moment, from the subjective point of view of that organism or system (Jonkisz, 2015; 2016; Jonkisz et al., 2017).

Ultimately, on the basis of hypotheses limiting consciousness globally (to systems that individuate information) and locally (to informational states most useful in action), consciousness may be characterized very concisely as "individuated information in action" (Jonkisz, 2015; 2016). Some of the consequences of this characterization will be discussed in the closing section below, while in the next part I shall offer a slightly more precise discussion of the concepts of individuation and information.

3. Consciousness and Subjectivity

In order to know what-it-is-like to see a red rose, smell its scent, or feel the prick of its spike, one must consciously experience the sensations oneself. It is generally assumed that any such qualitative character of consciousness is only available from the internal or private perspective of the subject: i.e., only subjectively. From an external perspective, or objectively, we can observe certain forms of accompanying behavior and physiological parameters correlated with these experiences, although in the case of humans we also encounter relations to verbal utterance. (It is worth noting that in this context the "subjective versus objective" distinction specifically refers to the form of cognitive accessibility involved; hence, it may be said to be understood epistemically).

Many researchers consider the subjectivity of consciousness, i.e., its phenomenological dimension, a particularly "hard problem", treating explanatory problems related to other dimensions as relatively easy to solve by comparison. It has even been argued that because science is unable to fully answer the question of "what-it-is-like to experience something", when it comes to qualia or so-called phenomenological consciousness we are basically faced with what is known as an "explanatory gap" (Bayne, 2009; Block, 1995; Chalmers, 1995; Dennett, 1988; Jackson, 1982; Kriegel, 2006; Levine, 1983; 2001). It is hard not to agree here with Edelman, who states that the hard problem, put this way, "does not require a solution, but rather, a cure" (Edelman et al., 2011, p. 5). The assumption that science should actually encompass the subjectivity of conscious

experiences, furnishing complete knowledge about what-it-is-like to have them, is a category error: this kind of knowledge is accessible only from within an experiencing system, not from any scientific statements or theories (Pigliucci, 2013). Scientific descriptions of subjective experiences, even of the most detailed kind, will not generate these experiences—that much is obvious. However, this need not mean that science is unable to explain subjectivity (Baars 1996, p. 2011; Edelman, Tononi, 2000, pp. 139–140). So how should science, which is essentially objective, seek to explain subjective consciousness? Besides, where possible, an unambiguous and precise determination of the concepts and research objectives involved, we usually expect from science explanations of either a functional or a mechanistic nature, or both. In this instance there is no reason to expect otherwise, so the actual goal must be to understand the functions and mechanisms of subjective consciousness. Moreover, since the research in question aims to shed light on a natural phenomenon (in that consciousness occurs in nature), both of these aspects should be interpreted naturalistically. Therefore, in asking about functions, we should be looking to identify a possible adaptive role for subjective awareness, in the sense of any advantages it might provide in the context of action of an organism. On the other hand, when it comes to mechanisms, one may here ask two questions—one posed at the evolutionary level, the other from a physiological perspective. The first would be this: When and how did subjective consciousness develop amongst living organisms? (Feinberg, Mallat, 2013; 2016.) The second, on the other hand, would be the following: What processes are responsible for the production of consciousness in a given organism? (Bisenius et al., 2015; Edelman, Seth, 2009; Koch et al., 2016) Below, I shall put forward hypotheses pertaining to both the functions and the mechanisms leading to the formation of subjectivity.

As was mentioned in the previous section, information is regarded as being superordinate (in conceptual-hierarchical terms) to consciousness, in that all conscious states are informational states, but not vice versa. That commitment receives a brief justification below. As a starting point, I shall accept, at least in broad terms, a characterization of informational states based on information integration theory: an informational state is a state of a system differentiated by that system from its other states, where a state of a system is determined by the interaction of its elements (Koch, Tononi, 2013; Tononi, Koch, 2014). Described thus, informational states must necessarily include all states of consciousness, as in order for a given organism-system to become conscious of something, it must somehow identify the latter, or at least differentiate it from other things (the system must detect the signal or stimuli and integrate it/them as a new whole). At the same time, many studies suggest that much of the information processed by our nervous systems is not conscious, and this applies not only to "lower-level" but also "higher-level" information processing, such as engages the prefrontal areas of the brain usually associated with fully formed consciousness (van Gaal et al., 2012). It is also argued, that even executive, top-down control of behavior (Kiefer, 2012) and fully integrated states (Mudrik et al., 2011; 2014) might be

carried out unconsciously. In the context of the characterization of informational states just offered, it can be said that not all states differentiated by a given organism-system become conscious for that system.[5] Ultimately, all the states of consciousness of a given system form a subset of the informational states available within that system. Yet if there are both conscious and unconscious informational states available within a certain organism or system, what is their relationship with subjectivity? Could only conscious states be subjective, as they surely are, or is it perhaps the case that all informational states of a given system possess this feature? The answer will largely depend on the notion of subjectivity applied—in this context, one characterized as "availability limited to the internal perspective of a given organism-system". Already, in (Jonkisz, 2009), I argued that the formation of subjectivity, understood this way, can be explained by pointing to the structural and functional uniqueness of organisms. In my recent studies (Jonkisz, 2015; 2016), as was already mentioned above, the concept of individuation has emerged as crucial, so I should now describe this in more detail.

Generally speaking, individuation is understood here as a complex selection process that includes both sources of information and the informational states themselves. In principle, it can be said that it begins at the evolutionary level, because the availability of information of a certain type is determined by the morphological and physiological equipment of a given species. Each and every creature is, quite simply, limited: for example, by its sheer manner of getting around (so flying, say, will furnish different informational possibilities than swimming or walking), but also by the type, amount and sensitivity of its receptors (which, for instance, only allow for the detection of specific wavelengths and frequencies of light and sound, or specific chemical compounds). As a consequence, organisms are able to detect just certain kinds of stimuli and process information of only a certain type (i.e., those which proved most efficacious for their biological ancestors—if we may be permitted to thus simplify the logic of evolutionary justification). The process of individuation continues as information, reduced at a phylogenetic level to specific resources, is subjected to further specifications, being modified by epigenetic factors (inherited by subsequent generations), changed by certain social components (e.g., different values and meanings within specific groups of organisms), and also reflecting specific environmental conditions, in force at a given moment in time (Ballestar, 2010; Bossdorf et al., 2008; Fraga, 2005; Migicovsky, Kovalchuk, 2011; Swaddle et al., 2005). Consequently, information acquires more and more specific forms and meanings, becoming virtually unique at the level of a given phenotype. Moreover, the differentiation of specific informational states, experienced thus and in no other way by given organism, ultimately depends on multiple individual factors, such as the following: the current state of the organism (e.g., biochemical parameters of its

[5] In practice, this may for example mean that not all new activity patterns, even integrated within the cortical regions, inevitably result in conscious experience—as is indeed often the case (Kiefer, 2012; Mudrik et al., 2011; 2014; van Gaal et al., 2012).

nervous system), its being located in some specific surroundings (i.e., limitations pertaining to the availability of space, time, relationships, engagements, etc.), its individual history (given that already experienced states will influence future states), and its currently extant decisions, challenges, plans undertaken, etc.[6] All these will be reflected in the constantly changing structure of its body—in particular, in the network of connections and activity patterns in the nervous system. That is why there are, in fact, no two identical nervous systems: even the brains of identical twins differ significantly (Freund et al., 2013; Frith, 2011; Marti et al., 2011; Pfefferbaum et al., 2004; Valizadeh et al., 2018). Once again, we are led here to agree with Edelman, who states that, as a result, "[a]t any given moment, a process of integration of collective neuronal activity generates an interwoven pattern of responses unique to a particular animal at that particular moment of time" (Edelman et al., 2011, p. 3).

In conclusion, we may assert that as a result of such a complex and extended process of individuation involving multiple levels—be they phylogenetic or ontogenetic, genetic or epigenetic—biological systems are structurally and functionally unique, and therefore operate in highly individualized informational spaces. Hence, any informational state that a given organism is capable of differentiating will in fact be available only at a given moment, only for that particular system, and only from its own unique and, in effect, private cognitive perspective. Ultimately, if subjectivity is understood in terms of availability limited to the internal perspective of a given organism-system, we may conclude that all of the informational states of a given system are subjective, regardless of whether they are conscious or not.[7] Consequently, subjectivity cannot be taken to be a feature specific only to states of consciousness, as its range of instances turns

[6] Many studies have confirmed the importance of both the top-down and bottom-up effects of bodily factors on information processing (e.g., Fleming et al., 2010; Pfeifer et al., 2014; Rochat, 2011; Shimono et al., 2012; Theeuwes, 2010; Zhou et al., 2013).

[7] As a reviewer has rightly pointed out, this talk of "availability limited to the internal perspective" needs to be fleshed out in more detail, since it bears the weight of important conclusions drawn in the present article. To be as concise as possible: the subjective character of conscious states should not be understood coextensively with their phenomenal character (the fact that they are experienced), as otherwise statements such as "consciousness is subjective because it is accessed/available only as experienced (only from the first-person perspective, from the inside, from within, etc.)" will be circular. Hence, a given state's being subjective (i.e., internally available for a given organism/system) cannot be coextensive with its being experienced. But in that case, what will it mean for an informational state to be subjective, yet not conscious? A given system's being informational will be understood here along Tononian lines: i.e., as "differentiated by that system" or "detected by that system". (A Shannonian take on this, involving uncertainty reduction in noisy-channels, will also be applicable here.) Ultimately, to be an informational state that is subjective but not conscious will mean that apart from being differentiated, it also has to be "available only from within a given system" (where this is explicated here in terms of "information individuation") but not experienced (i.e., with no phenomenology presenting itself).

out to be wider.[8] At the same time, such a process of individuation can be construed as a hypothetically posited natural mechanism, responsible for the development of subjectivity in the animal world. But, of course, this will not then serve to explain the emergence of consciousness.

It will quite likely prove possible to discern not only mechanistic differences between consciousness and subjectivity, but also functional ones. First, however, we should address the question of what adaptive advantage such a highly individualized perspective may provide for an organism. By way of justification, we may appeal in our answer to the rather obvious assumption that the selection of effective ways of action, combined with their rapid adaptation to the changing conditions of the moment, represent key adaptations for any organism. It is also quite plain that, in a complex and ever-changing environment such as we are dealing with here, organisms are potentially capable of distinguishing an infinite amount of information in an infinite number of states. In connection with such an "informational overflow", and the need for effective, but also swiftly executable actions, we may posit the existence of an evolutionary pressure to filter out the least valuable sources of information and choose the most useful ones from those available. This scenario is extremely well suited to the very process of individuation just described—one which, through a complex selection of possible informational states, leads to the emergence of subjective perspectives. I would thus assert that subjectivity is, most likely, an adaptive response to informational overflow, with its basic function being the selection of information that is the most valuable from the perspective of a given subject-organism-system (Jonkisz, 2016). As regards the function of consciousness, as was already indicated (in the previous section), this is taken to be manifested in action. (Its function will be described in more detail in the next section).

4. The Gradability of Consciousness

The issue of the graded versus the dichotomous nature of consciousness hinges on multiple heterogeneous factors, and presents itself as being even more complex than the issues discussed above. The very concept of consciousness utilized in the relevant research can play a determining role in this regard. For example, in so-called Higher-Order Theories or HOTs, one may incline towards treating consciousness as a property that appears suddenly, because arriving at a higher-order state by a given subject (be it perception of perception, representation of representation, or thought about thoughts) is something that takes place all at once rather than gradually (Carruthers, 2016; Gennaro, 2005; Lau, Rosenthal, 2011; Lycan, 1996; Rosenthal, 1986). On the other hand, gradability seems quite natural as something to embrace in approaches associated with the so-called "integration consensus" (Seth, 2009; Tononi, Koch, 2014) or using non-

[8] Such a conclusion regarding the existence of "unconscious subjectivity" may strike one as surprising, but is not isolated (Farisco, Evers, 2017; Neisser, 2006; 2015).

report methodologies (Tsuchiya et al., 2015). These conceptions utilize numerical measures of consciousness, and also quite often take non-human creatures and even artificial systems to be capable of being conscious. The tendencies towards viewing consciousness as graded or dichotomous may also be at least partly subject to polarizing influences stemming from the particular field of research being brought to bear on this topic. For example, in psychiatry or neuropathology, the notion of levels of consciousness is quite widely accepted (it being depicted in different scales of consciousness; see Giacino, 2005; Schnakers et al., 2008; Teasdale, Jennett, 1974), whereas in contemporary philosophical and psychological approaches this is by no means obviously the case (Bayne et al., 2016). Finally, the methodology used in research may exert an influence on the answer given: for example, within the so-called "subjective measures of awareness" (e.g., Timmermans, Cleeremans, 2015), what may be at least partially responsible for the outcomes is the simple choice of scale used in the experiment, or the mere selection of specific tasks or stimuli presented to participants (whether, for example, those are more or less complex, more or less abstract, induce higher or lower processing levels, etc.).[9]

It is quite likely that the difficulties involved in answering the question about the graded or all-or-none nature of consciousness are also caused by the fact that it is simply not clear what we are asking about. In other words, it is not being specified precisely enough what it is that can actually appear suddenly or emerge in steps or with varying intensity—whether we mean by this the subjective content of consciousness, or some specific physiological parameters of that state, or something else. The matter becomes even more complicated if we take on board the assumption that consciousness is a phenomenon having (at least) four different dimensions: i.e., phenomenological, physiological, semantic and functional (as described in the first section here). It is not clear whether gradedness should be visible in each of the dimensions independently, or rather in all of them at the same time—so, should we be looking for four different hierarchies of levels of consciousness, or rather for just one, somehow averaged out across these? In any case, considering the multidimensionality of consciousness, one must accept that individuals cannot be "ordered on the basis of how conscious they are, just as they can be ordered on the basis of their age, height, or blood pressure" (Bayne et al., 2016, p. 406). Even so, is it really necessary to draw critical conclusions from this line of thinking for all of the graded approaches, as the authors of the text just quoted do? Below, I shall put forward some practical guidelines for how to reconcile the four-dimensional conception of consciousness with gradability: more specifically, I will show what is or could be

[9] For example, it has been shown that stimuli/tasks that manifest higher levels of processing (like semantic discriminations) will more often result in the subject's believing the emergence of conscious experiences to be something occurring on an all-or-none basis, whereas low-level features (e.g., shapes, locations) result in experiences that are taken to appear gradually (Windey et al., 2013).

graded in each of the dimensions and how to measure it (in the sense of describing possible or actually existing methods of measurement; see Jonkisz, et al., 2017).

What, then, can be pointed to as being a graded element in the phenomenological dimension? Just to recall, this dimension refers to the qualitative characteristics of states of consciousness, which are accessible only from the private perspective of the subject (subjectively). During conscious seeing, hearing, smelling, bodily sensation, thinking, imagining, etc., we experience different objects, sounds, colors, feels, smells, etc. Actually, these experiences appear as more or less vivid, sharp, intense, clear, rich, detailed, etc. It can therefore be concluded that, if something is graded here—i.e., it decreases or increases—then we may point to these very qualities: i.e., vividness, sharpness, intensity, etc. Generalizing this idea, it can be assumed that the q u a l i t y of experienced states of consciousness is the gradable element in the phenomenological dimension, in the sense that the states possessing a higher quality grade would present themselves as being more vivid, sharp, intense, etc., while those with low quality would show up as less clear, unclear, blurred, barely perceptible, etc. The idea seems quite plausible, but is it possible to actually measure the phenomenal quality garade? In fact, a variety of methods already exist in consciousness studies that are applied to measure this parameter. These include objective methods, based on behavioral criteria, signal detection data and/or neuronal activity patterns analysis (Heavey, Hurlburt, 2008; Tsuchiya et al., 2015), and subjective methods, based on the analysis of reports concerning one's own conscious experience, as given by participants (Overgaard, 2015; Overgaard, Sandberg, 2012; Wierzchoń et al., 2012). For example, the results obtained using so-called subjective measures of consciousness (Wierzchoń et al., 2014) suggest that consciousness is in fact subjectively graded in certain cases—to be more specific, in these cases participants use all available grades of a given scale to report on the quality of experience they have had, following a specific presentation of stimuli on a screen (Overgaard et al., 2006; 2010). Nevertheless, in other studies employing similar methodology, conscious experience seems to be dichotomous, with respondents in such cases invoking extreme ends of the scale and indicating that the presented stimulus was either clearly visible or that there was no experience of it whatsoever (Sergent, Dehane, 2004). Therefore, some researchers claim that from a subjective perspective consciousness can actually be both: i.e., sometimes graded and other times dichotomous. (It is assumed that the hypothesis of the level of processing may help to explain this claim; see Windey et al., 2013; 2014).

Apart from its subjective characterization, consciousness also stands in an objective relation to what it refers to or is about (Legrand, 2007, p. 577). This referentiality of consciousness forms the basis of its semantic dimension. So, is there any chance for a graded element to show up here, too? Conscious states may refer to anything that we sense, feel, think of, remember, imagine, etc. Yet the reference may be either more direct, as in cases where one is j u s t conscious of the sheer sensations, feelings, thoughts, etc., or more abstract, as in cases where one is also conscious of the sensing, feeling, thinking, etc., too. Hence, it

can make sense to say either that the subject *X* is conscious of *Y*, or that the subject *X* is aware of being conscious of *Y* (Jonkisz, 2012; 2015; 2016, where five consecutive orders of consciousness are described). In dealing with the first sort of instance, researchers apply, among others, such terms as "first-order consciousness" or "non-reflective consciousness", whereas in the second case they talk of such things as "higher-order consciousness", "reflective consciousness", "introspective consciousness", or "metacognition" (Armstrong, 1979; Lau, Rosenthal, 2011; Morin, 2006; Overgaard, Sandberg, 2012). Ultimately, on the basis of the order of reference involved, this relation may be considered more or less abstract, so a b s t r a c t n e s s can be considered a graded element within the semantic dimension. Although higher-order states and metacognition have been studied empirically (e.g., Fleming, Lau, 2014; Middlebrooks, Sommer, 2012), there are no measures of abstractness itself in use as of today. However, one could expect that performing certain types of activity, or completing certain kinds of task, would result in the occurrence of more or less abstract states. For example, in procedures that apply subjective measures of consciousness, a visual stimulus is displayed to a participant in near-threshold time durations (e.g., simple geometrical shapes, strings of letters, numbers, or more complex objects like male or female faces). The participant is subsequently given an identification task, followed by the task of assessing the experienced quality of the image (perceptual awareness scale or PAS) or rating their level of confidence in what they have just seen (confidence ratings or CR) on a scale of four grades (Dienes et al., 1995; Ramsøy, Overgaard, 2004; Wierzchoń et al., 2014). One may conclude that first-order visual consciousness is not sufficient to complete these tasks, as in order to assess (first-order) visual experience one needs to be aware not only of the visual object itself, but also of the experienced quality of the (higher-order) seeing of that object.[10] In practice, it may prove useful to create the sort of procedures that will allow us to assess more precisely the order of reference invoked by a given task.

Gradability in the physiological dimension seems to be a quite obvious affair. Thanks to the development of new research methods combining neuroimaging with electroencephalography (EEG) and transcranial magnetic stimulation (TMS), we find ourselves increasingly well placed not only to determine, but also to understand, the brain mechanisms and distinctive neuronal activity patterns associated with occurrence of consciousness (Bandettini, 2009; Bisenius et al., 2015). Analysis of these patterns enables one to assess the level of integration of the various brain regions cooperating at a given moment (mostly on the basis of the synchronization of the activities involved), as well as the range of differentiation of these regions (in the sense of assessing their heterogeneity across different portions of the cortex). The relationship between integration and differentiation is currently being intensively studied, and at least three different

[10] Thus, it remains a matter of dispute whether the quality of conscious experience, or in fact the quality of metacognition, is what is actually being measured by means of PAS and CR (Wierzchoń et al., 2014).

ways of enabling its numerical determination have been proposed. In integrated information theory, this dependence is reflected by the Φ-value, with the theory working on the assumption that the higher the Φ-number is, the greater will be the ability of a given system to integrate information (Tononi, 2004; 2008; 2010; Tononi et al., 2016). Anil Seth (2008), meanwhile, proposes the so-called "causal density" value or "cd", calculated on the basis of the analysis of interaction between elements of the neuronal network relevant at a given moment (Barrett, Seth, 2011). Lastly, Missimini and his colleagues have developed the so-called Perturbational Complexity Index (PCI), in which the cortical response to intentional perturbations evoked by Transcranial Magnetic Stimulation (TMS) impulses is assessed (its EEG complexity pattern being calculated using Lempel-Ziv; see Casali et al., 2013). Simplifying the overall notion underpinning such models, we can state that according to such proposals the more complex the activity patterns (indicated in a higher Φ, "cd" or PCI value), the higher the probability of the occurrence of consciousness—or the higher its level. Ultimately, it can be assumed that the physiological gradability of consciousness is reflected in the overall c o m p l e x i t y of the activity patterns involved. However, one should keep in mind that these methods assume a correlation with consciousness: in other words, while not very likely, one might still obtain a high numerical value unaccompanied by consciousness.

On a four-dimensional approach, one can certainly still inquire into functional gradability. So is it possible, in this dimension, to point to some parameter or other that increases and decreases, or appears in steps? The issue is not straightforward, because there is no consensus even as to specific function supposedly performed by consciousness (Hesselman, Moors, 2015). However, as was already mentioned, the assumption that consciousness is an evolutionarily valuable adaptation seems quite obvious (Feinberg, Mallat, 2013; 2016; Griffin, 2001; Hassin, 2013; Lindahl, 1997). The value of adaptations is reflected in the abilities they provide for organisms, so we can ask what it is that the conscious processing of information actually furnishes. There have been many proposals regarding this matter: for example, that consciousness enables learning, decision making, action planning, problem solving, etc. However, it has been argued that all such functions could also be performed in the absence of consciousness (e.g., Hesselman, Moors, 2015). Recently, though, one idea does seem to have gained fairly wide acceptance in the context of the currently predominating theoretical approaches: it is that conscious processing enables the integrating of signals and information from various systems (e.g., sensory, motor, memory) and different cortical regions (Baars, 1994; 2002; Baars et al., 2013; Dehaene, Changeux, 2011; Dehaene et al., 1998; Dehaene, Naccache, 2001; Edelman, 2003; Edelman, Tononi, 2000; Edelman et al., 2011; Tononi, 2004; 2008; 2010; Tononi, Koch, 2014; Seth et al., 2005; Seth, 2009; Palmer, Ramsey, 2012). Although unconscious processing is much faster and more economical (in terms of energy consumption), information integration pays off, as it provides significant flexibility in action: i.e., it enables ongoing adaptation of behavior to changing

external situations and internal preferences (Baars et al., 2013; Pally, 2005; Seth, 2009). It seems, then, that right now flexibility may be considered the most plausible function of consciousness. The usefulness of conscious processing would then be directly proportional to the flexibility required in a given activity: i.e., it would increase when the demand for flexibility grows, and decrease when flexibility is not needed (as, for example, in repetitive actions). Ultimately, the varying usefulness of conscious processing seems to be a good candidate for a graded element in the functional dimension. At the present stage of my research, functional gradability, as determined by the degree of usefulness of conscious processing, can thus be entertained as a reasonable preliminary hypothesis. However, it should be pointed out that any potential measures of usefulness would have to take into account subjective factors (individual preferences, biases, aims, motivations, etc.) relating to previous experiences, as well as objective ones dictated by the actual state of the organism itself (available energy, possible behavioral responses, available sensory inputs and sensitivity, etc.) and by environmental conditions (available time, space, relations, interactions etc.).[11]

5. Consequences

Characterizing Consciousness. On the conception presented above, a key role is played by the differentiation of four dimensions of consciousness: i.e., phenomenological, semantic, physiological and functional. What we have found is that apart from its explicatory usefulness (enabling us to taxonomize the concept of consciousness), this set of distinctions also serves to bring to light important explanatory and methodological values (enabling to identify four important research problems). From this four-dimensional perspective, consciousness has been broadly characterized here as a state co-occurring with or caused by specific neurophysiological processes, in which a given organism experiences certain (referential) contents related to its actions. Moreover, global and local limitations imposed on such a conception have finally allowed us to characterize consciousness as individuated information in action.

As a consequence of the above, we must consider all biological and (even) artificial systems capable of utilizing individuated informational states in action to be (at least to some extent) conscious. Characterized thus, the real range of consciousness depends, however, on the way the terms involved are interpreted. It is obvious, then, that in order to achieve practical usefulness for such a concept, it will be necessary to introduce more precise guidance regarding the notions of

[11] Such assumptions seem to fit well with so-called Bayesian Brain models, in which cognitive systems are seen as a kind of inference-generating or predictive machine. In that context, conscious states could be described as those whose predicted usefulness ranks highest from the system's own perspective. The evaluation of usefulness could then be modeled using Bayesian statistics. Even so, how our nervous systems actually do this remains debatable, the principal issue being whether brains really quantify probability, or instead somehow test the expected efficacy of actions (Sanborn, Chater, 2016; Seth, Friston, 2016).

information, individuation and action. Otherwise, it will prove difficult to give a reasonable answer to the fairly obvious counterargument that, after all, not every instance of individuated information in action need be conscious. The issue requires separate, much more extensive research. However, it seems that we already now have reasons for thinking that the notion of information used in consciousness studies must be naturalized, as only this will allow us to properly register its biological uniqueness and/or individuatedness. In the light of these findings, we can now point to a direct connection with the function performed by conscious informational states in relation to a given organism's actions (namely, enabling flexibility), where this also seems to constitute a valuable achievement.

Consciousness and Subjectivity. In consciousness studies, the notion of subjectivity is typically understood in terms of privileged access, in the sense that qualitative characteristics of conscious experiences are taken to be accessible only from the first-person perspective of a given organism or system. The conception proposed here sheds light on the relationship between such subjectivity and consciousness. At first, it assumes that all states of consciousness are informational states, but not vice versa (i.e., not all informational states are conscious). It argues, then, that both the sources of information and the very informational states available to a given system undergo a complex process of individuation (with this process being justified functionally, as an adaptive response to the overflow of possible informational states). As a consequence, all informational states of a given system are individuated—which, de facto, means that they are accessible only from the perspective of this particular system: hence, they must be considered subjective (in the sense described above). Ultimately, this leads to a rather controversial conclusion about the existence of subjective but unconscious informational states. If the proposed line of argument is valid, and subjective states are not coextensive with conscious ones, then a characterization of states of consciousness in terms of their subjectivity or qualitative character (such as is quite common in contemporary conceptions) turns out to be inadequate. My proposal, on the other hand, also enables one to point to functional differences between consciousness and subjectivity. It has been argued that while the function of consciousness is manifested in action, in that it confers flexibility on the latter, the basic function of subjectivity should be considered to be the selection of information valuable from the perspective of a given organism. The process of individuation may, in addition, be considered an evolutionary mechanism leading to the emergence of subjective perspectives; yet that does not explain the emergence of consciousness. Ultimately, one can argue that the scientific—i.e., functional and mechanistic—explanations of subjectivity and consciousness simply differ. Despite the fact that all conscious states are indeed subjective, a straightforward identification of the so-called hard problem of consciousness with its subjective character or its phenomenological dimension now seems to fall short of being conclusively justified, to say the least.

The Gradedness of Consciousness. Gradational approaches enable more adequate descriptions of various forms of consciousness, including non-human consciousness, consciousness in the wake of injury to the brain, various neurological disorders, consciousness as exhibited at different developmental stages, and so on. On the other hand, consciousness is a very complex, multidimensional phenomenon—one that, as Bayne and his colleagues have rightly pointed out (2016), poses serious theoretical and practical problems. Those problems have been defined here in terms of two key questions: What is, or can be, graded with respect to consciousness, and can we measure it? In order to answer the first of these, the four-dimensional conception of consciousness was adopted, and then in each of the dimensions a graded element was identified—this being, respectively, quality of information in the phenomenological dimension, abstractness in the semantic dimension, complexity in the physiological dimension and usefulness in the functional one. As a consequence, consciously processed information has the potential to differ in at least four respects: with respect to its grade of quality, order of abstraction, level of complexity, and degree of usefulness. So far, two of these parameters have been measured in practice, these being the experienced grades of quality of conscious states (e.g., by means of report-based procedures, such as subjective measures of awareness) and the complexity levels of their neuronal underpinnings (e.g., by analyzing activity patterns with respect to their integration and differentiation in terms that enable us to calculate their Φ, "cd" or PCI values). There are, however, no practicable ways to measure orders of abstraction reached by conscious states, or degrees of usefulness achieved in the context of a given organism's actions. Yet certain preliminary proposals and limitations regarding these issues have, I think it is fair to say, already been successfully marked out.

It is worth noting that four-dimensionally graded consciousness will not give rise to a linear scale, since a given organism or system may be ranked differently in each of the posited dimensions (e.g., simple visual images may be experienced with high-quality, while at the same time being not especially abstract semantically and exhibiting rather low levels of physiological complexity). Despite being seemingly complicated, such an approach is advantageous on many grounds: in explaining, predicting and putting forward hypotheses. For example, it is possible to more adequately describe consciousness in such states as *blindsight* or *locked-in syndrome*. As far as the first of these is concerned, it may be said that a blindsighted person would most likely have a very low or zero quality grade of visually experienced images. (Such persons usually claim that they do not experience any clear images; see Sahraie et al., 2010). In spite of lesions (usually located in the primary visual cortex or V1), visual information in the brains of such people is still processed in a way sufficient for them to guess what they see (with an above-random level of accuracy) and navigate efficiently in previously unknown spaces, avoiding obstacles. Hence, the degree of usefulness of such impoverished visual information is definitely not zero. It may also be plausibly argued that in blindsight the physiological complexity of the activity patterns

involved can be pretty high, while visual information nevertheless only reaches the first-order level of abstraction (in that it only ever refers directly to perceived objects and lacks higher-order information about what is perceived or the very perception itself). On the other hand, when locked-in syndrome is considered the situation clearly looks different. A person who is in that condition may experience states with high quality (e.g., feeling a very sharp and localized pain, seeing and hearing clearly, etc.), and present neuronal activity patterns whose complexity does not deviate from the norm. Such a person could not only be conscious of different perceptual objects, but may also be aware of being conscious of them: consciousness as exhibited by locked-in patients does not seem any less abstract than in a normal state. However, patients that remain in this state are not able to practically perform any motor actions—except for vertical eye movements and, sometimes, blinking (Laureys et al., 2005; Schnakers et al., 2008; Smith, Delargy, 2005). Hence, the degree of usefulness of most of the information consciously available will be rather low for such a person, at least in sensorimotor-related terms. The examples described here can also be presented graphically (see Figure 1 for blindsight, and Figure 2 for locked-in syndrome).

A final closing question that I would like to raise here is this: If any of the four parameters is rated zero (e.g., quality in blindsight), should a state still qualify as conscious? Intuition would, I think, undoubtedly suggest a negative answer, the assumption being that a state is only conscious if it receives a non-zero result in each of the four dimensions. Yet properly justifying such a conclusion is hardly a straightforward matter, and constitutes yet another objective worth further study.

Figure 1

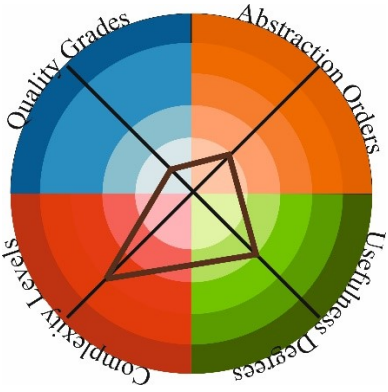

Figure 2

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