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## **Abstract**

of

DISSERTATION WORK

for the acquisition of the educational-scientific degree "doctor" in a professional  
direction 2.3. Philosophy (Theory of Knowledge)

## **Epistemological externalism in mental models**

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The dissertation has a volume of 213 pages. It consists of seven sections - an introduction, four main chapters, a conclusion and a bibliography. The bibliography contains 269 titles in Bulgarian and English.

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## 1. Introduction

Mental models are a widely applied approach in psychology that is used to explain people's cognitive acts. The construction of models (including in philosophy) and their application in explaining complex phenomena is discussed, for example, by Williamson (Williamson, T., 2017). For him, progress in philosophy occurs through the construction of better models that represent the structure of the studied phenomenon more adequately. When we talk about mental models, we mean the integrated representations of the world that allow for contextualizing information that comes from the world and action that is based on that information.

In this sense, mental models are not simply a representation of a phenomenon, but a set of integrated representations that are so related to each other that they are like a map of the world that orients the knowing agent. It is difficult to point to isolated representations. The representation of the color green from a traffic light has meaning beyond the representation itself. This representation is related to other information and, combined with it, gives us meaning – we can cross the street, for example.

Mental models have been used by psychologists for at least 60 years, with no systematic study of their relationship to epistemological externalism or internalism (Johnson-Laird, P., 1983). An implicit acceptance of an internalist framework of explanation can be found in the theory of these cognitive mechanisms, but contemporary findings in the fields of cognitive science, cultural anthropology, computer modeling, etc. tilt the scales more and more in favor of an externalist explanatory model. The dissertation attempts to defend the externalist project in considering mental models as cognitive mechanisms.

The present study uses a wealth of empirical data, which is brought forward as a continuation of the naturalized epistemology project. Therefore, mental and neural models are treated here as identical. This identity is assumed in the present work.

Since much of the dissertation follows the project of naturalizing epistemology, it is not surprising that studies from fields such as primatology, ethology, cultural anthropology, endocrinology, psychology, neuroscience, behavioral genetics, social science, etc. have been used to epistemological externalism and its varieties became established as the main explanatory framework of mental models.

Thus added, the objectives of the dissertation have several tasks to be accomplished. The first is to briefly reconstruct the debate between internalism and externalism. In carrying out this task, it will be shown that there are grounds for preferring externalism to internalism in analyzes of knowledge, reasoning, and the intellectual virtues. The second task is to analyze the concept of "mental model". Included in this task is the conceptual analysis of the concept of 'model' and why a mental model can be assumed to be identical to a neural model. The third task is related to demonstrating the influence of external factors on the expression of the model and how it functions. The fourth task is to show that there is an intellectual virtue tied to mental models that is of an externalist type.

The methods used in the dissertation are conceptual analysis, interdisciplinary approaches from the fields of cultural anthropology, neuroscience, psychology, etc., empirical data and analogy. In defense of the use of interdisciplinary approaches, the fact that philosophy, epistemology in particular, has passed the in-depth study of mental models in relation to internalism and externalism is used. Mental models are used in the mentioned disciplines and therefore their methods are appropriate in their study.

The structure of the dissertation follows a certain logic. It is: if mental models are influenced primarily by external factors and there are intellectual virtues that are not of the internalist type, then externalism should be preferred as an explanatory framework. Culture and technology have a proven impact on the structure and functioning of mental models. Culture and technology are external to the knower. The reliability of different mental models that arrive at the same result cannot be explained by reference to mental state or reflective capacity, which are internalist criteria. Externalism is therefore the preferred explanatory framework when we examine mental models. This structure is developed in subsequent chapters.

From the examined goals, tasks and methods of the dissertation work, it can be concluded that the majority of the literature used will not be from the field of epistemology. In view of the defended thesis and the attempt to solve the problem neuro-mentally, as well as the fact that mental models are not sufficiently considered by philosophy, we can argue that it is imperative to include primarily literature external to the theory of knowledge. This literature comes primarily from neuroscience and its offshoots, but there are works from other disciplines already mentioned that have an established tradition of using "mental models" as terms.

## **1. A historical overview of studies of knowledge from internalism and externalism**

Plato was among the first to deal more thoroughly with the study of knowledge. He sees knowledge as composed of three parts: belief, justification, and truth. In the dissertation work, I have chosen to keep belief as belief, not as conviction. What is meant by "belief" is propositional belief. Belief carries with it a reference to the doxastic conviction of a proposition, and is therefore avoided.

Internalism of knowledge defends the proposition that knowledge is grounded in the knower's access to it. We always have the opportunity to consciously reach the foundations of our knowledge. Some internalist positions argue that the mental state itself grounds beliefs (Papay, G., 2014). Moreover, there are arethical attempts of the internalist type that defend the claim that grounding is a kind of personal responsibility of the knower, and that he has a duty to conduct the inquiry in a sufficiently skeptical and rigorous way to arrive at knowledge. Externalism defends the position that the need for access is not a sufficient condition, and often not a necessary one, for us to have grounded knowledge. According to externalists, there are other things beyond mental states that justify our beliefs.

Payer summarizes the positions internalists hold. He (2001, p.108) writes that the main positions of internalism are the following:

" (i) The strongest form of internalism defends an internalism of access with respect to all beliefs one holds (Bonjour exemplifies a defense of this position in his coherentist period).

(ii) An intermediate form of internalism is inferential internalism, but here it is denied that one needs special access to immediate grounds (Fumerton defends this view).

(iii) The weakest form of internalism accepts all forms of access internalism. According to this position, the fact that a base is adequate must be determined internally, but one does not need special access to whether that base is adequate.'

Audi (2003, p. 244) and Karageorgieva (2013, p. 71) mainly consider the internalism of justification as more accessible to analysis than the internalism of knowledge, and it is this that is mainly considered in the dissertation. It should be said, at least, that knowledge internalism defends the position that we have knowledge when we can articulate our grounds for that knowledge. The problem with this position is that it doesn't tell us much about the truth of our beliefs, and so most internalists engage in justification analysis. The dissertation examines the internalism of foundationalism and coherentism as theories of justification.

The position of internalist foundationalism can be summarized as follows: Knowledge is something based on irreducible apprehension. This irreducible understanding is often not accessible. An example is foveal vision (Wang et al., 2011; Gloriani AH & Schütz AC, 2019; Tuten, S. & Harmening, M., 2021). Chisholm criticizes foundationalism on the grounds that validity claims rest on the probability that a belief is true, and when it comes to probability, reference to external factors is mandatory ( see Karageorgieva 2013).

Regarding coherentism, Lehrer argued (1974, p. 154): "...a belief is fully justified if and only if it coheres with a belief system." According to this requirement, in a belief system, each belief must cohere with the others, if we want to have justification. On the same page, Lehrer continues: "S is fully justified in believing that p if and only if p coheres with other beliefs belonging to a belief system of type k.". Coherentism and its criteria are well discussed by Bonjour (1988, pp. 92-99), but the problem with coherent beliefs is that they tell us nothing about the truth of the beliefs. We can have untrue but well-coherent beliefs.

Externalists argue that we have knowledge when we have a true belief that is produced by a reliable process, even if we do not have access to the process itself. Nagel (2014, p. 64, ch. 5) argues: "If it is a fact... and you relate to that fact in the right way... then you know... even if you cannot explain the reasons for it. Externalists are content to accept that sometimes we not only know something, but also have special first-person access to how we know it. But from an externalist perspective, this insight into how we know is a bonus, not something that should generally accompany all knowledge. Externalists argue that requiring such insight always into how we know risks allowing a vicious cycle." Conscious access is optional, according to externalism. It may be desirable, but there are many types of knowledge that do not require any special access to the foundations.

Since externalism is committed to truth, these reliable processes must somehow follow truth. One of the first externalist ideas developed by Nozick (1983, pp. 172-176) proposed four conditions for knowledge. They are 1) p is true; 2) S believes that p; 3) If p is not true, S

would not believe that p; 4) If p is true, then S believes that p. This is the so-called tracking theory. Let us consider what standards of reliability Goldman gives (Epistemology and cognition, 1988, p. 26). According to him, criteria of reliability are "processes, methods, systems, or what have you" that produce beliefs, and those beliefs that are true exceed some evaluative threshold. He argued: "Reliability then consists in the tendency to produce a high truth ratio of beliefs."

Externalism is also concerned with the environment in which the process is reliable. A boat made for lake fishing is only as reliable as it is in the environment for which it was made. Epistemological externalism is entirely relevant to the aims of the thesis, because the environment in which our mental models operate determines reliability to a significant degree.

## 2.1. Value of knowledge and intellectual virtues

The value of knowledge is explored by Plato in various dialogues, for example in Protagoras. Aretic epistemology contributes to the field of theory of knowledge by examining intellectual virtues. The aim is to understand what epistemic goods and merits are, to analyze issues related to rationality, epistemic responsibility, good research, etc.

Virtue epistemology uses many analogies with ethics in its study (Riggs, W., 2009). In order to master moral behavior, one must specify what behavior falls under this definition. When we try to learn a virtue, we need to know whether it is a single thing or composed of different things. If they are many things, then they must be connected in some way, because if they are completely separate, then certain irreconcilable contradictions arise. Moral character, therefore, cannot be broken down into its component parts without something being lost in the process.

Olson (2012) misses this in his quest to reconcile the positions of virtue externalism and virtue internalism. In his attempt to create an virtue pluralism, he forgets that if the epistemic virtues are entirely separate from each other, then we might have paradoxes such as an irresponsibly rational knower who would be both epistemically virtuous and non-virtuous. Even if we consider the individual virtues, we must not forget that they are part of a single conceptual field of study.

Much of the study of good research has its origins in Plato's analogy of knowledge with the statues of Daedalus. These statues were so well made that people tied them up because they looked like they could escape at any moment. Plato argued that knowledge is something that is bound by our reasoning. This rationale is articulable.

Some cognitive researchers disagree with this statement. We have many kinds of knowledge that cannot be expressed (Ryle, 1949). Other criticisms are directed at the grounds being external to the knower. According to externalists, the criterion for articulability of knowledge is too strong, and most of our knowledge cannot be articulable. In that case, internalists can only defend higher-order virtues, because much good research is of the externalist type.

The value of justification is different for cognitive mechanisms such as perception, memory, imagination, and articulability. The first part is defended by aretic reliabilists (representatives of externalism), while the ability to verbally declare is defended by representatives of internalism. Virtue reliabilism, to clarify, differs from procedural reliabilism in that virtue reliabilism is a cognitive achievement attributable to the overall cognitive character of the knowing agent. Procedural reliabilism is concerned with the study of those processes that manage to reliably lead to true beliefs (Hirvela, J., 2023).

Sosa (1980) emphasized that intellectual virtues are reliable and they justify our beliefs. This is supported by research on general intelligence (IQ). People who perform well on such tests achieve better socioeconomic status (Ganzach, 2011) and have better academic success (Akubuilu et al., 2020).

Internalists accept the claims of reliabilism, but defend that there are other desirable epistemic states and virtues besides reliable intellectual capacities. The internalist project seeks to impose non-externalist normative virtues such as responsibility, which is irreducible. Accountability has to do with more than the knower's reliability, namely his motivation, coherence of belief, and ability to articulate. Good connoisseurs approach not only in a reliable way, but also in the most responsible way possible, which is required by the seriousness of good research.

Zagzebski also disagrees with Sosa about the criterion of reliability as a good basis for knowledge (Zagzebski, L., 2000). For her, it is not clear how knowledge is superior to true belief if both are reliably produced. Moreover, reliability is far from the primary value of the intellectual virtues. Other values are understanding, wisdom and, as we have already indicated, responsibility. It is these values that we admire when we try to educate ourselves in epistemic virtue rather than simply trying to reliably arrive at some answers that are true at the end of the inquiry.

Reliability even in the field of articulation is, according to the thesis defended, a reliable process. When talking about virtue, there is no escaping the fact that this virtue is such because it manifests itself persistently in time, i.e. in a reliable way. If it manifested itself in an unreliable way, then it would be an epistemic accident rather than a virtue. Therefore, reliability is a kind of meta-value that is defining for all other intellectual virtues.

This is so because of the very process of ontogenetic development of cognitive abilities. The reason vision is reliable is because, over long periods of time, it has represented some kind of advantage over organisms that have no such mechanism for knowing the environment. Sight is a reliable advantage over organisms that have not evolved such a mechanism. An argument against this claim is that there are organisms that lack vision and other cognitive mechanisms, but this simply sidesteps the main issue. Clearly, vision is a desirable cognitive mechanism for humans because it is key to their cognition and evolved because it was reliable for the environment they needed to know to cope with its demands.

Internalists miss the point that any ability evolved because it was a reliable advantage over the alternative of not having it. Rationality is a virtue because it leads us not to random answers, but because it reliably guides us to the truth. Articulation is a virtue because it reliably states the grounds on which we accept something as justification. Responsibility is a reliable approach to research, etc.



Internalists and externalists distinguish between lower and higher knowledge, and people should strive to acquire higher knowledge. Inferior knowledge is more characteristic of animals because it is based entirely on reliable faculties alone. According to this distinction, people differ in that their knowledge is coherent, reflexive, and articulate. However, this distinction does not stand up to examination through the lens of neuroscience. Our cognitive abilities depend on the reliable functioning of neural networks in the brain. So a cognitive schema for higher cognition would look like this:

“S has knowledge k if and only if it can articulate the justification O for k. S can articulate O if the center in the brain responsible for language E is working well. If E works well, he is a reliable articulation ability. S knows k if E is a reliable mechanism.’

The aretic approach succeeds in analyzing the intellectual virtues and epistemic goods that are not limited to knowledge alone. Good research is as important as its output, and in some cases can be seen as a higher epistemic good. In a world where the Internet can provide true beliefs in a 2-minute Google search, the project of aretic epistemologists becomes increasingly important not only for defining desirable epistemic goals, but also for cultivating desirable qualities.

## 2.2. Justification, justifying factors and the architecture of justification

Much of the project of internalism and externalism is concerned with finding the grounds that make a rationale sound. The elements that are assumed to be related to how well justified a justification is are called justifiers (j-factors). If the justifying factors are primarily internalist, then we would prefer an internalist paradigm as the explanatory force for the validity of the justification. We would do the same if they were mostly of the externalist type. Goldman (2009) provides two criteria that, if proven, would tip the scales in the debate towards an externalist explanatory framework.

The first criterion is existential. If there is at least one justifying factor that satisfies the externalist requirements, then externalism is preferable. This is because internalism cannot provide a satisfactory explanation for these factors, while externalism has no difficulty accepting that there are cases in which the justifying factors are of the internalist type, but there is at least one that is not. The second criterion is majoritarian. According to him, if most justifying factors are of the externalist type, then internalism cannot be a preferred explanatory framework.

There are two types of justification. One is doxastic and the other propositional. The doxastic is the degree of conviction in a given proposition. Propositional is related to the evidence that p at a certain time t. Alston (Alston, W., 1989, p.192) defines the justifying factor as: "everything that affects the validity of the belief positively or negatively". Goldman extends this definition to a doxastic attitude by arguing that the justification of a belief or doxastic attitude is anything that is relevant in a positive or negative way to the justificatory status of that attitude. This extension allows one to cover causes that are not entirely states of mind.

What justifying factors are internalist? One is when we have access to a grounding factor and it somehow affects the grounding and/or doxastic relation to p. This approach is called accessibilism. The other is when the mental state we are in affects in a positive or negative way the doxastic attitude or justification. This approach is known as mentalism.

The task of externalism on the existential criterion is to find a grounding factor that we do not have access to and that is not a mental state. Goldman suggests rules for deriving the correct justifications. Analyzing these rules, if they are not of the internalist type, we can conclude that the resulting grounding factor is neither accessibilist nor mentalist. Goldman claims that through the linkage principle this can be achieved. According to this principle, we have a justification for a doxastic relation to p in t under certain conditions. These conditions must directly support the doxastic relation.

Internalists seek to assert that the rules are internal to S, but this design does not stand up to closer scrutiny. Let's see why. Rules are of two types – inferential and non-inferential. Inferential follows the rules of logic. Non-inferential are related to perception and/or memory.

Internalists argue that every perception or memory is actually an internalization of an external fact. This means that something external becomes part of a mental state, or is simply accessible to consciousness, and only then can it be a grounding factor. Without an external verifier of that soundness, it simply cannot claim anything about the soundness of the rationale. The only things it can claim with doxastic conviction are the relations between different mental (entirely internal) states.

Goldman offers the following scheme for inferential rules (Goldman, A., 2009, p.9):

"If subject S, at time t, justifiably has doxastic relations D1, D2...,Dm to proposition q, r..., s respectively and if proposition p has relation R to the conjunction of q, r..., s, then S is allowed to have relation Dn to proposition p at time t.'

The doxastic attitude itself is always internal to S. The very causes of that attitude, however, must be external to S in order to affect it in a positive or negative way. I.e. the justifying factors must fall under the externalist criterion.

Internalists attempt to defend their project of grounding factors for non-inferential rules by appealing to memory, and more specifically to a foundationalist theory of memory. According to her, all recall is conscious and is a justification for believing what we retrieve from memory. However, memory thus not only conveys grounding, but also creates it.

Heumer (1999) observes that this position has a serious flaw. If I cannot recall the grounds for a belief, but only the belief itself, then I would be more justified in believing the belief if the grounds were not good before, simply because I now remember the belief. If I do not remember the grounds on which to reject it, but only remember the belief itself, according to the foundational theory, I am justified in believing that r. A second difficulty with this theory is that every day that I recall the grounds , that p, give a new justification for believing in p. The memory M of p today justifies me O that p. Tomorrow the memory M + the new recall M2 gives me greater justification O2 that p. The passage of time itself would give me a stronger justification.

On these grounds, a foundationalist theory of memory fails to preserve the internalist project, but it is not the only theory linking memory to justification. Preservation theory

claims that memory is simply a warehouse that stores validity in the river. Here, memory cannot create validity, but only transmits it. This theory conveys validity over time, but may change the degree of validity as new evidence becomes available. This theory does not need mentalism and accesibillism because it does not depend on S's mental state at the time of believing that p, as long as he ever had good justification that p. Having preserved the degree of justification, that S cannot remembering his reasons for believing p does not mean that he is any less justified in believing that p.

In order to derive a scheme of the justification that perceptions give for believing that p, we must avoid the problem that perceptions sometimes mislead us. An analogy with law is presented here, where facts refer to laws, and we examine whether the facts follow the word of the law or violate it. Some such facts are direct evidence, while others are more circumstantial. Referred to the field of epistemology, the question would be an inquiry into what the rules of justification (laws) are, and when justification directly or indirectly violates these laws.

Whatever we may say about the laws of justification, we can claim that they are external to the knower. Legal laws apply to people whether they want them to or not and have consequences. Likewise, epistemic laws, good or bad, are external and do not concern the individual S. Goldman (1999) defends the relationship between belief and truth, realized through a reliable process (this is procedural reliabilityism) as constitutive of knowledge. Since most reliable processes are sensory, and without them we would know nothing about the external world, the external environment contains and enforces the rules of reasoning. Justifying factors are intrinsically external to S. Thus Goldman shows that, on both the existential and majoritarian criteria, externalism has greater explanatory power than internalism.

### 2.3. A critique of externalism and the problem of infinite regress

One of the problems that externalism has to deal with in terms of justification is that of infinite regress. This problem has to do with the fact that any proof of a belief requires proof of itself. At worst, the infinite regress problem leads to logical circularity or infinite regress.

For Bonjour (1999), the doctrine of the given provides the best answer to this problem. He builds his argument on two assumptions, the first of which relates to the relationship between adequate evidence and the guarantor of belief. According to him, if S has adequate evidence, then he is justified in believing in Zalabardo (2006) calls this assumption an evidentiary limitation on the guarantor (EL). Bonjour's second assumption is beautifully captured in a quote from Zalabardo (p. 3):,,... a subject has adequate evidence for a proposition she believes only if she has other warranted beliefs whose truth she believes make the truth of the present proposition probable.'

This assumption is called by Zalabardo the inferential framework for adequate proof (AP).

Under these two assumptions, there can be no evidence that warrants our beliefs and that evidence lead to an unwarranted belief (from the EL and AP constraints). Zalabardo

introduces another principle by which to avoid the circularity of NC (principle of non-circularity). According to Bonjour, it is not possible to have an unlimited number of beliefs and, if we accept EL, AP and NC, there is no belief that is guaranteed. Therefore, externalism cannot deal with the problem of infinite regress. Externalism is not required to accept these three assumptions. Some authors such as Armstrong (1973, p. 166), for example, argue that we can have knowledge that is "simple perceptual judgments". These judgments warrant our beliefs, without the need for the evidence Bonjour speaks of. Even if we don't have adequate evidence, that doesn't mean there aren't other avenues for a belief to be warranted.

If we direct our inquiry to the sources of warrant for our beliefs, then externalism can deal with the infinite regress problem. Reliabilism is the approach that advocates of externalism develop to give the conditions under which something warrants our beliefs. If p is the result of a reliable process M (procedural reliability), then this process M is a guarantor of p. Which processes are reliable? Most often these are cognitive processes such as perception.

However, Bonjour disagrees with the vagueness of what is meant by a "reliable" process. It offers a thought experiment in which clairvoyance is a reliable tool. Norman is a clairvoyant in a world where there is no reason to believe that this ability is unreliable or impossible. Norman believes, thanks to his clairvoyance, that the President of the United States is in New York, and there is no evidence for this belief. Bonjour finds this example counterintuitive. Because reliabilism assumes that if Norman's clairvoyance is reliable, then he has a warrant for his belief, then reliabilism makes a mistake by looking for the warrant conditions for our beliefs in "reliability."

Reliabilists reject this example, insisting that this thought experiment is "contaminated" by the belief that clairvoyance cannot be a reliable faculty. However, in a world where everyone has this ability and it achieves similar results, then we would call this ability reliable. This means that the ability is reliable regardless of who has it. Track and field speed is believable, Kryptonian super strength is believable in the DC comics universe, clairvoyance in a world with clairvoyants is believable in Norman's world if other people have it.

Even if other people in Norman's world do not possess the ability of clairvoyance, an argument can still be made that defends Norman's clairvoyance as a reliable ability. If a person with normal auditory perception ends up on an island whose inhabitants do not have this ability, it does not mean that auditory perception is an unreliable process. According to Bonjour's subsequent thesis, externalism succeeds in providing the conditions for a guarantor of beliefs, but not with the necessary explanatory power. This is the irrelevance thesis (Sosa, E., 1994).

However, this is another argument, and accepting that externalism can circumvent EL by reliably warranting beliefs means that the infinite regress problem is solvable by a purely externalist framework.

### **3. Definition of what a mental model is**

Before analyzing the concepts of 'model' and 'mental model', it is appropriate to justify the reason why technologies and cultural narratives will be considered as important to the

cognitive value of mental models in what follows. In their seminal paper, Chalmers and Clarke (1988) viewed consciousness as extended to external elements. This means that consciousness is not within the boundaries of the body, but extends to all external elements that participate in cognitive processes. For example, using a design software program becomes part of the designer's mind because it affects their overall cognitive competence. This, according to the authors, means that the external elements that are relevant to the competent performance of a given task become part of the system in which the agent and these external elements are included. Clark and Chalmers continue by writing (Clark, A., Chalmers, D., pp. 8-9): "... the human organism is related to an external entity in a two-way interaction, creating a joint system that can be seen as a cognitive system by itself. All components of the system play an active causal role and jointly govern behavior in the same way that cognition normally does. If we remove the external components of the system, its behavioral competence will drop, as if we remove part of the brain. Our thesis is that these combined processes count equally well as a cognitive process whether it is entirely in the head or not."

The thesis makes a more modest claim than the augmented consciousness hypothesis, namely that externalities are part of the increased or decreased competence of our mental models (since mental models are neural models and the identity theory is accepted, then consciousness cannot be expanded, at least as far as how it is used in the present work). An example of this is Galileo, who has a very reliable mental model, but without a telescope is not competent enough to make certain valid claims about the world. The environment has an active role in determining the competence and reliability of our mental models. Therefore, it can be assumed that the cultural narratives and technologies we use either increase or decrease the epistemic value of our mental models. Since these things are external to S, they fall under the explanatory framework of epistemic externalism.

To understand mental models, first consider the concept of 'model' as discussed by Williamson (Williamson, T., 2017). According to him, models are reduced cognitive constructs that allow the study of complex processes in the world. He says that (p.1): "When one model is replaced by another that covers more than just how a phenomenon works, then science advances."

Since the models are a reduced version of the phenomena being studied, the formal relations between the studied phenomena must be preserved. If the model succeeds in recreating these formal relations, then the inferences that can be made about that model can be applied to the modeled entity of the world itself. The problem that arises is that the conclusions of the model are simply approximations of the phenomenon under study. This can be circumvented through deductive thinking, but for Williamson, progress is made not by obtaining true statements, but by creating better models that better reflect the relationships in the world. In this sense, progress is when the results we get from using the model help us make the same model better.

One thing Williamson makes as a distinction that is not made in the thesis is the difference between a model and a universal statement. In the thesis, the universal statement is a kind of model of the world, because it is not assumed that there can be a representation that stands by itself, isolated from other representations. A universal statement is a kind of semantic representation of the world, but it represents some relations in the world itself and is

in relation to other representations such as visual, auditory and kinesthetic. Viewed in this way, there is no conceptual obstacle to considering it as a model for the world or as part of a model for the world.

In defense of this use of the concept of models, a statement from Popper is used, which he gives in his lecture (1977): "Let our hypotheses, our theories, die for us!". Peterson (2019) comments on this claim by saying, "We can construct *abstract models* (italics mine) of Being..., let these ideas die for us." Thus defined, it turns out that our thoughts are models of Being and their main role is to orient us in the world, and when they become unnecessary, to be abandoned or improved. This means that our minds are in a Darwinian competition and only the best approximations of the world survive.

The concept of a mental model first appeared in the work of Craik (1943), but was developed as a theory by Johnson-Laird (1983). One of the definitions given for a mental model is (Jones, R. et al, 2011, p.1): "Mental models are personal, internal representations of the external world that people use to interact with the world around them. They are created by individuals based on their unique life experiences, perceptions and understandings of the world. Mental models are used to think and make decisions and can underlie individual behavior. They provide the mechanism by which newly arriving information is filtered and stored."

Mental models are a cognitive structure that enables any other cognitive activity. Individually, representations simply reflect entities from the world. Only when we have integrated representations and other cognitive mechanisms such as thinking, memory and attention can we speak of a model that allows for adaptive behavior in the world. Let us make some assumptions in the work that further clarify the concept of "mental model".

1. A mental model is a representation.
2. It is constituted by perceptive and/or semantic elements.
3. Creates a world map that allows interaction with the world.
4. Mental model and neural structure are isomorphic.
5. Mental models create order in the flow of information.
6. The world can only be represented within a mental model, which means that much of it is ignored.

Damasio writes (2014, p.89): "Maps are formed when we interact with an object, such as a person, machine or place, in the following sequence – from the surface of the brain to its interior. Here I would like to emphasize the interaction factor. It reminds us that mapping is most often about a specific action that we need to take. Action and cards, movements and thought – they are all parts of an endless cycle."

The brain itself does not see. It interprets signals from receptor cells. Therefore, the creation of a representation for an image is simply a model (mental as opposed to computer) of the world. It is a miniature model that is obtained by stimulating certain biological mechanisms. Damasio goes on to point out specific brain structures that are involved in mapping. From this we can infer that the use of the word "mental" means neural. Because it is neural, we can look at mental models through the lens of externalism and what the environment's relation to the neural is and point out the contribution of this consideration to epistemology.

The moment we cite the necessary examples that convince us of the impossibility of divorcing neural and mental (examples are given by Eagleman (2017)) we can see that introspection and conscious access are not a good enough explanatory framework for mental models. These mechanisms have also been well criticized by other neuroscientists such as Gazzaniga (2019) and Sachs (2020).

The aim of the paper is to indicate that externalism is a preferred framework that can help to understand the interaction between the knower and the known. Much of the work of the nervous system is automatic and characterized by a lack of conscious control. Visualizing the neural system in formal terms has played a major role in the advancement of artificial intelligence (Chergarov, P., 2023) and is based on the classic paper by McCullough and Pitts (1943). The neural can be recreated formally to a certain extent. These arguments set the tone for the following sections, which show the specific relationships and influence of external factors on mental models.

#### **4. The influence of culture on mental models**

When we talk about an externalist framework to explain mental models, we cannot ignore the influence of culture. Culture is one of the biggest external factors that influence our cognitive schemas. Let's start by looking at what culture is. Taylor (2012) describes it as a complex whole containing shared norms, traditions, art and values. In the present work, this definition will be narrowed down to how culture facilitates the transmission of ideas from one people to another. For simplicity, it will be assumed that ideas are communicated verbally, although an argument can be made that the non-verbal method of communicating ideas is significantly more significant in a society.

Having defined culture and specified which part of it will be examined in more detail, let us make a further clarification that cultural narratives, i.e. stories that are primarily transmitted in society will demonstrate how culture plays a key role in shaping the content that is incorporated into a given mental model. Narrative is linguistic in nature and is explicative. It is for this reason that it is suitable for analysis here.

There are numerous experiments that support the influence that others have on our behavior. Since our behavior is the result of our model of the world, we can assume that if there is a difference in behavior, there is a difference in the mental model. And if there is a difference in the narrative that is dominant in a society and the narrative that was dominant before the current one, and together with this difference there is a difference in behavior, we can assume that cultural narratives have an influence on our cognitive schemes. One could counter this argument by saying that different mental models lead to different narratives and the relationship is the reverse of the above, but we will see compelling arguments that the model is a consequence of the cultural narrative rather than the other way around. However, it is difficult to draw a sharp line because the two are linked and influence each other, but the evidence weighs heavily in favor of the external environment shaping the pattern.

Several proofs of this are, for example, the experiments of Sheriff (1935) and Asch (1956). Nor are we the only species whose nervous system is shaped by social interactions. So are ancient species such as lobsters (Corson, T., 2005), which predate the dinosaurs by several million years. Social influence on the nervous system was present long before Homo sapiens.

Maddux (2008) shows that other people like us based on how much we imitate them. Earley and Livav (2000) show that people strive for difference. Burger (2017) argues that successful athletes worldwide are more likely to have an older sibling. Bandura (1961) demonstrated that we learn our behavior primarily by observing how others behave. All these studies suggest that we are extremely susceptible to external influence in a social context.

Three studies are key to the relevance of narratives to behavior. Crum and his team (2011; 2017) show that different linguistic formulation leads to changes at the biological level. The difference can be measured by blood pressure, heart rate, blood sugar, hormones and more. Another study (Brooks, A., 2014) shows that even what emotions we experience depends on how we define them linguistically.

The cultural narrative exemplified in the dissertation is that explored by Douglas Murray (2023) in his book *The War on the West*. This is the narrative of CRT (critical race theory). According to him, history is the development of a struggle between races, and this struggle has led to the present political and economic institutions. According to this narrative, the highest criterion for truth is subjective feeling. Furthermore, modern society is characterized as racist and people must fight against it by destroying all oppressive structures.

How does this narrative affect mental models? By distorting expectations and interpretation of incoming information. Center for Skeptical Studies (2021) shows that people overestimate black people killed by police officers. The drive to raise a generation of activists who share the narrative of CRT has led to the publication of books such as Nagara's (2012) where every letter is associated with this system (e.g. L is for LGBT, T is trans, etc.). The implications of this narrative is that Gallup (2022) indicated that people identifying as part of the LGBT community increased from 5.6% in 2020 to 7.1% in 2022.

Other consequences are in the field of economics, where Harris (1993) wants to abolish private property and redistribute it along racial lines. Some like Candy (2019) want to remove Hume, Mill, Kant, Aristotle, etc. philosophers from the programs studied, because of racist comments, often made under a note. Even the elite scientific journal *Nature* (2021) writes:

"Fighting systemic racism requires changing the system by which science operates...too often the conventional criteria—publications, citations, profits—benefit those in powerful positions rather than helping to shift the balance of power."

Some traditional virtues have been discussed by Jones and Okun (2001) as harmful and indicative of racism. Other writers want Shakespeare not to be studied, but for more non-white authors to be inserted as the only standard to be considered in curriculum development (Macgregor, A., 2021). A *Guardian* article (2021) also identifies botanic gardens as a form of elitism and systemic racism. Even mathematics is defined as a mechanism for pushing racial difference.

Apparently, cultural narratives have a huge impact on our behavior and our mental models. This is an argument in favor of the thesis that the validity and value of mental models should be viewed primarily through an externalist framework.



## 5. The influence of technology on mental models

Technologies that influence mental models are not limited to modern ones such as the Internet and electronic devices. However, it is they who will be the focus of consideration. They have a defining role in the formation of representations of the world and of the way of thinking.

One reason for considering modern electronic technologies is that they are used by many people and over a considerable period of time. For example, the Bureau of Labor Statistics (2004-2008) shows that American adults spend at least 6 hours in front of a screen. Because the brain is a plastic structure, the way neurons connect depends on which neurons are most frequently activated. The continued use of certain technologies reinforces the use of certain circuits, and hence patterns, at the expense of others.

Attention is greatly influenced by the use of technology (Ralph, C., et al., 2015). The cognitive cost the brain places on using a variety of highly and continuously stimulating technologies results in us processing new information more quickly, but not being able to hold our attention for long on one task (Ralph, C. et al 2014 & Ralph, C et al 2015). Hebruck and his team (2003) argue that learning new things is more difficult and takes longer if we are performing or engaged in more than one thing at a time.

Tapscott (2008) points out that even reading habits have changed with the advent of new technologies. The brains of people who read regularly are anatomically different from those who do not (Ostrosky-Solis et al., 2004). Wolff (2007) states that people who have mastered reading activate fewer neural networks associated with decision-making and analysis. This means that significant cognitive potential is freed up and can be directed to the assimilation of information and its connection with other elements, rather than its decoding. The newspaper *Dnevnik* (2023), for example, claims that 50% of Bulgarians have not read a single book in the past year, and online reading leads to shallower absorption and understanding.

Furthermore, Dijksterhuis (2004; 2008) points out that taking a break from a task allows for unconscious processing of information that is key to deep learning and understanding. In addition to rest, we must have a conscious purpose for this type of processing to occur. Distraction with constant access to new and interesting information hinders this process.

The medium through which we access the new information also matters. Miall and Dobson (2001) show that reading on an electronic medium leads to difficulty in understanding and remembering the plot and main characters in a fiction text. People who read on paper do not have such difficulties. Rockwell and Singleton (2007) show that presentations that contain audiovisual content also interfere with the assimilation of what is presented. Students who use laptops during a lecture (Hembrooke, H., 2003) do worse on a test that is given immediately after the lecture itself, while students who take written notes do not have this problem.

All these results show that parts of our personal identity can be changed. Damazio (2009) suggests that some emotions may be inaccessible to experience because of the nature of the neural mechanisms that produce them, which require more time to activate. If they do

not have this time, then they are not activated. In an article examining the emotion problem (Mar, R. A., K. Oatley, and J. B. Peterson; 2009) wrote, “After controlling for variables, familiarity with fiction was a good predictor of performance on empathy tasks... fiction correlates with social support. Reading nonfiction, in contrast, was associated with loneliness and negatively correlated with social support.” Some results suggest that people are becoming increasingly unable to empathize (Konrath, S. H., E. H. O'Brien, and C. Hsing ; 2010).

Technologies shape our models of the world and through the metaphors that enter everyday use. Lakoff and Johnson (1980) argue that metaphors shape our thinking and perception. This happens by moving elements from one field to another. The metaphor of time as money leads accordingly to the perception of time as an investment, and so on. One of the greatest influences of technology is the computer metaphor (Cisek, P., 1999). This metaphor gives some impetus to the study of consciousness, but is inaccurate if taken literally and leads to certain misconceptions.

What has been described so far shows us how technology has the ability to influence our models of the world. They determine the functioning, constitutive nature and content of mental models. The implications of this are still under analysis.

## **6. Reliabilism and mental models**

Considering the value of mental models and their place in aretic epistemology can entail a bias towards internalism. In this section, arguments are offered in defense of considering the value of these cognitive schemas through a purely reliabilistic framework.

Mental models can be viewed as reliable cognitive mechanisms. One external criterion in considering these cognitive constructs is the similar output that different models produce. If different models, with different premises, assumptions and functioning, lead to similar conclusions, then these conclusions can be assumed to be of higher epistemic value compared to what would be obtained from models with the same assumptions and functioning. The reliability of the mental model is derived from reliably obtaining a certain result. The frequency of the result is high enough to be non-random and this result is epistemically significant.

This means that the reliability of mental models is constituted in a way external to the mental model itself (P1). When different mental models lead to the same result, then this result is more reliable (P2). If different experts make arguments in defense of the same thesis, then the probability that this thesis is true is more likely than if only experts from one field defended it.

Some facts of the world point to precisely such an external epistemic value of mental models. The assimilation of rich experience is more valuable for the founding of technology companies (Azoulay et al., 2020). A wealth of experience means more models at S's disposal. Intelligence is a significant factor, but not more significant, because if it were, the average age of founding companies in the IT sector would be lower than 45 years.

For example, Nobel Prize-winning scientists are 22 times more likely to engage in side hobbies than their peers. Broad-spectrum interests have been shown to correlate with academic achievement (Root-Bernstein, R. & Root-Bernstein, M., 2004). Another example of the value of mastering multiple mental models comes from the research of Flynn (2007). He notices that children's IQs rise every decade, and this happens because of the education he teaches in abstract models. This statement is supported by Luria (Homskeya, D., 2001), who noticed great differences in the thinking of the urban industrialized society and the backward rural areas in the USSR. Epstein writes (2021, p. 58):

„It is also true, however, that the modern way of life requires a wide scope and the discovery of connections between very distant realms and ideas. Luria analyzed this type of "categorical" thinking, which Flynn would later call "science-like glasses." "Usually it is very flexible," Luria writes, "subjects easily transfer from one attribute of objects to another and construct the corresponding categories. They classify objects by nature (animals, flowers, appliances), by material (wood, metal, glass), by size (large, small), by color (light, dark) or by other characteristics. The ability to move freely, to move from one category to another, is one of the main characteristics of "abstract thinking.““

Dunbar (1995; 2001) observed that laboratories with diverse experts make faster breakthroughs in the research field compared to laboratories in the same field but with homogeneous scientists. Tetlock (2005), on the other hand, studied the people who make the best predictions about world events and came to the conclusion that people who integrate different streams of information do better than experts who have access to classified data.

To understand the epistemic value of mental models in an externalist explanatory framework, we can turn to examining the qualities of someone we exemplify intellectually and indicate why those qualities are admirable. In parallel with the ethics of the moral virtues, the intellectual virtues will be considered here. The epistemic example we will focus on here is that of John von Neumann.

Zagzebski, who deals with aretic epistemology, writes the following about moral examples (2013, p.2):

1. To fulfill the philosophical goal of creating a comprehensive ethical theory,
2. To fulfill the practical purpose of moral education by structuring the theory around motivating emotion,
3. To connect a priori ethics with empirical research in psychology and neuroscience,
4. To contribute to the ongoing attempt to find a moral dialogue that has a thin version for cross-cultural debate and also a dense version for use in particular communities.'

Carrying these points over to the field of epistemology, we can say that the intellectual virtues of the admirable knower serve the practical purpose of inciting emulation. What were von Neumann's intellectual virtues and how did he acquire them?

He is first and foremost a man of broad interests who has been involved in the development of game theory, set theory, number theory, the architecture of modern computers, and much more. It also participated in the Manhattan Project (Bhattacharya, A., 2022).

John von Neumann purposefully acquired a set of different mental models by memorizing technical formulas from his physics, mathematics, and theoretical biology textbooks. He realized that models can be transferred and have epistemic utility from one field to another. Some practical pointers from his epistemic example are:

1. Examine the syntactic sequence of a given mental model.
2. Master heterogeneous mental models whose syntactic sequence is repeated in other areas of scientific knowledge.

All this points to an arethical explanation that is of an externalist type. Knower responsibility remains an epistemic virtue, but examining the role of reliabilism in explaining mental models shows us that internalism is not a required framework when we talk about mental processes.

## **7. Conclusion**

The examination of mental models in a purely externalist framework can be considered the main contribution of the dissertation work. At the time of writing, there is not a single title addressing internalism or externalism in relation to mental models. When we talk about the mental, internalism seems like the main explanatory framework, but this can only be so if one ignores many advances in cognitive science. A naturalized epistemology should view these cognitive schemes primarily through externalism.

The concept of "mental" cannot be divorced from "neural". Empirical evidence does not support such a dichotomy. Confidence in these data is justified by the most rigorous methods possible that any field of study has used. If they are rejected, empirical knowledge itself must be rejected as a reliable and valid way of knowing. Insofar as the mental model is a neural model, the modeling of external entities is determined by these external factors. As we have shown, the external factors that influence patterning by influencing neural structure determine the mental models themselves.

The main thesis is defended based on the arguments in favor of preferring externalism as a stronger explanatory framework over internalism. The goals that were set at the beginning of the work have been fulfilled. The debate between internalism and externalism was outlined and the concept of mental model was introduced into its framework. A virtue that is not internalist is successfully demonstrated. The result of the research was realized thanks to the methods which, due to the multiple relevant fields of research, are interdisciplinary.

There remain some interesting fields for further research. One of these is the gap between AI and mental models, which will be an increasingly pressing topic as self-learning systems close the gap with human mental models. Another has to do with the clash between different mental models in a cultural context. A third field is the study and pedagogical value of different models in education. These are issues that received little attention in the dissertation and may be of interest for future analysis.

### **Contributions :**

- Arguments of a conceptual nature are presented for accepting the explanatory framework of externalism in epistemic virtues, justification, justifying factors and knowledge.
- A solution to the infinite regress problem is proposed that does not undermine the positions of externalism.
- A conceptual analysis of the concept of "mental model" was made.
- The thesis constructs the argument that culture, which is external to the knower, has a huge influence on mental models and therefore their explanation must be in an externalist framework.
- The impact of technology on mental models is examined with the same result as in the previous point.
- Aretic reliabilism is shown to be appropriate in explaining epistemic virtue as an aspect of mental models.

### **Publications in connection with the dissertation :**

Чергаров, П. (2023). Сравнителен анализ на ментални модели и изкуствен интелект. Обучение по природни науки и върхови технологии, 32(2), pp.140–157. doi:<https://doi.org/10.53656/nat2023-2.04>.

Чергаров, П. (2022). Ментални модели и решаване на проблеми. Научни предизвикателства – годишник за студенти, докторанти и научни ръководители, т. 2, pp. 165-172.

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