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Is System 2 uniquely human?

The paper examines whether it can be said that older authors like Aristotle anticipated the claim that System 2 is uniquely human, made by some dual-system theorists. Anticipation is understood as implying a hierarchical relation between a prior, naïve theory, and a later, more elaborated one. Thus, it is examined whether the claim that System 2 is uniquely human made by dual-system theorists can be understood as a mature and empirically well corroborated articulation of the intuition that humans have unique cognitive capacities, or rather a vague repetition of that intuition. The first part of the paper briefly presents Aristotle's theory of the soul and modern dual-system theories respectively. In the second part, dual-system theories are examined in more detail using three criteria. It is concluded that dual-system theories do not present a mature articulation the intuition about human uniqueness. Thus, it is not the case that authors like Aristotle anticipated these dual-system claims.

Keywords: Aristotle, De Anima, dual-system theories, two minds hypothesis, philosophy of science.

1 Introduction

In the last four decades, different fields of psychological research saw a significant surge in theories that took notice of an apparent duality of human cognitive processes. Referred to with an umbrella term dual-process theories, they hold that many cognitive tasks can be solved by two distinct types of processes. Type 1 processes are fast, autonomous, and unconscious, while Type 2 ones are slow, deliberate, and conscious (Evans, 2008; Frankish, 2010; Frankish and Evans, 2009; Evans and Stanovich, 2013; Pennycook, 2018). Later, starting in the 1990s, dual-system theories that attributed “two types of process to two separate reasoning systems, System 1 and System 2” (Frankish, 2010: 914) started to emerge. Some researchers even suggested that there are, in fact, two separate minds in our brain, one evolutionarily ancient and shared with animals, and another evolutionarily recent and uniquely human (Evans, 2009: 2014).

However, as dual-process and dual-system theorists also recognize themselves, theories that try to account for duality or some other partitions of human cognition are not new. In their paper, titled “The duality of mind: An historical perspective,” Frankish and Evans (2009) present a broad if hurried review of different historical traditions – spanning from Plato’s division of the soul to Freud’s theory of the unconscious – and their possible similarities with modern dual-process theories. In passing, they mention that “many philosophers have held that humans exhibit a qualitatively different kind of mentality from other animals” (Frankish and Evans, 2009: 3). They mention “Aristotle, Aquinas, and Descartes” who “anticipated” the claim of some dual-system theories that humans have a unique cognitive architecture, a qualitatively distinct System 2 or a “new mind,” that separates us from other animals (Frankish and Evans, 2009: 3). A similar claim can be found in Frankish’s (2010) paper: “Several authors have proposed that humans exhibit a qualitatively different kind of mentality from other animals, anticipating the modern claim that there is a uniquely human reasoning system” (Frankish, 2010: 915).

In this paper, I will examine the claim that some older authors *anticipated* modern dual-system theories in more detail. If we take the relation of anticipation to imply a hierarchy between a naïve theory and a more developed theory, then it must be shown that the claim that System 2 is uniquely human made by dual-system theorists is a mature and scientifically well corroborated articulation of a much older intuition that human and animal cognitions are qualitatively distinct. Three criteria will be used to evaluate this. First, dual-system theories must show that there is strong empirical evidence that humans and animals indeed have different cognitive abilities. Second, they must show that these differences correspond to System 1 and System 2. Third, while accounting for these differences, dual-system theories must stay coherent. I will show that dual-system theories do not meet these criteria. Therefore, I will conclude that modern dual-system theories, rather than

providing a mature articulation, just repeat this old intuition about differences between humans and other animals. Given that, claims that authors like Aristotle “anticipated” (Frankish and Evans, 2009; Frankish, 2010) modern dual-process theory will be shown to be unwarranted.

2 Human and animal cognition in Aristotle and dual-system theories

In this chapter, I will briefly present both Aristotle’s and dual-system theorists’ respective ideas about the differences between human and animal cognition. My goal here is not to present the theories in detail, but to point out some possible parallels between them. I will first sketch Aristotle’s theory of the soul and then turn to the contemporary theories.

Aristotle’s theory of the soul

Here, I will present Aristotle’s theory of the soul in the most general outlines. It is based on his doctrine of hylomorphism which states that all things are formed from two substances, matter (potentiality) and form (actuality). Like all other things than, an organism is unity of an appropriate matter (body) and a form (soul). Or, as Aristotle writes: “it is necessary, then, that the soul is a substance as the form of a natural body which has life in potentiality” (2016: 22). In other words, soul is a form which, together with a body that can be animated, generates a living organism that grows, is nourished, and eventually decays. Being alive distinguishes bodies that are enformed by a soul, i.e., ensouled, from those that are enformed by other forms; that is, the object that have a soul are living (Aristotle, 2016: 24).

Further, Aristotle claims that “living is spoken of in several ways” (Aristotle 2016: 24); besides nourishment and growth, living organisms can also have other faculties: reason, perception, locomotion, imagination, desire. He then makes a connection between these different capacities of organisms and different faculties of the soul, saying that “among the capacities of the soul, all belong to some, to others some of them belong, and to still others only one belongs” (2016: 27). If all living beings have a capacity for growth and nutrition, only some organisms have others. Aristotle holds that the capability to perceive forms (i.e., perception) separates animals from plants, while reason belong only “to humans and to anything else there may be of this or of a more elevated sort” (2016: 27). Given this, we can conclude that the faculties of the soul that Aristotle established function also as a principle of differentiation between animal and non-animal species.

Dual-system theories

Now, I will turn to the presentation of dual-system theories. At the face value, they differ strikingly from Aristotle in everything from methodology and metaphysical commitments to the kinds of empirical evidence they use. Nevertheless, like Aristotle, several dual-system accounts, especially the ones promoted by Jonathan St. B. T. Evans, hold that some of our cognitive abilities are shared with animals, while others are uniquely human (Evans, 2003; 2009; 2014). Although some dual-system theories are completely void of such claims (e.g., Sloman (1996)), the claims were already present in some early dual-system accounts (e.g., Reber's (1996) influential book about implicit learning) and gained traction in 2003 with the publication of Evans' review paper in the journal *Trends in Cognitive Sciences*.

In his 2003 paper, Evans presents a broad account of the two systems, which includes hypotheses about their architecture and evolutionary age. He characterizes System 1 as "universal cognition shared between humans and animals," a "set of sub-systems that operate with some autonomy" that is evolutionarily older, responsible for associative learning, instinctive behavior, and other processes that are "rapid, parallel and automatic" (Evans 2003: 454). System 2, in contrast, is characterized as "slow and sequential in nature" since it makes use of the "central working system" and is responsible for deductive reasoning, hypothetical thinking, explicit learning etc. (Evans, 2003: 454). It is evolutionarily more recent, uniquely human and it can inhibit System 1 responses (Evans, 2003: 454).

Later, several problems were found with this picture (cf. Evans 2009) which prompted a move away from using this theoretically richer concept of a system and towards talking about different kinds of processes. Nevertheless, researchers did not completely abandon the concept of cognitive systems. Namely, Evans (2008; 2014) started using a new distinction between the "old mind" and the "new mind" or what he calls the "two minds" hypothesis. He defines the mind as "as a high-level cognitive system capable of representing the external world and acting upon it in order to serve the goals of the organism" (Evans, 2009: 35). He proposes that the human brain contains two such minds. One that is capable of "associative and procedural learning", is evolutionarily old and shared with animals (Evans, 2014: 131). And the other that is responsible for "controlled attention" and is evolutionarily more recent (Evans, 2014: 131).

Although Evens now argues that "it was an error in earlier forms of dual system theories to describe System 2 as unique to human beings" (Evans, 2014: 131), he still seems to hold that it is the new mind that separates humans from other nonhuman animals. I will present this argument in more detail below; for now, it is only important to notice that, despite some additional qualifications, the claim that System 2 or the new mind is uniquely human still plays an important role in dual-system theories.

3 Evaluating the claim about anticipation

As was shown above, both Aristotle and dual-system theorists argue that we humans have some special cognitive architecture that separates us from other animals. But does this mean that Aristotle and other authors anticipated the dual-system theorists' claim that humans have a unique cognitive architecture? To answer this question, we must first understand what kind of relation between theories is implied by *anticipation*.

In essence, anticipation implies a hierarchical relation between a prior, naïve theory, and a later, more developed theory. First, a theory expresses a plausible intuition, but it does not articulate it fully or in a right way; then, another theory comes and manages to articulate it in a much more satisfying way. Or, to put it concretely, Aristotle's theory of the soul only hinted at the idea that humans have a unique cognitive system; later this idea was fully articulated and corroborated by dual-system theorists.¹

For the claim about anticipation to hold, it must be shown that dual-system theories can be understood [1] as a mature and empirically well corroborated articulation of the intuition about human uniqueness, rather than [2] a vague repetition of that intuition. The burden of proof seems to lie on [1], since a theory, to be understood as maturely articulated, needs sufficient evidence for all claims that follow from it. Thus, I will place the claims made by dual-system theorists under more scrutiny and try to establish that [1] rather than [2] holds by directly examining them. Specifically, I ask two things: (1) are dual-system theorists' claims about uniqueness of human cognitive capabilities grounded in evidence? And (2) are they a part of a coherent and well thought-out theory that can predict and accommodate novel evidence?

To establish this, I will use three criteria. First, dual-system theories must show that there is strong empirical evidence that humans and animals indeed have different cognitive abilities. Second, they must show that these differences correspond to System 1 and System 2. Third, while accounting for these differences, dual-system theories must stay coherent. Furthermore, they should be able to account for new empirical evidence about human vis-à-vis animal cognition, without significant

¹ One way of arguing that Aristotle could not anticipate dual-system theories is to say that scientific theories from different paradigms (e.g., cognitive science versus Aristotelian biology) cannot be compared, since they are simply different. This is the famous "incommensurability thesis" (see Oberheim and Hoyningen-Huene, 2018). I will not be making this argument. Rather, I will argue that dual-system theories are lacking as an articulation of the idea that humans have a unique cognitive architecture and thus are not necessarily better than Aristotle's theory of the soul.

changes made to them.² Together, these criteria are sufficient to prove that dual-system theories are a mature articulation, while each of them is necessary.

First and Second Criteria

The first criterion is trivially satisfied. The computer on which I am writing this paper, and most of the other artifacts I interact with day-to-day can serve as evidence that humans have developed in a radically different way than other animal species and that we probably indeed have unique cognitive abilities. But the problem is in establishing how exactly are we different from other animals. Or, in other words, is the first criterion satisfied in a way that the second criterion is also satisfied?

Satisfying the second criterion proves to be a harder challenge for dual-system theories. One problem is that dual-system theorists themselves present scarce evidence to support the claim that System 1 is shared with animals while System 2 is uniquely human.³ Evans presents some archeological evidence that *homo sapiens sapiens* developed qualitatively differently than other animal species (Evans, 2003: 457). For example, he quotes “the qualitative change in the archaeological record c. 50,000 years ago when there was sudden evidence of representational art, religious imagery and rapid adaptations in the design of tools and artefacts” (Evans, 2003: 457). But this evidence is not that convincing; it might suggest that something indeed had happened to the human brain, but it does not support the claim that a separate reasoning system developed. In other words, it only satisfies the first criterion, but not the second.

In addition, Reber, who is often cited as making one of the earliest claims about the evolutionary age of the two systems of reasoning (Frankish and Evans, 2009; Frankish, 2010), introduces his claim that “consciousness is a late arrival on the evolutionary scene” (Reber, 1996: 86) as an axiom. This may not be problematic for his argumentation, but it does not help satisfy the second criterion. Furthermore, there is evidence against the claim that the distinction between System 1 and System 2 can function as a principle of differentiation between humans and animals. It was shown that something resembling the System 1/System 2 dichotomy could also be found in rats, which can, in new circumstances, inhibit established behavior patterns (Toates 2004). Experiments with rats also showed that they are capable of causal reasoning that cannot be explained by associative learning

² This third criterion is admittedly a very strong one. I do not hold that any psychological theory (or any theory in the special sciences) should generally satisfy it. However, it is necessary, if we want to claim that a theory is a conceptually mature articulation of an idea that another theory anticipated.

³ They present both psychological and neurological evidence that indeed points to the existence of two different reasoning systems in humans (cf. Evans, 2003: 455-56). What they lack is evidence which would show that one system is shared with nonhuman animals while the other is uniquely human.

(Blaisdell et al., 2006). If it is System 1 that is responsible for associative learning and System 2 that can inhibit autonomous System 1 responses (Evans, 2003) then at least a basis for both System 1 and System 2 also exist in rats.⁴

Does the two minds hypothesis satisfy the second criterion?

Citing similar evidence, Evans (2009; 2014) himself recognized that the claim that System 2 is uniquely human is too strong. As already mentioned above, rather than claiming that System 2 is only found in humans, he now promotes the idea that it is “uniquely developed in humans” (Evans, 2014: 131) or that what is a “relatively small cognitive facility in animals became magnified greatly in humans” (Evans, 2009: 39).⁵

Nevertheless, he still seems to hold that his two minds hypothesis can conceptualize a qualitative difference between humans and other animal species. For example, he states that our seemingly less instrumentally rational behavior⁶ is often a consequence of “the fact that we have a new mind. An animal lacking such higher-order concepts and representations will naturally follow the path to the immediate goals” (Evans, 2014: 140). In the face of the extraordinary human development in the last few millennia, he writes: “Not only is the difference in human achievement from any other species staggering in scale but the thought processes which permit these developments seem qualitatively different” (Evans, 2014: 139). In the conclusion of the paper, he suggests that the old mind is responsible for “a form of instrumental rationality which we share with other animals” (Evans, 2014: 143), implying that the “new mind” is uniquely human.

We can thus ask whether the old/new mind distinction satisfies the second criterion of conceptualizing the differences between human and animal cognitive capacities. To achieve this, Evans should be able to make the old mind/new mind distinction independently from the Type 1/Type 2 distinction which is commonly used to separate System 1 and System 2.⁷ He indeed seems

⁴ Arguably, this is also not a strong evidence *against* dual-system theorists claim about human and animal cognition. Nevertheless, they themselves (cf. Evans’ 2009 and 2014 papers) accepted it as decisive, which suggest that the strong claim about System 2 being uniquely human was not well corroborated in the first place.

⁵ This distinction seems to be based on the fact that although nonhuman animals have capabilities which suggest the presence of System 2, these capacities are quite limited in comparison to human ones. But admittedly, this is a very thin distinction. This becomes especially apparent when Evans restates the uniquely human thesis through the distinction between the new and the old mind, as I will show below. I thank the anonymous referee for pointing out that this distinction might not be obvious for the reader.

⁶ He gives an example of a “sunk cost” effect. “If I have expensive tickets bought months ago for an opera tonight but (a) am feeling tired and (b) discover that my favorite football team is playing live on television, then at this point I might prefer to stay home rather than go the opera. But I go to the opera anyway as I have bought the tickets” (Evans, 2014: 139). This type of behavior was traditionally considered as irrational since the money spent for the opera ticketed is “lost” in both cases. But, as he points out “phenomena like sunk costs are a much more complex issue because humans have higher-order goals, values, and self-perceptions all of which can affect this kind of decision making” (Evans, 2014: 140).

⁷ One possibility of this kind of characterization that I ignored throughout this argument is that some parts of the brain evolved more recently (i.e., the new brain) while others are evolutionarily older (i.e., the old brain). While this may be

to argue that these are two different distinctions: he states that it is not simply true that the “Type 2 processing [is] in the new mind or System 2, and Type 1 processing [is] in the old mind or System 2” (Evans, 2014: 132). The example he gives is modular cognition (e.g., the visual system). It involves processes that “are fast, automatic, mandatory, and parallel, hence fitting the criteria for Type 1 processing” (Evans, 2014: 132). Nevertheless, some “modules play a critical foundation for the new mind” (Evans, 2014: 132); therefore, modules as such cannot simply be categorized under the old mind.

But instead of providing an independent characterization of the old/mind distinction, Evans goes on to state that “the key difference is that the old mind operates through automated Type 1 systems that have mandatory outputs, whereas Type 2 systems are in some sense volitional: the new mind is capable of forming plans and carrying out intentions under controlled attention” (Evans, 2014: 133). Reading this statement as coherent with former emphasis that “most of the processing in the new mind is also Type 1 in the sense of being autonomous, rapid, and preconscious” (Evans, 2014: 132), it seems to mean that the old mind operates *only* through automated Type 1 systems, while the new mind can *also* operate through volitional Type 2 systems.

This characterization of the relation between the old/new mind distinction and Type 1/Type 2 distinction might not be strictly problematic, but it also cannot support the claim that the new mind is only found in humans. If nonhuman animals really are capable of some rudimentary Type 2 processes, as we have seen above (cf. Blaisdell et al., 2006), and these processes are characteristic of the new mind, then nonhuman animals too must possess the new mind, albeit in some rudimentary form.

Therefore, the two minds hypothesis does not provide sufficient ground to suppose a qualitative difference between human and animal cognition. According to Evans’ definition of the new and the old mind (Evans, 2014: 133) the distinction between cognitive capacities of humans and other animals is either quantitative (i.e., both have the new mind, but it is developed to different degrees) or it cannot be captured fully by the distinctions he makes. Thus, his theory does not satisfy the second criterion. Rather, it seems to accept the claim that humans have qualitatively different cognitive abilities without providing a substantial evidential ground for it.

true and indeed a big part of telling a story of human uniqueness (or similarity with other animals), it moves us to a different level of analysis altogether: we are seeking distinctively human cognitive capabilities, not physiological features. Furthermore, even if some uniquely human capabilities, e.g., language or hypothetical thinking, can be mapped onto those evolutionarily more recent parts of the brain, an independent distinction between the new and the old brain, which would be consistent with this evidence, must be made. Otherwise, the old and the new brain function only as a shorthand for different parts of the brain and their corresponding capabilities.

Third criterion

Having shown that dual-system theories fail to satisfy the second criterion, namely that System 1/System 2 and old/new mind dichotomies cannot account for differences in cognitive capabilities between humans and other animals, I can now move to the third criterion. This one states that besides providing empirical evidence (which they do not), dual-system theories must also be coherent. This is not a necessary step in my argumentation. Dual-system theories should fulfill all three criteria; showing that they do not meet the second criteria is already enough to conclude that the theories cannot be understood as a mature articulation of the intuition about human cognitive uniqueness.

Nevertheless, I want to point out the general disarray on the field of dual-process studies: even the most fundamental conceptions and distinctions made by the researchers in the field are a subject of continuous debate. Different dual-system and dual-process theories are attacked both by researchers who subscribe to different views of human cognition (Keren and Schul, 2009; Kruglanski and Gigerenzer, 2011; Osman, 2004) and by researchers who themselves commit to dual-system or dual-process view but think specific theories are lacking in some way (Evans, 2009; Evans and Stanovich, 2013).

Take for example Evans' (2009) discussion of symmetry between Type 1 and 2 processes and Systems 1 and 2 (40), favored by some earlier theories, for example Sloman (1996). Sloman (1996) argued that humans can provide responses to problems using two different types of processes, associative and rule-based (9-11). For example, we can categorize different animals based on similarities among them (e.g., we see different animals that all share a similar feature, wings, and then group them together, as birds), or we can apply rules to categorize them (e.g., "if it has wings, then it is a bird"). From this, he concluded that two separate systems exist, one responsible for associative and other for rule-based responses (Sloman, 1996: 11), thus establishing a symmetry between Type 1 and 2 processes and Systems 1 and 2.

But Evans pointed out that such clear distinction between System 1, responsible for one type of processes, and System 2, responsible for another type of processes, is hardly consistent when considered in detail. For him, the problem mainly lies in using working memory access as a defining distinction between System 1 and System 2 (Evans, 2009: 37–39). The idea is that Type 1 processes, e.g., heuristics for solving reasoning tasks, memory retrieval, or word and face recognition, do not have access to working memory and are therefore fast and automatic. In contrast, Type 2 processes, e.g., deductive reasoning, explicit learning, or hypothetical thinking, need working memory and are therefore slow, require high effort, and have limited capacity.

The problem is that working memory cannot be used for distinguishing Systems 1 and 2 in the same way. First, working memory needs content, which is mostly provided by the fast, Type 1 processes. If we say that System 1 is responsible for them, while System 2 has access to working memory, a significant overlap between the two systems is established. This can be solved by saying that System 2 needs access to working memory “among other resources” (Evans, 2009: 38). However, that leaves us with two, equally unsatisfying options. We can either reduce System 2 to working memory alone or say that there is not only one System 2, but maybe a set of Type 2 systems defined as Type 1 units plus working memory (Evans, 2009: 38). Given this, he argues for introducing a new type of processes (Evans, 2009: 42) and discourages the use of the terms System 1 and System 2 (Evans, 2009: 50).

Further, this production of new theoretical concepts has not slowed in recent years. Beside Evans’ (2009) introduction of the new type of processes, other authors from the field are introducing concepts like an additional system (Stanovich, 2009), a “conflict monitor” (Pennycook, 2018)) or presenting new theories altogether (“fuzzy trace theory” (Reyna et al., 2017)). This indicates that dual-system and dual-process theories, in their present state of development, are not a coherent theoretical framework that could easily incorporate new evidence. This means that we cannot safely say that they satisfy the third criterion.

4 Conclusion

Given that dual-system theories fail to satisfy both the second and the third criterion, it can be concluded that they cannot be taken as a conceptually mature articulation of the difference between human and animal cognitions. Rather, the claim that System 2 (or the new brain) is uniquely human, while System 1 (or the old brain) is shared with animals, should be understood as a preconceived notion that is neither sufficiently supported by evidence nor theoretically coherent. Therefore, it is not the case that authors like Aristotle “anticipated” (Frankish, 2010; Frankish in Evans, 2009) this claim made by some dual-system theorists. Instead, dual-system theorists try to provide a new conceptualization of a much older intuition but are not much more successful than authors like Aristotle. In other words, the claim made by dual-system theorists’ that older authors anticipated their arguments about a uniquely human reasoning system is therefore of not much relevance since these modern claims are still not coherent and well corroborated.

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Je Sistem 2 izključno človeški?

Članek raziskuje trditev nekaterih teoretikov dvojih sistemov [*dual-system theories*], da so klasični avtorji, na primer Aristotel, anticipirali njihovo tezo o obstoju dodatnega, unikatno človeškega kognitivnega sistema. Anticipiranje je razumljeno kot hierarhično razmerje med zgodno, naivno teorijo in novejšo teorijo, ki je bolj razdelana. Članek se tako vpraša, ali lahko trditev teoretikov dvojih sistemov, da je Sistem 2 izključno človeški, razumemo kot empirično podprto in teoretično koherentno artikulacijo starejše intuicije o človeški kognitivni unikatnosti ali pa gre zgolj za nič boljše podprto ponovitev te intuicije. V prvem delu članka so tako najprej na kratko predstavljene Aristotelova teorija duše in sodobne teorije dvojih sistemov. Drugi del članka pa s pomočjo treh kriterijev natančneje razišče, ali teorije dvojih sistemov lahko razumemo kot podprto artikulacijo intuicije o človeški unikatnosti. Članek se zaključi z ugotovitvijo, da to ne velja, torej posledično tudi ne velja, da so klasični avtorji (kot Aristotel) predvideli trditve sodobni teoretikov dvojih sistemov.

Ključne besede: Aristotel, O duši, teorije dvojih sistemov, hipoteza dvojnega uma, filozofija znanosti.

Works Cited

- Aristotle. (2016). *Aristotle: De Anima*. Edited by Christopher Shields. Oxford: Clarendon Press.
- Blaisdell, A. P., Kosuke Sawa, Kenneth J. Leising, and Michael R. Waldmann. (2006). "Causal Reasoning in Rats." *Science*, 311 (5763), pp. 1020–22. <https://doi.org/10.1126/science.1121872>.
- Evans, Jonathan St. B. T. (2003). "In Two Minds: Dual-Process Accounts of Reasoning." *Trends in Cognitive Sciences*. <https://doi.org/10.1016/j.tics.2003.08.012>.
- Evans, Jonathan St. B. T. (2008). "Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition." *Annual Review of Psychology*, 59(1), pp. 255–78. <https://doi.org/10.1146/annurev.psych.59.103006.093629>.
- Evans, Jonathan St. B. T. (2009). "How Many Dual-Process Theories Do We Need? One, Two, or Many?" In *In Two Minds: Dual Processes and Beyond*, pp. 33–54. <https://doi.org/10.1093/acprof:oso/9780199230167.003.0002>.
- Evans, Jonathan St. B. T. (2014). "Two Minds Rationality." *Thinking & Reasoning*, 20(2), pp. 129–46. <https://doi.org/10.1080/13546783.2013.845605>.
- Evans, Jonathan St. B. T., and Keith E. Stanovich. (2013). "Dual-Process Theories of Higher Cognition." *Perspectives on Psychological Science*, 8(3), pp. 223–41. <https://doi.org/10.1177/1745691612460685>.
- Frankish, Keith. (2010). "Dual-Process and Dual-System Theories of Reasoning." *Philosophy Compass*, 5(10), pp. 914–26. <https://doi.org/10.1111/j.1747-9991.2010.00330.x>.
- Frankish, Keith, and Jonathan St. B. T. Evans. (2009). "The Duality of Mind: An Historical Perspective." In *In Two Minds: Dual Processes and Beyond*, pp. 1–30. <https://doi.org/10.1093/acprof:oso/9780199230167.003.0001>.
- Keren, Gideon, and Yaacov Schul. (2009). "Two Is Not Always Better Than One." *Perspectives on Psychological Science*, 4(6), pp. 533–50. <https://doi.org/10.1111/j.1745-6924.2009.01164.x>.
- Kruglanski, Arie W., and Gerd Gigerenzer. (2011). "Intuitive and Deliberate Judgments Are Based on Common Principles." *Psychological Review*, 118(1), pp. 97–109. <https://doi.org/10.1037/a0020762>.
- Neys, Wim De, ed. (2017). *Dual Process Theory 2.0*. Routledge. <https://doi.org/10.4324/9781315204550>.

- Oberheim, Eric, and Paul Hoyningen-Huene. (2018). "The Incommensurability of Scientific Theories." In Zalta, E. N., *The Stanford Encyclopedia of Philosophy*. URL = <https://plato.stanford.edu/entries/incommensurability/#Aca>.
- Osman, Magda. (2004). "An Evaluation of Dual-Process Theories of Reasoning." *Psychonomic Bulletin & Review*, 11(6), pp. 988–1010. <https://doi.org/10.3758/BF03196730>.
- Pennycook, Gordon. (2018). "A Perspective on the Theoretical Foundation of Dual Process Models." In *Dual Process Theory 2.0*, 5–27. <https://doi.org/10.4324/9781315204550-2>.
- Reber, Arthur S. (1996). *Implicit Learning and Tacit Knowledge. Implicit Learning and Tacit Knowledge: An Essay on the Cognitive Unconscious*. Oxford: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780195106589.001.0001>.
- Reyna, Valerie F., Shahin Rahimi-Golkhandan, David M. N. Garavito, and Rebecca K. Helm. (2017). "The Fuzzy-Trace Dual Process Model." In *Dual Process Theory 2.0*, pp. 82–99. Routledge. <https://doi.org/10.4324/9781315204550-6>.
- Sloman, Steven A. (1996). "The Empirical Case for Two Systems of Reasoning." *Psychological Bulletin*, 119(1), pp. 3–22. <https://doi.org/10.1037/0033-2909.119.1.3>.
- Stanovich, Keith E. (2009). "Distinguishing the Reflective, Algorithmic, and Autonomous Minds: Is It Time for a Tri-Process Theory?". In *In Two Minds: Dual Processes and Beyond*, pp. 55–88. <https://doi.org/10.1093/acprof:oso/9780199230167.003.0003>.
- Toates, Frederick. (2004). "'In Two Minds' – Consideration of Evolutionary Precursors Permits a More Integrative Theory". *Trends in Cognitive Sciences*, 8(2), 57. <https://doi.org/10.1016/j.tics.2003.12.005>.