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SUPPRESSION AND BELIEF REVISION, TWO SIDES OF THE SAME COIN?

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This paper examines three experimental paradigms, designed for common sense reasoning. The comparison regards the effect disablers and alternatives exercise on the data. It was previously shown that alternatives and disablers influence the reasoning process in the three experimental paradigms: the Inference paradigm (e.g., Cummins et al., 1991), the Suppression paradigm (e.g., Byrne, 1989) and the Belief Revision paradigm (e.g., Elio, 1997). However, they were never directly compared due to large variations in the pragmatic type of conditionals and in the answer format. With this paper, we hope to fill this gap as we provide a direct comparison of the paradigms to gain more insight in reasoning with inconsistencies.

Introduction

In reasoning research, increasing attention is paid to common sense reasoning these days. Reasoning researchers recognize the importance of pragmatics (e.g., among many others, Johnson-Laird & Byrne, 2002) and they have an eye for the non-deductive character of human reasoning (e.g., among many others, Politzer & Bourmaud, 2002). This attention has not (yet) resulted in a uniformisation of the research at hand, on the contrary, it developed in different directions.

With this paper, we set out to bring together three lines of research related to 'common sense reasoning' that have evolved in different directions. Although we are fully aware that each attempt to classify research lines is doomed to have shortcomings, we have tried to divide the research at hand in three groups based on their experimental paradigm, and dubbed them: Inference paradigm (based on Cummins, Lubart, Alksnis, & Rist, 1991), Suppression paradigm (based on Rumain, Connell, & Braine, 1983) and Belief Revision paradigm (based on Elio & Pelletier, 1997). The goal of this paper is to investigate how closely the three paradigms are related to each other.

Elio (1997) has drawn attention to the relation between the different paradigms. She refers to the similarity between the different paradigms suggesting that: '*The belief revision tasks, by presenting a contradiction, may*

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prime a subject's consideration of possible worlds in which additional factors come into play' (Elio, 1997, p.215).

This specific topic, viz. how triggered disabling and alternative situations (or, as she states it, the consideration of possible worlds) affect the reasoning process, is certainly worthwhile for further investigation. In what follows, we will compare studies with causal statements on the three aforementioned paradigms.

The Inference Paradigm

First, we will have a look at the *Inference paradigm*. Cummins (1995; Cummins et al., 1991) conducted seminal work on the *Inference paradigm*: she manipulated the availability of possible counterexamples in causal conditionals and measured its effect on conditional arguments (see also De Neys, Schaeken, & d'Ydewalle, 2002; Thompson, 1994; Verschueren, 2004). She adopted conditionals for which pilot work indicated that people could retrieve many (e.g., a conditional with many possible alternatives 'If you study hard, then you pass the exam') or few counterexamples (e.g., a conditional with few possible alternatives 'If you grasp the glass with your bare hands, then your fingerprints are on it'). For conditionals with many alternatives, where successful retrieval was very likely, the invalid arguments Affirmation of the Consequent (if p, then q; q; thus p) and Denial of the Antecedent (if p, then q; not p; thus not q) were less accepted than for conditionals with only few possible alternatives. Likewise, the valid arguments Modus Ponens (if p, then q; p; thus q) and Modus Tollens (if p, then q; not q; thus not p) were less accepted when a conditional had many disablers than when only few were available.

In addition, reasoning performance has been related to individual differences in the efficiency of the counterexample retrieval process (e.g., Janveau-Brennan & Markovits, 1999; De Neys et al., 2002). In these studies, participants were first presented a generation task where they were asked to generate, in a limited time, as many counterexamples as possible for a set of conditionals. The same participants then received a conditional reasoning task with different conditionals. Janveau-Brennan and Markovits (1999) have found that the more alternatives one could generate in the generation task, the more Affirmation of the Consequent and Denial of the Antecedent were rejected in the reasoning task (see also Markovits & Quinn, 2002). Likewise De Neys et al. (2002) have observed that better disabler generation capacity resulted in lower Modus Ponens and Modus Tollens acceptance ratings.

The *Inference paradigm* has been used in an enormous amount of studies. In this paper, we will focus on studies that used the paradigm to show that the Modus Ponens inference is heavily susceptible to pragmatic factors, more

precisely, to information from background knowledge. Although a study of other conditional arguments (such as Modus Tollens) would undoubtedly also reveal interesting information, it would lead us too far to include them in this comparative study. Moreover, Modus Ponens has a special status because of its easiness. From the statements 'if p, then q' and 'p', between 89% and 100 % of the reasoners derive deductively correct that 'q' follows (see Evans, Newstead, & Byrne, 1993).

The results of the various studies described above are very consistent. By way of example, and to provide a direct comparison with the other paradigms, we stick here to the discussion of De Neys, Schaeken, and d'Ydewalle (2003a). For a summary of the methodology, see Appendix. They asked 294 participants to solve problems of the following kind:

Rule: If a match is struck, it lights
Fact: The match is struck
Conclusion: It lights

1	2	3	4	5	6	7
Very Sure	Sure	Somewhat Sure		Somewhat Sure	Sure	Very Sure
that I CANNOT draw this conclusion					that I CAN draw this conclusion	

The participants marked their (dis)agreement with the conclusion by ticking one number on the seven point scale. By ticking a number below four, participants expressed their disagreement with the conclusion, the lower the number the higher the disagreement. By ticking a number above four, participants expressed their agreement with the conclusion, the higher the number the higher the agreement. By ticking four, participants expressed that they could not decide whether to agree or disagree with the conclusion.

The selection of the conditional items was done on beforehand by another group of participants. Their task was to sum up as much alternative and disabling causes they could think of. An example of a frequently given alternative cause to the above example is: the match is lit with other fire. An example of a frequently given disabling cause to the above example is: the match is wet.

The causal items selected for this study were categorised in four groups (see De Neys et al., 2002, see Appendix) on the basis of the given number of alternative and disabling causes: items with many disablers and many alternatives (MD-MA), items with many disablers and few alternatives (MD-FA), items with few disablers and many alternatives (FD-MA), and items with many disablers and few alternatives (MD-FA).

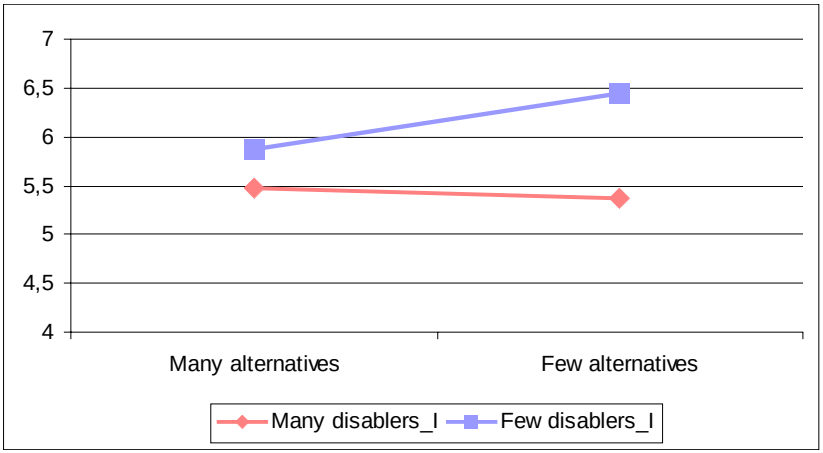


Figure 1.

The belief in the Modus Ponens conclusion, in an Inference paradigm. The belief is rated on a seven point scale (1-7) for items with many and few alternatives, and many and few disablers.

As Figure 1 shows, items with many disablers are more prone to Modus Ponens suppression than items with few disablers (MD: 5.4 vs. FD: 6.2; $F(1, 293) = 171$, $MSE = 0.94$, $p < .00001$). Contrary to Cummins' results, an effect of number of alternatives (MA: 5.7 vs. FA: 5.9; $F(1,293) = 23.7$, $MSE = 0.63$, $p < .00001$) is observed. Both variables interact ($F(1,293) = 34.0$, $MSE = 0.79$, $p < .00001$). Dieussaert, Schaeken, and d'Ydewalle (2002a; see also De Neys et al., 2002) found a similar effect of alternatives with another item set. This effect will be discussed further in the general discussion. For now, we conclude with stating that the effect of disablers is a very robust one.

As mentioned in the introduction, this paper is restricted to causal statements, we can now explain why. In previous studies (e.g., Dieussaert et al., 2002a), the authors collected disabling and alternative situations to conditional statements of a wide variety of pragmatic types, such as inducements, advise, causal statements, and so on (see also Thompson, 1994; Newstead, Ellis, Evans, & Dennis, 1997). They noticed that the kind of disabling and alternative conditions given differ widely between the pragmatic types (for a categorisation of disablers, see Elio, 1998; for a categorisation of alternatives, see Verschueren, De Neys, Schaeken, & d'Ydewalle, 2002). These different kinds each have a different weight on the reasoning process, as demonstrated in Dieussaert, Schaeken, and d'Ydewalle (2002b). Due to the restriction to causal statements, which have been extensively studied with regard to

the effect of disabling and alternative causes, the variation in alternatives and disablers people come up with, is severely reduced. This makes the comparison between the three paradigms methodologically stronger.

The Suppression Paradigm

The second paradigm we would like to discuss is the *Suppression paradigm*. In this paradigm, introduced by Rumain et al. (1983), a second conditional premise (if r, then q) is added to the standard *Inference paradigm* (if p, then q, p, thus q?). For example: 'If the match is dry, it lights' (additional premise). The belief in the Modus Ponens inference (or other inferences) is measured.

Byrne (1989) demonstrated that the introduction of an additional premise results in a suppression of the logically valid Modus Ponens inference (see also Byrne, 1991; Byrne, Espino, & Santamaria, 1999). Although the genuine nature of the suppression was initially doubted (e.g., Politzer & Braine, 1991), many other researchers have reported a similar influence of additional premises on the acceptance of Modus Ponens.

Chan and Chua (1994), for example, interpreted their findings in terms of a relative salience model. According to them, the critical component is the relative salience of the two antecedents with respect to the consequent. Stevenson and Over (1995) focussed on the uncertainty of the conditional (see also e.g., George, 1997; Politzer & Bourmaud, 2002). Bonnefon and Hilton (2002) gave an account for the data in terms of pragmatic implicatures. Byrne et al. (1991, 1999) explained the data within the framework of the mental model theory, in terms of counterexample availability (see also Dieussaert, Schaeken, Schroyens, & d'Ydewalle, 1999, 2000). For our purposes, viz. to attempt the direct comparison of three related paradigms, it is important to note that different kinds of thematic material were used in the studies mentioned above. However, none of them worked (exclusively) with causal conditionals, so definitely not with an item set controlled for the number of disablers and alternatives.

It is easy to see how the *Inference paradigm* and the *Suppression paradigm* are similar: the antecedent of an additional premise (*Suppression paradigm*) reminds the participant of an additional requirement, in addition to the original antecedent, for the consequent to be true. In the *Inference paradigm*, this explicit reminder is absent but the reasoner is supposed to retrieve it more or less easily from background knowledge. For example, in the case of the aforementioned 'match' problem, 'the match is wet' could be a disabling cause for the statement 'if the match is struck, it lights', that prevents the participant from concluding 'it lights'. The additional premise 'if the match is dry, it lights' could remind the reasoner of the disabling cause of a wet

match. Despite this obvious resemblance, the relation between these studies was never directly tested (but see Dieussaert & De Neys, 2003).

In this paper, we fill this gap through a comparison of the studies of De Neys et al. (2003a) and De Neys, Dieussaert, Schaeken, and d'Ydewalle (2004). For a summary of the methodology of the latter study, see Appendix.

We asked 105 participants to solve problems of this kind:

Rule:	If a match is struck, it lights
	If the match is dry, it lights
Fact:	The match is struck
Conclusion:	It lights

1	2	3	4	5	6	7
Very Sure	Sure	Somewhat Sure		Somewhat Sure	Sure	Very Sure
that I CANNOT draw this conclusion					that I CAN draw this conclusion	

The selection of the conditional statements was done on beforehand, as explained above in the section on the *Inference paradigm.* The causal items selected were categorised in four groups (see De Neys et al., 2002) on the basis of the given number of alternative and disabling causes: items with many disablers and many alternatives (MD-MA), items with many disablers and few alternatives (MD-FA), items with few disablers and many alternatives (FD-MA), and items with many disablers and few alternatives (MD-FA).

As is characteristic for the *Suppression paradigm*, Modus Ponens inferences receive an additional premise that hints at a disabling condition. The additional premises were based on the most frequently mentioned disablers (see De Neys et al., 2002, see Appendix).

Results of this study (see Figure 2, full lines) are in line with the results obtained in the *Inference paradigm* (dotted lines). Items with many disablers are more prone to Modus Ponens suppression than items with few disablers (MD: 4.8 vs. FD: 5.5; $F(1,104) = 36.5$, $MSE = 1.28$, $p < .00001$). No effect of number of alternatives (MA: 5.3 vs. FA: 5.1) is observed, nor an interaction between disablers and alternatives.

Although the overall belief in the conclusion is lower with the *Suppression paradigm* (5.2) than with the *Inference paradigm* (5.8; $F(1,397) = 39.7$, $MSE = 2.9$, $p < .00001$), merely mentioning an additional premise does not seem to influence the participant's search for (other) counter-examples, be it alternatives or disablers. As De Neys, Schaeken, and d'Ydewalle (2003b; see also

Verschueren, Schaeken, De Neys, & d'Ydewalle, 2004) have previously shown, participants do not necessarily stop their search for counterexamples when they have retrieved one: up to four different counterexamples can be taken into account. Each additionally retrieved counterexample will gradually affect the inference acceptance ratings. This study confirms the strength of this search process: despite the explicit mentioning of an additional premise, participants are influenced by additional counterexamples they can retrieve from background knowledge.

The Belief Revision Paradigm

Finally, we will discuss the *Belief Revision paradigm* (see also in this issue Legrenzi & Johnson-Laird, 2005; Revlin, Calvillo, & Ballard, 2005). Research on belief revision has only very recently become a topic of interest within reasoning research. In this paradigm, participants are given a conditional statement (if p, then q) and a categorical statement (e.g., p), and are asked to deduce the conclusion, or are given the conclusion (e.g., q). Next, new information that contradicts the conclusion is given (e.g., not-q) and participants are asked to revise one of the former statements in order to get a consistent belief set again. Generally, the belief in the conditional premise (and in the categorical premise) is measured.

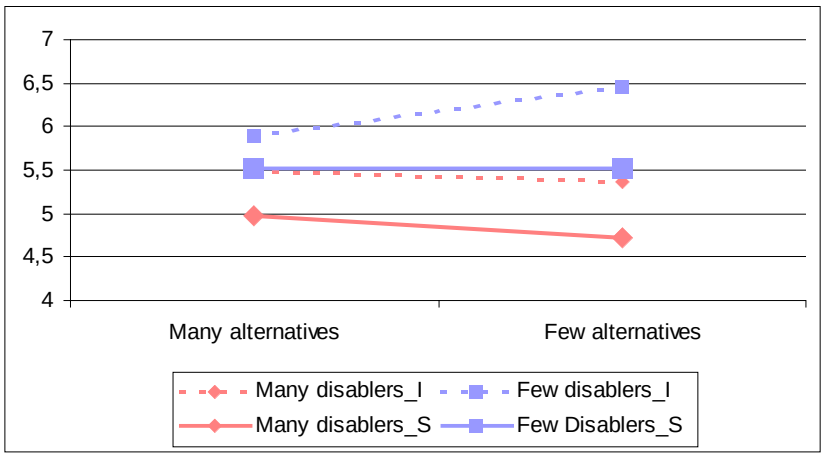


Figure 2.

The full lines represent the belief in the Modus Ponens conclusion, in a Suppression paradigm (S). The belief is rated on a seven point scale (1-7) for items with many and few alternatives, and many and few disablers. The dotted lines represent the belief in the Modus Ponens conclusion, in an Inference paradigm (I).

Elio and Pelletier (1997; see also Elio & Pelletier, 1994) have published a seminal article in which they showed that the conditional premise is revised rather than the categorical premise when an inconsistency arises. Consequently, it has been repeatedly shown that the initial belief in the conditional plays an important role: the lower the initial belief in the conditional statement, the more revision of the conditional statement takes place (e.g., Dieussaert, Schaeken, De Neys, & d'Ydewalle, 2000; Politzer & Carles, 2001; Calvillo & Revlin, 2002).

While one group of researchers focused on the influence of initial belief on the final effect, others focused on problem structure to gain more insight in the belief revision process (e.g., Byrne & Walsh, 2002; Johnson-Laird, Girotto, & Legrenzi, 2004). We will not go deeper into detail on these studies, as they are not of core interest for this paper.

As mentioned above, in the *Belief Revision paradigm*, the main dependent measure (i.e., the belief in the conditional statement) differs from the dependent measure in the other two paradigms (i.e., the belief in the Modus Ponens inference).

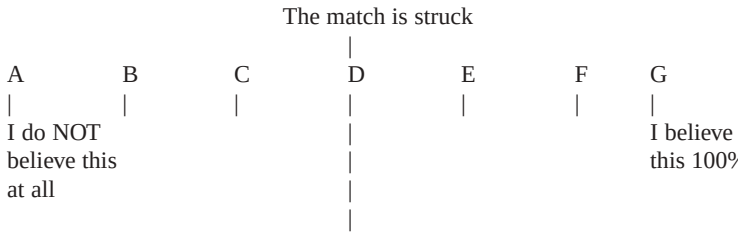
We conducted three subsequent studies (for a summary of the methodology, see Appendix) in which we asked 227 participants to solve problems of this kind:

This is what you initially believe: If a match is struck, it lights
The match is struck
From this you conclude: It lights
You do further investigation and discover: It does not light
Assuming the new information is true, what do you think should be the belief for

If the match is struck, it lights

A	B	C	D	E	F	G
I do NOT believe this rule at all						I believe this rule 100%

In Study 1, we asked participants to solve problems of this kind also:



The participants marked their (dis)agreement with the conditional rule/categorical premise by ticking one letter on the seven point scale. By ticking a letter below D, participants expressed their disagreement, the earlier the letter comes in the alphabet, the higher the disagreement. By ticking a number above D, participants expressed their agreement; by ticking D, they expressed undecibility on the question at hand.

We will first present the overall results over the three studies on the belief in the conditional statement.

The results (see Figure 3, full lines) are in line with the results obtained in the *Inference paradigm* and *Suppression paradigm* (dotted lines). Items with many disablers give sign of a lower belief in the conditional statement after contradiction than items with few disablers (MD: 4.7 vs. FD: 5.3; $F(1,226) = 52.3$, $MSE = 1.39$, $p < .00001$). Items with many alternatives give sign of a lower belief in the conditional statement after contradiction than items with few alternatives (MA: 4.9 vs. FA: 5.2; $F(1,226) = 19.4$, $MSE = 1.14$, $p < .00005$). No interaction is observed.

Elio (1997) also studied the effect of the initial belief in the conditional. She used indicative (high or low familiar) and causal material and selected items with many and few disablers. She also showed that in the *Belief Revision paradigm*, the number of disablers is of major influence to the belief in the conditional statement. However, the experiment contained a flaw in the design. Elio (1997) did not rate the individuals' belief of the conditional premise before they were confronted with the contradictory information. We will now further investigate the two possible negative consequences of this flaw. A first critique on Elio (1997) is that she measured the belief in the conditional statement and the categorical statement at the same time. Since her results clearly revealed a mirror effect (see further), we suspect that the belief rating of the categorical statement was influenced by the belief rating of the conditional statement. A more severe critique that can be posted is that Elio has no evidence that belief revision of the conditional statement took place at all. It may be that the belief in the conditional statement is already uncertain by the mere existence of disablers and alternatives in background knowledge (as e.g., Stevenson & Over, 1995 would suggest). In the following para-

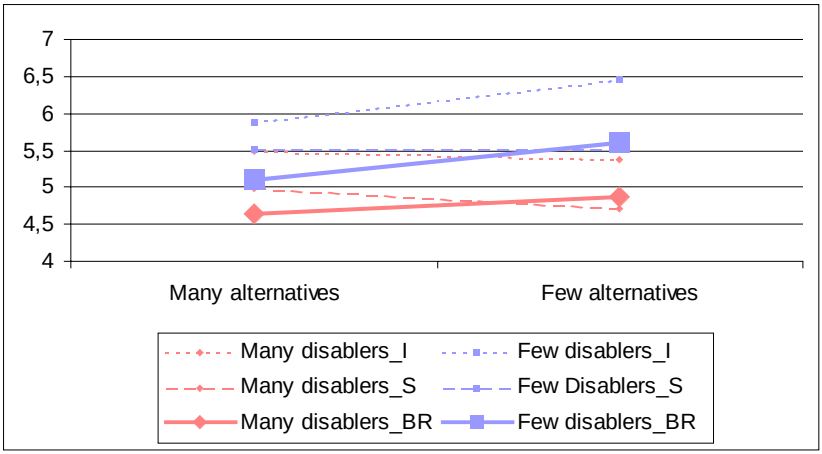


Figure 3.

The full lines represent the belief in the conditional statement, in a Belief Revision paradigm (BR). The belief is rated on a seven point scale (1-7) for items with many and few alternatives, and many and few disablers. The dotted lines represent the belief in the Modus Ponens conclusion, in an Inference paradigm (I) and a Suppression paradigm (S).

graphs, we will provide counter-evidence for the former critique, and give support for the second one.

The mirror effect

We conducted three studies. In Study 2 and 3 only the belief in the conditional statement (after contradiction) was measured. In Study 1 the belief in the categorical statement was measured as well (as was the case with Elio, 1997). The rating of the belief in the categorical statement may have an influence on the rating of the belief in the conditional statement. It may in fact be that participants rate the belief in the conditional statement differently because they oppose it to their belief in the categorical statement. Indeed, if we have a closer look at Study 1, we observe that the belief in the categorical premise is the mirror of the belief in the conditional premise (see Figure 4). For items with many disablers, the categorical premise is less subject to revision, than for items with few disablers (4.5 vs. 3.8; $F(1,21) = 15.0$, $MSE = 0.7$, $p < .001$). The same holds for the number of alternatives: for items with many alternatives, the categorical premise is less subject to revision, than for items with few alternatives (4.3 vs. 4.0; $F(1,21) = 8.6$, $MSE = 0.2$, $p < .01$). These results confirm the findings of Elio (1997).

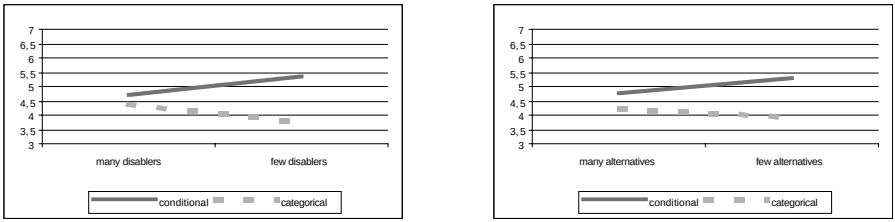


Figure 4.

The full lines represent the belief in the conditional statement, in a Belief Revision paradigm (BR). The dotted lines represent the belief in the categorical premise, in a Belief Revision paradigm (BR). The belief is rated on a seven point scale (1-7) for items with many and few alternatives, and many and few disablers.

But the crucial question is whether the double measure rating differs from ratings where the belief in the conditional statement is the only dependent variable. To sort this out, we compared the results of Study 1, on the one hand, with Study 2 and 3, on the other hand.

No difference between the three studies could be observed ($F(2,224) = 1.2$, $p = .3$). A Tukey HSD post hoc comparison shows no differences between the studies per category (MD-FD-MA-FA). Thus, the effects of disablers and alternatives are similar in the three studies. This demonstrates sufficiently that the double measure did not affect the ratings on the conditional statement.

Revision?

In the previous section, it has been shown that the number of dependent variables (two vs. one) does not influence the belief ratings. In this section we will investigate a second critique formulated on Elio (1997). Elio did not collect individual belief ratings before the contradiction was introduced. Thus, there is no strict evidence that a revision of the belief in the introduced statement has taken place. We conducted a study (Study 1) in which we collected individual belief ratings.

In Study 1, we did a pre- and a post measure. Before participants were given the Belief Revision task, they were asked to rate their belief in the conditional statements, without any extra information given. Afterwards, they received filler items for about half an hour, such that they would not remember the exact ratings given.

To our surprise, the belief in the conditional statement was not lower in comparison with the belief in the statement after the contradiction (pre-mea-

sure: 5.4 vs. post-measure: 5.1; $F(1,19) = 3.96$, $MSE = 1.4$, $p = .06$). A Tukey HSD post hoc comparison shows a difference between the pre- and post measure only for the FA cases (5.4 vs. 5.0 for the MD-FA-items, $p < .005$ and 6.1 vs. 5.5 for the FD-FA items, $p < .0005$)

From this, we can conclude that the number of alternatives and disablers one can think of for a certain causal conditional statement, does not only influence the belief in the Modus Ponens inference, but also the belief in the conditional statement, even before any contradiction is introduced.

General Discussion

Common sense reasoning is studied in a variety of paradigms. We compared three common experimental paradigms: the *Inference paradigm*, the *Suppression paradigm* and the *Belief Revision paradigm* on their dealing with information from background knowledge. Reasoners take background knowledge into account when reasoning, and one of the important predictors of their reasoning behaviour is the number of disabling and alternative events they can think of. This has been shown important for the three aforementioned paradigms. However, a direct comparison between the three paradigms was not conducted until now. We opted for comparisons with causal items, since the disablers and alternatives reasoners generally think of are causally linked with the items at hand. With other pragmatic types, the variety in alternative and disabling events is often much larger.

We have shown that the effect of disablers is similar for the three paradigms. Participants take into account the number of disablers they can think of for an item in their belief rating, whether no additional information is present (*Inference paradigm*), the suggestion of a specific disabler is present (*Suppression paradigm*), or a contradiction is present (*Belief Revision paradigm*). Disablers affect the belief ratings of the Modus Ponens conclusion (*Inference and Suppression paradigm*), as well as the belief ratings of the conditional statement (*Belief Revision paradigm*).

The case is less clear with alternatives. Leaving the *Inference paradigm* undecided, a clear difference between the *Suppression paradigm* and the *Belief Revision paradigm* is observed. The belief ratings in the *Suppression paradigm* are not influenced by the number of alternatives one can retrieve from background knowledge. The belief ratings in the *Belief Revision paradigm* are influenced by the number of alternatives. This may have different causes. It may be due to the different task, i.e., a belief rating of the Modus Ponens conclusion (*Suppression paradigm*) versus a belief rating of the conditional statement (*Belief Revision paradigm*). It also may be due to a difference in focus. By presenting additional information that refers to a possible disabler, the focus in the *Suppression paradigm* is merely on disablers. In the

Belief Revision paradigm, no direction of focus is introduced, such that participants may search for disablers as well as for alternatives in their background knowledge. The first explanation can account for data on the *Inference paradigm* of Cummins et al. (1991), who did not observe an effect of alternatives, but not for the data of De Neys et al. (2002) who observed an effect of alternatives. The reverse is true for the second explanation. It can account for the data of De Neys et al. (2002), but not for Cummins et al. (1991). The (relative) weight of these explanations is subject to further research.

Let us return now to the statement mentioned in the introduction "*The belief revision tasks, by presenting a contradiction, may prime a subject's consideration of possible worlds in which additional factors come into play.*" (Elio, 1997, p.215). The data we observed force a three-fold correction of this statement.

A first correction the data force us to make concerns the part 'by presenting a contradiction'. Reasoners take disabling information into account, even without any mentioning of contradictory information. In terms of possible worlds, we could state that reasoners consider other possible worlds, even if this search is not triggered by external information. This has been shown for the belief rating of the Modus Ponens conclusion in the Inference paradigm as well as for the belief rating of the conditional statement in the pre-measure of Study 1 (*Belief Revision paradigm*, cfr. supra).

A second correction the data force us to make concerns 'the additional factors', with which Elio (1997) refers to disablers. Reasoners do not only take into account disablers, but also alternatives, to rate their belief in the Modus Ponens conclusion (*at least in the Inference paradigm, cfr. supra*) or the conditional statement. In terms of possible worlds, we could state that reasoners consider two kinds of possible worlds, the ones in which 'disabling factors to a result' come into play and the ones in which 'alternative causes of a same result' come into play.

A third correction the data force us to make concerns the phrasing in terms of consideration of possible worlds. It is easy to see how the belief in the 'strength' of the result decreases, as the number of disablers goes up. The more possible worlds 'with disabling factors to a result' one can think of the weaker the possibility of the actualisation of the result (i.e., the Modus Ponens conclusion) becomes. It is more difficult to see how the belief in the 'strength' of the result decreases with the number of alternatives. In fact an analysis in terms of possible worlds seems to predict the reverse result. The more possible worlds 'with alternative causes to a result' are considered, the more probable the actualisation of the result (i.e., the Modus Ponens conclusion) becomes. The data do not support this kind of analysis. If Elio (1997) sticks to this possible worlds analysis, it is up to her to explain how the pres-

ence of 'many alternatives' can lower the belief in the conditional statement.

As an alternative explanation, we would rather suggest that participants estimate the correlation between the antecedent and consequent of a conditional statement, and let this guide their belief rating. The presence of many alternatives, as well as many disablers, lowers the correlation between the antecedent and the consequent.

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APPENDIX

Items with many alternatives and many disablers

1. If fertilizer is put on plants, then they grow quickly
2. If the brake is depressed, then the car slows down
3. If John studies hard, then he does well on the test
4. If Jenny turns on the air conditioner, then she feels cool

Items with many alternatives and few disablers

5. If Bart's food goes down the wrong way, then he has to cough
6. If Mary jumps into the swimming pool, then she gets wet
7. If the apples are ripe, then they fall from the tree
8. If water is poured on the campfire, then the fire goes out

Items with few alternatives and many disablers

9. If the trigger is pulled, then the gun fires
10. If the correct switch is flipped, then the porch light goes on
11. If the ignition key is turned, then the car starts
12. If the match is struck, then it lights

Items with few alternatives and few disablers

13. If the intensity of the light increases, then the pupils of the eye grow smaller
14. If Larry grasps the glass with his bare hands, then his fingerprints are on it
15. If the gong is struck, then it sounds
16. If water is heated to 100°C, then it boils

Inference paradigm

Resumed Methodology (see also De Neys et al., 2003a):

*Participants.*294 first year psychology students participated in the experiment.
Design. Complete within subjects design.
Material. Items 1, 2, 6, 7, 9, 12, 13, and 16 were presented in a randomized order.
Procedure. Participants could solve the computer presented problems in a self-paced manner.

Suppression paradigm

Resumed Methodology (see also De Neys et al., 2004)

*Participants.*105 first year psychology students participated in the experiment.
Design. Complete within subjects design.

Material. Items 3, 5, 6, 10, 11, 13, and 16 were presented in a randomized order. The additional premises that were presented:
with 3. If the test is easy, then he does well on the test
with 5. If the air conditioner works correctly, then she feels cool
with 6. If there is water in the swimming pool, then she gets wet
with 10. If the electrical current is intact, then the porch light goes on
with 11. If the motor works correctly, then the car starts
with 13. If the eyes are open, then the pupils of the eye grow smaller
with 16. If the water is pure, then it boils
Procedure. Participants could solve the paper-and-pencil presented problems in a self-paced manner.

Belief Revision paradigm

Resumed Methodology

Participants. Respectively 22, 100 and 105 participants participated in Study 1, Study 2 and Study 3. The participants in Study 2 and 3 are first year psychology students from the University of Leuven who participated as a partial fulfilment of a course requirement. The participants in Study 1 are paid (8euro/hour) students from the University of Leuven. None of the participants was enrolled in a logic course before participating in the experiment.
Design. The design is completely within subjects for the three Studies. In Study 2 and 3 the dependent variable is the belief in the conditional statement after a contradiction is introduced. In Study 1, two extra measures were added: a pre-measure of the belief in the conditional statement (i.e. before any contradiction is mentioned), a measure of the belief in the categorical premise after the contradiction is introduced. The belief was measured on a seven point scale.
Material. In Study 1: Items 1 to 16 were presented in a randomized order.
In Study 2: Items 1, 2, 6, 7, 9, 12, 13, 14, 15, and 16 were presented in a randomized order.
In Study 3: Items 1, 2, 7, 9, 12, 14, and 15 were presented in a randomized order.
Procedure. Participants could solve the paper-and-pencil presented problems in a self-paced manner.