

AS FORMAS LÓGICAS DEPENDEM DE MODELOS SEMÂNTICOS: AS SENTENÇAS DISJUNTIVAS ILUSÓRIAS COMO EVIDÊNCIA

LOGICAL FORMS DEPEND ON SEMANTIC MODELS: THE ILLUSORY DISJUNCTIVE SENTENCES AS PIECES OF EVIDENCE

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Resumo: A teoria dos modelos mentais é capaz de explicar um amplo espectro de fatos relacionados à cognição. No entanto, pode-se pensar que o problema com essa teoria do ponto de vista linguístico é que ela ignora a forma lógica e, portanto, a sintaxe. Foi proposto que existem maneiras de vincular a teoria dos modelos mentais a estruturas formais. Contudo, permanece um problema em propostas desse tipo: a detecção de formas lógicas sempre parece depender de possibilidades icônicas como as suscitadas pela teoria mencionada, o que, por sua vez, parece significar que esse último arcabouço se refere a aspectos realmente básicos da cognição e da linguagem. Este artigo tenta mostrar que tudo isso está correto recorrendo a um exemplo que parece não ter sido estudado em profundidade a partir dessa perspectiva: o caso das sentenças ilusórias disjuntivas, ou seja, sentenças disjuntivas que as pessoas tendem a considerar verdadeiras e que na verdade não são.

Palavras-chave: Disjunção; Possibilidade Icônica; Ilusão; Forma Lógica; Semântica

Abstract: The theory of mental models is able to explain a broad spectrum of facts related to cognition. However, it can be thought that the problem with this theory from the linguistic point of view is that it ignores logical form and hence syntax. It has been proposed that there are ways to link the theory of mental models to formal structures. Still, a problem remains in proposals of that kind: the detection of logical forms always seems to depend on iconic possibilities such as those raised by the aforementioned theory, which in turn appears to mean that this last framework refers to really basic aspects of cognition and language. This paper tries to show that all of this is correct by resorting to an example that does not seem to have been studied in depth from this perspective: the case of the illusory disjunctive sentences, that is, disjunctive sentences people tend to consider to be true and which are not actually.

Keywords: Disjunction; Iconic Possibility; Illusion; Logical Form; Semantics



1 INTRODUCTION

The theory of mental models is a contemporary theory about reasoning and language. Its claims are several, but perhaps, as far as the aims of this paper are concerned, it can be said that it proposes that logic is not a basic element in the human mind, that syntax is a secondary aspect in the intellectual activity, that semantics and pragmatics are more essential in that very activity, and that reasoning and language are led by models describing reality in an iconic way (e.g., Johnson-Laird, 2012; Orenes & Johnson-Laird, 2012; Quelhas, Rasga, & Johnson-Laird, 2019). Thus, it gives accounts of many controversial results reported in the specialized literature, including those referring to the way people apply inference rules such as *Modus Tollendo Tollens* (e.g., Byrne & Johnson-Laird, 2009), to how individuals often understand certain paradoxical inferences (e.g., Orenes & Johnson-Laird, 2012), to the case of certain illusory disjunctive sentences (e.g., Quelhas et al., 2019), or to the manner the human mind tends to consider probabilities (e.g., Johnson-Laird, Khemlani, & Goodwin, 2015). However, it might also lead one to a very important philosophical and linguistic consequence: it makes logical form superfluous. This is so because, as pointed out, the main idea of the theory seems to be that human reasoning has nothing to do with formal structures, and that it is mainly related to iconic models or possibilities (e.g., Johnson-Laird, 2012; López-Astorga, 2019).

This paper will follow the general theoretical line of works such as López-Astorga (2017, 2019). López-Astorga (2017, 2019) proposes that, indeed, reasoning is made as the theory of mental models claims. Nevertheless, according to those very works, that does not mean that syntax has to be rejected, since the method of analysis used by the theory also allows deriving from it the real logical forms corresponding to sentences in natural language. López-Astorga (2019) shows that this last point does not cause any problems to the theory of mental models, and that it is possible to speak about iconic models and logical forms at once under the same approach. This is exactly what will also be argued here from another perspective, the one of the illusory disjunctive sentences. The main idea is that, in fact, the possibility to derive logical forms from iconic models strengthens the main theses of the theory of mental models, since it reveals that, without a previous assumption of the general ideas of the theory, there is no way to find logical forms to sentences. Thus, in practice, what will be explained is something that the literature already also indicates: that semantics, which is the essential aspect taken into account by the theory of mental models, appears to be an aspect more important in cognition and language than syntax (e.g., López-Astorga, 2019).

Therefore, the novelty that will be presented below is that this relation between semantics and syntax will be reviewed by analyzing an example that seems not to have been dealt with from the point of view of works such as the ones of López-Astorga (2017, 2019). That is the case of certain disjunctive sentences that people usually tend to consider as totally true under any circumstance, that is, in Kantian terminology, that people tend to deem as ‘analytic’ (or, by using a concept provided by Carnap, 1947, ‘L-true’), when, actually, they do not have that characteristic.

To achieve that goal, the structure of the paper will be as follows. The first section will describe in detail the example selected, that is, the real nature of the disjunctions pointed out, why they can be false, and the reasons the theory of mental models gives to explain the fact that people often assess them as true. Secondly, it will be explained how, according to the framework proposed in López-Astorga (2017, 2019), which is based upon the explanation the theory of mental models offers, other logical forms can be extracted and attributed to the sentences. Finally, some reflections about what all of this means are included.

2 CONTINGENT DISJUNCTIONS THAT SEEM TO BE ANALYTIC

As Quelhas et al. (2019) show, there are disjunctions with a special characteristic. Although these disjunctions can be false, people usually ignore that possibility. So, the problem with this kind of disjunctions is that, in spite of the fact that they are contingent disjunctions, individuals tend to deem them as analytic disjunctions. ‘Contingent disjunctions’ is the denomination in Quelhas et al. (2019). However, it is obvious that other expressions could also be used to refer to them. For example, following Kant, they could be synthetic disjunctions, and, according to Carnap (1947), F-true or F-false disjunctions. In any case, one example would be as follows:

(1) “Either the food is hot or else it is tepid, but not both” (Quelhas et al., 2019, p. 9).

Quelhas *et al.* (2019) experimentally show that people usually evaluate sentences such as (1), which is literally one of their examples, as true. Nevertheless, they can be false. In the particular case of (1), as Quelhas et al. (2019) state, if the food were cold, it would be neither hot nor tepid, and, therefore, the sentence in entirety would be false. Classical logic clearly reveals why this is so.

In this last logic, as it is well known, an exclusive disjunction such as (1) can only be true in two cases: when just one of its disjuncts, the first one –in (1), the food is hot– or the second one –in (1), the food is tepid–, is true. If the two disjuncts are true, as well as if they are false, the exclusive disjunction is false. The last case is exactly what would happen if the food were cold: the two disjuncts would be false and, accordingly, (1) too.

Nevertheless, the theory of mental models can account for why people often think that sentences such as (1) are absolutely true. According to this theory¹, individuals reason deriving models from the sentences. Those models are iconic representations or possibilities, and they try to reproduce reality in a way as exact as possible (see also, e.g., Khemlani & Johnson-Laird, 2019). But people do not always come to the same models. There are two mental systems, which in Quelhas et al. (2019) are related to Johnson-Laird and Wason (1970). Depending upon the one that is used, the models detected can be different. Of course, this is an important point of the theory. However, what is truly relevant here is that, at best, and even using the system that can offer more models and more exact representations, individuals only consider models directly linked to words in the sentences. This means that the models that, at most, can be drawn from (1) are, following a way akin to that used in López-Astorga (2019) to express them, these:

(2) (the food is hot) & (the food is not tepid)

(3) (the food is not hot) & (the food is tepid)

This is so, in addition, because, according to the theory, individuals only tend to pay attention to the possibilities in which the sentence is correct (see also, e.g., Khemlani, Hinterecker, & Johnson-Laird, 2017), which leads to ignore not only the case in which the food is both hot and tepid (an impossible case), but also an absolutely possible case such as the one in which the food is cold and, therefore, neither hot nor tepid.

So, while (1) is not analytically true, people often think that it is. The reason is clear under the framework of the theory of mental models. As indicated, individuals only deploy the models that can be directly attributed to what is expressed in the sentences, and that means that, given (1), the circumstance in which the food is cold is not even taken into account.

¹ The explanation in this section is mostly derived from the arguments given by Quelhas et al., 2019.

This does not happen with English only. Following the theory of mental models, reasoning considers iconic possibilities (i.e., possibilities mentally describing the different possible alternatives in the world as accurately as possible) no matter what language is used. In fact, Quelhas et al. (2019) carried out their experiments in Portuguese, and it is obvious that nothing changes if, instead of (1), the sentence considered is its translation into that language:

(1.a) Ou a comida é quente ou é morna.

As indicated by Quelhas et al. (2019), the structure in sentences such as (1.a) clearly denotes exclusivity in the disjunction. However, maybe what is important now is that all of this can have a different interpretation from López-Astorga's (2019) perspective, since it seems that, without negating any thesis of the theory of mental models, it is still possible to keep speaking about logical forms.

3 THE LOGICAL FORM OF THE CONTINGENT DISJUNCTIONS THAT APPEAR TO BE ANALYTIC

Actually, the particular study by López-Astorga (2019) is just an example that is being considered here to achieve the goals of this paper, which also refers to link iconic models to logical forms, but mainly in the case of the illusory disjunctive sentences. Many analyses resorting to a similar approach are to be found in the literature (see also, e.g., López-Astorga, 2017). These analyses usually address cases very similar to those reviewed both here and in López-Astorga (2019). In general, the studies deal with sentences that appear to have a logical form and it is proposed that their real formal structures are very different, or that seem to be true or false in certain scenarios or circumstances and it is argued that they are actually so in other scenarios or circumstances that are very distinct. This is, therefore, the position that is assumed in the present paper.

Nevertheless, before analyzing the concrete case that is the object of this paper, it can be suitable to describe the general lines of works such as the one of López-Astorga (2019). The basic idea in such works consists of transforming the iconic possibilities indicated by the theory of mental models into rows of a hypothetical truth table in classical logic. In particular, what should be done is to consider the possibilities in which the sentence is true to be rows in the table indicating that the proposition or formula corresponding to the sentence is true as well. Likewise, any other possibility is deemed as a row in which the proposition or formula is false. Thus, based upon that hypothetical table, it is possible to identify the real logical form that can be attributed to the sentence in natural language. Following López-Astorga (2019), this point is crucial, since logical form is a very important element in linguistic theories such as the one of government-binding.

As far as (1), (2), and (3) are concerned, this means that it is necessary to assume that (2) and (3) represent rows in a truth table in which the formula that can be assigned to (1) is true. Regarding the remaining combinations, it is evident that the one stating that the food is hot and tepid at the same time has to be considered as a row in which the formula is false, and this is so because the combination reflects an impossible situation. Nonetheless, the case in which the food is neither hot nor tepid is different. That combination, even if it is not often taken into account by individuals, is clearly possible and, accordingly, it should be assumed as one representing another combination in which the logical formula corresponding to (1) is true. Obviously, this last combination could be expressed in this manner:

(4) (the food is not hot) & (the food is not tepid)

Thus, if it is supposed that (2), (3), and (4) stand for the rows in which the formula is true, the result is that several logical forms can be thought. One of them is undoubtedly:

(5) $p \rightarrow \neg q$

Where ‘p’ indicates the fact that the food is hot, ‘q’ represents the situation in which the food is tepid, ‘ \rightarrow ’ is the material conditional, and ‘ \neg ’ denotes negation.

But another formula consistent with the supposed rows is also, for example,

(6) $q \rightarrow \neg p$

In fact, even more complex or sophisticated formulae can be thought, since (7) is also coherent with the truth table that can be linked to (2), (3), (4):

(7) $(p \rightarrow \neg q) \wedge (q \rightarrow \neg p)$

Where ‘ \wedge ’ represents conjunction.

In this way, irrespective of the formula chosen, (5), (6), (7), or any other (which does seem to be undoubtedly true if ‘p’ and ‘q’ mean what has been indicated above, i.e., that the food is hot and that it is tepid respectively), what is clear is that this account is compatible with López-Astorga’s (2019) view. According to this view, even accepting the theory of mental models, linguistic theories claiming the existence of logical forms related to natural language such as the government-binding theory (e.g., Chomsky, 1981) continue to make sense. The key is just in something that has already been said in very elementary textbooks of logic: there is no direct correspondence between the natural language sentences and their logical forms (see, e.g., Deaño, 1999).

In the case of (1), the expression in natural language is an exclusive disjunction, but its actual logical form can be a conditional in which the consequent is negated, as it happens in (5) and (6), or, for example, a conjunction in which the conjuncts are two conditionals with those very characteristics, as it occurs in (7). But all of this is far from causing difficulties to the theory of mental models. In fact, it can even strengthen and support it.

4 CONCLUSIONS

Certainly, as pointed out in works such as López-Astorga (2019) and as shown above, it is only possible to find logical forms such as (5), (6), and (7) after a semantic analysis of possibilities akin to those carried out by the theory of mental models. Without a detailed revision of the real possibilities that can be attributed to a sentence, it is impossible to determine an alleged underlying logical form compatible with the way people usually interpret that sentence (in the case studied here, compatible with the fact people deem the sentence as true).

However, in practice, as also acknowledged in those very works (see also, e.g., López-Astorga, 2017), this supports the theory of mental models. If the literature is reviewed, one might note that, to explain cognition, it is necessary to resort to neither syntax nor logical form (see also, e.g., Johnson-Laird, 2010, where proposals such as the one described in the previous section are clearly questioned). The theses of that theory can predict the results of most of the

reasoning experiments in general by themselves. In particular, the study by Quelhas et al. (2019) is a very good example in this sense, as their account is absolutely consistent with the results of their experiments. Nevertheless, at no time they use a logic or syntax of any kind, which reveals the possibility that the search for logical form may be one more additional step that is completely unnecessary.

The framework offered in López-Astorga (2019) can be important at least from the linguistic point of view. In linguistics, it is hard to ignore syntax, and what that framework is intended to show (and that is pointed out in works such as López-Astorga, 2017, as well) is the connection between everything the theory of mental models raises and the formal structures of language.

Therefore, the particular case analyzed in this paper can be considered to be one more piece of evidence for the conclusions that, while the theory of mental models can be accepted as a correct description of the human intellectual activity, logical forms can be drawn from its analyses, this fact further supporting, and not undermining, the basic framework of the theory. Clearly, these conclusions side with the theoretical line of works such as the one of López-Astorga (2019). It appears that the theory of mental models has the machinery necessary to explain most of the cognitive and linguistic phenomena that challenge what is required by classical logic. Nonetheless, these works provide a possible link between that machinery and syntax at once.

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