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Representations, direct perception and scientific realism. In defence of conservative predictive processing

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Summary

Many researchers accuse the Predictive Processing (PP) framework of returning to nineteenth-century speculations regarding the knowledge of reality, the difference between phenomena and things in themselves, or questions about idealism. Dan Zahavi's (2018) harsh criticism follows in this tradition. He argues that the supporters of PP are not able to justify realism or the common sense belief that the world of objects given in experience exists objectively, i.e. regardless of our cognitive capacities. In his opinion, adopting PP assumptions, we must abandon "our naïve realism", i.e. our conviction about the objective existence of everyday objects of experience, (Zahavi 2018, 48). In these considerations I will argue against the criticism made by this author. I will show that it can be reduced to three main objections: (1) representationalism objection; (2) indirect perception objection and (3) anti-realism objection. In response to these three objections, I will argue that Zahavi's criticism is based on a very selective and simplified reading of PP. Next, I will defend the thesis according to which perception in PP can be understood as indirect only in the psychological sense, not in metaphysical and epistemic. In response to the last charge, I will show that the representationalism postulated by conservative PP allows to justify the thesis that PP is the position of scientific realism. To this end, I will refer to the analysis of the concept of structural representations (S-representations), and then I will argue for the ontic nature of explanations using S-representations, based on the mechanistic model of scientific explanations.

1. Predictive processing

Many papers on cognitive and computational neuroscience analyse the human brain as a probabilistic prediction machine which minimizes prediction errors understood as signals that encode the discrepancies between actual and expected sensory stimulations (see Clark 2013, 2016; Howhy 2013; Friston, 2010; Wiese, Metzinger 2017). Minimization of prediction errors is a fundamental function of the brain (multilevel and hierarchically organized generative model[1]) because all perception serves the aim of ensuring that the organism functions efficiently in the environment. The generative model generates predictions which impose a top-down structure on the bottom-up flow of information from the sensory input. Information in the model is processed in two directions: top-down (predictions about information reaching the model) and bottom-up (information about potential prediction errors). This means that each level of the model (which processes information) predicts (generates predictions) about what is happening at the level below, while at the same time receiving information about the magnitude of the predictive error. The model is effective when predictions generated at a higher level lead to minimization of prediction errors occurring at lower levels. Effective prediction error minimization presupposes a degree of precision. Precision weighing allows to determine to what extent a given error is precise, i.e. whether the information it carries is reliable for the system or not. The more precision the system attributes to a given predictive error, the smaller the error (Friston 2010). For example, if I expect a given predictive error to be particularly reliable or highly likely, then I reduce its weight, i.e. the degree to which it can affect model parameters. Precision is therefore a measure of uncertainty

According to the PP framework, the brain processes information based on some form of statistical inference. This ability is best explained by the Bayesian model (see Hohwy, 2013; Harkness, Keshava 2017). It means that the central nervous system constructs and tests internal models of external reality by implementing cognitive processes which are approximations of Bayesian inference, a computational method of rationally combining existing information (at least some of which is uncertain) with new, unspecified data. In this approach, "uncertainty" means that a given piece of information may be described by means of probability distribution. The best possible prediction is made here by applying Bayes' Rule, which describes the

[1] Generally, generative models are statistical models which capture relationships between values of a set of random variables. These dependencies are represented by model parameters, and the variables can be observed (i.e. some of their values can be provided directly by the data) or hidden. In PP, the generative model is understood as such a statistical model whose variables are hidden, i.e. it is impossible to unambiguously assign the relevant data to the causal processes producing them.

probability of a given hypothesis (prediction) based on the brain's prior knowledge of conditions that might be related to the incoming sensory signal. The Bayesian approach offers a rational solution to the problem of how the brain updates the generative model on incoming sensory signals and the hidden causes of these signals (Wiese, Metzinger 2017, 6).

It must be said that there are two ways for agents to match their predictions to the world. In other words, a prediction error is minimized when there is a change in predictions about the sources of statistical information from sensory inputs. This can be achieved by either (1) changing the properties of the model (change of adopted predictions), i.e. the so-called perceptual inference; or (2) by changing the environment (active inference), i.e. an action which interferes with the causal structure of the world (Friston 2010, 129). Perception minimizes prediction errors by changing predictions, whereas action achieves this through changing the information reaching the model.

2. Dan Zahavi's critique of predictive processing

Many authors accuse the supporters of the PP framework of returning to the 19th-century speculations concerning the knowing of reality, the difference between phenomena and things in themselves, or questions about idealism. In this context, Dan Zahavi (2018) accuses the PP approach discussed here of neurorepresentationism according to which the entire content of experience is a construction or simulation created by the brain. This is a strong objection that leads to a general statement that the PP approach inspired by Kant and neo-Kantism is in fact neurocentric and far from thinking about cognition in the categories of 4Es (embodied, embedded, extended, enactive). Additionally, Zahavi accuses PP's supporters of being unable to justify realism, i.e. of believing that the world of the objects of experience exists objectively, i.e. independently of our cognitive capacities. He claims that such a state of things is to be blamed, firstly, for equating spontaneous human cognition with the model of cognition developed by science (cf. also Bruineberg, Kiverstein, Rietveld 2016), and, secondly, for adopting representationalism which, according to Zahavi, leads to questioning the objectivity of the world of experience. Dan Zahavi is not isolated in his criticism of the idea of PP. Some researchers criticize PP for its radical neurorepresentationism, constructivism, Kantism or even idealism (See Anderson 2017; Anderson, Chemero 2013; Orlandi 2017). It is not difficult to surprise such critics, because some PP supporters claim that perception is understood here as a "controlled hallucination" or the experience of "virtual reality" (Hohwy 2013, 137-138). This is related to the general belief in PP that, because of the unexpected character of the causes of

sensory input, the brain has to "make guesses" (Clark 2016, 2) or perceptual hypotheses about them. Many researchers also emphasize the Kantian character of PP (Clark 2013; Hohwy 2013; Gładziejewski 2016, 2017a; Swanson 2016). This is claimed to be the case, among other things, because of the top-down way of understanding cognition, the active and receptive character of the cognitive system, or the emphasis on the importance of internal representations in the process of cognizing the world.

The critique of Zahavi and other authors requires an answer, because it seems that accepting their arguments can lead to the conclusion that we are not only dealing with the concept of reopening old epistemological disputes, but that we are also doomed to a number of metaphysical aporia dating back to the 19th century. Before providing an answer, however, I want to look more closely at Zahavi's objections. They can be summed up in three main points:

1. Objection from representationalism: PP position leads to radical neuro-representationalism, anti-realism and internalism showing important similarities between the PP account and the ideas found in and developed by German neo-Kantians in the mid-19th-century. Zahavi claims that according to PP „the content of our conscious experiences is a neural construct, a brain-generated simulation" which means that „our access to the external world is mediated by neural representations, but rather that the world of experience is itself a representational construct" (Zahavi 2018, 47, 48).
2. Objection from indirect perception: PP does not justify direct perceptual contact with the external state of affairs. According to this objection „the immediate objects of perception are in fact mental constructs. The visually appearing rose, the touched ice-cube, the heard melody, etc., are all brain generated representations, are all internal to and contained in the brain". Zahavi goes on to ask: "Why are we in the first place considering the possibility that our objects of perception are internally generated constructs rather than real spatiotemporal objects? Because this is what our neuroscientific investigation of the brain suggests" (Zahavi 2018, 49, 54).
3. Objection from anti-realism: PP does not accommodate „our natural inclination to realism" because it does not defeat the position of scientific realism. Zahavi wonders "how can we ever know that our scientific theories, which are offered as explanations of the world of experience, really capture external reality? Why are they not merely elaborate cognitive extrapolations that remain as brain-generated and as internal to our constitution as everything else?". "How are scientists able to

> transcend their internal world simulation? How do they manage to pull off this epistemic achievement?". "How the position in question (=PP) can so confidently embrace scientific realism?" (Zahavi 2018, 53).

All these objections come down to the key question of how the PP framework can defend "our natural inclination for realism" (Zahavi 2018, 47), which Zahavi associates with naïve realism, i.e. with "our confidence in the objective existence of ordinary objects of experience "(Zahavi 2018, 54)?

In these considerations, I formulate three responses to the objections presented by this author. At the beginning I will answer the objection from representationalism. I will show that the criticism of PP as a form of idealism, constructivism or neurorepresentationalism is based on a very selective reading of its various interpretations. Namely: the critique covers only those researchers who can be included in the conservative PP camp. Representationalism and internalism are important in this approach. In his critique, however, Zahavi does not refer to the authors representing the radical PP approach, which is not very much committed to representations, while emphasizing a closer relationship between the generative model and the environment. However, Zahavi's approach can be defended by saying, for example, that some anti-realist and constructivist assumptions are inscribed in the very idea of PP, based as it is on the inferential and constructivist treatment of perception. I will answer whether the criticism formulated in this way is justified.

In response to the objection from indirect perception, I will show that one can speak of the directness of perception in three irreducible senses, i.e. psychological, metaphysical and epistemological (Drayson 2017). Making this distinction is crucial because it is not entirely clear what Zahavi understands by the concepts of directness and realism. The attitude he defends as "our natural tendency to realism" does not allow us to justify the claim that PP is fundamentally constructivist and anti-realistic. I will show that it is only in the psychological sense that we can say that perception in PP is indirect. However, psychological indirectness does not automatically exclude metaphysical or epistemological directness. Zahavi's criticism in this approach cannot be treated as argumentative, because it is not really clear what position and what interpretation of this position the author argues against.

In response to the objection from anti-realism, I will show that the representationalism postulated by conservative PP allows to justify the thesis that this framework is the position of scientific realism. To this end, I will refer to the analysis of the concept of structural

representations (S-representations), and then argue for the ontic nature of explanations using S-representations based on the mechanistic model of scientific explanations.

3. In response to the objection from representationalism: Conservative vs radical predictive processing

Even a sketchy reading of some PP studies leads to the conclusion that there is no single and comprehensive interpretation of this framework. On the contrary, there are a number of different, often mutually exclusive and critical views. Analysing this research approach, one can notice a number of discrepancies when it comes to the understanding of basic concepts, terminology, the explanatory or methodological status of every statement, as well as the role it can play in the cognitive science and philosophy. There are two basic approaches: conservative and radical (cf. Clark 2015a, 2015b; Gładziejewski 2017b; Orlandi, Lee 2018). Distinguishing these approaches is important because it will show the groundlessness of many PP critiques, including Dan Zahavi's criticism discussed here.

3. 1. Conservative predictive processing

The conservative approach to PP (see Gładziejewski 2016, 2017b; Hohwy 2013; 2018; Kiefer, Hohwy 2018; Wiese 2016) emphasizes that the mind is relatively isolated from the environment, which means that its cognitive contact with the outside world has its source in the neuronal activity of the brain and only in it. The internal model of the world is coded at the neuronal level (Clark 2015a, 14). The generative model produces predictions that function as representations of what is happening in the external environment. This means that the relationship between the mind and the world is mediated by internal representations. The approach can be described as "reconstructive" (Anderson 2014), because in this framework the world model is reconstructed on the basis of internal representations of the world which are isomorphic with its causal structure (Gładziejewski 2016, Kiefer, Howhy 2018). Some describe these representations as structural because they operate on the basis of the structural similarity between the representation itself and what it represents (cf. Gładziejewski 2016; Gładziejewski, Miłkowski 2017; Kiefer, Hohwy 2018; O'Brien, Opie 2004; Shea 2014). In this context, one can recall the words of Hohwy who claims that "the causal net of the environment and the causal net represented in the internal model will mirror each other " (Hohwy 2018, 4), because the cognitive system is "an internal mirror of nature" (Hohwy 2013, 220).

Paweł Gładziejewski (2017b) points to three basic commitments characteristic of conservative PP. These are: 1. the commitment to representationism; 2. the commitment to use the concept of inference as subserving perception and action; and 3. the commitment to internalism as the position that cognitive mechanisms are based solely on the work of the central nervous system. This means that the content of mental representations is determined only by the internal states of the organism (see Lau 2002).

The first commitment is particularly important for the analyses presented in this article. Gładziejewski claims that this commitment can be interpreted in two ways. The so-called weak (pragmatic) interpretation assumes that the content of mental states is attributed to the internal model of the world for purely pragmatic reasons. In this approach, internal representations do not have real content, but they are only postulated by some researchers who want to explain the cognitive functions of the mind (cf. Egan 2014; Downey 2017). Strong (realistic) conservative PP postulates that mental states contain real and causally efficacious representative content. For this reason, it should be stated that the generative model has real content and represents the world in a non-trivial way. This means that (1) it generates environment-oriented predictions that guide actions; (2) the function of guiding action depends on the resemblance between functional relationships among encoded variables and the causal structure of the environment; and (3) the degree of structural similarity between the environment and the model is causally dependent on the degree of effectiveness of the model in action.

Assuming a strong interpretation, it should be stated that the commitment to the inferential nature of the relationship between perception and actions, and the commitment to inferentialism, are closely related and result from the commitment to representationism (Gładziejewski 2017b, 106, 111; Kiefer 2017). In this approach, internalism means a position that, in contrast to extended and embodied approaches to cognition, emphasizes that the limit within which one should think and study cognition is the limit of the nervous system. Thus, a strong interpretation of the conservative PP assumes premises for methodological individualism, i.e. a position that assumes that the explanation of cognitive processes and phenomena is carried out by analysing and explaining the cognitive mechanisms implemented in the brain. As a consequence, the environment and interactions with it are largely ignored, because they are not individual properties (cf. Fiske, Taylor 2013; Goldman 1977). The role of the environment and social factors is secondary.

However, Gładziejewski emphasizes that a consistent reading of the conservative approach (even with a strong interpretation of the commitment to representations) allows it to be included in the 4E approaches to cognition. He formulates a number of arguments for this

claim. First, representations are not static images of reality, but internal, guiding actions or structural representations that allow the recognition of representational errors. They are modal in nature and their content is constrained by the way the body is embodied and embedded in the environment. Secondly, the key concept of inference for PP is liberal, which means that the representations have truthfulness conditions and the way they are updated is active rather than reactive. Thirdly, the conceptual resources related to PP allow for an interesting connection of this approach with other existing 4E approaches. Jakob Hohwy (2018) adds that this framework is able to better explain how embodied subjects interact dynamically with the environment, and that the boundary between the mind and the world on the one hand is self-evidencing (Hohwy 2016), which means that the causes of sensory stimuli are indirectly known by inference about the information coming from the sensory inputs, while on the other it is causal. There is a dynamic feedback between the mind and the world, made possible by perception and actions in the world.

3. 2. Radical predictive processing

The conceptions that can be included in the radical PP are much more diverse than the proposals under the conservative approach. It can be said that what is common to them is criticism or rejection of one or more commitments characterizing conservative PP. Radical PP is exemplified by the works (among others) of Andy Clark (2015a; 2016 etc.), Nico Orlandi (2016; 2017; Orlandi, Lee 2018), Jelle Bruineberg, Julian Kiverstein and Erik Rietveld (2017; Bruineberg, Kiverstein, Rietveld 2016; Bruineberg, Rietveld 2014) and Michael Kirkchhoff (2018; Kirchhoff , Robertson 2018). These authors emphasize that, firstly, action and perception stand in close relation to each other. Secondly, and more importantly in this context, they also claim that some levels of the hierarchical generative model are directly representational, whilst others are only indirectly so,[2] being related to the world in an enactive way, which means that representations "aim (is) to engage the world, rather than to depict it in some action-neutral fashion" (Clark 2015b, 4).

Radical PP is inspired, on the one hand, by ecological psychologists developing ideas proposed by James J. Gibson (1966; 1979) , and on the other hand by enactivists referring to the works of Francisco Varela and Humberto Maturana (Varela, Maturana, Uribe 1974; Varela, Thomson, Rosch 1992). Ecological approaches are characterized aptly by Pfeifer and Bongard

[2] Some researchers belonging to radical PP reject the existence of representation at all.

by means of the so-called "Principle of Ecological Balance". It states that, “first… that given a certain task environment there has to be a match between the complexities of the agent’s sensory, motor, and neural systems… second... that there is a certain balance or task-distribution between morphology, materials, control, and environment"(2007, 123).

We can now return to the responses to Zahavi’s representational objection. Criticism of PP framework as a form of idealism, constructivism or neurorepresentationalism seems to be based on a very selective reading of various interpretations of PP. Only those researchers who can be included in the conservative PP are criticized. Representationalism and internalism are key to this approach. In his criticism, however, Zahavi does not refer to the authors included in the radical PP, which does not show strong commitments towards representation, while underlining the closer relationship between the generative model and the environment. However, Zahavi's approach can be defended by saying, for example, that some anti-realistic and constructivist assumptions are inscribed in the very idea of PP, which is based on inferential and probabilistic treatment of perception. Is this really the case? To answer this question, I will refer to the example of the ecological approach of PP proposed by Nico Orladni (2016; 2017).

Contrary to representational interpretations of PP, Orlandi proposes an approach that completely breaks with Helmholtz's constructivism. The author defends the belief that PP is not inferential and constructivist, but ecological. She justifies her position based on the *Natural Scene Statistics* model. This model assumes that (1) perceptive systems are used to interpret images; and that (2) they evolved in response to the physical properties of the environment (Geisler, Diehl 2003; Geisler 2008). In addition, this model discovers certain statistical properties in the environment, thanks to which we can perceive regular properties of images rather than, as constructivism maintains, rely on our prior knowledge about them. It is not that we perceive the world as so structured because of the way we process information. Rather, it is the world we live in that has already a certain regularity that has meaning for us as embodied and embedded in the environment of biological systems (Orlandi 2016, 13). Orlandi shows that the Bayesian generative model is in fact relativized to the *Natural Scene Statistics*, or more figuratively: to the environment. Why? Because, with the exception of some initial perceptive hypotheses, it postulates the existence of structures that are not representations but certain constants present in the environment. Thus, Bayesian perceptual inferences are in fact not inferences, but processes that are armed with detection mechanisms. Detectors are usually understood as those states that monitor proximal conditions, i.e. which stimulus or object is closer to the reference point (perception), as well as those that causally affect each other. They do not model any objects or relationships between them and operate on a very limited scale.

The behaviour of the system that uses detectors is based on information from the monitored environment. What a system can do is explained by referring to a specific environmental situation on which the detectors are set.[3]

Nico Orladni's proposal (cf. also Orladni 2017) suggests that one can explain the generative model without referring to (1) inferentialism and (2) internal representations. If this is the case, and her use of the *Natural Scene Statistics* proves this, it turns out that it is possible to interpret PP as a framework which breaks with both constructivism and representationalism and which can be described as ecological, provided that the term is associated with psychological and epistemological directness of perception and acceptance of the anti-representativist thesis. Orlandi's analyses show that neither constructivism, inferentialism, nor representationalism are implicitly contained in PP's assumptions. The way in which PP is interpreted therefore depends on a number of theoretical and meta-theoretical assumptions. From this perspective, it must be said that the criticism made by Zahavi and others cannot be sustained and that it concerns only a limited portion of PP research.

The analyses carried out here also lead to several more general conclusions:

1. How PP is applied is closely related to a number of theoretical and methodological assumptions and solutions;
2. The basic assumptions of PP do not specify which of the approaches (conservative or radical) and interpretations (representationalist, enactive, anti-representationalist, ecological, etc.) are appropriate and satisfactory;
3. PP does not lead directly to constructivist, neurorepresentationalist or fictionalist theses.

4. In response to objection from indirect perception: Three meanings of directness of perception in predictive processing

According to Zahavi, direct objects of perception are in fact mental constructs. "The visually appearing rose, the touched ice-cube, the heard melody, etc., are all brain generated representations, are all internal to and contained in the brain" (Zahavi 2018, 49). This means that we never have direct access to objects in the world. Zahavi refers here to the words of Hohwy, who claims that there is an "evidentiary boundary" separating the brain from everything outside the skull (Hohwy 2016). This approach, Zahavi believes, leads to a dualistic position.

[3] Examples of detectors are some of the cells of the human immune system.

There is no direct access to reality because perception is a form of testing hypotheses (see Gregory 1980) and ultimately it consists in inferring about the causes of sensation based on the content of the sensory signal. Zahavi says that, due to this understanding of perception, PP is becoming a modern form of neo-Kantianism with its epistemological and metaphysical consequences (Zahavi 2018, 49-53).

Zahavi's criticism is somewhat understandable. Analysing the statements of Hohwy and Clark, one can understand why this author explicitly declares that PP assumes only indirect access to reality outside the cognitive system and for this reason "we should reject all claims concerning the existence of a seamless tight coupling between mind and world" (Zahavi, 2018, 49). Let's take a closer look.

Hohwy states that " perception is indirect […] what we perceive is the brain's best hypothesis" (2007, 322). It is indirect in the sense that the external states of affairs "remain hidden behind the veil of sensory input and can only be inferred'' (Hohwy 2013," (Hohwy 2013, 50). "It is thus not satisfactory to claim that the perceptual relation is direct, nor to claim it is indirect. The right response to this situation is not to force a choice between them but to try to reconceive the perceptual relation to the world such that we do not have to choose between perception being 'direct' or 'indirect' in the first place" (Hohwy 2013, 228). The point is that "from inside the skull the brain has to infer the hidden causes of its sensory input, which crucially depends on interaction with the 'creatures' body." (Hohwy 2013, 220) etc. It is not difficult to notice that Hohwy emphasizes the indirect nature of perception. On the other hand, he is not fully convinced that such a description satisfactorily reflects the relationship between the brain and the environment, because the latter can be treated as an organ explaining the embodied mind (cf. Hohwy 2015; 2018).

Let's move on to Clark. In his opinion, the problem of directness or indirectness of perception is a "delicate issue" that will not be resolved (Clark 2013b, 493). Elsewhere he claims that "it is difficult for sensory systems to deduce the causes of sensory stimulation from their bodily effects" (Clark 2016, 19). "The brain must discover information about the probable causes of sensory signals without any form of direct access to their sources (Clark 2016, 16). "All that it "knows", in any direct sense, are the ways its own states (e.g., spike trains) flow and alter. In that (restricted) sense, all the system has direct access to is its own states." (Clark 2013a, 183). "What we perceive is the world, as (hopefully) revealed by the best hypothesis. Nor is there any sense in which the objects of perception are here being treated as anything like Moorian 'sense data' 60, where these are conceived as proxies intervening between the perceiver and the world. "(Clark 2013b, 492). Finally, he adds that he associates PP with a

„metaphysical perspective [that] may most safely be dubbed ‘not-indirect perception’ ”(Clark 2013b, 493). Clark, like Hohwy, is ambivalent about the problem of indirect / direct perception. Interestingly, he rejects the classically understood phenomenalism, assuming the existence of some representations or impression data between the subject and the world, saying that only access to his own internal states is direct.

In an important article *Direct perception and the predictive mind* (2017) Zoe Drayson convincingly shows that PP supporters use the concepts of directness and indirectness in three irreducible senses: psychological, metaphysical and epistemological. More importantly, in her opinion, individual authors dealing with PP often do not distinguish the sense of the concept of directness/indirectness, which they use, which further hinders the proper reading of their intentions. In practice, this means that, for example, perception can be indirect in the psychological sense, and direct in the metaphysical and epistemological sense. Let's take a closer look at those three senses.

Speaking about the psychological sense of the concept of directness/indirectness, one means that perception either is or is not inferential. The sources of this distinction should be sought in the works of James J. Gibson (1967; 1979), who showed that the question about the psychological directness of perception concerns primarily the way in which stimuli (information coming from sensory inputs) are processed. In this way, Gibson contrasted views that understand perceptions in a constructivist fashion, i.e. those that are based on the so-called perceptual inferences (cf. Gregory 1980) with internal representations or the ecological approach, which implies the "direct or immediate awareness of objects and events when the perceptual system resonates so as to pick up information” (1967, 168). The constructivist approach presupposes the psychological indirectness of perception, and the ecological one - its psychological directness.

The metaphysical concept of directness / indirectness refers to the way in which one should think about the objects of perception and the relationship between these objects and the subject perceiving them. This method should do justice to our veridical experiences, i.e. those for which we can declare truthfulness or falsity, while taking into account our non-veridical experiences (e.g. dreams) (Cf. Burge 2011; Drayson 2017, 9). This problem is addressed by such metaphysical theories of perception as naïve realism, phenomenalism or the theory of sensory data. For example, the naïve realist, says Zahavi , maintains that the world itself is the object of his own perception. The perception of physical objects and their properties is real experience. In the case of veridical experiences, their content is determined by these objects together with their properties. Non-veridical experiences, on the other hand, are not what one

experiences, so their content cannot be constituted by the objects (dreams are an example of the content of such experiences). This leads to the conclusion that assumes the so-called metaphysical disjunctivism according to which there is both veridical and non-veridical perception, even if it is not possible to show the difference between these types of experiences (cf. Burge 2005; McDowell 2013). To keep his beliefs about the metaphysical directness of perception, the proponent of this approach must accept the non-intuitive claim about the metaphysical individuation of his perceptual states (Drayson 2017, 10). A proponent of sensory data theory will maintain that perception is essentially based on the perception of internal mental entities or "sensory data." Thus, veridical and non-veridical cases of perceptual experience can be classified as the same type of experience because their reference object is the same. Perception is therefore veridical when there is a correspondence between a sensory data and the outside world, and is non-veridical when there is no such correspondence.

Directness / indirectness in an epistemological sense refers to the nature of our perceptual beliefs about the world and the way we justify them. If beliefs are justified in a non-inferential way, they are direct. If they are justified in an inferential way, they are indirect perceptive beliefs. A given belief is justified non-inferentially when it is justified by such states which are not themselves justified. In other words, a belief is directly justified if it is not based on other beliefs, but, for example, specific perceptual experience. In this approach, the naïve realist assumes direct justifications for perceptual beliefs, while the sensory data theorist believes they are justified indirectly. According to Drayson, problems with the epistemological concept of the direct / indirect perception in PP are caused by the various functions that researchers assign to inferences. They are used now as steps in reasoning, now as elements justifying given theorems (Drayson 2017, 16). It should be noted that both Hohwy and Clark go straight from the psychological indirectness of perception in PP to the thesis about their epistemological indirectness, which Drayson believes to be an abuse.

According to Drayson, in PP, perception should be understood as indirect in the psychological sense, which means that it is assumed here that all information must be processed in some way before it is used by the cognitive system. However, this does not tip the scales in favor of claiming that perception is indirect in the other two senses, i.e. metaphysical and epistemological. PP allows the interpretation of perception both in terms of metaphysical and epistemological directness or indirectness. This means that the problem is not determined *a priori*, as Zahavi might suggest. The above analyses are therefore of paramount importance for the response to the objections and criticisms formulated by Zahavi and other researchers. Namely, it is not entirely clear what meaning Zahavi gives to the concepts of directness and

realism. The attitude he defends as "our natural inclination to realism" does not allow us to justify the claim that PP is fundamentally constructivist and anti-realistic, because, according to Drayson, only in the psychological sense we can state that perception in PP is indirect. However, psychological indirectness does not exclude a position of either metaphysical or epistemological realism. Zahavi's criticism in this approach cannot be treated as well-founded, because it is not really known what position and what interpretation of this position the author argues against.

Neither does Zahavi seem to distinguish between the indirectness of perception and its systematic nonreliabity. A given belief[4] is justified if and only if it was created by a reliable cognitive process. Therefore, in order to be a reliable cognitive process, perception must lead to justified beliefs, which may be the starting point for making inferences, as well as to the emergence of new justified beliefs, which in turn leads to actions that are effective in a given environment. It is important that the justification of belief depends not only on the process that created it, but also on whether these processes are reliable in the real world. In this sense, a justified belief is one that, to put it simply, comes from cognitive operations that are effective (Goldman, 1986, 182). A supporter of PP may therefore claim that perception is in some sense indirect, while defending the thesis that perception understood in this way must be at least to some degree "faithful" to reality, otherwise it could not effectively minimize prediction errors. By minimizing potential prediction errors, the generative model expects information reaching the brain to be reliable to some extent. If it was not, it would not be possible to update its internal model of the world. The point is therefore to prevent the model from being unduly distorted by unreliable data. This means that the indirect nature of perception does not imply, as Zahavi suggests, a lack of reference to the world. Of course, there are cognitive operations that have a greater degree of justification for the truth of beliefs (e.g. long-term observation) and those that justify the truth of beliefs to a lesser degree (e.g. a cursory observation). However, this does not change the fact that, in PP, perception fulfills not only the function of providing information, but also its initial justification. This is directly related to the Bayesian nature of changing and updating the internal parameters of the generative model based on a probabilistic network of prior beliefs and abductive reasoning (cf. Kiefer 2017).

5. Response to the objection from anti-realism:

[4] Belief in PP is not a term form folk psychology. It does not imply existence of any propositional attitude. Rather it refers to whatever plays the functional role of top-down prediction in the generative model (Sims 2017, 2).

S-representations in predictive processing

Zahavi finds that, in PP framework, "a central claim is that the brain doesn't process all the information it receives, but rather focuses its resources on unexpected input." (Zahavi 2018, 48). Given the rather vague description, it is difficult to say what Zahavi means here. Nevertheless, as he explains further in his argument: "To minimize costly surprises, however, the brain constantly seeks to anticipate what signals its sensory organs will be receiving. To do this as efficiently as possible, the brain constructs internal models of the possible causes of those inputs. These models allow the brain to better predict likely inputs, and these predictions are then continuously compared with the actual incoming sensory inputs. In case of error - i.e., if there is a large discrepancy between the predicted and actual inputs - the model is revised and improved "(Zahavi 2018, 48). It is difficult to disagree with such a reconstruction. Basically, this is how the operation of the brain can be described in the PP framework. However, the conclusions Zahavi draws are problematic. He is aware of the fact that PP offers a scientific explanation of the nature of perception, but he does not distinguish what can be described as an empirical observation report of certain data from their interpretation. He asks: "how can we ever know that our scientific theories, which are offered as explanations of the world of experience, really capture external reality? Why are they not merely elaborate cognitive extrapolations that remain as brain-generated and as internal to our constitution as everything else? " And he continues: "How are scientists able to transcend their internal world simulation? How do they manage to pull off this epistemic achievement?" (Zahavi 2018, 53). According to Zahavi, if PP is accepted as a credible theory of how the brain "reaches" external reality, then it will be necessary to abandon "our naïve realism", i.e. our confidence in the objective existence of ordinary objects of experience, (Zahavi 2018, 54) i.e. "our natural inclination for realism" (Zahavi 2018, 48).

Accepting Zahavi's arguments, we can have reasonable doubts about whether science tells us anything at all about the world of our experience. Rather, scientific explanations "construct" a certain scientific picture of the world that should be opposed, or at least, as far as possible, juxtaposed with the picture of the world of our experience (cf. Sellars 1962/1991). Here we come to the well-known dispute about scientific realism, whose full analysis and consequences for PP go far beyond the framework adopted for this paper. Namely, is the assumption of naïve realism in the context of modern science to some extent justified? I will not answer this question here but will limit myself to such a discussion of the problem of scientific realism that will put Zahavi's view in perspective.

5. 1. Concept of scientific realism

Researchers have different definitions of the concept of scientific realism, but it can generally be assumed the position consists in an epistemically positive attitude toward the outputs of scientific investigation, regarding both observable and unobservable aspects of the world (see Chakravartty 2017). For the purposes of these considerations, I will accept the understanding of scientific realism as such a position, which I understand to mean that both subjects of experience and at least some subjects or theoretical processes really exist. Anti-realism, on the other hand, can be defined as a position that recognizes the reality of objects of everyday experience, but refuses the reality of various theoretical objects. Scientific realism can be defined in terms of epistemic achievements created by theories and scientific models. Here, realism is associated with the current epistemic status of a given theory or model, and can be described, for example, in terms of truth and falsehood. It can also be defined in terms of the epistemic aims of scientific inquiry (van Fraassen 1980, 8; Lyons 2005), i.e. it is interested in what the goals of a given theory or model are. The realist will maintain that their purpose is to create true or at least approximately true descriptions of the world or phenomena, while the anti-realist may claim that the aims of scientific practice are purely pragmatic.[5]

Chakrabartty suggests that scientific realism should be understood in three basic ways, i.e. (1) ontological, (2) semantic and (3) epistemological:

> (1) Ontological scientific realism assumes that the world studied by science exists independently of the mind.
>
> (2) Semantic scientific realism is associated with the literal interpretation of scientific claims about the world. This means that claims about scientific objects, events, processes, properties and relationships should be literally understood as having truth values: true or false. This semantic commitment contrasts primarily with certain "instrumentalist" epistemologies that interpret descriptions of unobservable phenomena simply as tools for predicting observable phenomena or for systematizing observational reports. Instrumentalists maintain that the claims of unobservable things have no literal meaning.

[5] For a critique of this approach to scientific realism, see Devitt 2005.

(3) In epistemological terms, scientific realism assumes that theoretical statements (interpreted literally as describing reality independent of the mind) constitute knowledge of the world. This approach should be contrasted with a position that, for example, accepts scientific realism in a metaphysical and semantic dimension, but rejects or doubts the belief that scientific research is epistemologically strong enough to provide true knowledge about phenomena.

It should be noted that Zahavi doubts the scientific realism of PP: "What is currently being questioned is not whether we are fallible cognizers, or whether science is a worthwhile enterprise, but rather how the position in question can so confidently embrace scientific realism" (Zahavi 2018 , 53). If Zahavi is right, then the following problem arises: why does explaining the brain with the concept of mental representations imply representationalism in relation to the description of world experience by cognitive agents? After all, for anti-realists, theoretical objects do not have to have any real designates (ontological anti-realists), or they only fulfil instrumental functions (semantic anti-realists), or knowledge about them is only probable or doubtful (epistemic anti-realists). In other words: it may be that we explain the brain using representational concepts, while rejecting representations as real elements of cognizing the world or valuable theoretical objects. We can therefore reject what I will describe as an ontic hypothesis regarding representation, which states that natural cognitive systems actually use representations; at the same time, we may adopt the epistemic hypothesis that the best models and/or explanations of natural cognitive systems refer to explicit representations (see Chemero 2000).

By doing so, we will argue that cognitive processes can be explained based on representational concepts, while proclaiming that the cognitive system is not representational itself. Our belief in representational explanations will therefore have either an instrumental or fictional character (cf. Egan 2014; Downey 2017). Zahavi, however, does not explain this issue, and for this reason, I say, he mixes these two hypotheses. In other words, he does not distinguish between what he explains (*explanans*) and what is explained (*explanandum*), which ultimately leads him to skepticism about the "realism" and "directness" of PP. It is not entirely clear whether he means the epistemic or ontic hypothesis when he speaks about the representative nature of PP. Arguments for both can be found in the extensive PP literature (cf. Clark 2015a; Downey 2017; Gładziejewski 2016; 2017b; Kiefer, Hohwy 2018; Williams 2018).

In this section I will show that the representationalism postulated by conservative PP allows to justify the thesis that PP is a position of scientific realism. For this purpose, I refer to

the analysis of the concept of structural representations (S-representations), which, according to some authors, meet PP requirements well (see Gładziejewski 2016; Kiefer, Hohwy 2018). I will show that S-representations are not fictitious objects and that, on their basis, it is possible to formulate non-trivial explanations of relevant phenomena (explanations by means of representation). Next, I will argue for the ontic nature of explanations using the S-representation, based on the mechanistic model of scientific explanations.

5. 2. S-representations in predictive processing

S-representations are mental representations that operate on the basis of a structural similarity between the representation itself and what is represented (see Cummins 1996; Gładziejewski, Miłkowski 2017; O'Brien, Opie 2004; Shagrir 2012; Shea 2014). They guide the actions of their users, are detachable, and also allow their vehicles to recognize a representational error.[6] There are strong arguments in support of the thesis that the representations postulated by conservative PP are structural (cf. Gładziejewski 2016; Kiefer, Hohwy 2018). I will not repeat them here. I will confine myself to discussing their role in explaining cognitive systems. Gładziejewski and Miłkowski (2017) argue that the vehicles of internal S-representations can be treated as components of cognitive mechanisms, as well as goals of various cognitive operations. Their argumentation is based on the statement that structural representations are casually relevant. This means that explanations of cognitive phenomena that refer to the notion of S-representation may be true because of the similarity between representation and its target. Structural correspondence can „literally cause the representation-user to be successful at whatever she (or it) is using the representation for, and lack of structural correspondence can cause the user to fail at whatever she (or it) is using the representation for" (Gładziejewski, Miłkowski 2017, 340). Success or failure is therefore causally dependent on the occurrence of a structural similarity or lack thereof. For this reason S-representations should thus be construed as causal explanations of certain facts regarding similarity as an explanans and success or failure as an explanandum. However, such an approach is not precise. The appropriate interpretative framework is determined by the neomechanistic theory of scientific explanations (see Craver 2007; Bechtel 2008).

In this model of explanation the mechanism whereby the phenomenon is to be explained should be identifiable and describable. This means, on the one hand, that the phenomenon

[6] Gładziejewski and Miłkowski (2017) and Gładziejewski (2016) present the full characteristics of the S-representation.

comprises some functional components to which relevant operations may be allocated and, on the other, that the mechanism which explains the phenomenon may be broken down to mutually integrated parts which are responsible for the phenomenon (Zednik 2008, 1454). In this approach, "mechanism" is defined as a "structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena" (Bechtelm Abrahamsen 2005; Bechtel, 2008, 13). A very important element of mechanistic explanations is the so-called decomposition consisting in identifying objects and processes which constitute a given mechanism. Generally speaking, to explain a given phenomenon is to indicate the mechanism responsible for its implementation. Gładziejewski and Miłkowski show that each mechanism equipped with S-representation as its component part is the basis for a specific cognitive ability. Thus, S-representations construed as components of mechanisms owe their functional characterization to how they contribute to the phenomenon that the larger mechanism is responsible for. This means that the structural similarity between the representation and what it represents is what contributes toward the mechanism's proper functioning.

Representations understood in this way perform specific causal functions in explaining phenomena. They therefore meet the "job description challenge" (cf. Ramsey 2007). It is worth noting that in the philosophical literature it has been proposed to treat spatial maps of the hippocampus in rats as a good example of internal S-representation (cf. Ramsey 2016; Shea 2014). The rat's hippocampus is considered to be an implementation of the internal map of the spatial layout of the environment, encoded in the Cartesian coordinate system. Co-activation patterns of the so-called space cells in the hippocampus are to correspond to the spatial structure of the rat's environment (Shea 2014). This means that the pattern of co-activation relationships between site cells (roughly the tendency of individual cells to show common activity) resembles the structure of metric relationships between locations within the environment. In this approach, the hippocampal map is a component of the cognitive mechanism on which the ability to navigate the environment is based (Craver 2007). This is indirect evidence for the thesis of the ontical nature of the concept of S-representation, which is relevant to the position of scientific realism.[7] Namely: the explanation of the function of the hippocampus in rats by means of the S-representation shows that this concept is not only instrumental or epistemic, but that there is a significant relationship between this concept and the mechanism present in the rat brain. In other words, the concept of S-representation fulfills a non-trivial explanatory function here.

[7] In this context, it is worth adding that E. and M. Moser and J. O'Keefe in 2014 received the Nobel Prize for discovering place cells, which are literal cognitive maps.

The above analyses lead to the following conclusions:

(1) the concept of S-representation used in PP is explanatory and non-trivial (because it is causally relevant);

(2) its explanatory significance proves that the concept of representation cannot be treated only in a functional or fictional way, as some researchers suggest;

(3) this concept plays a non-trivial casual role in explaining the functioning of cognitive systems in PP (see Gładziejewski 2016; Kiefer, Hohwy 2018);

(4) PP may offer mechanistic explanations for relevant cognitive phenomena (cf. Hohwy 2015; Gładziejewski 2019; Gordon et al. 2018; Harkness 2015)

(5) there are strong reasons to consider mechanistic representational explanations as ontic, not just epistemic (cf. Craver 2009; 2013). New mechanicism is a realistic position because it postulates the real existence of the described mechanisms: "Distinguishing good mechanistic explanations from bad requires that one distinguish real components from fictional posits" (Craver 2007, 131);

Therefore:

(6) Conservative PP using the concept of S-representation is a position of scientific realism. The last of Zahavi's objections is therefore rejected.

Conclusion

In this article I have referred to the criticism of PP formulated by Dan Zahavi. I have shown that it can be reduced to three basic objections (representational objection; indirect perception objection; anti-realism objection). I demonstrated that the criticism is unfounded and justified the thesis according to which PP can be considered a position of scientific realism due to the fact that its conservative interpretation uses S-representations. S-representations interpreted in the spirit of the mechanistic theory of scientific explanations allow to formulate non-trivial and causally relevant explanations for specific cognitive mechanisms. For this reason, the criticism of PP as a form of constructivism and neurorepresentationalism is unfounded and based on false premises.

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