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¿Surrogative Reasoning as Representational or Logical-Based Thinking?

¿Razonamiento sustituto como pensamiento basado en la representación o en la lógica?

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Abstract

The aim of our paper is to carry out a critical analysis of the notion of representation as a basis for hypothesis generation in scientific modelling. Indeed, we will show the inconsistencies generated by this way of grounding hypothesis generation in some of the most representative approaches to scientific representation. Depending on the approach and the definition of representation considered, we show that these inconsistencies range from the use of non-logical resources to a certain circularity in the definitions. The idea underlying all this critique is that *surrogative reasoning* must find its foundations in logic itself.

Keywords: representation; hypotheses; surrogative reasoning; model; target system.

Resumen

El objetivo principal de nuestro artículo es realizar un análisis crítico de la noción de representación como fundamento de la generación de hipótesis en la modelización científica. En efecto, mostraremos las inconsistencias que genera este modo de fundamentar la generación de hipótesis en algunos de los más representativos enfoques sobre la representación científica. Dependiendo del enfoque y la definición de representación considerada, mostramos que estas inconsistencias van desde el uso de recursos no lógicos hasta cierta circularidad en las definiciones. La idea que subyace a toda está crítica es que *surrogative reasoning* debe encontrar sus fundamentos en la lógica misma.

Palabras clave: representación; hipótesis; razonamiento sustituto; modelo; sistema objetivo.

1. Introduction

The reader of this paper may have been curious about the title we choose. What other than logic could something called reasoning be? On what other than logic could any reasoning be based? Of course, one could argue about the meaning of '*logical*' and what logic we would be talking about. However, from our point of view, justifying 'reasoning' in something other than logic, it seems an adequate proposal. Concretely, this paper argues against approaches that defend the hypotheses generation, from a model *M* and on a target system *TS*, as a subsidiary issue to the notion of representation. Indeed, according to how it was first identified by Chris Swoyer (1991) —and it has been worked on by different authors such as Robert Sugden (2000), Mauricio Suárez (2004), and Uskali Mäki (2009)— and has been synthesized by Roman Frigg and James Nguyen (2017), *surrogative reasoning* is identified with a certain type of *representational-based thinking*. In the following, we will show that this idea is only an extension of realist presuppositions based on certain perspectives of the notion of modeling. On the other hand, we will give a justification of why surrogative reasoning must find its basis in logic itself.

2. On modelling in science

As is well known, modeling is one of the main scientific practices that consists on constructing and using models to represent, explain, understand, predict, teach or manipulate phenomena, among various other uses. Models have unquestionable usefulness, 'ductility,' and variety, which justifies scientists' predilection for this type of tool. In the philosophy of science, models have been a topic of great interest since the 1960s, since the emergence of the semantic approach to scientific theories (Suppes, 1960, 1962, 1970, 1974; Stegmüller, 1970, 1973; Sneed, 1971; van Fraassen, 1980; Balzer *et al.*, 1987; Giere 1988, 1999; Worrall, 1989; da Costa and Steven French, 2003). Today, scientific modeling continues to occupy an important place on the agenda of most philosophical approaches to science, mainly because of its dynamic nature and the consequences that models have —in general— for the understanding of scientific knowledge, especially in 'more complex' areas such as biology or economy.

3. Models and representation

The dominant philosophical perspective of models, in which the semanticist conception is introduced (Lopez-Orellana and Redmond 2021), has been understood from the concept of *scientific representation* (Cassini, 2016): models are *idealized* or *simplified representations* of phenomena. Indeed, the idea of representation has a long tradition in philosophy; it refers to how we access and know the world. Indeed, within the different contemporary approaches to scientific realism, it is assumed that representation is the most crucial function of a model (van Fraassen, 1980, 1987; Kitcher, 1993; Giere, 1988, 1999; Morrison, 1999; Suárez, 2016). This function establishes the correspondence relationship between the structure of theories and the structure of world phenomena. It shows a close but confusing relationship between the notions of model and representation. It is not easy to set limits between their meanings (Chakravartty, 2010, 198). Still, they all listen to the wide range of *tools* with which scientists represent the world: equations, flowcharts, photographs, graphs, diagrams, affinity trees, magnetic resonance imaging, computer simulations, theories, and models, among many others.

But in philosophy, there is no agreement on what representation can be, especially in the empirical sciences. The elucidations on the concept of representation appeal to different types of relations between models and phenomena, such as 'homomorphy,' 'simplification,' 'idealization,' 'abstraction,' 'approximation,' 'distortion,' 'mediation,' 'fictionality,' among others; resulting in the lack of a complete theory, especially about the use and general process of scientific modeling. Of course, there are different answers with different nuances. However, the question is still active: what is the most appropriate way to the scientific evidence in which the models and systems of phenomena are related to which they are directed? Let's look at the latter in more detail.

4. Models and problematic portions of phenomena [*PPP*]

The modeling of phenomena is as extensive as the possibility of considering different types of phenomena. Therefore, for our paper, we restrict ourselves to considering those cases in which the phenomenal portion considered for modeling presents itself as problematic. That is, we define a problematic portion of phenomena (*PPP* henceforth) as that which presents itself as a real challenge to understanding. Either because we do not know if it is there or if it is one, if there are many, or what exactly is there —it is an *ontologically uncertain phenomenon* (Redmond, 2021)—. And we do not know the latter because of our limitations relative to both macro and micro of this portion and its complexity. Either they are chaotic phenomena or phenomena whose regularity (if any) is very difficult for us to establish. It is these *PPPs*, from our point of view, which present a real challenge for the generation of hypotheses from a model. Finally, in the present work, we will consider *TS* = *PPP*.

5. Conditions for a suitable modeling approach

The consideration of substitute reasoning is part of what Frigg and Nguyen (2016) call problems and conditions that every approach to modeling must meet to be considered suitable. These authors argue that any perspective on scientific representation firstly must be able to fill in the blank space in the following scheme:

‘*R* is a scientific representation of the target system *TS if and only if* ___.’[1]

This formula is known as the Problem of Scientific/Epistemic Representation (*Scientific Representation Problem*; *Epistemic Representation Problem*). The difference between scientific and epistemic refers to what Craig Callender and Jonathan Cohen (2006, 68-69) point out as the ‘demarcation problem’ (following Popper) for ‘scientific representations,’ for those who demarcate scientific representations from those that are not; and ‘epistemic representations’ for those who consider this distinction irrelevant, following the suggestion of Gabriele Contessa (2007) to expand the scope of research.

Other issues that need to be addressed for a well-defined modeling perspective are as follows:

i. The *representational demarcation problem*: the question of how scientific representations differ from other types of representations.

ii. The *problem of style*: what styles are there and how can they be characterized?

iii. The formulation of *standards of accuracy:* how to identify what constitutes an exact representation?

iv. The *problem of ontology*: what kind of objects serve as representations?

In addition, as *conditions of adequacy* or *sufficiency*, the following issues should be taken into consideration:

v. *Surrogate reasoning*: scientific representations should allow hypotheses to be generated about their target systems.

vi. *Possibility of distortion* (*misrepresentation*): if *R* does not exactly represent *TS*, then it is a distortion but not a non-representation.

[1] Here we have replaced ‘S’ (*scientific representation*) by ‘R’, and also ‘T’ (target) with ‘TS’ (target system), from the original scheme of Frigg and Nguyen (2016).

vii. *Targetless models*: answer the question, *what should we do with scientific representations that lack targets but are equally successful?*

viii. *Directionality requirement*: scientific representations refer to their targets, but targets do not refer to their representations.

ix. *Applicability of mathematics*: how is the mathematical apparatus used in some scientific representations linked or linked to the physical world?

In the face of these challenges, different approaches have taken them seriously and resolved each of them to a greater or lesser degree. A summary of these approaches can be found in Frigg and Nguyen (2017) and Redmond (2021). For the interest of our paper, we will now focus only on the notion of surrogate reasoning.

6. The challenge of justifying surrogate reasoning

In the general literature (Frigg and Nguyen, 2017) the practice of generating hypotheses based on the model (*M*) and on the target system (*TS*) is called *surrogative reasoning.* The idea comes from Swoyer (1991, 449), which defines it as a type of thinking based on representation, since the relationship between *M* and *TS* is a relationship of *structural representation*:

> Structural representation enables us to reason directly about a representation in order to draw conclusions about the things that it represents. By examining the behaviour of a scale model of an aircraft in a wind tunnel, we can draw conclusions about a newly designed wing's response to wind shear, rather than trying it out on a Boeing 747 over Denver. By using numbers to represent the lengths of physical objects, we can represent facts about the objects numerically, perform calculations of various sorts, then translate the results back into a conclusion about the original objects. In such cases we use one sort of thing as a surrogate in our thinking about another, and so I shall call this surrogative reasoning. (Swoyer, 1991, 449)

For Swoyer, structural representation or representation with models allows reasoning about the things he represents or models. The aim of these representations is *to mediate inferences* about the phenomena of the world (cf. Lopez-Orellana *et al.,* 2019). Of course, this is because such representations have "many of the same structural characteristics as these phenomena [...] such a shared structure precisely explains the applicability of a wide range of representation systems —including many non-mathematical ones— to the things they represent" (Swoyer, 1991, 451).

In short, according to Swoyer, the link between *M* and *TS* is then strictly representational. In effect, what justifies —or, as Frigg and Nguyen (2017) say, what 'allows explaining'— the extrapolation of these conclusions to the *PPP* as a hypothesis is then the very notion of representation. With this, we are forced to assume that the inferential process of modeling is based on representation. We believe that this is a profound mistake. How is it possible for an inferential process to be based on a notion that is not logical? And, in general, how to explain this claim that a logical process, such as surrogate reasoning, is considered a type of representation-based thinking?

To start answering this question, let us first consider how different approaches generally represent the inferential function engaged in modelling:

1. *M* is presented and identified through quantitative (mathematical) and/ or qualitative descriptions (properties, relationships, functions, Etc.), both retrieved both from the information provided by the *PPP* (mostly through measurements) and from different theoretical approaches (Physics, Chemistry, Biology, Etc.).

2. From the data of *M*, conclusions are inferred according to different types of 'inferential relationships' (deduction, induction, abduction, Etc.)

3. What is inferred in *M* is *extrapolated* and tested or evaluated, as a hypothesis, in the *PPP*. The double standard of statements, conclusions on one side, and hypotheses on the other.

If extrapolation is based on the notion of representation, then 3 is not part of surrogative reasoning, i.e., it is not a logical process. But we believe the opposite: 3 must be considered a logical process, i.e., as part of surrogative reasoning. So now, how to understand and justify the latter from a logical point of view?

Our point is that the appeal to the notion of representation is part of a realist epistemological program. That is to say, in the perspectives on representation assumed by some approaches to modelling practice, there are ontological commitments that are extrapolated (inappropriately, according to our point of view), as a justification for the inferential process engaged in modelling. We will now analyze the impact of the paradigmatic realist approach of classical logic on the most known approaches to representation.

6.1 Representation and realism

The *realistic point of view* (scientific realism) we are referring to, as Anjan Chakravartty (2017) points out, is a positive epistemic attitude towards the content of our best theories and models, which manifests itself from the classical perspective of the Inherited Conception to the semanticist or metatheoretical positions that continue to have a strong influence today (Lopez-Orellana, 2020). Following Stathis Psillos (1999), this attitude translates into three central theses:

i. a *metaphysical thesis*: the world has an unequivocal structure independent of the mind;

ii. a *semantic thesis*: theories are descriptions of their unobservable and observable domain and are likely to be true or false. If theories are true, the unobservable entities that postulate exist in the world; and

iii. an *epistemic thesis*: mature and predictively successful scientific theories are well confirmed and are roughly true about the world.

As Antonio Diéguez (1998) correctly points out, i. and ii. compromise the existence of theoretical entities postulated by mature theories; in other words, the terms of scientific theories are not referentially empty. In addition, ii. affirms the basic *correspondence* between theories and phenomena (reality). And iii. states that "scientific theories provide us with adequate (albeit perfectible) knowledge of phenomena (reality) as it is irrespective of our cognitive processes" (Diéguez, 1998, 79, our translation). These are, in short, the ontological commitments that a realist maintains —with different nuances—.

Concerning models, as we have already pointed out, scientific realism assumes that representation is the most important function of a model and that it establishes the correspondence relationship between the structure of theories and the structure of world phenomena. The existence of such structures is then assumed.

The following is a schematic and non-exhaustive presentation of the most well-known approaches to representation.

6.2 The structuralist conception

This perspective (Balzer, Moulines, and Sneed 1987; Worrall, 1989; van Fraassen, 1987; Giere, 1988; and others) assumes that representation is a dyadic relationship of correspondence between the representative vehicle (the model) and its target system, as being two types of structures, as being two kinds of structures. (v. g., Cartwright *et al.*, 1995; Morrison and Morgan, 1999; Suárez, 2003; Suarez, 2004; Knuuttila and Merz, 2009). Therefore, the notion of representation has been approached based on the metaphor of 'mirror,' 'speculum,' or 'replication' (mirroring), which have to do with the concept of morphism (homomorphism, isomorphism, etc.) From our point of view, the more representative definitions, as presented by Frigg and Nguyen (2017), are the followings:

> *Structuralism 1*: A scientific model M represents its target T iff S_M is isomorphic to S_T.
>
> *Structuralism 2*: A scientific model M represents a target system T iff there is an agent A who uses M to represent a target system T by proposing a theoretical hypothesis H specifying an isomorphism between S_M and S_T.

The target system exhibits an $S_T = \langle U_T , R_T \rangle$ structure and the model an $M_T = \langle U_M , R_M \rangle$ structure, both composed of the corresponding elements of each universe and their relations.[2]

6.3 The similarity conception (or cognitivist perspective)

Ronald Giere (1988) states that models are entities of a broader nature and without a given form (diagrams, drawings, maps, organisms, Etc.), which are used based on a connection of a type different from that of mathematical or logical connections (instead of mathematical isomorphism): the *similarity*. In this way, Giere emphasizes the scientific uses of the different models that scientists employ in their practices, not only the mathematical ones. This shows that the models are rather similar in certain aspects and sufficient degrees depending on their use and according to a specific epistemic context (Giere, 1988, 81). Thus, the relationship between a model and the actual system it represents is established by similarity, and this means that the representational function of a model understood as similarity leads to thinking of models in cognitive and pragmatic terms: "they are 'internal maps' of the external world" (Giere, 1988, 6). The success of representation can be explained by the success of our cognitive capacities, in our ability to build and use a model for a specific epistemic purpose, mainly to explain or predict phenomena.

From this perspective, the more representative definitions, in our view, are the following presented by Frigg and Nguyen (2017): *Similarity 2*: A scientific model *M* represents a target *T* iff *M* and *T* are similar in relevant respects and to the relevant degrees. *Similarity 3*: A scientific model *M* represents a target system *T* iff there is an agent *A* who uses *M* to represent a target system *T* by proposing a theoretical hypothesis *H* specifying a similarity (in certain respects and to certain degrees) between *M* and *T* for purpose *P*.

6.4 The inferentialist approach of Mauricio Suárez

There is currently a different approach, the *inferentialist approach* of Mauricio Suárez (2004), which displaces the notion of representation to focus on the surrogative inferences about phenomena using a model: *models are primarily tools that allow us to target and generate plausible hypotheses about their systems of phenomena* ('*target systems*'). Following Mäki (2009, 32-33), this perspective asserts that when we say that a model (*M*) 'represents' a certain *TS*, we want to

[2] "Two structures $S_a = \langle U_a ; R_a \rangle$ and $S_b = \langle U_b , R_b \rangle$ are isomorphic iff there is a mapping $f: U_a \rightarrow U_b$ such that (i) *f* is one-to-one (bijective) and (ii) *f* preserves the system of relations in the following sense: The members $a_1 , \ldots , a_n$ of U_a satisfy the relation r_a of R_a iff the corresponding members $b_1 = f(a_1), \ldots , b_n = f(a_n)$ of U_b satisfy the relation r_b of R_b, where r_b is the relation corresponding to r_a" (Frigg and Nguyen, 2017, 58).

indicate that *M* is the *TS* surrogate system. This idea suggests a minimalist (or deflationary) way of defining representation. So, the primary function of a model is its inferential function, which allows us to gain knowledge not by directly examining *TS* but rather by directly examining M (*indirect* knowledge of *TS*), as long as *M* is 'coherent' or 'addresses' the target system in appropriate aspects and to sufficient degrees. In short, the best way to understand the relationship between models and phenomena is to assume that inferences fill the gap between the 'model world' and the real world, whether deductive, inductive or abductive (Sugden, 2000, 3). Scientific modeling proceeds in this way, and it just depends on the ability of scientists —*agentiality*— to target and make inferences from models. Thus, the scientific representation is defined by the following scheme:

> [Inf]. *A* represents *B* only if (i) the representational force of *A* points towards *B*, and (ii) *A* allows competent and informed agents to draw specific inferences regarding *B*. (Suárez, 2004, 773)

7. Critics

As a critical exercise, let us now replace each of these definitions in Swoyer's proposal for surrogate reasoning. We will summarise Swoyer's proposal (as also defined by Frigg and Nguyen 2016) as follows:

Surrogate reasoning is based on the idea that *M represents TS* and consists on the hypotheses generation from *M* and about *TS*.

For the structuralist approach, if we replace '*M* represents *TS*' for the corresponding definition, we have:

For *structuralism 1*, the replacement would be:

A. Surrogate reasoning is based on the idea that [there is an isomorphism between S_M and S_{TS}] and consists on the hypotheses generation from *M* and about *TS*. In other words: surrogate reasoning is a kind of thinking based on the isomorphism between S_M and S_{TS}, and consists on the hypotheses generation from *M* and about *TS*.

Critical remarks: once again we insist that if surrogative reasoning is to be considered a logical procedure, it cannot be based or grounded on properties of phenomena such as isomorphism between structures presupposed as present in phenomena. We believe that the metaphysical thesis of realism is present in this proposal.

For *structuralism 2* the replacement would be:

B. Surrogate Reasoning is based on the idea that [there is an agent *A* who propose a theoretical hypothesis H specifying an isomorphism between S_M and S_{TS}], and consist on the generation of hypotheses from *M* and about *TS*. In other words: surrogate reasoning is a kind of thinking based in an agent who propose a theoretical hypothesis H specifying an isomorphism between S_M and S_T, and consist on the generation of hypotheses from *M* and about *TS*.

Critical remarks: this definition of representation (which assumes a pragmatic turn), generates a certain circularity as it assumes entitlement to [generate an *H* from *M* and about *TS*] is based on an agent being able to propose a theoretical hypothesis *H* specifying an isomorphism between S_M and S_{TS}.

It should be noted that this complication arises because this definition justly included the notion of hypothetical reasoning to solve other difficulties of Structuralism 1, as acknowledged in Frigg and Nguyen (2017, 70):

> Most of these problems can be resolved by making moves similar to the ones that lead to *Similarity 3*: introduce agents and hypothetical reasoning into the account of representation.

But what else is this hypothesis resulting from hypothetical reasoning than the hypothesis generated as substitute reasoning?

For the notion of representation in the similarity approach, we would have the following:

For similarity 1:

C. Surrogate reasoning is based on the idea that [*M* and *TS* are similar in relevant respects and to the relevant degrees], and consist on the generation of hypotheses from *M* and about *TS*. In other words: surrogate reasoning is a kind of thinking based on the similarity between *M* and *TS* in relevant aspects and to the relevant degrees, and consist on the generation of hypotheses from *M* and about *TS*.

Critical remarks: as in A, we have a logical procedure, surrogative reasoning, based on a correspondence between properties of phenomena, even more indeterminate than that of structuralism, such as similarity. We also believe that the metaphysical thesis of realism is present in this proposal.

For similarity 2:

D. Surrogate reasoning is based on the idea that [there is an agent *A* who propose a theoretical hypothesis *H* specifying a similarity (in certain respects and to certain degrees) between *M* and *TS* for purpose *P*], and consist on the generation of hypotheses from *M* and about *TS*. In other words: surrogate reasoning is a kind of thinking based in an agent *A* who propose a theoretical hypothesis *H* specifying a similarity (in certain respects and to certain degrees) between *TS* and T for purpose P, and consist on the generation of hypotheses from *M* and about *TS*.

Critical remarks: as in B, we believe we detect a certain circularity when it is assumed that the generation of hypotheses from *TS* and about *TS* is based on an agent *A* proposing a theoretical hypothesis specifying physical properties and with a purpose *P*.

6.5 The case of Mauricio Suárez's inferentialist approach

If we rewrite the definition of surrogative reasoning only considering the second of the two necessary conditions proposed by Suárez: (ii) *M* allows competent and informed agents to draw specific inferences regarding *TS*, we would have the following:

E. Surrogative reasoning is based on the idea that [*M* allows competent and informed agents to draw specific inferences regarding *TS*] and consist on the generation of hypotheses from *M* and about *TS*. In other words, surrogate reasoning is a kind of thinking based on a competent and informed agent who draws specific inferences between *M* and *TS*, and consist on the generation of hypotheses from *M* and about *TS*.

Critical remarks: As in B and D, hypothesis generation (surrogative reasoning) is based on the fact that *M* allows agents to draw specific inferences regarding *TS*, i.e., to generate hypotheses from *M* and about *TS*. And what else is 'to draw specific inferences' but the generation of hypotheses?

7. Logic and realism: the contribution of classical logic to realism

Our point is that the basic logic that is used in most of the inferential processes in logic is the logic known in the specialized literature as classical logic (Frege-Russell-Quine tradition). And the semantics that characterizes this logical approach is ontologically committed. Indeed, according to Stewart Shapiro and Teresa Kouri Kissel (2018), the semantics of classical logic are characterized by the following:

- a *K* set of non-logical terms;
- an interpretation for the language L_1K = to the structure $M = \langle d, I \rangle$
- *d* is a non-empty set called the domain of discourse.
- *I* is an interpretation function.

The most relevant feature of this semantics is that if *k*1 is a constant in *K*, then *I* (*k*1) is a member of domain *d*.

Indeed, as the authors point out, each constant denotes something. Systems in which this does not happen are called *free logics*. The two logical principles that reflect this commitment are (i) the principle of Existential Generalization

(EG): $Fb \rightarrow x\,(Fx)$, that is, if b is F, then there is something that is F. The second principle —as Reicher (2019) points out— is less prominent, rather rarely explicitly stated, but often tacitly assumed. It is about the Predication Principle (PP): $Fb \rightarrow x\,(x = b)$, that is, if b is F, then there is something that is identical to b.

Our point is that using classical logic engages us ontologically. However, how does this connect with the notion of representational-based thinking? To answer this question, we must bear in mind that classical logic is not expressive enough to justify that what is proved in *M* is also justified in *TS*. But to resort to the notion of representation to explain the latter is to align oneself with the ontological commitments of classical logic, mostly expressed in terms of reference or denotation. That is, we believe that the realist commitments assumed by the semantics of this logic give rise to the proposal we criticize. Of course, we do not mean that classical logic finds its ultimate foundation in representation, but denotation somehow entails this commitment. Thus we propose that the challenge is how to think of a purely logical foundation for this justification that what is proved in *M* has sustainability in *TS*.

8. Surrogate reasoning as *logical-based thinking*

In the present paper, we have called surrogative reasoning, following Swoyer, the general act of generating inferences between *M* and *TS*. In general terms, it would be a matter of obtaining conclusions in *M* that are then considered legitimate to be evaluated in *TS*. From our point of view, there is a kind of transposition of conclusions from one place to another. Several things should be borne in mind here.

Firstly, that surrogative reasoning requires a logical justification that points to how the conclusions obtained in *M* will be considered for evaluation in TS, and not to how these conclusions were obtained in *M*. We believe that an interesting discussion is opened here regarding the latter, especially when these conclusions are obtained by abduction in *M*, but this is not the objective of the present article.

Secondly, the conclusion obtained in *M* has, in this surrogative reasoning process, a double standard: the conclusion of a reasoning on the one hand and hypothesis on the other. We will develop this further below. Thirdly, from our point of view, the inferential process seems to be divided here into two well-defined instances: on the one hand, the conclusion obtained in *M* and, on the other hand, considering that conclusion as legitimate in *TS*. We will call these two instances as *proofs*. Therefore, our claim is that if we are going to call what is inferentially generated in *M* a hypothesis (*H*) in *TS*, it is not only because it is a conclusion obtained in *M* but also because there is a logical process that grounds the legitimacy of that conclusion as a hypothesis in *TS*. That is, on the one hand, we have the proof that supports the conclusion in *M* and, on the other hand, the logical justification necessary to affirm that this conclusion gains the status of hypothesis in *TS*. However, it is always the same insight obtained in *M*. It is therefore necessary, we believe, to understand that the splitting we pointed out above corresponds to a dependence relation.

So, when I prove a statement p in *M* and then sustain it in *TS*, it is not because between *M* and *TS*, there is a relation of representation, but because there is a relation of dependence between the proof in *M* and its sustainability in *TS*. And this dependence, this is our claim, is a logical dependence and must be justified from a logical point of view. So let us now develop the idea of double standards for the conclusion drawn in *M* a little further.

9. Double standards and provisionality

By double standards we mean that a conclusion drawn in *M* attains the status of a hypothesis in *TS*. If we follow the meaning of hypothesis as "a plausible supposition, with which we anticipate knowledge because it is intended to be evaluated by direct observation or by the observation of its consequences, i.e. a hypothesis" (Lalande, 1997, 428), we have that the change of status is very clear. What is the conclusion of a reasoning in *M* that reaches the status of *provisionally* true in *TS*, i.e., it is a hypothesis. From one point of view, what is logically proved in *M* is 'as if' it was also proved in *TS*. But only in *M* does it possess the character of a conclusion of reasoning, whereas in *TS*, it is only a hypothesis. In other words, whatever the proof of a conclusion in *M*, in *TS* it will always possess a *provisional* character: it can be rejected or falsified after evaluation. On the one hand, we argue that the conclusion affirmed in *M* must also be supported in *TS* on a logical basis, on the other hand, it remains an open question whether this double standard is justified on the same grounds. Secondly, and very importantly, if the relationship between *M* and *TS* is to be thought of as non-necessary, from our point of view, an agential point of view is required to understand it. That is, the relationship must be established by agents according to uses and purposes.

Thus, *provisionality* (in this case), from our point of view, can only be captured pragmatically. All the turns to pragmatism in the different approaches to representation point to this idea, i.e., that the relationship between *M* and *TS* must be understood as agential. And agential in the sense of purposes and uses.

Moreover, the latter attests that surrogative reasoning must be weighed in the same way.

10. By way of conclusion

Basically, we believe that the discussion could take two directions:

1. Defend that the ‘reasoning’ of surrogative reasoning only refers to what happens in *M*. And that the transposition from *M* to *TS* is not a logical process.
2. Surrogative reasoning refers not only to what happens logically in *M* but also to the consideration of these results in *TS* as hypotheses.

Regarding 1, from our perspective, there is nothing more to say from a logical point of view. Those who support this idea can justify the transposition of results from *M* to *TS* in different ways. For example, on ideas coming from aesthetics or politics: what is inferred in *M* is valid or tenable in *TS* because an agent (a politician, an artist) following certain aims (political or aesthetic) has established a certain correspondence (aesthetical or political) between the two: artistic objects or human groups.

Regarding 2, which is the point we want to defend, it is a real challenge because, from our point of view, we are trying to justify a relationship between proofs. Indeed, it is about justifying —from a logical point of view— that what is logically obtained in *M* has logical sustainability at the same time in *TS*. Perhaps the way forward is to think of an epistemic logic that justifies the construction of relations of this type. Undoubtedly a logical-pragmatic approach would be most useful, allowing us to account for the action of agents, who use *M* following purposes, and in doing so logically construct this relation that validates as hypotheses in *TS* the inferences obtained in *M*.

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