

## Inferences from semifactual ‘even if’ conditionals

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### Abstract

We report three experiments on semifactual conditionals such as ‘even if he had worn his seatbelt he would have been injured’. Semifactuals contain a counterfactual antecedent (the presupposed fact is, he did not wear a seatbelt) and a true consequent (the fact is, he was injured). The experiments show that from the denial of the antecedent, ‘he did not wear his seatbelt’, reasoners do not infer the standard conclusion ‘he was not injured’ but instead they infer the asymmetric conclusion, ‘he was injured’. From the affirmation of the consequent, ‘he was injured’, they do not infer the standard conclusion ‘he wore his seatbelt’ but instead they infer that there is no valid conclusion. The first experiment shows this pattern for ‘even if’ subjunctive conditionals compared to ‘if’ indicative conditionals, the second extends it to ‘even if’ subjunctive conditionals compared to ‘even though’ indicative concessives, and the third extends it to ‘if...also/still’ subjunctive conditionals. The results suggest that people think about two possibilities to understand a semifactual: the conjecture, he wore his seatbelt and he was injured, and the presupposed facts, he did not wear his seatbelt and he was injured.

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### 1. Introduction

We aim to examine ‘even if’ conditionals, such as ‘even if he had worn his seatbelt he would have been injured’. What does someone uttering this sort of conditional mean to imply? On our analysis, a person making such an assertion has suggested something about at least two possibilities, one in which he wore his seatbelt and he was injured, and another in which he did not wear his seatbelt and he was injured. The speaker has also conveyed that the first possibility is a conjecture whereas the second corresponds to the presupposed facts. These conditionals are sometimes called semifactuals by philosophers (e.g., Chisholm, 1946) because they seem to convey that their antecedents are false, he did not wear his seatbelt, yet their consequents are true, he was

injured. Semifactual conditionals can serve to deny a causal link between the antecedent, to wear a seatbelt, and the consequent, to be safe, and so the speaker may cancel an assumption of the hearer’s that wearing a seatbelt would prevent injury (see Byrne, 2005 for a review). We report the results of three experiments that examine the inferences that reasoners make from semifactual conditionals.

#### 1.1. Indicative conditionals

Most psychological studies of conditional inference focus on the meaning and use of ‘if’ in the indicative mood,<sup>1</sup> such as ‘if the lever was pressed the platform

<sup>1</sup> Linguistic ‘mood’ is the grammatical term to refer to the form of the verb to indicate whether it expresses a fact, command, wish (indicative, imperative, subjunctive, respectively). It is sometimes referred to less technically as ‘mode’.

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stopped’. Hypothetical inference is central to understanding human rationality, and ‘if’ remains one of the most intriguing and possibly most theoretically challenging of linguistic connectives, as the hundreds of experiments on it testify (e.g., Manktelow, 1999). Studies of ‘if’ often examine the situations in which people judge conditionals to be true and false, and the inferences that they make from them (e.g., Evans & Newstead, 1993).

When people understand a conditional in the indicative mood, such as, ‘if the lever was pressed the platform stopped’, they can make some inferences readily, such as the modus ponens (MP) inference, from ‘the lever was pressed’ to ‘the platform stopped’ (see Table 1). But they find it difficult to make other inferences such as the modus tollens (MT) one from ‘the platform did not stop’ to ‘the lever was not pressed’. The difference in difficulty has been explained by several different theories and the one that we test here is that people understand conditionals by keeping in mind possibilities (Johnson-Laird & Byrne, 1991). To understand a conditional in the indicative mood, people keep in mind just a single true possibility at the outset, ‘the lever was pressed and the platform stopped’. They may be aware that there are alternatives to this possibility (what we will call a “implicit model”) but they have not thought through what these alternatives may be, perhaps because of the constraints of working memory (Johnson-Laird, Byrne, & Schaeken, 1992). As a result they make the MP inference readily. But to make the MT inference, they must think explicitly about the alternatives to the initial possibility. They must appreciate that the conditional is consistent with the possibility ‘the lever was not pressed and the platform did not stop’. Reasoners do not think about false possibilities, e.g., ‘the lever was pressed and the platform did not stop’ (Johnson-Laird & Byrne, 2002), except to understand certain sorts of possibilities such as obligations (Quelhas & Byrne, 2003).

Two further inferences are crucial for our experiments: the denial of the antecedent (DA) inference, from ‘the lever was not pressed’ to ‘the platform did not stop’ and the affirmation of the consequent (AC) inference, from ‘the platform stopped’ to ‘the lever was pressed’. Reasoners make these inferences from indicative ‘if’ when they consider the conditional to be consistent with just the two possibilities already outlined, ‘the lever was pressed and the plat-

Table 1  
Four inferences for a conditional

If the lever was pressed the platform stopped	
MP	AC
The lever was pressed	The platform stopped
The platform stopped	The lever was pressed
DA	MT
The lever was not pressed	The platform did not stop
The platform did not stop	The lever was not pressed

Key: MP = modus ponens, AC = affirmation of the consequent, MT = modus tollens, DA = denial of the antecedent.

form stopped’ and ‘the lever was not pressed and the platform did not stop’ (a ‘biconditional’ interpretation). They resist the two inferences as fallacies when they consider a third possibility to be consistent, ‘the lever was not pressed and the platform stopped’. This third possibility is consistent with a ‘conditional’ interpretation of indicative ‘if’. On our account, this third possibility is especially salient for semifactual conditionals and so it predicts that reasoners should readily resist the DA and AC inferences from them.

### 1.2. Subjunctive conditionals

People envisage initially a single possibility to understand indicative ‘if’ but they envisage more than one possibility from the outset for some conditionals, such as those in the subjunctive mood, e.g., ‘if the lever had been pressed, the platform would have stopped’ (Johnson-Laird & Byrne, 1991). The counterfactual conditional leads people to envisage not only the conjectured possibility, ‘the lever was pressed and the platform stopped’, but also the presupposed facts, ‘the lever was not pressed and the platform did not stop’ (Carpenter, 1973; Fillenbaum, 1974), as Table 2 illustrates. They keep track of the epistemic status of the possibilities as corresponding to the facts or an imagined possibility. Reasoners judge that someone uttering a counterfactual means to imply these facts, i.e., ‘the lever was not pressed’ and ‘the platform did not stop’ (Thompson & Byrne, 2002). They readily make inferences that require access to these facts, such as the otherwise difficult MT inference, from ‘the platform did not stop’ to ‘the lever was not pressed’. They also frequently make the DA inference from ‘the lever was not pressed’ to ‘the platform did not stop’ (Byrne & Tasso, 1999). These data support the view that counterfactual conditionals are understood by keeping in mind two possibilities (Byrne, 2005).

Table 2  
The initial true possibilities people keep in mind for different sorts of conditionals

Indicative: If the lever was pressed the platform stopped
<i>Initial possibilities</i>
The lever was pressed and the platform stopped
...
Counterfactual: If the lever had been pressed the platform would have stopped
<i>Initial possibilities</i>
Facts: The lever was not pressed and the platform did not stop
Conjecture: The lever was pressed and the platform stopped
...
Semifactual: Even if the lever had been pressed the platform would have stopped
<i>Initial possibilities</i>
Facts: The lever was not pressed and the platform stopped
Conjecture: The lever was pressed and the platform stopped
...

The ellipsis represents an implicit model of other true possibilities that can be accessed subsequently for example: “The lever was not pressed and the platform stopped” or “The lever was not pressed and the platform did not stop”.

On our account semifactual conditionals such as ‘even if the lever had been pressed, the platform would have stopped’ also enable reasoners to envisage several possibilities readily. Semifactuals convey that their antecedents are false and their consequents are true (whereas counterfactual conditionals convey that both their antecedent and consequent are false). Many conditionals seem to depend on a connection between the antecedent and the consequent but an intriguing feature of semifactuals is that they appear to deny such a connection (Haspelmath & König, 1998). In fact, semifactuals appear to cancel an expected causal link between the antecedent and the negation of the consequent (Dancygier, 1998; Rodríguez Rosique, 2001; Schwenter, 2001), for example, that if the lever was pressed, the platform moved (did not stop).

Individuals readily imagine semifactual alternatives when they think about how an outcome might have turned out the same, for example, a runner would still have lost her race, despite changes to various antecedents, such as even if she had not sustained an injury, or even if she had not taken a drug with drowsiness as a side effect (McCloy & Byrne, 2002). Semifactual thinking may be important in everyday life for working out the relations between events, as philosophers have long suggested. Semifactuals help people to deny that an antecedent was the cause of an outcome, by describing how past events would have turned out the same. (In contrast, counterfactual conditionals, e.g., ‘if she had trained better she would have won’ help people establish that an antecedent was the cause of an outcome, by describing how past events would have turned out differently.) Reasoners who generate ‘even if’ thoughts about an outcome then consider the antecedents to be less causally related to the consequent, e.g., they judge a runner’s injury to be less causal of her losing the race (McCloy & Byrne, 2002).

### 1.3. Inferences from semifactual conditionals

On our account when people understand a semifactual, ‘even if the lever had been pressed the platform would have stopped’ they keep in mind not only the possibility ‘the lever was pressed and the platform stopped’, but also the possibility ‘the lever was not pressed and the platform stopped’, as well as the implicit model indicating that there are other alternatives (see Table 2). Our predictions are based on the mental model theory, which was originally postulated in order to explain the comprehension of discourse and elementary deductive reasoning (Johnson-Laird & Byrne, 1991; see also Johnson-Laird & Byrne, 2002). The representation of the assertion takes the form of mental models: mental representations of the meaning of the sentences. Reasoners rarely look for all possible alternatives. The initial representation may skew the inference process: reasoners will be more ready to accept those conclusions that match the models of the premises. Semifactual conditionals, unlike indicative conditionals, are represented with

two initial mental models obtained from the two possibilities shown in Table 2.

Corroboration for this theory comes from the finding that when people read an ‘even if’ conditional, they are primed to read the subsequent conjunction ‘the lever was not pressed and the platform stopped’ more quickly than when they have read an ‘if’ conditional (Santamaría, Espino, & Byrne, 2005). The theory leads to novel predictions about the inferences that reasoners will make. Conditionals are most often studied by examining the inferences that reasoners make from them and we rely on inferences in the three experiments we report.

The theory predicts that reasoners’ understanding of semifactuals should have a dramatic effect on their tendencies to make the AC and DA inferences. It makes four predictions. The two primary predictions concern the AC and DA inferences. First, given the AC premise ‘the platform stopped’, reasoners should readily resist the standard conclusion ‘the lever was pressed’. They should make fewer AC inferences than from ‘if’. For ‘even if’ they have in mind two possibilities in which the platform stopped, in one the lever was pressed and in the other it was not; they should conclude readily that no valid conclusion is possible (the lever may or may not have been pressed). Second, given the DA premise, ‘the lever was not pressed’, they should readily resist the standard conclusion ‘the platform did not stop’. They should make fewer DA inferences than from ‘if’. They have in mind two possibilities and in one of them the lever was not pressed, and in this possibility the platform stopped. The theory predicts that reasoners should make an ‘asymmetric’ inference, from ‘the lever was not pressed’ to ‘the platform stopped’.

Third, given the MP information ‘the lever was pressed’, the inference ‘the platform stopped’ can be made as readily from ‘even if’ as from ‘if’: people keep in mind from the outset the possibility ‘the lever was pressed and the platform stopped’ for both sorts of connectives. Of course reasoners have in mind two possibilities for ‘even if’ and only one for ‘if’ and as a result they may experience a general difficulty in making inferences from ‘even if’ because of the additional load on working memory. If so, they should make fewer inferences from ‘even if’ than from ‘if’ including fewer MP inferences. Fourth, the MT information, ‘the platform did not stop’ does not correspond to any information in the two possibilities reasoners have envisaged initially for a semifactual. They should have some difficulty making the inference. Note that we do not make a prediction of an asymmetric inference similar to the DA case, because there is no information corresponding to the MT minor premise ‘the platform did not stop’ represented in the two possibilities (see Table 2). Reasoners may even have more difficulty making the MT inference from ‘even if’ than from ‘if’: for ‘even if’ they have in mind two possibilities and they must envisage a third to make the inference; for ‘if’ they have in mind a single possibility and they must envisage a second to make the inference – the

greater number of possibilities to envisage for ‘even if’ may make the inference harder.

Two previous studies have examined inferences with semifactual conditionals. Two of us (Moreno-Ríos & García-Madruga, 2002) tested these predictions in a developmental study. Participants had to make the four inferences, given one “if” conditional (“if Carlos played football, he wore a red T-shirt”) and one “even if” (“*aunque*” in Spanish; “even if Carlos played football, he would have worn a red T-shirt”) semifactual conditional. The results were consistent with the present explanation. Inferences that were based on one explicit representation, such as concluding Carlos wore a red T-shirt from Carlos did not play football, were made by younger participants. Adults but not children rejected the AC inference, which requires considering the two explicit inconsistent representations (Carlos played and did not play). Adults showed similar results to those predicted here.

Similar results with adults were also obtained by Handley and Feeney (2004, Experiment 2), again with two unique conditionals per experiment (and two versions of each) and again the same “even if” conditional was immediately followed by the four inferences. Although their results were similar to ours, they obtained differences in the frequencies of inferences for the two contents of the “even if” expressions. The authors assumed that the difference obtained with the two conditional expressions demonstrates a peculiarity of the “even if” representation: it is dependent on pragmatic and/or probabilistic effects. However the difference might not be specific to “even if” but could be due to a well known effect of content in deduction with conditionals (see Evans & Newstead, 1993; Johnson-Laird & Byrne, 2002). Unfortunately the authors only included “if then” control inferences in Experiment 1 and not in Experiment 2, in which they tested the specificity of the effect of the content in “even if” conditionals.

In this study we try to provide a more extensive and exhaustive test of the expressed predictions, improving some methodological features of previous studies. The mental model theory explains how people reason with conditionals: they construct initial mental models from the premises, integrate the information from the premises, make a tentative conclusion and look for alternative conclusions. In the comprehension phase, semifactual conditionals will lead to the representation of two mental models instead of only one, as proposed for “if then”. According to the mental model theory, this initial representation of the two models will lead to the pattern of frequencies of the four inferences described above.

We test these predictions in three experiments. In the first we compared semifactual ‘even if’ subjunctive conditionals such as ‘even if the lever had been pressed, the platform would have stopped’, to ‘if’ indicative conditionals, such as ‘if the lever was pressed, the platform was stopped’. In the second, we replicated the results for ‘even if’ subjunctive conditionals and compared them to ‘even though’ indicative concessives, such as ‘even though the lever was

pressed, the platform stopped’. In the third we extended the results for ‘even if’ subjunctive conditionals to ‘if...also/still’ subjunctives, such as ‘if the lever had been pressed, the platform still would have stopped’.

## 2. Experiment 1: Semifactual ‘even if’ conditionals

The experiment aimed to test the predictions that reasoners would make fewer DA and AC inferences from semifactual conditionals than from factual conditionals. We compared subjunctive past tense ‘even if’ conditionals (‘*incluso si*’ in Spanish) to indicative past tense ‘if’ conditionals. ‘If’ conditionals may be interpreted as biconditionals (supporting all four inferences), or as conditionals (supporting the MP and MT inferences but not the DA and AC ones), and in either case, the pattern of inferences from semifactual ‘even if’ conditionals should be different from ‘if’. That difference should be produced by the additional initial possibility represented in the subjunctive conditional. Because the relative frequencies of each inference are influenced by the content of conditionals (see Evans & Newstead, 1993; Johnson-Laird & Byrne, 1991, 2002), the same set of contents were shown as indicative conditionals to half the participants and as subjunctive conditionals to the other half.

### 2.1. Method

#### 2.1.1. Materials and design

We constructed two sorts of arguments, one based on ‘even if’ conditionals in the subjunctive mood and past tense, e.g., ‘even if Luis had pressed the button, the machine would have started’, and one based on ‘if’ conditionals in the indicative mood and past tense, e.g., ‘if Luis pressed the button, the machine started’. There were 16 arguments for each sort, four each of the MP, MT, DA, and AC inferences.

We used the words ‘*incluso si*’ in Spanish in this experiment (and ‘*aunque*’ in the second experiment and ‘*si...tambien*’ in the third). We chose them because in Spanish they are the most natural way to communicate a semifactual, and correspond well to ‘even...if’ and ‘if...still/anyway/also’ in English. We asked six Spanish–English bilinguals (fluent in both languages from childhood) to translate 12 sentences used in our experiments, 4 with ‘*si...también*’, 4 with subjunctive ‘*aunque*’ and 4 with indicative ‘*aunque*’. Three individuals translated the sentences we used in Spanish into English, and the other three individuals translated the 12 resulting English sentences into Spanish. The results are shown in Table 3.

We assigned 32 contents to the arguments at random, and we created a different set for each participant. The contents had been evaluated by two independent judges who assessed them as natural expressions in daily language of factual and semifactual assertions. Also the sentences fitted the requirement of being meaningful when antecedents and

Table 3

The percentage of expressions used in the three experiments translated by six bilingual English–Spanish subjects, from English to Spanish and from Spanish to English (see text for more details)

English expression	Translation %	Spanish expression	Translation %
Even if	<b>Aunque</b> 67% Incluso sí 34%	Aunque	Even if 100%
Although (indicative)	<b>Aunque</b> 67% A pesar de 25% Aún 8%	Aunque (indicative)	Although 58% Even though 25% Despite 17%
If Also	<b>Sí... también</b> 75% Hasta... sí 17% Incluso sí 8%	Sí... también	If... also 75% If... too 25%

consequents were affirmative and negative. Participants carried out all 32 inferences in a within-participants design, and the order of presentation of materials was varied for each participant. The problems were given to them in their native Spanish and the materials are provided in the [Appendix](#).

### 2.1.2. Procedure

The problems were presented on a PC computer using E-prime software. The instructions explained the conditional inference task with reference to one MP example, and participants were requested to consider that the premises were true, and that the conclusion had to be the only possible conclusion, otherwise they should select the option ‘there is no valid conclusion’. They were informed that the time to respond as well as their response was recorded, and they were to answer as quickly as possible. They carried out three practice inferences, based on MP, MT, and AC, and they received feedback about the accuracy of their answer to the first inference only.

Each trial began with a conditional presented on the screen, and the participants pressed the ‘space’ key when they had finished reading it. The conditional disappeared from the screen and was replaced by the minor premise (several lines below the space previously occupied by the conditional on the screen) and the expression ‘therefore...’. The participants were instructed to press the ‘space’ key only when they knew the conclusion. When they did so, the minor premise disappeared from the screen and was replaced by three possible conclusions (several lines below the space previously occupied by the minor premise on the screen). A typical display, illustrated for an MP inference is as follows:

First screen: Even if Luis had pressed the button the machine would have started.

Second screen: Luis pressed the button. Therefore...

- Third screen: 1. The machine started.  
2. The machine did not start.  
3. There is no valid conclusion.

The participants responded by pressing the ‘1’, ‘2’ or ‘3’ keys to choose the corresponding answer. The materials contained two instances of each argument, in one instance the affirmed component of the conclusion appeared first, associated with the ‘1’ response key; in the other instance, the affirmed component appeared second, associated with the ‘2’ response key. The conclusion, ‘There is no valid conclusion’ always appeared last, associated with the ‘3’ response key. The participants were tested individually in a quiet room and each testing session lasted about 25 min.

### 2.1.3. Participants

Thirty-two undergraduates (5 men and 27 women) from the University of Granada (with an average age of approximately 19 years), who were registered on a developmental psychology course, participated voluntarily in the experiment in return for experimental credits. The participants had not been trained in formal logic, nor had they participated previously in any reasoning study.

## 2.2. Results and discussion

We carried out a 2 (conditional: semifactual vs factual) by 4 (inferences: MP, MT, DA, AC) ANOVA by participants and sentences ( $F_1$  and  $F_2$  analyses, respectively) with repeated measures on both factors, on the standard inferences endorsed (e.g. if A then B, A, therefore B). There was a main effect of conditional,  $F_1(1, 31) = 80.5$ ,  $MSE = 1.6$ ,  $P < .0001$ ;  $F_2(1, 31) = 133.7$ ,  $MSE = 0.1$ ,  $P < .0001$ , and inferences,  $F_1(3, 93) = 16.1$ ,  $MSE = .8$ ,  $P < .01$ ;  $F_2(3, 93) = 14.1$ ,  $MSE = .1$ ,  $P < .01$  and the two factors interacted,  $F_1(3, 93) = 8.4$ ,  $MSE = .6$ ,  $P < .0001$ ;  $F_2(3, 93) = 4.8$ ,  $MSE = .1$ ,  $P < .01$ . Planned comparison tests on the interaction showed that participants made fewer DA inferences from ‘even if’ than ‘if’ (41% vs 88%;  $F_1(1, 31) = 54.9$ ,  $MSE = 1.0$ ,  $P < .0001$ ;  $F_2(1, 31) = 61.3$ ,  $MSE = 0.1$ ,  $P < .0001$ ) and fewer AC inferences (46% vs 88%;  $F_1(1, 31) = 45.6$ ,  $MSE = .8$ ,  $P < .0001$ ;  $F_2(1, 31) = 53.2$ ,  $MSE = .1$ ,  $P < .0001$ ), as [Table 4](#) shows. They also made fewer MP inferences from ‘even if’ than ‘if’ (82% vs 97%;  $F_1(1, 31) = 11.0$ ,  $MSE = .5$ ,  $P < .01$ ;  $F_2(1, 31) = 13.3$ ,  $MSE = .1$ ,  $P < .01$ ), and fewer MT inferences from ‘even if’ than ‘if’ (52% vs 88%;  $F_1(1, 31) = 31.1$ ,  $MSE = 1.1$ ,  $P < .0001$ ;  $F_2(1, 31) = 17.4$ ,  $MSE = 0.1$ ,  $P < .001$ ).

To examine these differences further we carried out similar ANOVAs on the ‘asymmetric’ responses (e.g. if A then B, A therefore not-B) and on the ‘no valid conclusion’ responses. For the asymmetric responses, there was a main effect of conditional,  $F_1(1, 31) = 32.2$ ,  $MSE = .6$ ,  $P < .001$ ;  $F_2(1, 31) = 26.6$ ,  $MSE = .03$ ,  $P < .001$ , and inference,  $F_1(3, 93) = 17.1$ ,  $MSE = .5$ ,  $P < .001$ ;  $F_2(3, 93) = 17.0$ ,  $MSE = .03$ ,  $P < .001$ , and the two factors interacted,  $F_1(3, 93) = 17.5$ ,  $MSE = .4$ ,  $P < .001$ ;  $F_2(3, 93) = 13.3$ ,  $MSE = .4$ ,  $P < .001$ . Planned comparisons on the interaction showed that participants made more asymmetric

Table 4

The percentages of responses in Experiment 1 (standard inferences (e.g., if A then B, A therefore B); asymmetric inferences (e.g., if A then B, A therefore not-B) and “no valid conclusion” responses for the four inferences with the standard deviations in parentheses

	DA	AC	MP	MT
Standard inferences				
Subjunctive ‘even if’	41 (1.3)	46 (1.2)	82 (1.0)	52 (1.4)
Indicative ‘if’	88 (1.0)	88 (.8)	97 (.3)	88 (.8)
Asymmetric inferences				
Subjunctive ‘even if’	44 (1.1)	17 (.9)	5 (.5)	9 (.8)
Indicative ‘if’	7 (.6)	3 (.3)	2 (.3)	8 (.7)
“no valid conclusion” responses				
Subjunctive ‘even if’	16 (.9)	37 (1.5)	13 (.8)	38 (1.5)
Indicative ‘if’	5 (.6)	9 (.8)	1 (.2)	4 (.4)

Key: MP = modus ponens, AC = affirmation of the consequent, MT = modus tollens, DA = denial of the antecedent.

inferences for DA from ‘even if’ than ‘if’ (44% vs 7%;  $F(1,31) = 46.5$ ,  $MSE = .7$ ,  $P < .00001$ ;  $F(1,31) = 33.8$ ,  $MSE = .05$ ,  $P < .00001$ ), as Table 4 shows. They made more asymmetric inferences for AC from ‘even if’ than from ‘if’ (17% vs 3%;  $F(1,31) = 11.3$ ,  $MSE = .4$ ,  $P < .01$ ;  $F(1,31) = 11.4$ ,  $MSE = .02$ ,  $P < .01$ ). There were no differences between the conditionals for the other two inferences.

Some of the symmetric responses are expected when people consider one of the two possibilities consistent with the conditional that is not represented initially (see Table 2). One of those possibilities, not-A and not-B, allows the acceptance of MT and DA inferences and the other, not-A and B, allows the rejection of the AC inference. Remember that in this experiment the indicative conditional inferences were used to obtain a base line to test how the additional initial representation from the subjunctive reduces or increases these frequencies.

For the ‘no valid conclusion’ responses, there was a main effect of conditional,  $F(1,31) = 28.6$ ,  $MSE = 1.6$ ,  $P < .0001$ ;  $F(1,29) = 78.7$ ,  $MSE = 0.03$ ,  $P < .0001$ , and inference,  $F(3,93) = 11.2$ ,  $MSE = .6$ ,  $P < .001$ ;  $F(3,87) = 7.5$ ,  $MSE = .05$ ,  $P < .001$ , and the two factors interacted,  $F(3,87) = 4.9$ ,  $MSE = .04$ ,  $P < .01$ ;  $F(3,87) = 4.9$ ,  $MSE = .04$ ,  $P < .01$ . Planned comparisons on the interaction showed that participants made more ‘no valid conclusion’ responses from ‘even if’ than from ‘if’ for AC (37% vs 9%;  $F(1,31) = 21.1$ ,  $MSE = 1.0$ ,  $P < .00001$ ;  $F(1,31) = 36$ ,  $MSE = 0.04$ ,  $P < .00001$ ), DA (16% vs 5%;  $F(1,31) = 4.8$ ,  $MSE = .5$ ,  $P < .05$ ;  $F(1,31) = 5.3$ ,  $MSE = .04$ ,  $P < .05$ ), MP (13% vs 1%;  $F(1,31) = 9.9$ ,  $MSE = .3$ ,  $P < .01$ ;  $F(1,31) = 12.6$ ,  $MSE = .02$ ,  $P < .01$ ), and MT (38% vs 4%;  $F(1,31) = 27.8$ ,  $MSE = 1.0$ ,  $P < .0001$ ;  $F(1,31) = 32.4$ ,  $MSE = 0.05$ ,  $P < .0001$ ).

We corrected the reading times for the subjunctive and indicative conditionals (there are more words in a subjunctive than an indicative) by estimating a linear

regression for each participant, with the logarithm of reading time in the conditional as the dependent variable and length in number of characters in the conditional as the explanatory variable. For each participant residual reading times were calculated by subtracting the actual reading time from the reading times predicted by the individual linear regression. Even after this correction, participants took longer to read ‘even if’ than ‘if’ ( $M = 3.6$  ms per word longer for ‘even if’) and this difference was reliable,  $F(1,31) = 25.8$ ,  $MSE = .006$ ,  $P < .00001$ ;  $F(1,31) = 8.2$ ,  $MSE = .02$ ,  $P < .01$ , as shown by a one-way ANOVA on the residual of the logarithmically transformed reading times for the conditionals.

The results corroborate the predictions that reasoners make fewer DA and AC inferences from ‘even if’ subjunctive conditionals than from ‘if’ indicative conditionals. They corroborate the view that people keep in mind two possibilities to understand an ‘even if’ subjunctive, such as ‘even if the lever had been pressed the platform would have stopped’. They think about the conjecture ‘the lever was pressed and the platform stopped’ and the presupposed facts, ‘the lever was not pressed and the platform stopped’. As a result they are able to resist the DA and AC inferences. For the DA inference, the information ‘the lever was not pressed’ matches information in the possibility ‘the lever was not pressed and the platform stopped’ and so participants make the asymmetric conclusion, ‘the platform stopped’ on 44% of trials, whereas they make the standard conclusion ‘the platform did not stop’ on 41% of trials. For the AC inference, the information ‘the platform stopped’ matches information in both possibilities, and in one the lever was pressed and in the other it was not, and so participants say ‘no valid conclusion’ on 37% of trials, whereas they make the standard conclusion ‘the lever was pressed’ on 46% of trials. The MP inference is made readily from ‘even if’ on 82% of trials, further corroborating the proposal that reasoners keep in mind the affirmative possibility, ‘the lever was pressed and the platform stopped’ for ‘even if’ conditionals. Participants made fewer MT inferences from ‘even if’ than from ‘if’. The inference requires reasoners to consider a possibility they have not envisaged from the outset for either connective, resulting in them keeping in mind three possibilities for ‘even if’ and two possibilities for ‘if’. The greater number of possibilities to be considered for ‘even if’ results in fewer MT inferences.

Of course, the results are for groups of individuals and point to general tendencies only. A substantial minority of participants make the standard DA inference from ‘not-A’ to ‘not-B’ (e.g., 41% for ‘even if’). It may be the case that a minority of participants envisage a single possibility for ‘even if’, and that there are individual differences in interpretation or inferential skill with semifactual conditionals (e.g., Byrne, 2005; Stanovich, 1999; Thompson & Byrne, 2002). Also, it is possible that some participants access the conjectural possibilities of the subjunctive condi-

tional, and not the factual possibility. In any case this DA inference is made only half as often as with indicative conditionals. The working memory load with the subjunctive has two initial representations instead of one, making it less probable that the subject will look for alternatives (fleshing out the implicit model "...").

Consistent with this, MT, which requires fleshing out, should be more frequent when only one initial situation is represented than when the working memory load is higher. That was exactly what happened: MT was more frequent with "if" than with "even if". Conversely, the response "nothing follows" in MT inferences would be expected when participants only consider the explicit models (without fleshing out). That was more frequent with "even if" with two explicit representations than with "if" with only one representation.

The experiment provides evidence that reasoners consider different possibilities to understand 'even if' subjunctive and 'if' indicative conditionals. The next experiment compares 'even if' subjunctive and 'even though' indicative connectives.

### 3. Experiment 2: 'Even if' and 'even though'

The results from the first experiment that compare 'even if' to 'if' are consistent with the proposal that people consider different possibilities to understand 'even if'. The next experiment examines whether the different pattern of inferences occurs because of the subjunctive nature of the 'even if' conditionals used in the first experiment, such as 'even if p had happened, q would have happened' or whether it occurs because of the concessive nature of 'even if'. On this latter account, the pattern of inferences observed for 'even if' subjunctive conditionals should be observed whether they are subjunctive or indicative. We compared 'even if' *subjunctive* conditionals such as 'even if he had pressed the lever the platform would have stopped' to their *indicative* counterparts, 'even though he pressed the lever the platform stopped' (instead of the indicative "if" in Experiment 1). Linguists have emphasised the concessive nature of 'even if' conditionals (Dancygier, 1998; König, 1986; Schwenter, 2001), that is, they possess the characteristic of hypotheticality that is typical of a conditional, but they also possess the characteristic of a contrast between two clauses that is typical of a concessive. 'Even though' has also been considered to emphasise the concessive nature of the connective (Haspelmath & König, 1998). Therefore, the predictions for the frequency and kind of responses for the expected inferences in this experiment are the same as in the concessive condition in Experiment 1: low frequencies for MT, AC and DA but more "nothing follows" responses for MT and AC and more asymmetric responses for DA. We expect differences in the frequency of the four inferences in the two conditional expressions to be similar in magnitude.

### 3.1. Method

#### 3.1.1. Materials, design and procedure

The materials, design and procedure were the same as the first experiment. We compared 'even if' conditionals in the subjunctive mood to 'even though' concessives in the indicative mood. We used the word 'aunque' in Spanish. 'Aunque' is a concessive-conditional in the subjunctive mood and a concessive in the indicative (Flamenco, 1999; Montolío, 1999).

#### 3.1.2. Participants

Thirty-two undergraduates (19 men and 13 women) from the University of Granada, registered on a Physical Education course (with an average age of approximately 20 years), participated voluntarily in the experiment in return for academic credits. The participants had not been trained in formal logic, nor had they participated previously in any reasoning study.

### 3.2. Results and discussion

We carried out the same sort of ANOVA by participants and sentences ( $F_1$  and  $F_2$  analyses, respectively) as in the previous experiment. It showed a main effect of conditional,  $F_1(1, 31) = 6.6$ ,  $MSE = 1.0$ ,  $P < .05$ ;  $F_2(1, 31) = 13.3$ ,  $MSE = 0.04$ ,  $P < .001$ , and inference,  $F_1(3, 93) = 53.8$ ,  $MSE = 1.0$ ,  $P < .0001$ ;  $F_2(3, 93) = 53.4$ ,  $MSE = 0.08$ ,  $P < .0001$  but the two factors did not interact,  $F_1(3, 93) = .8$ ,  $MSE = .9$ ,  $P = .5$ ;  $F_2(3, 93) = 1.2$ ,  $MSE = .06$ ,  $P = .3$ . We carried out planned comparisons on the non-reliable interaction to test our predictions (see Winer, Brown, & Michels, 1991; for a defence of the legitimacy of such comparisons in this situation). Participants made few DA inferences from either subjunctive 'even if' or indicative 'even though' (19% and 31%,  $F_1(1, 31) = 4.5$ ,  $MSE = 1.0$ ,  $P = .05$ ;  $F_2(1, 31) = 5.3$ ,  $MSE = 0.07$ ,  $P < .05$ ), as Table 5 shows. Instead, as in the first experiment, they tended to make the asymmetric inference, and they did so more often from subjunctive 'even if' than from indicative 'even though' (72% vs 47%  $F_1(1, 31) = 14.2$ ,  $MSE = 1.1$ ,  $P < .001$ ;  $F_2(1, 31) = 8.8$ ,  $MSE = 0.1$ ,  $P < .01$ ). This difference was found by planned comparisons carried out on the interaction in an ANOVA on the asymmetric responses, which showed a main effect of conditional,  $F_1(1, 31) = 12.0$ ,  $MSE = .6$ ,  $P < .01$ ;  $F_2(1, 31) = 8.9$ ,  $MSE = .05$ ,  $P < .01$ , and inference,  $F_1(3, 93) = 58.4$ ,  $MSE = .9$ ,  $P < .0001$ ;  $F_2(3, 93) = 65.6$ ,  $MSE = .05$ ,  $P < .0001$ , and the two factors interacted,  $F_1(3, 93) = 6.3$ ,  $MSE = .6$ ,  $P < .001$ ;  $F_2(3, 93) = 4.3$ ,  $MSE = .05$ ,  $P < .01$  (see Table 5).

Participants also made few AC inferences from subjunctive 'even if' and indicative 'even though' (42% vs 52%;  $F_1(1, 31) = 2.9$ ,  $MSE = .9$ ,  $P = .09$ ;  $F_2(1, 31) = 6.3$ ,  $MSE = 0.1$ ,  $P < .05$ ). Instead, as in the first experiment, they tended to say 'no valid conclusion' (36% and 32%;  $F_1(1, 31) = .2$ ,  $MSE = .6$ ,  $P > .6$ ;  $F_2(1, 31) < .1$ ,

Table 5

The percentages of responses in Experiment 2 (standard inferences (e.g., if A then B, A therefore B); asymmetric inferences (e.g., if A then B, A therefore not-B) and “no valid conclusion” responses for the four inferences with the standard deviations in parentheses

	DA	AC	MP	MT
Standard inferences				
Subjunctive ‘even if’	19 (1.0)	42 (1.3)	76 (1.0)	38 (1.0)
Indicative ‘even though’	31 (1.2)	52 (1.2)	84 (.9)	39 (1.2)
Asymmetric inferences				
Subjunctive ‘even if’	72 (1.2)	23 (1.1)	8 (.6)	18 (.7)
Indicative ‘even though’	47 (1.0)	14 (.9)	4 (.7)	22 (1.0)
“no valid conclusion” responses				
Subjunctive ‘even if’	8 (.8)	36 (1.3)	14 (.8)	46 (1.3)
Indicative ‘even though’	22 (1.1)	32 (1.3)	9 (.6)	38 (1.0)

Key: MP = modus ponens, AC = affirmation of the consequent, MT = modus tollens, DA = denial of the antecedent.

MSE = .06,  $P > .8$ ). This result was found by planned comparisons carried out on the interaction in an ANOVA on the ‘no valid conclusion’ responses which showed no main effect of conditional,  $F(1,31) = 0$ , MSE = .7,  $P = 1$ ;  $F(2,31) = 0.4$ , MSE = .05,  $P > .1$ , a main effect of inference,  $F(3,93) = 13.4$ , MSE = 1.3,  $P < .0001$ ;  $F(3,93) = 19.2$ , MSE = 0.06,  $P < .0001$ , and the two factors interacted,  $F(3,93) = 4.2$ , MSE = .7,  $P < .01$ ;  $F(3,93) = 1.8$ , MSE = .05,  $P = .1$ .

There were no differences between the subjunctive and indicative versions for MP (76% vs 84%;  $F(1,31) = 1.5$ , MSE = .4,  $P > .1$ ;  $F(2,31) = 0.1$ , MSE = .1,  $P > .1$ ) or for MT (38% vs 39%;  $F(1,31) = 1.4$ , MSE = .7,  $P > .1$ ;  $F(2,31) = 0.3$ , MSE = .05,  $P > .1$ ). The one-way ANOVA on the residual reading times showed that after they were corrected in the same manner as the first experiment, participants took somewhat longer to read the subjunctive ‘even if’ than the indicative ‘even though’ ( $M = 1.8$  s longer for subjunctives), although the difference is not reliable by sentences ( $F(1,31) = 5.3$ , MSE = 1.8,  $P < 0.05$ ;  $F(2,31) = 3.8$ , MSE = 2.9,  $P = 0.08$ ).

The experiment shows that ‘even if’ and ‘even though’ exhibit a similar pattern of inferences. The results replicate the findings of the first experiment for subjunctive ‘even if’ and extend them to indicative ‘even though’. The pattern of inferences is somewhat more pronounced for subjunctive ‘even if’, perhaps because the subjunctive mood increases the tendency to keep the two possibilities in mind. The results corroborate the suggestion that reasoners envisage initially two possibilities when they reason from ‘even if’ conditionals, the conjectured possibility and the presupposed facts. As a result they do not tend to make the DA and AC inferences. The results also indicate that reasoners think about these two possibilities for indicative ‘even though’. Reasoners take a little longer to read the subjunctive ‘even if’ than the indicative ‘even though’ perhaps because they must keep track of the epistemic status of the two possibilities they envisage, as corresponding to the facts or the conjecture.

Participants made fewer DA inferences in this experiment than in Experiment 1. Although we must be cautious when comparing results from different experiments, we think that the reason is that in Experiment 1, participants were presented with “if” together with “even if”. The presence of alternatives (the implicit model) is more noticeable to the participant for “if” than for concessive conditionals, because there is only one initial representation. The general tendency for fleshing out in Experiment 1 (cued by “if”) can increase the tendency for fleshing out with all the inferences, including “even if” conditionals. This tendency is not cued in Experiment 2, and that is why the frequency is lower here. In Experiment 3 we test this explanation.

#### 4. Experiment 3: Semifactual ‘if...still/anyway/also’

The aim of the experiment was to examine inferences from semifactual conditionals that use linguistic constructions other than ‘even if’ such as ‘if...also’ conditionals e.g., ‘if the lever had been pressed the platform would have also/still/anyway stopped’. Philosophers of language have debated the best expression of semifactuals, with some championing ‘even if’ (Bennett, 1982; Goodman, 1973) and others ‘if...still’ (Barker, 1991). In everyday discourse, the truth of the consequent in the context of a false antecedent can be expressed using a great variety of conditional and concessive connectives, e.g., ‘even if the lever was pressed...’, ‘even though the lever was pressed...’, ‘although the lever was pressed...’, and a great many adverbs and adverbial phrases e.g., ‘...the platform stopped anyway/nonetheless/still/regardless/also/all the same’ (Byrne, 2007). Our aim was to extend the results of the previous experiments for ‘even if’ to another construction ‘if...also’. We compared it to the indicative ‘if’ conditional.

If the presence of “if” inferences together with concessive conditionals increases the general tendency to consider alternatives, similar frequencies of DA to Experiment 1 (and more than in Experiment 2) would also be expected.

##### 4.1. Method

###### 4.1.1. Materials, design and procedure

The materials, design and procedure were the same as the previous experiments except that we compared semifactual ‘if...also’ subjunctive conditionals, e.g., ‘If Luis had pressed the button then the machine would also have started’ to ‘if’ indicative conditionals, e.g., ‘If Luis presses the button then the machine starts’. We used the words ‘si...tambien’ in Spanish and half the conditionals had an affirmative antecedent and half had a negative antecedent.

###### 4.1.2. Participants

Thirty-two undergraduates (9 men and 23 women) of the Universidad Nacional de Educación a Distancia, Madrid, (with an average age of approximately 22 years)



who were registered in a developmental psychology course, participated voluntarily in the experiment in return for experimental credits. The participants had not been trained in formal logic, nor had they participated previously in any reasoning study.

#### 4.2. Results and discussion

We carried out a similar ANOVA as in the previous experiments. There was a main effect of conditional,  $F(1, 31) = 77.8$ ,  $MSE = 1.2$ ,  $P < .0001$ ;  $F(1, 31) = 58.1$ ,  $MSE = 1.7$ ,  $P < .0001$ , and inference,  $F(1, 31) = 25.3$ ,  $MSE = .8$ ,  $P < .0001$ ;  $F(3, 93) = 26.6$ ,  $MSE = .8$ ,  $P < .0001$ , and the two factors interacted,  $F(1, 31) = 5.1$ ,  $MSE = .9$ ,  $P < .01$ ;  $F(3, 93) = 6.1$ ,  $MSE = .7$ ,  $P < .001$ . Participants made fewer DA inferences from the semifactual ‘if also’ than from the indicative ‘if’ (41% vs 76%;  $F(1, 31) = 25.5$ ,  $MSE = 1.2$ ,  $P < .0001$ ;  $F(1, 31) = 32.6$ ,  $MSE = 0.9$ ,  $P < .0001$ ), as Table 6 shows. Instead participants made the asymmetric response for semifactual ‘if also’ more than for indicative ‘if’ (45% vs 13%  $F(1, 31) = 18.9$ ,  $MSE = 1.3$ ,  $P < .001$ ;  $F(1, 31) = 29.8$ ,  $MSE = 0.8$ ,  $P < .0001$ ), as shown by planned comparisons on the interaction in the ANOVA on the asymmetric responses. It showed a main effect of conditionals,  $F(1, 31) = 17.2$ ,  $MSE = .5$ ,  $P < .001$ ;  $F(1, 31) = 14.7$ ,  $MSE = .6$ ,  $P < .001$ , and inference,  $F(1, 31) = 11.5$ ,  $MSE = .7$ ,  $P < .00001$ ;  $F(3, 93) = 12.8$ ,  $MSE = .6$ ,  $P < .00001$ , and a reliable interaction ( $F(1, 31) = 7.4$ ,  $MSE = .7$ ,  $P < .001$ ;  $F(3, 93) = 10.9$ ,  $MSE = .5$ ,  $P < .0001$ ).

Participants also made fewer AC inferences from semifactual ‘if also’ than from indicative ‘if’ (39% vs 84%;  $F(1, 31) = 42.8$ ,  $MSE = 1.2$ ,  $P < .00001$ ;  $F(1, 31) = 61.1$ ,  $MSE = 0.8$ ,  $P < .00001$ ). Instead, participants responded that there was ‘no valid conclusion’ for semifactual ‘if also’ more than indicative ‘if’ (47% vs 7%;  $F(1, 31) = 43.6$ ,  $MSE = .9$ ,  $P < .00001$ ;  $F(1, 31) = 45.2$ ,  $MSE = .9$ ,  $P < .00001$ ) as shown by planned comparisons on the inter-

action in the ANOVA on the ‘no valid conclusion’ responses. It showed a main effect of conditionals,  $F(1, 31) = 46.5$ ,  $MSE = 1.0$ ,  $P < .0001$ ;  $F(1, 31) = 43.8$ ,  $MSE = 1.0$ ,  $P < .0001$ , and inference,  $F(1, 31) = 16.9$ ,  $MSE = .7$ ,  $P < .0001$ ;  $F(3, 93) = 21.6$ ,  $MSE = .6$ ,  $P < .0001$ , and a reliable interaction ( $F(1, 31) = 13.8$ ,  $MSE = .5$ ,  $P < .0001$ ;  $F(3, 93) = 13.4$ ,  $MSE = .6$ ,  $P < .0001$ ).

Participants made fewer MP inferences from semifactual ‘if also’ than from indicative ‘if’ (79% vs 91%;  $F(1, 31) = 6.5$ ,  $MSE = .6$ ,  $P < .05$ ;  $F(1, 31) = 5.4$ ,  $MSE = .7$ ,  $P < .05$ ). They made fewer MT inferences from semifactual ‘if also’ than from indicative ‘if’ (38% vs 69%;  $F(1, 31) = 25.8$ ,  $MSE = 1.0$ ,  $P < .0001$ ;  $F(2, 31) = 17.6$ ,  $MSE = 1.4$ ,  $P < .001$ ), and these results replicate the findings of the first experiment.

Even after correcting the reading times in the same manner as the previous experiments, participants took longer to read ‘if...also’ than ‘if’ ( $M = 6.2$  s longer for ‘if...also’,  $F(1, 31) = 70.2$ ,  $MSE = .02$ ,  $P < .0001$ ;  $F(1, 31) = 59.7$ ,  $MSE = .04$ ,  $P < .0001$ ), as shown by a 2 (‘if...also’ vs ‘if’) by 2 (negative vs affirmative antecedent) ANOVA on the residual of the logarithmically transformed reading times for the conditionals. Likewise, participants took longer to read negative conditionals than affirmative ones ( $M = 3.1$  s longer for negatives,  $F(1, 31) = 45.5$ ,  $MSE = .04$ ,  $P < .0001$ ;  $F(1, 31) = 107.4$ ,  $MSE = .03$ ,  $P < .0001$ ). The two factors did not interact,  $F(1, 31) < 1$ ,  $MSE = 0.4$ ,  $P > .05$ ;  $F(1, 31) < 1$ ,  $MSE = 0.0$ ,  $P > .05$ .

Participants made the four inferences with similar frequencies to those in Experiment 1. As was mentioned previously, we think that the presence of “if” with only one initial explicit representation should increase the general tendency in the task to look for alternatives, even with the concessive conditionals. That could explain the greater similarity between the results of Experiments 1 and 3 (which used “if”) than with Experiment 2 (which did not).

The experiment shows that semifactual ‘if...also’ conditionals are understood differently from indicative ‘if’ conditionals. As expected, reasoners made the DA and AC inferences less often from ‘if...also’ compared to ‘if’. Reasoners took longer to read ‘if...also’ than ‘if’. The experiment extends the results for semifactuals from ‘even if’ to ‘if...also’.

## 5. General discussion

The main aim of the three experiments was to examine how people make inferences from semifactual conditionals, such as ‘even if he had caught the train, he would have been late’. The experiments show that people resist the standard DA inference from ‘he did not catch the train’ to ‘he was not late’, and instead they infer ‘he was late’. They resist the standard AC inference from ‘he was late’ to ‘he caught the train’ and instead they infer that there is no valid conclusion. They often make the MP inference from ‘he caught

Table 6

The percentages of responses in Experiment 3 (standard inferences (e.g., if A then B, A therefore B); asymmetric inferences (e.g., if A then B, A therefore not-B) and “no valid conclusion” responses for the four inferences with the standard deviations in parentheses

	DA	AC	MP	MT
Standard inferences				
Subjunctive ‘if...also’	41 (1.3)	39 (1.3)	79 (1.0)	38 (1.2)
Indicative ‘if’	76 (1.0)	84 (.9)	91 (.5)	69 (1.1)
Asymmetric inferences				
Subjunctive ‘if also’	45 (1.4)	14 (.8)	10 (.6)	19 (.9)
Indicative ‘if’	13 (.7)	9 (.6)	9 (.5)	19 (.7)
“no valid conclusion” responses				
Subjunctive ‘if...also’	14 (1.0)	47 (1.4)	11 (.8)	44 (1.4)
Indicative ‘if’	11 (.9)	7 (.8)	0 (0)	13 (.9)

Key: MP = modus ponens, AC = affirmation of the consequent, MT = modus tollens, DA = denial of the antecedent.

the train' to 'he was late', but they have some difficulty with the MT inference from 'he was not late' to 'he did not catch the train'. The experiments show this pattern of inference for different semifactual expressions, corresponding to 'even if', and 'if...also'.

The pattern of inferences corroborates the view that a semifactual conditional, such as 'even if he had caught the train, he would have been late' makes available in the minds of reasoners not only the conjectured possibility, 'he caught the train and he was late', but also the presupposed facts, 'he did not catch the train and he was late'. The availability of these two possibilities affects the inferences reasoners make. Reasoners made few DA and AC inferences from the conditional of the form 'even if A B' because the availability of the 'not-A and B' possibility helps them to resist the inferences. The communicative intent and pragmatic use of semifactuals may be to ensure the resistance to these inferences. Just as 'if' may 'invite' the DA and AC inferences (Geis & Zwicky, 1971), so too 'even if' may invite their resistance (Byrne, 2007). Instead, from the DA premise 'not-A', reasoners made the asymmetric conclusion, 'therefore B' because only one of the two possibilities they envisage matches the information 'not-A', and in this possibility 'B' occurs. From the AC premise 'B', they concluded that nothing follows, because the two possibilities they envisage both match the information 'B', and in one B occurs with A and in the other B occurs with not-A.

In everyday discourse, people may use semifactuals to deny causal links. Of course these presuppositions can themselves be cancelled by subsequent information. A speaker may assert, 'even if John had caught the train, he would have been late' to counterbalance the known facts, John did not catch the train and he was late, with the conjectured alternative possibility, he caught the train and he was late, and so to convey there is no causal link between his catching the train and his being late. However, another person may cancel the presupposed facts by asserting, 'in fact, he was not late'. The MT inference follows that he did not catch the train. The MT inference can be difficult because the information 'he was not late' does not match any of the information in the two possibilities. Reasoners must think of a third possibility.

Of course different semifactuals may have different interpretations, just as 'if' may have different interpretations. There are several distinct interpretations of 'if' and its mental representation is modulated by content and context (Johnson-Laird & Byrne, 2002). Depending on content and context, an 'even if A, B' conditional may be judged to be consistent with just two possibilities, 'A and B', and 'not-A and B'. An alternative interpretation is the conditional one, in which a third possibility corresponding to 'not-A and not-B' is judged to be consistent too. A third interpretation, sometimes called a 'disabling' interpretation, is one in which the third possibility judged consistent with the conditional corresponds to 'A and not-B' (Byrne, 2005).

The idea that people spontaneously keep in mind two possibilities for some conditionals is consistent with studies of other conditional expressions, including counterfactual 'if' (Byrne & Tasso, 1999), and 'unless' (e.g., García-Madruga, Carriedo, Moreno-Ríos, Gutiérrez, & Schaecken, submitted for publication). It is readily explained by the view that people understand and reason from conditionals by constructing and combining models (Johnson-Laird & Byrne, 1991, 2002). The theory proposes that reasoners mentally represent what is true, and to understand counterfactual possibilities, they represent what is false temporarily supposed to be true (Johnson-Laird & Byrne, 1991). They represent some true possibilities explicitly, and some implicitly (Johnson-Laird et al., 1992).

In Experiment 1, the DA inference was made in only 41% of the trials. This result is in line with the proposal that participants had in mind an initial mental model consistent with a different response. However, although many people make inferences based on the initial mental model they constructed to understand the premises, some people 'flesh out' their understanding of the premises and construct alternatives to the initial model. In fact the 41% of trials with "even if" for DA inferences is much less than the 88% made in "if" trials. Likewise, the asymmetric response for DA inferences is obtained more frequently in "even if" (44%) than in "if" (only 7%).

Note that predictions referring to the increase or decrease in frequency of the inferences with "even if" are made with reference to "if": the difference results because in the first case an additional situation "not-A and B" is explicitly represented. That is why it is so important to test predictions using the same contents and comparing "even if" with "if".

There are, of course, alternative theories of reasoning, based on inferential rules. Abstract rule theories propose that reasoners have a mental repertoire of inference rules, such as 'if p then q, p therefore q' which they marshal in order to construct a proof of a conclusion (e.g., Braine & O'Brien, 1998; Rips, 1994). Domain-specific rule theories propose that reasoners access schemas which have at their core rules that are sensitive to some content, such as 'if the action is to be taken the precondition must be met' (e.g., Cheng & Holyoak, 1985; see also Fiddick, Cosmides, & Tooby, 2000). These theories have not yet provided any systematic account of counterfactual or semifactual conditionals, and it is not clear how they could encompass the connectives examined here. In fact, a consideration of counterfactual conditionals led philosophers to identify limitations with a truth-functional account of conditionals (Lewis, 1973; Pollock, 1986; Stalnaker, 1968). All counterfactual and semifactual conditionals have false antecedents, and hence on a truth-functional account (according to which a conditional is true when its antecedent is false or its consequent true), all of them are true. Yet people can distinguish between counterfactuals which are plausible and ones which are

not (e.g., Tetlock & Lebow, 2001), and they can readily generate counterfactual scenarios about what might have been different in the past (Byrne & McEleney, 2000; Byrne, Segura, Culhane, Tasso, & Berrocal, 2000; Kahneman & Miller, 1986; Walsh & Byrne, 2004), and their counterfactual thoughts may be implicated in other sorts of reasoning (e.g., Byrne, 2002; Roese & Olson, 1995). Our analysis explains how people can distinguish between different counterfactuals and semifactuals on the basis of the multiple possibilities that they keep in mind (pace Evans & Over, 2004).

Also we assume that the two initial representations are constructed from the beginning after reading the “even if” conditional. But the same result could be expected if the second representation was obtained later, for example after reading the second premise. The inference task used in this study cannot distinguish between these two options. However, as we mentioned previously, Santamaria et al. (2005) in a comprehension task, obtained a result that is consistent with the representation of the two mental models while reading the semifactual conditional: when people read an ‘even if’ conditional, they were primed to read the subsequent conjunction ‘the lever was not pressed and the platform was stopped’ more quickly than when they had read an ‘if’ conditional.

The present study avoids some of the problems of previous studies that used different contents for every inference by comparing the frequency of “if” with the same semifactual expressions and the same contents. We examined several sorts of semifactual expressions in these experiments, ‘even if’, and ‘if...also’ (‘aunque’, ‘incluso si’ and ‘si...también’). They each convey a counterfactual antecedent and a true consequent, but there may be subtle differences in the possibilities they make readily available. An assertion such as ‘if it had been sunny, the picnic would also have been awful’ may emphasise the enduring truth of the consequent, that the picnic was in fact awful and it would have been so despite differences in the antecedent events. In contrast, an assertion such as ‘even if it had been sunny, the picnic would have been awful’ may emphasise the falsity of the antecedent, that in fact it was not sunny.

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### Appendix

The content used in the three experiments, illustrated for indicative ‘if’. We here provide the English translation first and the original Spanish sentences second.

- If the applicant took the car he arrived on time.
- If the exercise had more than four graphics it was valid.
- If the bus turned it avoided the impact.
- If the workers knew the terms of the new agreement they went on strike.
- If the message appeared in red it was false.
- If the spokesman mentioned the issue he was dismissed.
- If the train stopped the travellers made a complaint.
- If the candidate’s name was underlined it was accepted.
- If the patient went to the beach he got better.
- If the player bet on red he won.
- If there were many voters the candidate won the election.
- If the employees reached an agreement they bought options.
- If the detainee told the truth he was imprisoned.
- If the swindler kept the material evidence the police arrested him.
- If the director participated the first candidate was chosen.
- If the invoice was high the company paid the invoice.
- If the driver put on the hazard lights he broke the law.
- If the speaker presented the first chapter the conference was interesting.
- If the telephone rang they caught the thief.
- If María stayed in Denmark she drew unemployment benefit.
- If the guests read the list of participants they attended the banquet.
- If the vehicle stopped the driver was fined.
- If the siren sounded the workers started working.
- If the guest got up very early they served him breakfast.
- If the government accepted the proposal taxes were increased.
- If Juana received the notice he returned home.
- If the policeman made a sign the cars stopped.
- If the librarian lent him the book the reader left.
- If Ana lost weight she wore the red skirt.
- If Jorge wrote the letter the trial was halted.
- If Carlos played the team won.
- If the technician arrived the employee stayed.

### Original Spanish

- Si el opositor cogió el coche entonces llegó a tiempo.
- Si el ejercicio tuvo más de cuatro gráficas entonces fue válido.
- Si el autocar giró entonces evitó el impacto.
- Si los trabajadores conocían los nuevos acuerdos entonces fueron a la huelga.

Si el mensaje apareció en rojo entonces fue falso.  
 Si el portavoz mencionó el asunto entonces fue destituido.  
 Si el tren se detuvo entonces los viajeros se quejaron.  
 Si el nombre del candidato estaba subrayado entonces fue aceptado.  
 Si el paciente estuvo en la playa entonces mejoró de la enfermedad.  
 Si el jugador apostó al rojo entonces ganó.  
 Si hubo muchos votantes entonces el candidato ganó la votación.  
 Si los empleados lograron el acuerdo entonces compraron acciones.  
 Si el detenido contó la verdad entonces fue encarcelado.  
 Si el estafador conservó la prueba entonces lo detuvo la policía.  
 Si el director intervino entonces se eligió al primer candidato.  
 Si la factura fue grande entonces la empresa pagó la factura.  
 Si el conductor encendió las luces de avería entonces cometió una infracción.  
 Si el ponente expuso el capítulo 1 entonces la conferencia fue interesante.  
 Si sonó el timbre del teléfono entonces cogieron al ladrón.  
 Si María se quedó en Dinamarca entonces pudo cobrar el paro.  
 Si los invitados leyeron la lista de participantes entonces asistieron al banquete.  
 Si el vehículo paró entonces fue multado.  
 Si la sirena sonó entonces los obreros estuvieron trabajando.  
 Si el huésped se levantó muy temprano entonces le sirvieron el desayuno.  
 Si el gobierno aceptó la propuesta entonces los impuestos subieron.  
 Si Juana recibió el aviso entonces volvió a casa.  
 Si el agente hizo la señal entonces los coches pararon.  
 Si el bibliotecario le prestó el libro entonces el lector se marchó.  
 Si Ana adelgazó entonces se puso la falda roja.  
 Si Jorge escribió la carta entonces se paralizó el juicio.  
 Si Carlos jugó entonces el equipo ganó.  
 Si el técnico vino entonces el empleado se quedó.

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