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Mechanizmy predykcyjne i ich normatywność

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Streszczenie

Celem niniejszej pracy jest uzasadnienie przekonania, zgodnie z którym istnieją biologiczne mechanizmy normatywne, które spełniają nietrywialne role przyczynowe w formułowanych przez badaczy wyjaśnieniach działań i zachowań określonych systemów. Przykładem takich mechanizmów są opisywane i wyjaśniane przez PP mechanizmy predykcyjne, które (1) przewodzą działaniom oraz (2) kształtują przyczynowe przejścia pomiędzy stanami, które posiadają określoną treść i warunki spełniania (np. stany mentalne). Przyświeca mi zatem określony cel teoretyczny, który wiąże się z koniecznością wskazania tych warunków, które *powinna* spełniać nietrywialna teoria mechanizmów normatywnych oraz określone modele proponowane przez zwolenników PP.

W niniejszej pracy wykorzystuję klasyczne metody filozoficzne, takie jak analiza pojęć czy krytyczny namysł. Analizuję wybrane badania z zakresu kognitywistyki, psychologii poznawczej, neurologii, teorii informacji i biologii w aspekcie wykorzystanej metodologii, argumentacji i języka, dobierając je ze względu na ich teoretyczną ważność dla omawianych w tej pracy zagadnień. W tym sensie prezentowane tutaj badania mają charakter interdyscyplinarny. Odpowiednią ramę badawczą wyznaczy mi mechanistyczny model wyjaśniania w nauce, który określa konieczne i wystarczające warunki wyjaśnienia danego zjawiska. Obrane przeze mnie metody badawcze są zatem zrelatywizowane do problemów, które zamierzam rozwiązać.

Wprowadzający rozdział *Pojęcie przetwarzania predykcyjnego* poświęcony jest omówieniu tego, czym jest PP oraz jakie są jego główne założenia i tezy. Zostają wyeksplikowane kluczowe dla tej ramy badawczej pojęcia oraz dystynkcje. Wielu autorów twierdzi, że PP jest współczesną wersją kantyzmu i narażone jest na podobne zarzuty, jakie można stawiać koncepcji Immanuela Kanta. Przedyskutowuję tę tezę i wykazuję, że tylko w bardzo ogólnym sensie rama PP ma charakter neokantowski. Nie mamy tutaj bowiem do czynienia ani z dedukcją transcendentalną, ani z zastosowaniem argumentów transcendentalnych. Twierdzę, że PP oparte jest na metodzie inżynierii odwrotnej i wnioskowaniach abdukcyjnych. W drugiej części tego rozdziału odpowiadam na zarzut sformułowany przez Dana Zahaviego, który wprost zarzuca tej ramie badawczej konsekwencje antyrealistyczne. Wykazuję, że stanowisko internalizmu, obecne w tzw. konserwatywnym PP, nie implikuje antyrealizmu, a z powodu eksplanacyjnej roli, jaką grają w nim skierowane na realne wzorce S-reprezentacje (reprezentacje strukturalne) zasadne jest twierdzenie, że PP ma charakter realistyczny. Tym sposobem wykazuję, że PP jest nietrywialną ramą badawcza, mająca swój przedmiot, określone metody oraz właściwy sobie status epistemiczny. Na koniec omówiam stanowiska zaliczane do tzw. radykalnego PP.

W rozdziale *Przetwarzanie predykcyjne jako bayesowski model eksplanacyjny* uzasadniam tezę, zgodnie z którą PP oferuje modelowanie typu bayesowskiego. Wielu badaczy twierdzi bowiem, że mózg jest zaimplementowaną statystyczną siecią probabilistyczną, która w *jakimś* sensie realizuje regułę Bayesa. W praktyce oznacza to, że wszelkie procesy poznawcze mają być zastosowaniem reguły Bayesa i dają się opisać w kategoriach rozkładów prawdopodobieństwa. Takie rozwiązanie wzbudza u wielu badaczy sprzeciw i jest przedmiotem szerokiej krytyki. Celem tego rozdziału jest uzasadnienie tezy, że bayesowskie PP jest nietrywialną ramą badawczą. W tym celu argumentuję za tym, że wyjaśnia ono określone zjawiska nie tylko na opisanym przez Davida Marra poziomie obliczeniowym, ale także na poziomach algorytmów i implementacji. W dalszej części rozdziału wykazuję, że PP jest modelowaniem normatywnym. Zwolennicy wykorzystania modeli bayesowskich w psychologii czy teorii decyzji twierdzą, że są one normatywne, ponieważ pozwalają na sformułowanie formalnych reguł działania, które pokazują, co należy robić, aby dane działanie było optymalne. Krytycy tego podejścia podkreślają, że takie myślenie o normatywności modelowania bayesowskiego jest nieuzasadnione oraz że w nauce należy przejść z pozycji preskryptywnych na deskryptywne. W polemice z Shirą Elqayam i Jonathanem Evansem (2011) wykazuję, że proponowany przez nich podział na preskryptywizm i deskryptywizm bayesowski jest pozorny, ponieważ ma się tutaj do czynienia z dwiema formami preskryptywizmu, tj. słabą i mocną. Argumentuję, że wersja słaba ma charakter epistemiczny i może prowadzić do antyrealizmu, zaś mocna jest ontyczna i pozwala uzasadnić realizm w odniesieniu do modeli bayesowskich. Twierdzę, że słaba wersja preskryptywizmu jest zasadna w odniesieniu do PP. Pozwala ona przyjąć antyrealizm w stosunku do PP. W praktyce oznacza to, że można wyjaśniać zjawiska przy użyciu twierdzenia Bayesa. Nie implikuje to jednak tezy, że są one są bayesowskie z natury. Pełne uzasadnienie realizmu w odniesieniu do bayesowskiego PP zakłada jednak przyjęcie mocnego preskryptywizmu. Stanowisko to zakłada, że zjawiska wyjaśnia się za pomocą twierdzenia Bayesa, ponieważ są one bayesowskie jako takie. Jeżeli są one bayesowskie z natury, to znaczy, że *powinno* się je wyjaśniać przy użyciu modelowania Bayesa. Teza ta zostanie uzasadniona w rozdziałach *Funkcje i mechanizmy normatywne w kontekście przetwarzania predykcyjnego* i *Mechanizmy normatywne a działania w przetwarzaniu predykcyjnym*.

W rozdziale *Zasada energii swobodnej w przetwarzaniu predykcyjnym* omówiam sformułowaną przez Karla Fristona zasadę energii swobodnej (FEP). Zgodnie z tą zasadą wszystkie systemy biologiczne (zdefiniowane w terminach koców Markowa) minimalizują energię swobodną swoich stanów wewnętrznych w celu utrzymania homeostazy. Niektórzy badacze uważają, że PP jest specjalnym przypadkiem zastosowania tej zasady odniesionym do poznania, a mechanizmy predykcyjne są homeostatycznymi mechanizmami minimalizującymi energię swobodną. Omówienie FEP jest istotne ze względu na to, że część autorów uważa ją za istotną eksplanacyjnie i normatywną. Jeżeli tak jest, to FEP okazuje się kluczowa dla wyjaśnienia normatywnych mechanizmów predykcyjnych i w ogóle wszelkich normatywnych mechanizmów biologicznych. Aby określić możliwości eksplanacyjne tej zasady, odwołuję się do dyskusji jej zwolenników dotyczącej zagadnienia określanego przez nich jako problem

ciągłości pomiędzy życiem a umysłem (*continuity and discontinuity between life and mind*). Krytyczna analiza tej dyskusji oraz dodatkowe, sformułowane przeze mnie argumenty pozwalają mi na rewizję pretensji eksplanacyjnych FEP. Odrzucam również przekonanie, zgodnie z którym zasada ta jest konieczna dla wyjaśnienia natury mechanizmów predykcyjnych. Argumentuję za tym, że zasada sformułowana i broniona przez Fristona stanowi istotną heurystykę badawczą dla analiz z zakresu PP.

W rozdziale *Funkcje i mechanizmy normatywne w przetwarzaniu predykcyjnym* moje analizy rozpoczynam od sformułowania odpowiedzi na pytanie dotyczące normatywnej natury mechanizmów homeostatycznych. Wykazuję, że mechanizmy predykcyjne nie są homeostatyczne. Bronię poglądu, że pełne wyjaśnienie mechanizmów normatywnych zakłada wyjaśnienie funkcji normatywnych. Przedyskutowuję najważniejsze propozycje rozumienia normatywności funkcji, zarówno w perspektywie systemowej, jak i teleosemantycznej. Stwierdzam, że nietrywialna koncepcja funkcji musi spełniać dwa wymogi, które określam jako eksplanacyjny i normatywny. Wykazuję, że żadna z przywołanych przeze mnie teorii nie spełnia satysfakcjonująco obu tych wymogów. W zamian proponuję model normatywności oparty na koncepcji Bickharda, ale uzupełniony o perspektywę mechanistyczną. Twierdzę, że funkcja jest normatywna wtedy, gdy jednocześnie: (1) pozwala wyjaśnić dysfunkcję danego mechanizmu; (2) przyczynia się do utrzymania stabilności organizmu w ten sposób, że kształtuje i ogranicza możliwe relacje, procesy i zachowania danego systemu; oraz gdy (3) (w odniesieniu do funkcji reprezentowania i predykcyjnej) pozwala wyjaśnić możliwość przypisywania wartości logicznych określonym reprezentacjom/predykcjom. W takim ujęciu mechanizm jest normatywny wtedy, gdy realizuje określone funkcje normatywne i gdy jest konstytutywny dla określonej aktywności, pomimo faktu, że z jakiegoś powodu nie może jej obecnie lub w dłuższej perspektywie realizować.

Takie rozumienie normatywności mechanizmów zakłada przyjęcie hipotezy epistemicznej.Twierdzę, że hipoteza ta nie jest satysfakcjonująca poznawczo, w związku z czym należy uzasadnić hipotezę ontyczną, co bezpośrednio wiąże się z przyjęciem stanowiska preskryptywizmu ontycznego. Z tego też powodu, w odniesieniu do mechanistycznej teorii wyjaśnień naukowych, formułuję ontyczną interpretację pojęcia mechanizmu normatywnego. Zgodnie z tym ujęciem mechanizm albo funkcja są normatywne wtedy, gdy spełniają one takie, a nie inne funkcje przyczynowe w wyjaśnieniach określonych działań i zachowań. W odniesieniu do normatywnych własności mechanizmów i funkcji predykcyjnych oznacza to, że są one przyczynami określonych działań danego organizmu w środowisku. Tym sposobem uzasadniam konieczność przyjęcia hipotezy ontycznej i odrzucenia hipotezy epistemicznej.

Rozdział piąty zatytułowany *Mechanizmy normatywne a działania w przetwarzaniu predykcyjnym* poświęcony jest problemowi ciemnego pokoju i powiązanemu z nim dylematu eksploracji i eksploatacji. Ciemny pokój oznacza stan, w którym mógłby znaleźć się podmiot, gdyby zminimalizował sumę wszystkich potencjalnych błędów predykcyjnych. Wykazuję, że zgodnie z bazowym założeniem PP o konieczności ciągłej i długoterminowej minimalizacji błędów predykcyjnych, taki stan powinien być dla podmiotu pożądany. Czy tak faktycznie jest? Wielu autorów sądzi, że nie. Argumentuję za tym, że sprawdzianem wartości PP jest możliwość

nietrywialnego rozwiązania tego problemu, który można sprowadzić do wyboru pomiędzy aktywną i zwiększającą niepewność eksploracją a bezpieczną i łatwo przewidywalną eksploatacją. Wykazuję, że obecne w literaturze rozwiązanie zaproponowane przez zwolenników PP nie pozwalają na w pełni satysfakcjonujące wyjaśnienie tego dylematu.

Następnie bronię stanowiska, zgodnie z którym pełne wyjaśnienie mechanizmów normatywnych, a w dalszej kolejności rozwiązanie dylematu eksploracji i eksploatacji, zakłada odwołanie się do istnienia ograniczeń obecnych w środowisku. Ograniczenia są m.in. tym elementem otoczenia, który czyni dany mechanizm nie tylko przyczynowym, ale także normatywnym. Są one zatem kluczowe dla wyjaśnienia mechanizmów predykcyjnych. Nie pełnią one bowiem tylko funkcji kontekstu, w którym mechanizm jest realizowany, ale przede wszystkim są jego konstytutywnym komponentem. Twierdzę, że pełne wyjaśnienie roli ograniczeń w normatywnych mechanizmach predykcyjnych zakłada integrację poszczególnych modeli określonych zjawisk poznawczych, ponieważ dopiero mechanistyczna integracja PP z innymi modelami pozwala na nietrywialne oraz mocne eksplanacyjnie wyjaśnienie natury normatywnych mechanizmów predykcyjnych. Monizm eksplanacyjny obecny w wielu ujęciach PP przesądza o niemożliwości rozwiązania problemu ciemnego pokoju.

W dalszej części tego rozdziału argumentuję za tym, że bayesowskie PP jest normatywne nie dlatego, że umożliwia sformułowanie takich, a nie innych reguł postępowania, ale dlatego, że normatywne są same mechanizmy predykcyjne. Są one normatywne, ponieważ warunkują wybór takich, a nie innych działań przez podmioty. Tym sposobem uzasadniam hipotezę, że mechanizmy normatywne pozwalają na wyjaśnienie, kluczowego dla rozwiązania problemu ciemnego pokoju, zjawiska motywacji podmiotów.

W ostatniej części rozdziału formułuję hipotezę normatywności rozproszonej, która zakłada, że o normatywnym charakterze określonych mechanizmów, funkcji czy przedmiotów decydują relacje, w które te mechanizmy, funkcje czy przedmioty wchodzą. Oznacza to, że normatywna (w sensie pierwotnym) jest struktura relacyjna, która konstytuuje normatywność określonych przedmiotów wchodzących w jej skład. Sugeruję, że hipoteza ta otwiera przed badaczami wiele obszarów badań i umożliwia przemyślenie wielu problemów na nowo.

W *Zakończeniu* podsumowuję wyniki moich badań oraz wskazuję dalsze perspektywy badawcze.

Słowa kluczowe: przetwarzanie predykcyjne; normatywność; mechanizmy; funkcje biologiczne; ograniczenia; wyjaśnianie; zasada energii swobodnej; predykcje

Summary

The aim of this study is to justify the belief that there are biological normative mechanisms that fulfill non-trivial causal roles in the explanations (as formulated by researchers) of actions and behaviors present in specific systems. One example of such mechanisms is the predictive mechanisms described and explained by predictive processing (hereinafter PP), which (1) guide actions and (2) shape causal transitions between states that have specific content and fulfillment conditions (e.g. mental states). Therefore, I am guided by a specific theoretical goal associated with the need to indicate those conditions that should be met by the non-trivial theory of normative mechanisms and the specific models proposed by PP supporters.

In this work, I use classical philosophical methods, such as conceptual analysis and critical reflection. I also analyze selected studies in the field of cognitive science, cognitive psychology, neurology, information theory and biology in terms of the methodology, argumentation and language used, in accordance with their theoretical importance for the issues discussed in this study. In this sense, the research presented here is interdisciplinary. My research framework is informed by the mechanistic model of explanation, which defines the necessary and sufficient conditions for explaining a given phenomenon. The research methods I chose are therefore related to the problems that I intend to solve.

In the introductory chapter, "The concept of predictive processing", I discuss the nature of PP as well as its main assumptions and theses. I also highlight the key concepts and distinctions for this research framework. Many authors argue that PP is a contemporary version of Kantianism and is exposed to objections similar to those made against the approach of Immanuel Kant. I discuss this thesis and show that it is only in a very general sense that the PP framework is neo-Kantian. Here we are not dealing with transcendental deduction nor with the application of transcendental arguments. I argue that PP is based on reverse engineering and abduction inferences. In the second part of this chapter, I respond to the objection formulated by Dan Zahavi, who directly accuses this research framework of anti-realistic consequences. I demonstrate that the position of internalism, present in the so-called conservative PP, does not imply anti-realism, and that, due to the explanatory role played in it by structural representations directed at real patterns, it is justified to claim that PP is realistic. In this way, I show that PP is a non-trivial research framework, having its subject, specific methods and its own epistemic status. Finally, I discuss positions classified as the so-called radical PP.

In the chapter "Predictive processing as a Bayesian explanatory model" I justify the thesis according to which PP offers Bayesian modeling. Many researchers claim that the brain is an implemented statistical probabilistic network that is an approximation of the Bayesian

rule. In practice, this means that all cognitive processes are to apply Bayes' rule and can be described in terms of probability distributions. Such a solution arouses objections among many researchers and is the subject of wide criticism. The purpose of this chapter is to justify the thesis that Bayesian PP is a non-trivial research framework. For this purpose, I argue that it explains certain phenomena not only at the computational level described by David Marr, but also at the level of algorithms and implementation. Later in this chapter I demonstrate that PP is normative modeling. Proponents of the use of Bayesian models in psychology or decision theory argue that they are normative because they allow the formulation of formal rules of action that show what needs to be done to make a given action optimal. Critics of this approach emphasize that such thinking about the normativity of Bayesian modeling is unjustified and that science should shift from prescriptive to descriptive positions. In a polemic with Shira Elqayam and Jonathan Evans (2011), I show that the division they propose into prescriptivism and Bayesian descriptivism is apparent, because, as I argue, there are two forms of prescriptivism, i.e. the weak and the strong. I argue that the weak version is epistemic and can lead to anti-realism, while the strong version is ontic and allows one to justify realism in relation to Bayesian models. I argue that a weak version of prescriptivism is valid for PP. It allows us to adopt anti-realism in relation to PP. In practice, this means that you can explain phenomena using Bayes' rule. This does not, however, imply that they are Bayesian in nature. However, the full justification of realism in relation to the Bayesian PP presupposes the adoption of strong prescriptivism. This position assumes that phenomena are explained by Bayesian rule because they are Bayesian as such. If they are Bayesian in nature, then they should be explained using Bayesian modeling. This thesis will be substantiated in the chapters “Normative functions and mechanisms in the context of predictive processing” and “Normative mechanisms and actions in predictive processing”.

In the chapter “The Free Energy Principle in predictive processing”, I discuss the Free Energy Principle (hereinafter FEP) formulated by Karl Friston and some of its implications. According to this principle, all biological systems (defined in terms of Markov blankets) minimize the free energy of their internal states in order to maintain homeostasis. Some researchers believe that PP is a special case of applying this principle to cognition, and that predictive mechanisms are homeostatic mechanisms that minimize free energy. The discussion of FEP is important due to the fact that some authors consider it to be important for explanatory purposes and normative. If this is the case, then FEP turns out to be crucial in explaining normative predictive mechanisms and, in general, any normative biological mechanisms. To define the explanatory possibilities of this principle, I refer to the discussion of its supporters on the issue they define as the problem of continuity and discontinuity between life and mind. A critical analysis of this discussion and the additional arguments I have formulated have allowed me to revise the explanatory ambitions of FEP. I also reject the belief that this principle is necessary to explain the nature of predictive mechanisms. I argue that the principle formulated and defended by Friston is an important research heuristic for PP analysis.

In the chapter “Normative functions and mechanisms in predictive processing”, I start my analyzes by formulating an answer to the question about the normative nature of homeostatic mechanisms. I demonstrate that predictive mechanisms are not homeostatic. I defend the view that a full explanation of normative mechanisms presupposes an explanation of normative functions. I discuss the most important proposals for understanding the normativity of a function, both from a systemic and teleosemantic perspective. I conclude that the non-trivial concept of a function must meet two requirements which I define as explanatory and normative. I show that none of the theories I have invoked satisfactorily meets both of these requirements. Instead, I propose a model of normativity based on Bickhard's account, but supplemented by a mechanistic perspective. I argue that a function is normative when: (1) it allows one to explain the dysfunction of a given mechanism; (2) it contributes to the maintenance of the organism's stability by shaping and limiting possible relations, processes and behaviors of a given system; and when (3) (according to the representational and predictive functions) it enables explaining the attribution of logical values of certain representations / predictions. In such an approach, a mechanism is normative when it performs certain normative functions and when it is constitutive for a specific action or behavior, despite the fact that for some reason it cannot realize it either currently or in the long-term.

Such an understanding of the normativity of mechanisms presupposes the acceptance of the epistemic hypothesis. I argue that this hypothesis is not cognitively satisfactory, and therefore the ontic hypothesis should be justified, which is directly related to adopting the position of ontic prescriptivism. For this reason, referring to the mechanistic theory of scientific explanations, I formulate an ontical interpretation of the concept of a normative mechanism. According to this approach, a mechanism or a function is normative when they perform such and such causal roles in explaining certain actions and behaviors. With regard to the normative properties of predictive mechanisms and functions, this means that they are the causes of specific actions an organism carries out in the environment. In this way, I justify the necessity of accepting the ontic hypothesis and rejecting the epistemic hypothesis.

The fifth chapter, “Normative mechanisms and actions in predictive processing”, is devoted to the dark room problem and the related exploration-exploitation trade-off. A dark room is the state that an agent could be in if it minimized the sum of all potential prediction errors. I demonstrate that, in accordance with the basic assumption of PP about the need for continuous and long-term minimization of prediction errors, such a state should be desirable for the agent. Is it really so? Many authors believe it is not. I argue that the test of the value of PP is the possibility of a non-trivial solution of this problem, which can be reduced to the choice between active and uncertainty-increasing exploration and safe and easily predictable exploitation. I show that the solution proposed by PP supporters present in the literature does not enable a fully satisfactory explanation of this dilemma.

Then I defend the position according to which the full explanation of the normative mechanisms, and, subsequently, the solution to the dilemma of exploration and exploitation, involves reference to the existence of constraints present in the environment. The constraints

include elements of the environment that make a given mechanism not only causal but also normative. They are therefore key to explaining the predictive mechanisms. They do not only play the role of the context in which the mechanism is implemented, but, above all, are its constitutive component. I argue that the full explanation of the role of constraints in normative predictive mechanisms presupposes the integration of individual models of specific cognitive phenomena, because only the mechanistic integration of PP with other models allows for a non-trivial explanation of the nature of normative predictive mechanisms that would have a strong explanatory value. The explanatory monism present in many approaches to PP makes it impossible to solve the problem of the dark room.

Later in this chapter, I argue that the Bayesian PP is normative not because it enables the formulation of such and such rules of action, but because the predictive mechanisms themselves are normative. They are normative because they condition the choice of such and such actions by agents. In this way, I justify the hypothesis that normative mechanisms make it possible to explain the phenomenon of agent motivation, which is crucial for solving the dark room problem.

In the last part of the chapter, I formulate the hypothesis of distributed normativity, which assumes that the normative nature of certain mechanisms, functions or objects is determined by the relations into which these mechanisms, functions or objects enter. This means that what is normative (in the primary sense) is the relational structure that constitutes the normativity of specific items included in it. I suggest that this hypothesis opens up many areas of research and makes it possible to rethink many problems.

In the "Conclusion", I summarize the results of my research and indicate further research perspectives.

Keywords: predictive processing; normativity; mechanisms; biological functions; constraints; explanation; free energy principle; predictions

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