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MODELS THEORY: INDUCTION AND COMPREHENSION

# LINGUISTIC INTER-UNDERSTANDING GIVES EVIDENCE IN FAVOR OF THE MENTAL MODELS THEORY: INDUCTION AND COMPREHENSION

[LA INTERCOMPRENSIÓN LINGÜÍSTICA DA EVIDENCIA EN FAVOR DE LA TEORÍA DE LOS MODELOS MENTALES: INDUCCIÓN Y COMPREENSIÓN]

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**ABSTRACT**: Linguistic inter-understanding is a communicative phenomenon that is well known and that has been studied in detail. It basically consists of the fact that an individual speaking a language is able to understand another person speaking a different language, and this without deeply knowing this last language or being able to express himself/herself in it. The phenomenon, which is especially frequent in the case of very similar languages, occurs because of certain inferential processes that can happen in the human mind when people try to interpret information in a distinct language. In this way, the main aim of this paper is to show how such processes are very akin to some of those that the mental models theory attributes to the human reasoning ability, and that hence linguistic inter-understanding can be considered as evidence that this last theory is, at least partially, correct.
**KEYWORDS**: iconicity; induction; inference; inter-understanding; mental models

**RESUMEN**: La intercomprensión lingüística es un fenómeno comunicativo bastante conocido y que ha sido estudiado detenidamente. Básicamente, consiste en el hecho de que un individuo que habla una lengua sea capaz de entender a otra persona que se comunica en un idioma diferente, y ello sin conocer en profundidad este último idioma ni ser capaz de expresarse en él. El fenómeno, que es especialmente frecuente en el caso de lenguas muy semejantes, se da a causa de procesos inferenciales que tienen lugar en la mente humana cuando los individuos tratan de interpretar la información que se halla en un idioma distinto. De esta manera, el principal objetivo de este trabajo es mostrar cómo tales procesos son bastante similares a algunos de los que la teoría de los modelos mentales atribuye a la capacidad de razonamiento humana, y, por tanto, que la intercomprensión lingüística puede ser considerada como una evidencia de que esta última teoría es, al menos, parcialmente, correcta.
**PALABRAS-CLAVE:** iconicidad; inducción; inferéncia; inter-entendimiento; modelos mentales

## INTRODUCTION

Linguistic inter-understanding is a very interesting phenomenon that deserves to be considered from very different points of views. As it is known, it refers to the possibility to understand what another person is saying or has written without the need to deeply know his/her language. Thus, the extensive literature on it

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(just some recent works about inter-understanding are, e.g., Chávez Solís & Erazo Muñoz, 2014; Erazo Muñoz, 2016; Tassara & Villalón, 2014; Wilke & Lauría de Gentile, 2016) allows noting that this phenomenon is really important to the knowledge and conservation of cultures, practices, and traditions, as well as to actually appreciate multilingual realities.

The number of projects in this way (as it can be checked in works such as those cited above) is high and they have led to relevant findings, one of them being that, if two languages are very close to each other, the inter-understanding between them is possible with only a very minimal effort and study. Of course, facts such as this one reveal that there are realistic alternatives to ideas such as those of Descartes or Leibniz related to the need of a universal language, or even to the development of such ideas carried out by Peano (1903). Indeed, maybe it is not necessary that all of us speak the same language, but only that all of us understand the languages spoken by other people, even if we continue to only speak our native language.

Be that as it may, it is evident that Portuguese and Spanish are two languages between which the inter-understanding is clearly easy. In fact, the linguistic inter-understanding between these two languages have been addressed in several of the projects mentioned above, just one example in this regard being that of *Eurom5* (Bonvino, Caddéo, Vilaginés Serra, & Pippa, 2015), which considers, in addition, three more languages (Catalan, Italian, and French). For reasons such as these ones, I will basically use those two languages for my arguments in this paper. However, my main goal is not focused on such languages or even on purely linguistic issues. As said, the relationships between related languages such as Portuguese and Spanish are obvious and have been well researched. What is interesting for this paper is a point that is more linked to cognition and human reasoning. That point is that phenomena such as the one of the inter-understanding show that a current cognitive theory, the mental models theory, seems to be the approach that better describes some aspects of our linguistic intellectual activity. In this way, I will resort to the clear relationships between Portuguese and Spanish here only to try to prove that the mental processes why a Portuguese text can be understood from Spanish by a Spanish Speaker are very similar to certain kinds of inference that, following the mental models theory, people often make.

To do this, I will take a fragment of a scientific paper in Portuguese with the intent to show that it has words that, if they are considered alone and ignoring their context, are very hard to understand for a Spanish speaker that does not speak Portuguese (from now on, I will denote this kind of person with the acronym SNP). So, secondly, I will argue that, if the general and complete text is taken into account and we pay attention to the places of those very words in it, it is not difficult to infer their meanings and to understand the global sense of the text. Thus, in accordance with what has been said, the aim is to clearly make it evident that these last inferences are of one of the types indicated by the mental models theory. And this implies that it will be also supported here that it appears that this theory can even to predict the circumstances in which a word or a sentence in other language can be understood, that is, in which linguistic inter-understanding can happen.

However, before commenting on the Portuguese fragment mentioned, it seems appropriate to present the parts to the mental models theory that, in my view, can be related to linguistic phenomena such as that of inter-understanding. Hence, the next section is devoted to the description of certain mental processes offered by the

proponents of this last theory. Those processes are, of course, those to which the inferences involved in the action of inter-understanding appear to refer.

## The mental models theory and its iconic scenarios

The literature on the mental models theory is also large (again, I only indicate a few recent works about it: Hinterecker, Knauff, & Johnson-Laird, 2016; Johnson-Laird, 2012, 2015; Quelhas & Johnson-Laird, 2017; Ragni, Sonntag, & Johnson-Laird, 2016). Besides, it has a wide coverage and tries to explain different aspects of human cognition. Nevertheless, as said, I will mainly focus on the theses of this framework that can be linked to inter-understanding here.

Such theses directly refer to problems that are hard to account for from cognitive approaches essentially based on a formal logic and, in this way, have to do with kinds of inferences that are not considered as correct in the traditional logical systems more or less close to the calculus proposed by Gentzen (1934, 1935). Obviously, a type of inference that can be classified under this category is the inductive one. As it is well known, standard logic does not allow making inductive inferences. Nonetheless, the mental models theory can explain how individuals often make them.

A fundamental concept in the theory is that of 'iconicity' (see, e.g., Johnson-Laird, 2012, p. 136). Thus, a very important thesis of this approach is that people tend to consider all of the possibilities that can be compatible with an asseveration, and those possibilities can be reviewed because the individual builds iconic scenarios representing them. The followers of the theory (see also, e.g., Johnson-Laird, 2012, p. 136) usually acknowledge that their idea of iconicity comes from general proposals such as those given by Peirce (1931-1938), but the most important point now is that, in the case of induction, people habitually decide in favor of the possibilities, or iconic scenarios, which seem most likely. An example can be useful in this regard.

Think about the following inference:

> "The starter won't turn".
> "Therefore, the battery is dead" (Johnson-Laird, 2012, p. 146).

In principle, we can assume that these sentences lead to four possible iconic scenarios representing the relationships between the starter and the battery:

| [I]: | Battery dead | Starter turn |
|---|---|---|
| [II]: | Battery dead | ¬(Starter turn) |
| [III]: | ¬(Battery dead) | Starter turn |
| [IV): | ¬(Battery dead) | ¬(Starter turn) |

Where '¬(x)' means that x is negated.

However, the premise 'the starter won't turn' removes [I] and [III] (the starter turns in them). In addition, although the remaining possibilities are actually two ([II] and [IV]), individuals tend to consider only one of them [III] because, based on their general knowledge, it is clearly more probable, and this explains why the conclusion 'the battery is dead' is derived (Johnson-Laird, 2012, p. 146; see also, e.g., López-

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Astorga, 2016a, p. 355).

As pointed out, the mental models theory is a framework with a far more comprehensive scope. It is able to account for many more inferential processes, including, of course, those related to certain deductions correct in standard logic. Nonetheless, the induction process just described can be enough to show how this theory has the necessary machinery to explain the intellectual actions involved in inter-understanding situations. Of course, this last fact does not have to lead to assume that all of the assumptions of the mental models theory are absolutely correct and to completely reject other alternative frameworks trying to describe the way the human mind works. In this way, this paper will only argue that the mental models theory can be the theory that better explains linguistic understanding in general and, as said, the linguistic inter-understanding processes in particular, but not that it is the theory that better explain all of the results obtained in the experiments reported in the literature of cognitive science. There are other frameworks nowadays that can complement the mental models theory, one very important one being that of the mental logic (e.g., Bompastor Borges Dias & Roazzi, 2003; Braine & O'Brien, 1998; Gouveia, Roazzi, O'Brien, Moutinho, & Bompastor Borges Dias, 2003; O'Brien, 2014; O'Brien & Li, 2013), of which there are even recent versions and updates (e.g., López-Astorga, 2016b), and it can be claimed that general approaches such as this last one can also be improved by means of theses of the mental models theory. Thus, both of these frameworks can be accepted to account for different aspects of human cognition, and, in fact, particular proposals of how both of them could be assumed at the same time have been at least mentioned (see, e.g., O'Brien, 1998; López-Astorga, 2015).

Nonetheless, the possible relationships between theories such as those of the mental models and the mental logic are an issue that is beyond my aims here. So, it seems appropriate to state that the point of this paper is only to make it explicit that the mental models theory can account for the inductive inferences, which is something that, at least until now, the mental logic theory cannot, and that, as claimed, the inter-understanding phenomena appear to show that the explanation given by the former of that kind of inference is valid. Thereby, leaving open the possibility of other approaches presenting more suitable explanations of other intellectual processes, in the next section, it is argued that, indeed, the mental behavior that the mental models theory attributes to individuals when faced to inductive inferences can be clearly observed, for example, in the cases in which a SNP tries to understand a text in Portuguese.

Inductive processes in the understanding of Portuguese from Spanish

That a SNP carries out inductions such as those described by the mental models theory when he/she tries to interpret a text written in Portuguese can be easily noted if we pay attention to the fact that, while that person may not understand certain words alone and without context, it does be possible that he/she does that when those very words are part of a general and wider paragraph. As indicated above, this will be essentially the basis of my arguments, and, to show it, I will resort to a Portuguese scientific text as an instance. The paragraph chosen is precisely one of a paper supporting the rival approach to the mental models theory (that of the mental logic theory) mentioned in the last section, and, in its original version in Portuguese, is as follows:

> "Processos inferenciais são necessários para que as pessoas sejam capazes de lidar com as inúmeras situações do dia-a-dia. De fato, apresentam-se em múltiplas

atividades de pensamento cotidiano e científico, no qual, a partir de um conjunto mais ou menos amplo de premissas, são inferidas conclusões que não aumentam as informações implicitamente presentes nas próprias premissas. Esta capacidade inferencial, tão simples que intuitivamente não precisa ser explicada, é atribuída pelos defensores da teoria da lógica mental à utilização de um esquema inferencial básico da lógica mental, isto é, o *modus ponens*" (Bompastor Borges Dias & Roazzi, 2003, p. 45; italics in text).

A translation of this text into English can be this one:

'Inferential processes are necessary so that people are able to deal with the countless everyday situations. In fact, they are present in numerous daily and scientific thought activities, in which, from a more or less wide set of premises, conclusions that do not increase the information implicitly present in those very premises are inferred. This inferential ability, which is so simple that it does not intuitively need to be explained, is attributed, by the proponents of the mental logic theory, to the use of a basic inferential schema of mental logic, that is, *modus ponens*'.

However, given the aims of this paper, it is evident that a translation of it into Spanish is necessary as well:

'Los procesos inferenciales son necesarios para que las personas sean capaces de lidiar con las innumerables situaciones del día a día. De hecho, se presentan en múltiples actividades de pensamiento cotidiano y científico, en el que, a partir de un conjunto más o menos amplio de premisas, son inferidas conclusiones que no aumentan las informaciones implícitamente presentes en las propias premisas. Esta capacidad inferencial, tan simple que intuitivamente no precisa ser explicada, es atribuida por los defensores de la teoría de la lógica mental a la utilización de un esquema inferencial básico de la lógica mental, esto es, el *modus ponens*'

Clearly, it can be noted that there is a significant number of words that are really similar in Portuguese and Spanish. Actually, it can be said that most of the words in the paragraph are so. However, it is also obvious that there are a few words in the text almost impossible to understand by a SNP if they are not in their context, that is, in their place in the paragraph. Indeed, intuitively, one might think that most of the words would be identified by a SNP. For example, it can be thought that it would be very easy to note that *processos* corresponds to *procesos*, *inferenciais* to *inferenciales*, *capazes* to *capaces*, etc. Nevertheless, other words, maybe because they are very small (just one or two syllables) and hence the proportion of letters that are different in Portuguese and in Spanish in them is higher, could be more difficult for a SNP. Some of these last words can be, for example, *são*, *sejam*, *tão*, or *pelos*. Certainly, these words are extremely unlikely to be understood by a SNP if they are not included in a context, and the reason is obvious: in cases such as these ones, there is no a Spanish word similar enough to provide a clear correspondence, and, if there is such a word, its meaning is very different. In this way, *são*, *sejam*, and *tão* are very difficult to relate to Spanish words, and, as far as *pelos* is concerned, although there is an identical word in Spanish, its meaning is not 'by the' (in Portuguese, *pelos* is a contraction of the words *por*, which means 'by', and *os*, the plural masculine case of 'the'), but 'hairs'.

Nonetheless, anything changes when the paragraph in entirety is taken into account. Firstly, let us think about the first sentence, in which both the word *são* and the word *sejam* appear. If we use square brackets to indicate between them the Portuguese

words that, in principle, can be hard to interpret, it can be stated that, generally, after reading that sentence, a SNP would understand the following:

> 'Los procesos inferenciales [*são*] necesarios para que las personas [*sejam*] capaces de lidiar con las innumerables situaciones del día a día'.

Thus, the only words that he/she would not identify would be precisely *são* and *sejam*. And this is so because the other words are very similar in the two languages. However, given these circumstances, according to the mental models theory, the SNP could build four models for this sentence. All of them would be almost identical and the only differences would be those linked to the meanings of the mentioned two words. In this way, the models would be as follows:

| [V]: | São = Son | Sejam = Sean |
|---|---|---|
| [VI]: | São = Son | Sejam ≠ Sean |
| [VII]: | São ≠ Son | Sejam = Sean |
| [IX]: | São ≠ Son | Sejam ≠ Sean |

In [V], the individual correctly translates the sentence, since he/she discovers the suitable meaning of both *são* and *sejam* (respectively, *son* and *sean*, that is, two forms of the verb 'to be' that, as shown above, can be translated into English, both of them, by 'are'). In [VI], nonetheless, only the meaning of *são* is identified. Something similar happens in [VII], where only *sejam* is understood. Finally, in [VII] neither *são* nor *sejam* are adequately translated.

Furthermore, it can be thought that the process that leads to the four previous models is akin to this one: the SNP knows that in Spanish the word *necesarios* (the plural masculine case of the English word 'necessary') is usually linked to *son* (which, as said, can be translated here as 'are'), and that something similar apply to *capaces* (the plural masculine case of 'able') and *sean*, the difference between *son* and *sean* being very subtle and related to the use of the subjunctive mood in Spanish (as it is also exactly the case for *são* and *sejam* in Portuguese). However, he/she is not absolutely sure about that, and, for this reason, considers the four options [V], [VI], [VII], and [VIII].

Nevertheless, perhaps the truly interesting point is that, following the mental models theory, it can be predicted that the SNP will tend to ignore [VI], [VII], and [VIII], and only pay attention to [V], the reason of that being, simply, that, by means of an induction process, he/she can select the iconic possibility considered to be the most probable one by him/her, which, in this case, is, of course, [V]. And [V] can be thought to be the most likely possibility because, on the one hand, as explained, it refers to very usual combinations of words in Spanish, and, on the other hand, once possible relationships between *são* and *son*, and *sejam* and *sean* have already been established, it can be noted that, in the first case, the two words have three letters and share two of them ('s' and 'o'), and that, in the second case, although one word has five letters and the other one has four, they share three letters too ('s', 'e', and 'a'), and two letters that are different in them ('m' and 'n') have a similar sound both in Portuguese and in Spanish.

The situation is not very different in the case of *tão*. Without being embedded in

a sentence, that word can be very hard to understand for a SNP. However, a context, although it is a purely linguistic one, can lead to a correct interpretation. Based on the previous explanation, it can be said, without the need to reproduce the complete sentence here as well, that …*tão simples que…* can, in all likelihood, cause a SNP to understand:

> '…[*tão*] simple que…'

And, given that *tan simple que* ('so simple that') is a usual expression in Spanish and, because the context offered by the paragraph, it is hard to find a word other than *tan* in this last language that can easily be linked to *simple* and *que*, it can be claimed that the models are two in this case:

> [IX]:        Tão = Tan
> [X]:         Tão ≠ Tan

Indeed, the SNP cannot be totally sure about the equivalence between *tão* and *tan*. Nonetheless, since, as indicated, it is not difficult to combine *tan* with *simple que* in the Spanish version of the text, and *tão* and *tan* share two of their three letters ('t' and 'a'), it can be said that the mental models theory also predicts that the option that will be chosen here will be [IX]. And this is so because, again, it is the most probable one.

Finally, the last example is that of *pelos*. As mentioned, this word exists in Spanish and means 'hairs'. Therefore, it is very unlikely that, out of context, a SNP identifies its true meaning in Portuguese (as said, one of the possible contractions of 'by' and 'the'). But, once again, it can be noted, without writing the entire sentence, that other words around it can show its real sense. Certainly, the SNP, as a result of reading the words before and after *pelos*, can interpret something like this:

> '…es atribuida [pelos] defensores de la teoría de la lógica mental a la utilización de…'

*Es atribuida* (the singular feminine case of 'is attributed') can be complemented in Spanish by two expressions: an expression starting with *por* ('by') and another expression beginning with *a* ('to'). The second case, that is, the one of *a*, as shown, can be clearly detected by a SNP, who can note that *a utilização de* means *a la utilización de* ('to the use of'). So, it can be thought that *defensores de la teoría de la lógica mental*, or, in Portuguese, *defensores da teoria da lógica mental* ('proponents of the mental logic theory') can be linked to *...es atribuida…* by means of *por los* ('by the' in the plural masculine case). Thus, the possible models would be now:

> [XI]:        Pelos = Por los
> [XII]:       Pelos ≠ Por los

However, the explanation in the previous paragraph along with the facts that it is difficult to find an option better than *por los* to translate *pelos*, and that, by being the plural masculine case of 'the', *los* matches with *defensores* (which also refers to the plural masculine case of the word) show that the prediction of the mental models theory is now a tendency to [XI]. And this is so because, once again, an inductive process must lead to the iconic alternative with highest probability.

## Conclusions

It is obvious that all of this reveals that the study of languages such as Spanish can bring immense benefits, since, with little effort and a brief revision of the grammar of a close language, it can be possible not only to interpret but also to more deeply know and correctly understand that close language. And this applies not only to Portuguese, which has been the language taken as an example here, but also to other languages related to Spanish too, such as Italian. Likewise, undoubtedly, the relationships are inverse as well, as the study of Portuguese can also be useful to understand without a great deal of effort both Spanish and Italian, as well as speaking Italian can enable, with only the knowledge of a minimal set of grammar rules, to comprehend messages both in Portuguese and in Spanish. Furthermore, the literature on linguistic inter-understanding shows that, from any Romance language, it is never very hard to receive information in any other Romance language, including French and Romanian, if only a few study hours are spent. And this independently of the programs and projects, some of them described in the literature cited above, addressing very different and not related languages.

Nevertheless, as said, these facts are well known and have been researched in detail, and hence the relationships that can be found between languages such as the mentioned ones are very clear. So, to insist in these aspects has not been the point of this paper. That point has been to argue that the mental models theory proposes specific mental mechanisms that can describe and even predict the way inter-understanding often works. Examples such as those of *são*, *sejam*, *tão*, and *pelos* in the previous section has been helpful to show that, and, although it is true that it can be claimed that my arguments here need to be confirmed by means of empirical data and experiments, it is also so that daily situations lived by people speaking languages such as those considered in this paper give us indications that the linguistic reality is not very different from what has been described above.

Maybe it is also opportune to point out, as an indirect conclusion of this work, that it would be interesting to analyze from the perspective of linguistic inter-understanding ancient languages such as Latin too. Perhaps an adequate point of view to study this last language can be to do that from a contemporary Romance language and by means of inductive processes such as those analyzed above. Latin is really an important language for philosophy and, while it seems that nowadays it is not necessary to speak it, to know to listen it, or even to write it, there is no doubt that, at least, reading it continues to be a very important skill in some academic fields. In this way, it is possible that a research based on the arguments developed here and trying to detect the problems or difficulties that students can have when they make inductive inferences to understand Latin texts reveals aspects to better teach them and characteristics of the language that can be specially complex to learn. And this could be relevant because it could provide students instruments to continue to improve their Latin by themselves making their own inferences.

Nonetheless, beyond these practical conclusions that can be derived from this paper, there are also other theoretical conclusions that can be drawn from it as well. As shown, the analysis presented confirms basic assumptions of the mental models theory, which, without necessarily accepting this last framework in entirety and without absolutely rejecting alternative approaches such as that of the mental logic theory (as mentioned, it has already been indicated that even theories so different as these ones

can coexist), given the results achieved in the previous section, must be taken into account. And this is so because it clearly opens important and interesting lines of work in several disciplines, including philosophy of language and philosophy of cognitive science. To make it explicit this fact has been the main finding of this study, which has simply tried to reveal that there is still much to be done with regard to certain topics referring to the relationships between cognition, reasoning, and language.

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