



Research Article

The Combinations of Possibilities of “If” in Academic Texts: A Study Based on Two Papers about Women’s History

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Abstract

From the theory of mental models, it has been proposed that the sentences with ‘if’ can refer to ten different interpretations. Those interpretations are related to the situations in which their clauses are possible. On the other hand, a study suggests that two of those interpretations seem to predominate in academic psychology texts: the conditional and biconditional interpretations, that is, those that logic links to ‘if’. Using sentences from two Women’s History papers, the present work shows a new study trying to move forward in this direction. It also addresses the importance of how historical inquiries relating to women in different contexts can reveal the possible clauses used in their drafting and interpretation. The results are not very different from the previous study. The consequences related to the predominant tendency to the use of ‘if’ as a conditional or biconditional in human and social sciences are discussed.

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Introduction

The two papers selected had several commonalities. Both papers were about history issues. In addition, both of them referred to the history of women and focused on gender. It is about the article by Leah Astbury titled "When a woman hates her husband: Love, sex and fruitful marriages in Early Modern England." The text was published in 2020 in the journal *Gender & History*. The second article titled "Solidarity and silence: Motherhood in the Spanish Civil War" was published by Brett Schmoll in 2014 in the *Journal of Spanish Cultural Studies*.

A way to understand language and cognition is to consider sentences to refer to models of possibilities (e.g., Johnson-Laird & Ragni, 2019). That is what the theory of mental models does (see also, e.g., Khemlani, Byrne, & Johnson-Laird, 2018). This view opens perspectives much broader than the one of classical logic. For example, in the case of an expression of the form of (1),

(1) If p then q.

In classical logic the tendency is to interpret that expression in only two possible ways: as a conditional or as a biconditional. If it is understood as a conditional, the material interpretation is assumed (e.g., Jeffrey, 1981). That interpretation seems to come from ancient Greece, and, in particular, from Philo of Megara (e.g., O'Toole & Jennings, 2004). It provides that, given the four possible combinations between the clauses in a sentence such as (1), which are (2), (3), (4), and (5),

(2) p and q.

(3) p and not-q.

(4) not-p and q.

(5) not-p and not-q.

Conditional (1) is false only in the case of (3). (2), (4), and (5) are situations in which the conditional would be true. However, as any basic logic book often points out (e.g., Restall, 2006), (1) can also be interpreted as (6).

(6) p if and only if q.

Sentence (6) is a biconditional sentence. In logic, biconditional sentences establish the conditional relation not only from the antecedent to the consequent, but also from the consequent to the antecedent. Thus, (6) is equivalent to (7).

(7) (If p then q) and (if q then p).

Sentences (6) and (7) are not, as the conditional, true in three cases. They are correct only in two scenarios: (2) and (5). This is because what the biconditional means is that the two clauses have to happen at the same time. Therefore, either both of them occur or none of them occur.

Nevertheless, the theory of mental models claims that the logical perspective is limited (see also, e.g., Johnson-Laird, 2010). That theory has identified at least eight more interpretations, the total number of possible interpretations being ten (Johnson-Laird & Byrne, 2002).

These ideas are relevant in linguistics. Nonetheless, there have also been studies trying to research to what extent people use the ten interpretations mentioned. For example, one study considered a psychology paper about autism. That study found that the psychology paper included 25 sentences with 'if'. 16 of those sentences were deemed as irrelevant. The reasons for that were several. However, one important reason was that, in a number of those sentences, 'if' was equivalent to 'whether'. The nine remaining sentences only corresponded to interpretations akin to those of the conditional and the biconditional in logic (the psychology paper was Rutherford & Ray, 2009; López-Astorga, 2020, describes the study about that paper taking into account the ten interpretations of the theory of mental models).

This might lead one to think that, while the ten interpretations exist, eight of them are not usual, that is, they are only occasionally used. The present paper is intended to keep analyzing this idea. To do that, it presents a new study in which the sentences with 'if' in two more papers were reviewed. The papers that were considered continued to be research academic texts. Nevertheless, in this case, they were not psychology papers, but history papers. This allowed checking whether the trend to use 'if' mostly referring to conditional or biconditional interpretations was in texts from other academic fields too. Before describing the study, the next section is devoted to the general theses of the theory of mental models about the sentences with 'if' and their possible interpretations.

The conjunctions of possibilities of 'if'

The theory of mental models proposes that the sentences linked by connectives can be understood as conjunctions of possibilities (see also, e.g., Khemlani, Hinterecker, & Johnson-Laird, 2017). In the case of a sentence such as (1), its conjunction of possibilities is the one in (8) (see also, e.g., López-Astorga, Ragni, & Johnson-Laird, 2021).

(1) Possible ($p \ \& \ q$) & Possible ($\text{not-}p \ \& \ q$) & Possible ($\text{not-}p \ \& \ \text{not-}q$).

Symbol '&' works as a conjunction in logic. Therefore, it expresses that all the conjuncts are true (e.g., Khemlani et al., 2017). Each possibility in (8) presents an alternative situation that (1) enables.

One might think that, given this explanation, the account of the theory of mental models is not different from that of classical logic. After all, the possibilities in (8) match the cases indicated above in which the conditional is true in that logic, that is, the cases in which the conditional is true in accordance with the material interpretation. Besides, the way the theory of mental models understands the biconditional relations is akin to the one of classical logic too. The possibilities of those relations in the theory are the first one and the last one in (8), that is, $p \ \& \ q$ and $\text{not-}p \ \& \ \text{not-}q$. It is enough to remove $\text{not-}p \ \& \ q$ to come to the conjunction of possibilities corresponding to the biconditional relation (e.g., Khemlani et al., 2018). But the theory of mental models is away from logic in many senses.

First, the possibilities in (8) can be accepted at the same time. They are only possibilities. This is not the case in classical logic. In this last logic, scenarios such as (2), (3), (4), and (5) are exclusive. They cannot be true at once (e.g., Johnson-Laird & Ragni, 2019).

Second, the three possibilities in (8) are not of the same kind. The first one ($p \ \& \ q$) is actually a possibility, but the other two ($\text{not-}p \ \& \ q$ and $\text{not-}p \ \& \ \text{not-}q$) are presuppositions. The only impossibility is the circumstance of $p \ \& \ \text{not-}q$. However, given that $p \ \& \ q$ is a possibility, that possibility presupposes the situations in which p does not happen, that is, $\text{not-}p \ \& \ q$ and $\text{not-}p \ \& \ \text{not-}q$ (e.g., López-Astorga et al., 2021).

In the same way, the theory of mental models has an account of the cases in which the sentences with 'if' are counterfactual. A counterfactual sentence with 'if' is, for instance, (9).

- (2) "If there had been a rose in the vase, then there would have been a daffodil (Byrne & Johnson-Laird, 2020, p. 768).

What (9) points out is a fact, an impossibility, and two situations that were possible but they are not anymore (that is what can be derived from Table 1 in Byrne & Johnson-Laird, 2020). (10) shows what (9) reveals.

- (3) Possible once (there is a rose in the vase & there is a daffodil in the vase) & Impossible (there is a rose in the vase & there is no daffodil in the vase) & Possible once (there is no rose in the vase & there is a daffodil in the vase) & Fact (there is no rose in the vase & there is no daffodil in the vase).

Finally, the point more related to the study described below is that the theory acknowledges modulation mechanisms (see also, e.g., Orenes & Johnson-Laird, 2012). Modulation has to do with semantics and pragmatics. By virtue of it, the possibilities linked to sentences can be modified (see also, e.g., Quelhas, Johnson-Laird, & Juhos, 2010). (11) gives an example of the action of modulation in the conditional.

- (4) If she goes to Russia, then she goes to Moscow.

The possibilities of (11) are not the ones in (8). Moscow is in Russia. Hence, it is not possible a case of $\text{not-}p \ \& \ q$ (i.e., that the antecedent is false and the consequent is true). Likewise, now it is possible a case of $p \ \& \ \text{not-}q$ (i.e., that the antecedent is true and the consequent is false). This is because it is possible to be in Russia without being in Moscow. So, the possibilities of (11) are those in (12).

- (5) Possible ($p \ \& \ q$) & Possible ($p \ \& \ \text{not-}q$) & Possible ($\text{not-}p \ \& \ \text{not-}q$).

Where p is the antecedent and q is the consequent.

Accordingly, the distance from classical logic is obvious. (11) and (12) correspond to one of the ten interpretations the theory of mental models identifies. In particular, it is named 'Enabling' (e.g., Johnson-Laird & Byrne, 2002, Table 4).

Another example of the interpretations is 'Tautology' (e.g., Johnson-Laird & Byrne, 2002, Table 4). It refers to the circumstance in which all the combinations of clauses are possible. An instance is (13).

- (6) "If there are lights over there then there may be a road" (Johnson-Laird & Byrne, 2002, p. 663, Table 4).

If p keeps being the antecedent and q continues to be the consequent, the possibilities of (13) are the following:

- (7) Possible (p & q) & Possible (p & not-q) & Possible (not-p & q) & Possible (not-p & not-q).

There may be lights. But both in the scenario in which there are lights and in the scenario in which there are no lights, it is possible both that there is a road and that there is no road.

Other examples of interpretations could also be illustrative. Nevertheless, 'Relevance' (e.g., Johnson-Laird & Byrne, 2002, Table 4) is especially important here; it is related to the results of the study below. Relevance is the interpretation of sentences such as (15).

- (8) "If you are interested in seeing *Vertigo* then it is on TV tonight" (Johnson-Laird & Byrne, 2002: 663, Table 4).

The possibilities in this case would be the ones in (16).

- (9) Possible (p & q) & Possible not-p & q).

What is possible in (15) is that you are interested in seeing *Vertigo*. That *Vertigo* will be on television tonight is known for sure.

Along with the interpretations corresponding to the conditional and biconditional relations, Enabling, Tautology, and Relevance are five of the ten possible interpretations the theory of mental models has detected (e.g., Johnson-Laird & Byrne, 2002, Table 4). They are enough to make the point of this paper: they suffice to analyze the results of the study reported here. Perhaps it is only important to add that the interpretations have been used from several perspectives and with different purposes (see, e.g., López-Astorga, 2016).

Methodology

The analysis addressed two history papers that were randomly chosen: the ones of Schmoll (2014) and Astbury (2020). The aim was to check whether, as found in a psychology paper (López-Astorga, 2020), there is a tendency to use sentences with 'if' linked to interpretations (8) and (17) in history papers as well.

- (1) Possible (p & q) & Possible (not-p & not-q).

As indicated, (8) is the conjunction of possibilities the theory of mental models initially considers for the conditional relations. On the other hand, (17) is the conjunction the theory attributes to the biconditional relations. Both of them seem to be similar in the way logic tends to understand conditional and biconditional logic.

The differences were in their perspectives of analysis and the historical contexts they dealt with. Schmoll (2014) reviewed motherhood processes during the Spanish Civil War. Several towns in a particular Spanish region were taken into account. The region was Castilla y León. The research was based on oral testimonies. It showed the fear and hard work to do in that period in that place. The conclusions were that the armed conflict modified family life, and the more frequent answers mothers gave were silence and solidarity.

As far as the paper by Astbury (2020) is concerned, it was related to the literature about compatibility in marriage. It addressed the cases of two wives and their opinions on not having children. The paper tried to make it explicit the social pressure those women felt.

The task was to identify all the sentences with 'if' in both texts. 30 sentences were found: six in Schmoll (2014) and 24 in Astbury (2020). Six sentences were eliminated from those 30 sentences because they were not relevant for the study (the reasons for this are explained below). Regarding the 24 remaining sentences, they were analyzed to determine whether they belonged to category [I] or category [II].

[I] Conditional/biconditional.

[II] Other interpretation following the theory of mental models.

The requirement to include a sentence in [I] was to fulfill what (18) provides:

(2) Possible (p & q) & Possible (not-p & not-q) & Impossible (p & not-q).

The two first possibilities in (18), that is, p & q and not-p & not-q, were necessary to guarantee that, at least, the relation was biconditional: they are the possibilities in (17). However, the analysis also had to verify that the sentences did not allow cases of p & not-q. This is because combination p & not-q is not enabled in the conditional or biconditional interpretations. With regard to the combination not-p & q, it was not considered a relevant combination. If it was possible, the sentence was conditional. If not, the sentence was biconditional. Given that category [I] included both the conditional and biconditional interpretations, that combination was ignored. Any other case was assigned to [II].

Results

Table 1 shows the relevant sentences identified in Schmoll (2014), as well as the category they belong. There was one more sentence in the paper. It was deemed as irrelevant because its connective was not 'if', but 'even if'. The sentence was this one:

While not voicing any explicit promise of equality or other feminist goals, this solidarity allowed the women in question to shape their own lives, even if that freedom was limited and temporary. (Schmoll, 2014, p. 485).

Table 1. Relevant sentences with 'if' in Schmoll (2014) and their category ([I] or [II])

Sentence	[I]	[II]
1.- "'The good state,' according to one editorial from 1938, 'rests in the family: and it will be strong if the woman, in the home, is healthy, fertile, laborious and happy.'" (Schmoll, 2014, p. 478; quotes in text).	X	
2.- "When she confronted the man while he was taking large bags of food to the priests, she simply yelled, 'if your father could see you, he would kill you.'" (Schmoll, 2014, p. 482; quotes in text).	X	

3.- "Hence, the daily work of the mother was central if the household was to survive." (Schmoll, 2014, p. 482).	X	
4.- "And according to Berta Hernández López, 'if someone needed help, there was always help.'" (Schmoll, 2014, p. 484; quotes in text).	X	
5.- "And Gregoria Esculta recalled, 'the neighbor would always give us salt if we didn't have any.'" (Schmoll, 2014, p. 485; quotes in text).	X	

In Table 1, sentences 1 to 5 correspond to [I]. For example, the interpretation of the first one seems to be the conditional interpretation. It appears to establish, as the only impossible situation, that the state is weak when the woman 'is healthy, fertile, laborious, and happy.' On the contrary, the case of the second one is different. It seems to be biconditional because it appears to indicate two impossible scenarios: that your father sees you and he does not kill you, and that your father does not see you and he kills you. Nevertheless, distinctions such as this one did not have an influence on the goals of the study. They were ignored and, as explained, the two kinds of interpretation (conditional and biconditional) were taken as one category: [I].

Regarding Astbury (2020), the sentences eliminated were five. Three of them included 'even if' again:

Even if this seed was jointly emitted, it might be 'unfruitful' because one or both parties were unhealthy, or because there needed to be a 'certain proportion' between their seed and between their constitutions. (Astbury, 2020, p. 523; quotes in text).

Fourthly he noted that sometimes the womb was too 'weak' to retain the seed, even if it could or wanted to attract it. (Astbury, 2020, p. 523; quotes in text).

But even if they had been of an age where they could get pregnant, their ravaged, depleted bodies could never have conceived in an early modern mind. (Astbury, 2020, p. 535).

One resorted to connective 'as if':

She felt as if she were choking and was unable to speak or open her mouth. (Astbury, 2020, p. 530).

And the second clause of the fifth one was a question:

Culpeper's vision of conception understood marital compatibility – bodily and emotional – as fundamental to fertility: '[I]f their hearts be not united in love, how should their Seed unite to cause Conception?' (Astbury, 2020, p. 524; quotes and square brackets in text).

Table 2 points out the category to which the 19 remaining sentences belong.

Table 2. Relevant sentences with 'if' in Astbury (2020) and their category ([I] or [II])

Sentence	[I]	[II]
1.- "If spouses' 'hearts be not united in love', their seed could not 'unite to cause Conception', the seventeenth- century astrologer-	X	

physician, Nicholas Culpeper noted." (Astbury, 2020, p. 523; quotes in text).		
2.- "If after sex, the woman 'cough, [s]neese, cry out, dance, or be angry, or frighted' she might lose the seed; the action of the womb was intimately connected with a woman's emotional state." (Astbury, 2020, p. 524; quotes and square brackets in text).		X
3.- "She had to be cheerful to be procreative. There might also be a problem with the womb if it was too moist, too hot or too dry." (Astbury, 2020, p. 524).		X
4.- "Finally, if there was insufficient menstrual blood to nourish the infant in the womb, its life could not be sustained." (Astbury, 2020, p. 524).	X	
5.- "Male and female bodies were 'one-sex' and anatomically similar, if not identical, differentiated only by their humours (men were hot and dry, and women cold and wet) and both women and men had to ejaculate, although childbearing guides of the period debated whether the male contribution was more powerful." (Astbury, 2020: 524; quotes in text).	X	
6.- "John Dod and Robert Cleaver noted in <i>A Godlie Forme of Householde Government</i> (1612) that if spouses did not perform their marital duties 'godily, carefully, and cheerfully on both sides', life would become 'lothsome and bitter, or rather more sharpe than death'." (Astbury, 2020, p. 526; quotes and italics in text).	X	
7.- "Thus, Mary Whitelocke, in her instructions to her son Samuel, explained that her first marriage to Rowland Wilson MP in 1634 had been childless because if they had had a baby they would have been 'surfetted with to[o] much creature injoyments' and forgotten their devotion to God." (Astbury, 2020, p. 528; quotes in text).	X	
8.- "Affection and love were central to both fertility and health more generally. Queen Mary reportedly told a delegation that had encouraged her to marry that 'if she were married against her will she would not live three months' [...]." (Astbury, 2020, p. 528; quotes in text).	X	
9.- "[...] and if she survived, would certainly not have any children." (Astbury, 2020, p. 528).		X
10.- "Correspondence with pregnant women often stressed the importance of being happy to their ability to bear a healthy baby. Anna Temple warned her pregnant daughter that if she were not	X	

more 'cheer full' she would miscarry like she had previously." (Astbury, 2020, p. 529; quotes in text).		
11.- "If she did manage to get pregnant he did not think the child would survive." (Astbury, 2020, p. 530).		X
12.- "He knew 'no reason but mine should beginn' as his wife had already conceived once, 'for if she does not, at her perill'." (Astbury, 2020, p. 530; quotes in text).	X	
13.- "The published account of Robert Devereux and Frances Howard's notorious 1613 annulment reported that the archbishop had attributed their inability to consummate their marriage to 'Want of Love, which restraineth all Motions of carnal Concupiscence' and opposed the judgement assuming that if the couple could rekindle their romance, all would be well." (Astbury, 2020, p. 531; quotes in text).	X	
14.- "But if one married poorly, conduct authors expected that incompatibility could be overcome through effort and will." (Astbury, 2020, p. 531).	X	
15.- "If he was a bad husband, she must be a poor wife for 'wee wiuies may do much in either making or marring our husbands' [...]." (Astbury, 2020, p. 532; quotes in text).	X	
16.- "[...] – if she were cheerful and submissive, their marriage would be harmonious." (Astbury, 2020, p. 532).	X	
17.- "Once interred and awaiting execution, she reflected that other women ought to take more pains 'to live in Love and Peace with their Husbands if it be possible'." (Astbury, 2020, p. 532; quotes in text).	X	
18.- "In one argument she told him that if all husbands acted the way he had no woman would ever 'venture upon Marriage'." (Astbury, 2020, p. 533; quotes in text).	X	
19.- "Dormer told her sister that her 'vowe of living with him [her husband] till death us do part make me resolve to endure anything rather then leave him if he will lett me live with him'." (Astbury, 2020, p. 535; quotes in text).	X	

Most of the relevant sentences in Astbury (2020) also correspond to [I]. 15 of them can be assigned to this last category. Only four refer to other interpretations. Two of them can be attributed to Tautology: number 2 and number 3 in Table 2. In the case of number 2, the antecedent can be both true and false. The woman may or may not act in the ways described after sex. Nevertheless,

whether or not she acts in those ways, to lose the seed is just a possibility. That is indicated by modal 'might'. Therefore, the four combinations in (14) are possible.

Something similar happens with number 3 in Table 2. Whether or not the womb has the characteristics mentioned in the if-clause, the problem with it is again just a possibility. That is because of the presence of modal 'might' as well. Hence, as in the previous case, the four situations in (14) can occur.

As far as numbers 9 and 11 in Table 2 are concerned, they are cases of Relevance. In both of them, the antecedent may or may not happen, but the consequent will happen for sure. What number 9 in Table 2 expresses is that she may or may not survive. However, in any case, she will not have children. With regard to number 11 in Table 2, he thought that any possible child she could have would not survive (as the consequent indicates).

By considering the two papers, the final results are the following: there are 24 relevant sentences with 'if'. 20 of them correspond to [I]. Only four of them are linked to other interpretations. Two of them are related to Tautology, and the other two are cases of Relevance.

Conclusions and discussion

Perhaps the results are not as strong as those in López-Astorga (2020). In this last paper, all the relevant sentences with 'if' were conditional or biconditional. Nevertheless, the present paper keeps showing a trend in those interpretations, too: 20 of 24 sentences can be assigned to the conditional or biconditional interpretations.

Furthermore, the four sentences corresponding to other interpretations seem to reveal the distance existing between natural language and logic. Because of the modal 'might,' the two sentences linked to Tautology could not be considered in logic (in this last case, in modal logic) as sentences with the form of (1). Their form would be the one of (19).

(1) If p then (q is possible).

Thus, following combinations (2) to (5) and the material interpretation of the conditional, the cases allowed would be three: p and (q is possible), not- p and (q is possible), and not- p and (q is not possible). The situation in which p is true and q is impossible would not be admitted. Nonetheless, as indicated, numbers 2 and 3 in Table 2 enable circumstances in which the if-clause is true and the fact described in the then-clause is not.

With regard to the two cases of Relevance, they reveal the great influence semantics has on the understanding of sentences with 'if' expressed in natural language. Number 9 and 11 in Table 2 are not classical logical conditionals either. They do not allow the circumstance in which the two clauses are false. This is because that circumstance is semantically impossible. In the case of number 9 in Table 2, a woman who does not survive cannot have children. In the case of number 11 in Table 2, a woman who does not get pregnant cannot have a child surviving.

However, as said, the study above seems to show that the predominant interpretations in history texts are the conditional and biconditional ones. Accordingly, it is not away from studies that have shown the same in texts from other academic fields (e.g., psychology in López-Astorga, 2020). In

this way, the limitations of the study reported here are also akin to those in previous papers (e.g., López-Astorga, 2020), which should be overcome in the future. The limitations refer to the need to consider more papers or books focused on both general history and history of women (and, e.g., psychology). Likewise, texts coming from other academic disciplines could be analyzed. In the same manner, it would be important to verify whether or not the phenomenon is repeated in works in other languages, and not only in English.

In any case, and beyond these limitations, the provisional conclusion is that it seems that people tend to use 'if' to most often express conditional or biconditional relations. Other interpretations are possible (the ones the theory of mental models proposes). The existence of those additional interpretations appears to show that natural language is not directly related to logic. Nevertheless, the usual case is that the connective mentioned is linked to the conditional or biconditional interpretation. But further studies should confirm this last point.

Consequently, it is relevant to continue researching conditional expressions in academic and everyday discourses. They help us understand how we are structuring and communicating our ideas about a topic, both in the real world and digital. Thus, for example, social networks and news could equally be the subject of this type of analysis. All this, undoubtedly, could serve to identify possible stereotypes or other biases.

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