An essentially syntactic and formal theory is still possible

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AN ESSENTIALLY SYNTACTIC AND FORMAL THEORY IS STILL POSSIBLE

ABSTRACT: In 2015, Johnson-Laird, Khemlani, and Goodwin indicated four reasons why a basically syntactic approach explaining the human inferential activity is hard to accept nowadays. However, in this paper, I try to show that such reasons do not reveal real problems for the syntactic frameworks, and that most of the difficulties related to them have already been addressed by the literature on cognitive science and considered to be clearly surmountable from a mainly formal perspective. In this way, I argue that it is still possible to claim that syntax plays an important role in human thought.

KEY WORDS: form; inference; logic; syntax; thought.

SUMMARY: 1. Introduction. 2. Four problems for the syntactic theories. 3. Monotonicity and formal logic. 4. The conditional does not have to be material. 5. Vapid conclusions are not actually possible. 6. There is a procedure to identify logical forms. 7. Conclusions.

AÚN ES POSIBLE UNA TEORÍA ESENCIALMENTE SINTÁCTICA Y FORMAL

RESUMEN: En 2015, Johnson-Laird, Khemlani y Goodwin plantearon cuatro razones por las que, en nuestros días, es complejo aceptar un enfoque básicamente sintáctico para explicar la actividad inferencial humana. No obstante, en este trabajo, intento mostrar que tales razones no revelan problemas reales en los marcos sintácticos y que la mayoría de las dificultades relacionadas con ellas ya han sido analizadas en la literatura de la ciencia cognitiva y consideradas como claramente superables desde una perspectiva principalmente formal. De este modo, argumento que todavía es posible defender que la sintaxis desempeña un rol importante en el pensamiento humano.

PALABRAS CLAVES: forma; inferencia; lógica; sintaxis; pensamiento.

SUMARIO: 1. Introducción. 2. Cuatro problemas en las teorías sintácticas. 3. Monotonicidad y lógica formal. 4. El condicional no tiene por qué ser material. 5. Las conclusiones absurdas no son realmente posibles. 6. Existe un procedimiento para identificar formas lógicas. 7. Conclusiones.

UNE THÉORIE ESSENTIELLEMENT SYNTAXIQUE ET FORMELLE EST ENCORE POSSIBLE

RÉSUMÉ: En 2015, Johnson-Laird, Khemlani et Goodwin ont indiqué quatre raisons pour lesquelles une approche essentiellement syntaxique expliquant l'activité inférentielle humaine est difficile à accepter de nos jours. Cependant, dans cet article, j'essaie de montrer que de telles raisons ne révèlent pas de problèmes réels pour les cadres syntaxiques et que la plupart des difficultés qui les concernent ont déjà été abordées dans la littérature sur les sciences cognitives et considérées comme clairement surmontables à partir d'une perspective essentiellement formelle. De cette façon, je soutiens qu'il est encore possible de prétendre que la syntaxe joue un rôle important dans la pensée humaine.

MOTS CLÉS: forme; inférence; logique; syntaxe ; pensée.

SOMMAIRE: 1. Introduction. 2. Quatre problèmes dans les théories syntaxiques. 3. Monotonie et la logique formelle. 4. Le conditionnel ne doit pas être matériel. 5. Conclusions absurdes ne sont pas vraiment possible. 6. Il existe une procédure d'identification des formes logiques. 7. Conclusions.

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1. INTRODUCTION

Several syntactic frameworks have been proposed in order to account for human linguistic activity and reasoning. Some examples in this regard can be approaches such as those of Beth and Piaget (1966), Henlé (1962), Macnamara (1986), Rips (1994), or, most recently, the mental logic theory (e.g., Bompastor Borges Dias & Roazzi, 2003; Braine & O'Brien, 1998a; Gouveia, Roazzi, O'Brien, Moutinho, & Bompastor Borges Dias, 2003; O'Brien, 2009, 2014; O'Brien & Li, 2013; O'Brien & Manfrinati, 2010). While all of these proposals are not exactly identical and there are important elements that differentiate each of them from the other frameworks (e.g., the formal schemata accepted in all of them are not always exactly the same), they seem to share a more or less direct relationship to natural deduction calculi akin to the one of Gentzen (1934, 1935) and based on the general lines of presentations of classical logic such as that of Deaño (1999). It is true that some of them, although they accept certain basic rules of standard propositional calculus, also explicitly reject certain relevant principles of this last system at the same time (e.g., as indicated below, the mental logic theory does not assume the material interpretation of the conditional). However, what is interesting for this paper is that the idea of fundamental logical forms related between them appears to be essential in all of the mentioned approaches, to the extend that several of them have even spoken about a 'syntax of thought' precisely consisting of relationships between logical forms or formulae similar (although, as said, not necessarily equal in all the cases) to those of classical logic (for example, the mental logic theory; see, e.g., Braine & O'Brien, 1998b).

Nevertheless, the paper authored by Johnson-Laird, Khemlani, and Goodwin (2015) seems to question the primary ideas underlying these theories. Indeed, they provide four reasons why frameworks of this kind cannot continue to be accepted (as also explained below, such reasons are that they cannot capture the everyday nonmonotonic inferences, that they usually understand the conditional as material, that they allow vapid inferences, and that they do not usually propose methods to identify the real logical forms of the sentences). In this way, my main goal here is to show that those reasons are not enough to undermine the formal or syntactic approaches. To do that, I will base on the literature on cognitive science and try to make it explicit that most of the possible problems that those reasons can cause to the formal proposals have already been dealt with in different works, which have given interesting responses and solutions to such problems. Thus, I will also argue that the option to support a syntactic approach still stands (regardless of the particular approach between those that have been

listed is assumed), and that hence it is also still possible to state that a syntax of thought exists (although that syntax is not necessarily the same as that raised by theories such as the one of the mental logic).

Thus, this paper is divided in five sections. The first one explains the four problems pointed out by Johnson-Laird et al. (2015) and mentioned between brackets by me above. On the other hand, the remaining four address in turn each of those four difficulties and show the arguments that can be offered to solve them. Hence I begin with a description of the problems.

2.   FOUR PROBLEMS FOR THE SYNTACTIC THEORIES

The first problem indicated by Johnson-Laird et al. (2015) is that of monotonicity. Certainly, standard logical systems and the syntactic theories directly or indirectly based on them tend to be monotonic, and this is a concern because human thought does not seem to be so. Monotonicity means that, if a particular formula q can be derived from a premises set {P}, the addition of a new formula or premise to {P} does not affect to the fact that q can be inferred from it (see, e.g., Lukowski, 2013: 63-64). In other words, in classical logic, if it is correct that

[I]: {P} → q (Where '→' expresses conditional relationship)

It is also correct that

[II]: {P} ∧ r → q (Where '∧' stands for conjunction and 'r' is any other formula)

In this way, Johnson-Laird et al.'s (2015) complaint appears to be that, if this is so, formal logic cannot explain situations such as the following.

Let us suppose that {P} refers to the fact that 'you take a taxi' and q represents the fact that 'you will arrive earlier'. Thus, [I] would express

[III]: If you take a taxi, then you will arrive earlier

But let us also suppose that r means that 'there is a traffic cut'. In this case, [II] would indicate that

[IV]: If you take a taxi and there is a traffic cut, then you will arrive earlier

So, the difficulty is evident. If our thought follows a conventional logical system, if we accepted [III], which is an action that seems reasonable to do, we would have to accept [IV] too, which is an action that seems unreasonable to do. True, taking a taxi can help to arrive earlier, but, if there is a traffic cut, taking a taxi may not be a good idea, since it can even cause one to arrive later.

Of course, one might argue that, while the human mind considers formal logic, syntax is not the only element playing a role in our reasoning. Indeed, formal approaches such as that of the mental logic theory claim that pragmatics is important in thought as well, and that human beings make inferences by taking into account not only the information explicitly stated, but also pragmatic premises included in their general knowledge (Braine & O'Brien, 1998b). In this regard, it could be said, for example, that people can accept [III] and, at the same time, reject [IV] because they know that traffic cuts cause people to be late, that is, because they know that r → ¬q (where '¬' denotes negation).

Nevertheless, following Johnson-Laird et al.'s (2015) arguments, this is not a solution for the problem. In calculi such as standard propositional calculus contradictions such as q ∧ ¬q (to which we can easily come from [II], {P}, r, and r → ¬q) enable, via *Ex Contradictione Quodlibet Sequitur* principle, to infer any formula from its denial, including of course, q. Although maybe it is almost trivial to present the following derivation, all of this can be very clearly seen by means of it.

[1] {P} ∧ r → q   (premise)
[2] {P}   (premise)
[3] r   (premise)
[4] r → ¬q   (pragmatic premise)
[5] {P} ∧ r   (∧I 2,3)
[6] q   (MPP 1, 5)
[7] ¬q   (MPP 3, 4)
[8] ¬q   (supposition)
[9] q ∧ ¬q   (∧I 6, 7)
[10] q   (ECQ 8-9)

Here, '∧I' represents the conjunction introduction rule, that is, the rule that allows inferring a formula such as A ∧ B from A and B. On the other hand, 'MPP' is *Modus Ponendo Ponens*, that is, the rule that can lead to B from formulae such as A → B and A. Finally, 'ECQ' stands for *Ex Contradictione Quodlibet Sequitur* principle, that is, the principle that, as said, enables to derive any formula from its negation if a contradiction is discovered (in this case, the formula is q in [10], which is obtained after supposing its denial in [8]).

Accordingly, even assuming that people know, by virtue of their pragmatic knowledge, that r → ¬q, as shown, it would also have to be admitted that, if our reasoning is related to logic, the acceptance of [III] implies the acceptance of [IV] too, since both of them allows inferring q if their antecedents are true.

Nonetheless, this is not the only difficulty that Johnson-Laird et al. (2015) observe in the formal frameworks. A second problem is that the conditional is interpreted materially in classical logic, and individuals do not seem to

understand it in that way. As it is well known, the material interpretation of the conditional provides that a conditional such as A → B is only false when these two conditions are fulfilled: (a) the antecedent (A) is true and (b) the consequent (B) is false. This appears to be obvious. However, it leads to unexpected consequences as well. On the one hand, under this interpretation, whenever B is true (i.e., whenever (b) is not fulfilled), the entire conditional, that is, A → B, is also true, which means that, given B, A → B can be deduced, or, if preferred, that the prediction is that people will consider as correct inferences such as these ones:

[V]: "He's angry.
Therefore, if she insulted him then he's angry" (Johnson-Laird et al., 2015: 202).

[Vb]: She is happy.
Therefore, if she passed her examination then she is happy.

Nevertheless, the truth is that, as shown by the literature (see, for example, as indicated by Johnson-Laird et al., 2015, Orenes & Johnson-Laird, 2012), people do not generally accept this kind of inferences. In the same way, a similar difficulty can be noted in the case in which the antecedent (A) is false (that is, in the case in which (a) is not fulfilled). Certainly, if the material interpretation of the conditional is the correct one, a premise such as ¬A should also allow concluding A → B, that is, individuals should also judge as valid inferences such as those of these two examples:

[VI]: "She didn't insult him.
Therefore, if she insulted him then he's angry" (Johnson-Laird et al., 2015: 202).

[VIb]: She did not pass her examination.
Therefore, if she passed her examination then she is happy.

But the literature has already studied extensively this kind of inferences as well and shown that people often consider it as incorrect too (see again, for example, as also indicated by Johnson-Laird et al., 2015, Orenes & Johnson-Laird, 2012). So, this is clearly another problem needing to be solved if a formal logical theory is assumed.

The third difficulty provided by Johnson-Laird et al. (2015) is even easier to understand. It is related to the 'vapid' deductions, which are "valid inferences that yield useless conclusions, such as the conjunction of a premise with itself" (Johnson-Laird et al., 2015: 202). Undoubtedly, they are referring to the ∧I rule in this quote, which enables, for instance, to derive A ∧ A ∧ A ∧ A from A, that is, a conclusion absolutely valid but, as said by Johnson-Laird and his colleagues, evidently vapid. Obviously, any syntactic theory

trying to explain human thought must account for why people tend not to deduce conclusions such as the aforementioned one, despite the usual natural deduction calculi allowing them.

Finally, Johnson-Laird et al. (2015) insist in other problem already raised in papers such as that of Johnson-Laird (2010). That problem is the one of logical forms and has to do with the fact that the formal theories also need to explain how the logical forms of the expressions in natural language are recovered, since how the process could be is unclear. One might think that natural languages have certain words that lead to certain symbols. Thus, it can be thought that in English, for example, 'and' leads to $\wedge$ and 'if... then...' to $\rightarrow$. However, this is not really so because it is possible to find sentences with words such as those that cannot be linked to such symbols. Consider, for instance, these sentences:

[VII]: "If oxygen is present then there may be a fire" (Johnson-Laird & Byrne, 2002: 663).

[VIIb]: If he is European then he may be Italian.

There is no doubt that, despite the fact that the sentences contain the words 'if' and 'then', they are not conditionals as understood traditionally in logic. Indeed, sentences of this kind, which is called 'Enabling' by Johnson-Laird and Byrne (2002), are not false, as these last writers pointed out, when their antecedent is true and their consequent is false (oxygen without a fire is possible, as well as being European without being Italian), but only when their antecedent is false and their consequent is true (what really is not possible is that there is a fire without oxygen, or that he is Italian and not European). Hence it can be stated that, if p refers to the fact that 'there is oxygen', or that 'he is European', and q to the fact that 'there may be a fire', or that 'he is Italian', the actual logical form of [VII], and of [VIIb], should not be $p \rightarrow q$, but $q \rightarrow p$. However, the way to note those associations cannot be merely syntactic. At least, other types of non-systematic processes are necessary to discover them. Accordingly, this is a difficulty that makes it complex to assume an essentially syntactic framework as well.

These are the four basic problems that, according to Johnson-Laird et al. (2015), have the formal proposals. Nevertheless, as said, the literature offers arguments to overcome most of them and continue to think about a syntactic approach. This is shown in the following sections, each of which addresses one of the four difficulties separately. So, the next section deals with the problem of monotonicity.

3. MONOTONICITY AND FORMAL LOGIC

The solution for the problem of the monotonicity in the syntactic theories is simple and has already been given by Lukowski (2013). Really, it is very

hard to find a situation of clear nonmonotonicity, and this is so because most of the situations that seem to be nonmonotonic are actually monotonic. In his paper, Lukowski (2013) reviews several types of apparently nonmonotonic inferences. However, as far as the sentences indicated above are concerned (that is, the sentences [I] to [IV]), just an important argument provided by him can be enough. Lukowski (2013: 67-68) claims that, in many cases, a sentence such as [I] is only an abbreviated formula with implicit content that is not made explicit because it refers to a large number of exceptions that can avoid that the consequent happens. Such exceptions constitute another set {S} including negated formulae that, if not denied, would block the derivation of the consequent via MPP. In this way, the really suitable form of [I] would be:

[VIII]: $\{P\} \wedge \{S\} \rightarrow q$

But this in turn means that what [III] really expresses is:

[IX]: If you take a taxi and a, b, c,…, a traffic cut,…, and z do not happen, then you will arrive earlier

As indicated, 'a, b, c,…, a traffic cut,…, and z' represent circumstances that can prevent the fact that 'you will arrive earlier' from happening, and, evidently, the fact that 'there is a traffic cut' (r) is included between them. Nonetheless, such circumstances are denied, which reveals that another form to express [VIII] can be as follows:

[X]: $\{P\} \wedge \neg a \wedge \neg b \wedge \neg c \wedge…\wedge \neg r \wedge…\wedge \neg z \rightarrow q$

Thus, if r were added as a premise, q could not be derived, since, in classical logic, the law of non-contradiction ($\neg(A \wedge \neg A)$) would make it impossible to have ¬r at the same time, and, therefore, to have all the elements that are present in the antecedent to apply MPP to the conditional and obtain q.

Evidently, this account alone is already a powerful argument against Johnson-Laird et al.'s (2015) objection about monotonicity, as it reveals that, as indicated, cases of true nonmonotonicity are really difficult to encounter. However, even if this particular Lukowski's (2013) explanation does not convince, we also have another possible account. That is the one of the mental logic theory.

Following this last approach, although the human mind applies many syntactic rules akin to those of standard logic, it does not work by taking all the requirements of this last logic into account. In this way, one of the principles of classical logic that this theory explicitly rejects is precisely that of *Ex Contradictione Quodlibet Sequitur*, since, under the framework of mental logic, contradictions only reveal a fact: some of the previous assumptions is/are false (e.g., Braine & O'Brien, 1998c). Thus, based on this proposal, it

can be said that a scenario with [I], {P}, and r, and in which it is known that r → ¬q, is not truly a problem.

Certainly, given that, as mentioned above, pragmatic premises such as r → ¬q are possible in the mental logic theory, it could be expected in that scenario that the presence of {P} led to q, and the presence of r to ¬q (in both cases, via MPP, which would be applied to [I] and {P} to obtain q and to r and the pragmatic premise to obtain ¬q). However, this contradiction would only show, as said, that at least one of the premises is false. In this particular example, probably, the premise that would be rejected would be [I], the reason of that being simply that {P} and r would be facts (that a taxi was taken and the traffic was cut would be two facts in the scenario), and, by coming from general knowledge, r → ¬q would be hard to reject. In this regard, it can be thought that the mental process would be akin to this one: prima facie it is assumed [I] and [III] because what is habitual is that, if a taxi is taken, one arrives earlier. Nonetheless, the presence of r reveals that it is not always so, as there are cases, for example, those of a traffic cut, in which, even taking a taxi, one might arrive later. So what actually happens is not that r blocks the derivation of q, but just that r shows that one of the premises is false ([I] or, if preferred, [III]). Hence, it seems that we are not really speaking about nonmonotonic inferences here, but only about inferences in which, in a particular time, a premise is removed because it is discovered that it is false. This action appears to be absolutely normal and usual in everyday human reasoning and, therefore, it does not have to be a difficulty for a syntactic theory. In fact, Lukowski (2013: 69-70) also seems to resort to arguments similar to these ones in his accounts on other types of inferences that appear to be nonmonotonic too, and, however, they are not truly so either.

Nonetheless, in any case, it can be said that the problem of the monotonicity of the syntactic theories is not very serious. To solve that problem, we have not only one explanation, but, as shown, at least two.

4. THE CONDITIONAL DOES NOT HAVE TO BE MATERIAL

As far as the second objection raised by Johnson-Laird et al. (2015) is concerned, an obvious, rapid, and simple answer can be given: not all the formal theories interpret the conditional materially. The mental logic theory can be an example here again, since this framework clearly rejects that interpretation for the conditional in several works (Braine & O'Brien, 1998c; O'Brien, 2014; O'Brien & Manfrinati, 2010...). Besides, there are even papers based on this theory trying to show that a sentence with the structure 'if... then...' can refer to different logical forms and pragmatic premises (e.g., López-Astorga, 2016).

In this way, the problem of examples [VI] and [VIb] directly disappears, since, if the conditional is not material, it is not necessary to assume that A → B is true whenever ¬A is so. However, this does not also apply clearly in

the case of examples [V] and [Vb], which, even if the material interpretation is ignored, do continue to be apparently a problematic point in respect of the conditional. This is so merely because the conditional introduction rule, that is, the rule enabling to infer A → B from B after supposing A, is admitted by most of the syntactic theories, including, of course, the mental logic theory (see, e.g., Braine & O'Brien, 1998d: 81), and, as said, it is not always considered as valid by people (Orenes & Johnson-Laird, 2012). Nevertheless, I think that a first important point that deserves to be mentioned in this regard is that, although, indeed, it is true that many syntactic theories accept the conditional introduction rule, it is also true that they often place restrictions and conditions for its use (for the particular case of the mental logic theory, see, e.g., Braine & O'Brien, 1998c). Thus, it is relevant to clarify that assuming a formal theory does not mean to claim that the conditional introduction rule is used by people whenever possible.

In this connection, it can also be said that, while it must not be forgotten that all of the syntactic theories are not the same, maybe there is an account on the real circumstances in which the conditional introduction rule can be applied that could be accepted by most of them and that, therefore, is linked to the material interpretation in no way. The idea is that the rule is only used or judged as correct when the antecedent is actually necessary to obtain the consequent, and it is not possible (because there is no enough information) to come to the consequent without the antecedent. Thus, the prediction is that individuals will tend to reject inferences such as this one:

[11] q   (premise)
[12] p   (supposition)
[13] q   (reiteration 1)
[14] p → q   (→I 2-3)

(Where, obviously, '→I' stands for the conditional introduction rule)

Likewise, the proposal implies that the contrary will happen in this case:

[15] ¬(p ∧ q)   (premise)
[16] ¬r → q   (premise)
[17] p   (supposition)
[18] ¬r   (MPT 15, 17)
[19] q   (MPP 16, 18)
[20] p → q   (→I 17-19)

(Where 'MPT' refers to the version of the *Modus Ponendo Tollens* rule that allows deriving ¬B from ¬(A ∧ B) and A)

The predictions regarding these two inferences are not the same. In the deduction in steps [11] to [14], p is not truly necessary to derive q, which is

already present in [11]. Nonetheless, in the inference in steps [15] to [20], p is absolutely needed to do so, to the extent that it can even be thought that it is the cause of q, since this last formula cannot be concluded without it. Of course, under this proposal, it should be also admitted that there can be cases in which an inference such as that in steps [11] to [14] is accepted (for example, the content of both p and q can lead individuals to provide relationships between them by virtue of their general knowledge and, based on information not explicitly offered in the inference, to think that p is the cause of q). In the same way, it is possible that the acceptance of the inference in steps [15] to [20] is hard because of an eventual abstract content in p, q, and r as well. However, the proposal in general is that people will only admit and apply →I when the antecedent is really necessary so that the consequent happens.

But, in any case, what is most important about this account for this paper is that it has several advantages: on the one hand, it is coherent with the main theses of different syntactic theories (e.g., as far as I understand them, it is clearly and obviously in the same direction as some theses of the mental logic theory in Braine & O'Brien, 1998c). Secondly, it can be checked by means of an empirical experiment (certainly, responses given by participants in tasks consisting in the two kinds of inferences indicated can be easily analyzed). Finally, what is truly relevant here: it explains the difficulty detected by Johnson-Laird et al. (2015) and indicates under what circumstances →I can be considered as correct and in which situations it can be thought not to be valid. And all of this is so without necessarily accepting the material interpretation of the conditional (and hence removing, at the same time, the complains linked to [VI] and [VIb]). Accordingly, it seems that the inconveniences related to the problems of the conditional are not insurmountable for the formal theories either.

5. VAPID CONCLUSIONS ARE NOT ACTUALLY POSSIBLE

In fact, the problem of the vapid conclusions was solved a long time ago. The proponents of the mental logic theory introduced the concept of 'Feeder Schemata' (see, e.g., Braine & O'Brien, 1998d) to indicate that there are formal rules that are only applied when necessary to continue an inference. In this way, if the use of the rule does not enable further inferential steps, it is not applied. Thus, the vapid conclusions are impossible.

Evidently, the mental logic theory includes in this category rules such as ∧I, which makes it possible to respond the Johnson-Laird et al.'s (2015) particular example in this regard, since, as just explained, from this framework, one cannot infer a formula such as A ∧ A ∧ A ∧ A from A. Nonetheless, in my opinion, the possibilities that the concept of Feeder Schemata opens go much further than the use given to it in the mental logic theory. I think that a syntactic theory could also claim that all the difficulties linked to →I can be removed if that concept is also applied to this last rule to some extent.

Obviously, →I cannot be thought to be a simple Feeder Schema, as, if it were, that fact would imply that its conclusion (A → B) should be useful only to derive more information, and the truth is that such a conclusion can be interesting alone, whether or not it leads to further conclusions. However, it is indeed possible to introduce as a new concept that of the Feeder Supposition and to consider that the supposition in →I (A) is a supposition of that kind, that is, a formula that can only be supposed if it actually serves to obtain at least a new datum (in this case, the consequent of the conditional, i.e., B).

As it can be noticed, assuming this thesis would not be saying something substantially different from what has been argued in the previous section, since the idea would continue to be that →I can only be used when the supposition of the antecedent (A) in the conditional of the conclusion (A → B) truly leads to the consequent (B), and this last clause (B) cannot be inferred by other means. But giving the supposition that has to be made in →I the status of Feeder Supposition does make it explicit a point that only was implicit in the explanation above: the restriction placed to →I prevents it from deducing vapid conclusions as well. Indeed, it is clear that A → B is not the only conclusion that can be derived from B. A formula such as, for example, A → {A → [A → (A → B)]} can also be inferred from B just using →I four times. In this way, the restriction raised, which, as indicated, is not different from the idea of considering the supposition of the rule a Feeder Supposition, seems to be helpful to argue against two problems pointed out by Johnson-Laird et al. (2015): the one of the conditionals and the one of the vapid conclusions.

Of course, a possible objection against the previous accounts can be that ∧I and →I are not the only rules that can cause vapid conclusions. Nonetheless, it is not hard to note that the concept of Feeder Schemata can be applied to any rule and that, therefore, it can be stated that the fact that the schemata can be considered as Feeder removes the objection related to the vapid conclusions.

6. THERE IS A PROCEDURE TO IDENTIFY LOGICAL FORMS

Really it is not unclear how logical forms are recovered from sentences in natural language. In, for instance, López-Astorga's (2015), a way to detect them is proposed, and what is surprising is that this way is based on the general methodology of the semantic theory that Johnson-Laird et al. (2015) support as an alternative to the formal approaches: the mental models theory (in addition to this last paper, see, e.g., Hinterecker, Knauff, & Johnson-Laird, 2016; Johnson-Laird, 2012; Khemlani, Orenes, & Johnson-Laird, 2014; Oakhill & Garnham, 1996; Ragni, Sonntag, & Johnson-Laird, 2016). Explaining the basic principles of this last theory is beyond the aims of this paper. In this regard, the only essential point of it that is relevant to the

present discussion is that it ignores logical forms and only takes into account the semantic and iconic representations corresponding to the possibilities linked to sentences. This, for the case of a conditional such as A → B means that what is important about it is not its syntactic structure, but the fact that it refers to these three possibilities:

[XI]: A & B, ¬A & B, ¬A & ¬B (see, e.g., Johnson-Laird, 2012: 138)

Because the mental models theory assigns [XI] to the conditional, *prima facie* it seems that the relation between this last theory and the truth tables of classical logic is very strong, since, as it can be noted, [XI] includes the three possibilities in which the conditional is true in accordance with the material interpretation, and hence excludes only the case in which the antecedent is true and the consequent is false. However, this is not so for several reasons. If the goals of this work are considered, the most important of them can be that the semantic content of the clauses and pragmatics can modify the possibilities. This phenomenon, which is called 'modulation' by the mental models theory (see, e.g., Johnson-Laird, 2012: 146), can be easily observed if we pay attention to an example such as [VII] again. If now A corresponds to the fact that 'there is oxygen' and B to the fact that 'there may be a fire', obviously, as it can be inferred from what has been said about this example and [VIIb] above, its possibilities are not those of [XI], but the following:

[XII]: A & B, A & ¬B, ¬A & ¬B

And its real logical form is not A → B, but B → A.

But, following arguments such as, for example, those of López-Astorga (2015), the reason why we can notice that B → A is the suitable form for [VII] is not dark, but very clear. It is very easy to build a truth table showing the possibilities in [XII] as the cases in which the sentence is true and the missing possibility as the case in which the sentence is false. Thus, proceeding in a similar way as López-Astorga (2015: 146), the content of [XII] can be expressed as follows:

v(sentence) = 1 if one of these is the case:
-v(A) = 1 and v(B) = 1
-v(A) = 1 and v(B) = 0
-v(A) = 0 and v(B) = 0

And v(sentence) = 0 if this is the case:
-v(A) = 0 and v(B) = 1

(Where '$v(\alpha)$' means 'truth value of α', 'sentence' refers to [VII], '1' denotes truth and '0' represents that the element between brackets is false)

In this way, from this information, it is not hard to come to a well-formed formula in standard logic that is true in exactly the same cases as [VII]. That formula is, of course, B → A, as, obviously, $v(A → B) = 1$ in exactly the same combinations of the truth values of A and B in which v(sentence) = 1, and $v(B → A) = 0$ in precisely the same scenario in which v(sentence) = 0.

So, undoubtedly, there is a procedure to recover the logical forms of sentences. That procedure has already been used in different papers, for example, as mentioned, the one of López-Astorga (2015: 146-147), in which the conditional is not the main connective analyzed, but disjunction. However, the most interesting point in this way can be that, given that the procedure is based on a methodology key for the theoretical approach held by Johnson-Laird et al. (2015), if these last authors continue to affirm that the process of identification of logical forms is not clear, they will have to assume that their methodology of analysis of possibilities is not clear either. And the reason of this seems to be obvious: according to arguments such as those of López-Astorga (2015: 146-147), the analysis of possibilities of the mental models theory may not be a procedure substantially different from that of the recovery of logical forms.

7. CONCLUSIONS

Therefore, it cannot be said that the factual communication shows that a formal perspective cannot be supported anymore. As argued in this paper, the main problems that can be raised against a syntactic framework can be easily responded, the basic ideas being that it is really difficult to think about a clear nonmonotonic inference, the material interpretation of the conditional is not the only possible interpretation, some formal rules are just Feeder Schemata, and the truth tables of classical logic reveal the actual logical forms of the sentences.

Nevertheless, this does not mean that there are no other difficulties to face with regard to the formal theories. As said, there is not a single syntactic approach. We have a number of them, and, therefore, adopting a formal perspective may not be sufficient. Perhaps it is also necessary to make a decision on the particular framework to be assumed, since, for example, accepting the idea that a syntax of thought really exists does not have to imply admitting that that syntax is exactly as described by the mental logic theory.

Furthermore, as also argued in papers such as that of López-Astorga (2015: 148), maybe the mistake is to deem pragmatics, semantics, and syntax to be irreconcilable or incompatible perspectives. As pointed out along this paper, pragmatics is present both in a syntactic proposal such as that of the mental logic theory and in a semantic approach such as the one of

the mental models theory. In turn, the link between semantics and syntax can be found in the way that has been indicated to recover logical forms, that is, in the arguments presented in the last section. Studies such as the one of López-Astorga (2015) already developed that way, according to which the meaning of the semantic and pragmatic possibilities of the mental models theory can lead to formal structures or, if preferred, logical formulae, to which, secondly, the formal rules would be applied. Perhaps, as raised in this last paper too, that is the right course, a course in which, as in the real inferential activity and the actual natural languages, pragmatics, semantics, and syntax complement and support each other.

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