

Modus Tollens, Modus Shmollens: Contrapositive Reasoning and the Pragmatics of Negation

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The utterance of a negative statement invites the pragmatic inference that some reason exists for the proposition it negates to be true; this pragmatic inference paves the way for the logically unexpected *Modus Shmollens* inference: “If p then q ; not- q ; therefore, p .” Experiment 1 shows that a majority of reasoners endorse Modus Shmollens from an explicit major conditional premise and a negative utterance as a minor premise: e.g., reasoners conclude that “the soup tastes like garlic” from premises “If a soup tastes like garlic, then there is garlic in the soup; Carole tells Didier that there is no garlic in the soup they are eating.” Experiment 2 shows that this effect is mediated by the derivation of a pragmatic inference from negation. It is discussed how theories of conditional reasoning can integrate such a pragmatic effect.

This article does not constitute an attempt at curing teenage angst. Of course, you probably never expected that it would; and as a consequence, you may have found that first sentence rather incongruous. Indeed, we seldom deny what nobody believes to be true—rather, we often use negative statements to correct an inaccurate belief we assume the listener to hold. In this article, we will show that this property of negation plays a crucial role in a seemingly outrageous fallacy we will call *Modus Shmollens*: “If p then q ; it is not the case that q ; therefore, p is true” – following Lance Rips’ (1988, p.116) coining of the term “Modus Shmonens” for the inference “If p then q ; p is true; therefore, it is not the case that q .” We begin with some introductory remarks on the relations between pragmatics and reasoning. We then turn to the gist of our argument, i.e., the distinction between negative utterances and negated propositions. Once we have delineated the specific pragmatic inferences raised by negative utterances, compared to negated propositions, we will be in a position to predict when and why reasoners accept Modus Shmollens. We will then report two experiments testing these predictions.

Pragmatics and Reasoning

Linguistic pragmatics has a key role to play in the psychology of reasoning in general, and in the psychology of conditional reasoning in particular. A psychological theory of conditional reasoning can only be complete with a pragmatic

component explaining how reasoners convert verbal input (the premises of the reasoning process) into the format of the inferential machinery the theory operates on (e.g., mental models, conditional probabilities, logical propositions). In the words of Thompson (2000), among many other similar statements: “Clearly, such an interpretive process largely determines which inferences are made and not made; consequently, a complete theory of deductive reasoning requires a well-developed model of interpretation.”

Within the psychology of reasoning, conversational pragmatics was originally called upon to explain a variety of puzzling inferential behaviours, mainly observed within the Piagetian paradigm (Piaget & Inhelder, 1964), the Heuristic and Biases program (Kahneman, Slovic, & Tversky, 1982), or related to Peter Wason’s 4-card and 2–4–6 tasks (Wason, 1960, 1966)—for extensive reviews of this early use of pragmatics, see Hilton (1995), and Politzer (2004).

An important consequence of this trend of research was that theorists gradually distinguished core reasoning phenomena (that their inferential machinery had to account for) from the mere pragmatic phenomena that could be left unaccounted for, as long as the theory explicitly included a pragmatic component, however underspecified this component. While pragmatics undoubtedly transformed the psychology of reasoning, research on pragmatic components is still needed, in order for these components not to be chiefly a convenient label for explaining away phenomena that do not fit in the core of their parent theories.

This objective requires a shift in research strategy: Rather than going from well-known reasoning or judgemental effects to their pragmatic explanation (Bonnefon & Hilton, 2002; Bonnefon & Villejoubert, 2006), we need to predict novel effects from pragmatic considerations, and thence indicate how such findings can enrich the pragmatic layer of existing theories of reasoning (Bonnefon & Hilton, 2004; Hilton, Kimmelmeier, & Bonnefon, 2005; Hilton, Villejoubert, & Bonnefon, 2005). With that objective in mind, we will now consider one pragmatic specificity of negative state-

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ments, and show how it is likely to yield one logically outrageous inference.

Negative Utterances vs. Negated Propositions

Conversational pragmatics deals with utterances rather than propositions: A pragmatic approach to reasoning capitalises on the fact that reasoners make inferences not only from premises (propositions), but also from the very fact that these premises were asserted (utterances). Consequently, a pragmatic approach to reasoning is appropriate as soon as the inferences made from the premises mismatch the inferences invited from the assertion of these premises. Such is the case with negative utterances, which invite inferences beyond those yielded by the negated propositions they embed.

As it was pointed out in the introduction of this article, we often use negative utterances to correct an inaccurate belief of the listener. In other words, one natural way for the statement “it is not the case that q ” to be felicitous is that the listener can be assumed to believe q . This principle is not included in the semantics of negation (Horn, 1989), and it does not amount to treating negation as the denial of a presupposition, in the semantic sense. Rather, what is denied is a belief the speaker assumes the addressee to hold, what Stalnaker (1991) called a pragmatic presupposition.

Early psycholinguistic experiments (De Villier & Tager Flusberg, 1975; Johnson-Laird & Tridgell, 1972; Wason, 1965, 1972) showed that negations were easier and quicker to process when the context (linguistic and otherwise) made it possible to interpret negation as a correction of the listener’s expectations. Quoting De Villier and Tager Flusberg (1975), the statement “I didn’t drive to work” is:

more plausible, and consequently easier to comprehend, if it is made by someone who normally drives rather than by someone who commutes by train. [...] Negative statements are generally used to point out discrepancies between a listener’s presumed expectations and the facts. (p.279)

Similarly, Wason (1965) asserted that the function of negative statements is generally to emphasise that a fact is contrary to expectation, and Strawson (1952) pointed out that the primary use of *not* is to contradict, cancel or correct a suggestion of one’s own or another’s. This pragmatic property of negative statements was also documented by Givon (1978), who used the following example: Saying that “Sally is pregnant” is felicitous even when the listener is completely neutral about the possibility of Sally being pregnant, but saying that “Sally is not pregnant” is not. A typical response in that case would be: “Wait a minute—was she supposed to be?” (See also Israel, 2004; Glenberg, Robertson, Jansen, & Johnson-Glenberg, 1999; Gualmini, 2004.)

Thus, negative statements of the form “it is not the case that q ” often trigger the inference that the speaker assumes the listener to believe q . This use of negation as a way to deny pragmatic presuppositions has already been put to good

use by Evans (1989) to explain the phenomenon of *matching bias* in conditional reasoning, on which see Evans (1998) for a review. However, we will now take one step further and ask the question of *why* someone who asserts that “it is not the case that q ” might assume the listener believes q . The most natural answer is that some reason p to believe q must be manifest to both speaker and listener. That is, the context of the utterance has a feature p such that p usually makes people think q , and the statement “it is not the case that q ” can be paraphrased as: “Even though p might let you think that q , in reality, it is not the case that q .” Hence, denying that q is true will invite the pragmatic inference that some reason p to believe q exists; and this is the point from which inferences will go awry, as we will now see.

Modus Tollens, Modus Shmollens

A natural way to express that p is a reason to believe q is to embed both propositions in an *epistemic* conditional (also called *inferential*, or *evidential*) of the form “if p , then q ” (Cummins, 1995; Dancygier, 1998; Declerck & Reed, 2001; Pearl, 1988; Politzer & Bonnefon, 2006; Sweetser, 1990; Thompson, 1994). Rather than expressing a causal relation between p and q (i.e., the occurrence of p causes the occurrence of q), epistemic conditionals express that believing p is a reason to believe q , too. Let us consider the conditional “if a soup tastes like garlic, then there is garlic in the soup.” This conditional does not express that the taste of garlic *causes* the presence of garlic. Rather, it expresses that the taste of garlic is a cue to the presence of garlic.

Now let us imagine that Carole and Didier are eating a soup, and that Carole tells Didier there is no garlic in this soup. This negative utterance triggers the pragmatic inference that a reason exists in this context for Didier to believe there is garlic in the soup. A taste of garlic would be a very good candidate. Thus, we might be tempted to conclude that the soup tastes like garlic. But let us take a closer look at this apparently reasonable inference. From the premises “There is no garlic in the soup” and “If a soup tastes like garlic, then there is garlic in the soup,” we have just concluded that “the soup tastes like garlic.” In abstract terms, we have concluded p from *if p then q* and *not- q* . Whilst this inference is quite sensible in a conversational context, it is a logical heresy—in fact, it is so fallacious that it has not even been given a name as a fallacy, hence our coining of the term *Modus Shmollens*.

We are now in a position to predict that reasoners will endorse the Modus Shmollens inference from an epistemic conditional “if p , then q ” *when the minor premise not- q is an utterance rather than a mere sentence*. Indeed, if in our soup example the minor premise “there is no garlic in the soup” is not uttered by one character to another, the pragmatic inferences from negation should not be invited, and Modus Shmollens should not be accepted. Additionally, we would like to show that the endorsement of the Modus Shmollens conclusion *requires* the explicit presence in the problem of the major conditional premise (thus preventing the objection that we are dealing with a general pragmatic issue rather than

with conditional reasoning in particular). Experiment 1 was conducted to test these two claims.

Experiment 1

Method

Participants were 60 students at the university of Toulouse (37 women and 23 men, mean age = 21.6, $SD = 3.2$), who were individually recruited on campus by research assistants. Participants responded to 4 problems, following a 2×2 full factorial design. The problems differed in the way the premises were introduced. The major conditional premise was either explicit or implicit, and the minor categorical premise was either an utterance or a mere sentence. Here is an example of a problem with an *explicit* major premise and an *utterance* as a minor premise:

Géraldine and Henri are listening to a record. Generally speaking, if Mick Jagger is singing on a record, then it is a Rolling Stones record. Géraldine tells Henri that this record is not a Rolling Stones record.

In the *major premise: implicit* variants of this problem, the sentence “Generally speaking, if Mick Jagger is singing on a record, then it is a Rolling Stones record” was omitted. In the *minor premise: sentence* variants of this problem, the sentence “Géraldine tells Henri that this record is not a Rolling Stones record” was replaced with “This record is not a Rolling Stones record.”

The four problems were embedded in four different contexts (see Appendix). Four different versions of the questionnaire were created, so that each problem appeared once in each context.

After reading each problem, participants judged to which extent a proposed conclusion appeared to be correct, from the information given in the problem. The proposed conclusion was always the affirmation of the antecedent of the (explicit or implicit) conditional premise, for example:

Mick Jagger is singing on this record.

Participants gave ratings from 1 to 5, where 1 meant “I think the conclusion is absolutely incorrect,” 2 meant “I rather think the conclusion is incorrect,” 3 meant “I think that the conclusion could be correct as well as incorrect,” 4 meant “I rather think the conclusion is correct,” and 5 meant “I think the conclusion is absolutely correct.” The experiment was conducted in French.

Results

Two participants were categorized as multivariate outliers using the Mahalanobis distance method (Mahalanobis, 1936). These two participants were omitted in subsequent analyses.

An analysis of variance revealed that the acceptance rating of the Modus Shmollens conclusion was reliably greater when the conditional premise was explicit, $F(1, 57) = 20.6, p < .001, \eta^2 = .27$, and when the minor premise was an utterance rather than a sentence, $F(1, 57) = 13.0, p <$

Table 1

Acceptance ratings (5-point scale) and frequencies of endorsement of the Modus Shmollens conclusion, as a function of type of major and minor premise. $n = 58$.

	Mean	SD	% of 4–5 ratings
<i>Major: Implicit</i>			
Minor: Sentence	2.2	1.2	12
Minor: Utterance	2.6	1.5	19
<i>Major: Explicit</i>			
Minor: Sentence	2.5	1.3	28
Minor: Utterance	3.4	1.4	55

.001, $\eta^2 = .19$. (See Table 1 for descriptive statistics; all the p values we report are two-tailed for F tests, and one-tailed otherwise.) Furthermore, the interaction of these two variables reliably affected acceptance rating in the expected direction; Modus Shmollens acceptance is especially high when the major premise is explicit *and* the minor premise is an utterance, $F(1, 57) = 2.9, p < .05, \eta^2 = .07$.

Another way to look at the results is to consider the *endorsement* of the Modus Shmollens conclusion as a binary dependent variable: Only participants who give ratings of 4 or 5 express their endorsement of this conclusion. Thus, by dichotomizing the acceptance ratings with a cut-off at 4, we can consider how our independent variables influenced the endorsement of the Modus Shmollens conclusion. As it appears in Table 1 (last column), explicit major premises and utterances as minor premises independently increased the base endorsement rate of 12% – but only when both these conditions were met did a majority of participants (55%) endorse the Modus Shmollens conclusion.

Results of Experiment 1 support our prediction that reasoners will endorse the Modus Shmollens inference from an epistemic conditional “if p , then q ” when the minor premise not- q is an utterance rather than a mere sentence. Furthermore, the endorsement of Modus Shmollens is much weaker when the major conditional premise is not explicitly introduced in the problem. One plausible explanation for this weaker effect is that participants who were not provided explicitly with the major conditional premise “if p , then q ” might have searched themselves for some plausible antecedent that would normally lead to q . These participants might have ended up with some p' , different from p , and such that if p' , then q . As a consequence, these participants rejected the conclusion p , not because it was an invalid Modus Shmollens conclusion, but because they preferred *another* invalid Modus Shmollens conclusion.

Now that Experiment 1 has demonstrated the basic phenomenon of Modus Shmollens endorsement, we wish to provide an even more direct demonstration that the derivation of Modus Shmollens results from the pragmatics of negation. Experiment 2 was conducted to provide such a demonstration. In addition to replicating the key result of Experiment 1, Experiment 2 will consider whether the effect of premise introduction (utterance or sentence) on accepting the Modus

Shmollens conclusion is mediated by the derivation of the pragmatic inference from negation.

Experiment 2

Method

Participants were 45 volunteer students at the university of Albi (43 women and 2 men, mean age = 23.5, $SD = 7.2$). Participants responded to one problem with a sentence as a minor premise, then to one problem with an utterance as a minor premise. (Major conditional premises were always explicit in Experiment 2.) In one half of the questionnaires, the first problem used the Garlic Soup context of Experiment 1, and the second problem used the Panther context of Experiment 1; the reverse was true for the other half of the questionnaires. Participants judged the correctness of the same conclusions as in Experiment 1, on a similar 5-point scale. In addition, for each problem, participants answered a yes or no question assessing whether they had derived a pragmatic inference from the minor premise. For example, after having read that:

Carole and Didier are eating a soup. Generally speaking, if a soup tastes like garlic, then there is garlic in the soup. Carole tells Didier that there is no garlic in the soup,

participants were first asked:

Is it a correct conclusion that the soup tastes like garlic?

And then:

Is it true that, according to Carole, Didier thought there was garlic in the soup?

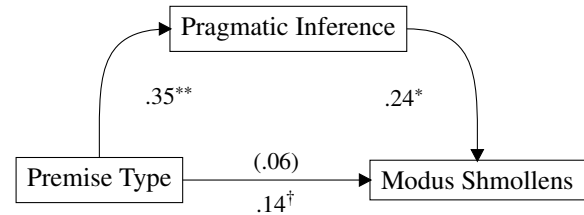
The experiment was conducted in French, during class time.

Results

Just as in Experiment 1, the way the minor premise was introduced made a significant difference to the willingness of participants to endorse the Modus Shmollens conclusion. Mean agreement with the Modus Shmollens conclusion was 2.6 ($SD = 1.6$) when the minor was an utterance, but only 2.1 ($SD = 1.4$) when the minor was a mere sentence, $t(44) = 1.97$, $p = .03$, $d = 0.33$. The endorsement rate of Modus Shmollens (i.e., the frequency of 4–5 ratings) was 31% for utterances, and only 15% for sentences.

Whilst 70% participants derived the pragmatic inference from negation when the minor premise was an utterance, a reliably lower 36% did so when it was a mere sentence (McNemar, $p = .002$, $h = 0.7$). Averaging across the 90 conclusions provided by the 45 participants, agreement with the Modus Shmollens conclusion was 2.8 ($SD = 1.4$) when the pragmatic inference was derived (with 33% of 4–5 ratings), and only 2.0 ($SD = 1.6$) when this inference was not derived (with 15% of 4–5 ratings), $t(87) = 2.6$, $p < .01$.

Figure 1. The type of minor premise (statement or mere sentence) has a mediated effect on agreement with the Modus Shmollens conclusion, the mediating variable being the derivation of a pragmatic inference from negation. Coefficients are standardized β s, $N = 90$, $^\dagger p < .10$, $* p < .05$, $** p < .001$.



We conducted a series of three regressions analyzes on the 90 sets of responses we collected (Baron & Kenny, 1986), using effect codings for premise introduction (sentence = -1, utterance = +1) and derivation of the pragmatic inference (no = -1, yes = +1). The direct effect of premise introduction on Modus Shmollens acceptance was only tangential, $\beta = .14$, $t = 1.33$, $p < .10$. (Note however that the statistical significance of this direct effect is not a strict requirement for concluding to statistical mediation.) The effect of premise introduction on the derivation of the pragmatic inference was significant, $\beta = .35$, $t = 3.48$, $p < .001$. In the third regression, premise introduction and pragmatic inference derivation were entered simultaneously. Pragmatic inference derivation was a reliable predictor of Modus Shmollens acceptance, $\beta = .24$, $t = 2.20$, $p < .05$, which was not the case of premise introduction, $\beta = .06$, $t = 0.55$ (see Figure 1). Thus, the contribution of premise introduction to Modus Shmollens acceptance dropped from .14 to .06 when the derivation of the pragmatic inference was controlled for. This decrease is significant according to the Sobel test, whose value was 1.9, $p < .05$ (Sobel, 1982). Consequently, all the conditions are met for concluding to statistical mediation: In line with our theoretical analysis, premise introduction affects Modus Shmollens acceptance *through* the derivation of a pragmatic inference from negation.

General Discussion

Two experiments showed that when the negation of some state of affairs is presented as a statement made in a conversation, a majority of reasoners endorse the Modus Shmollens inference, which makes no sense from a logical perspective, but perfect sense from a conversational perspective. For example, a majority of reasoners endorsed the conclusion “the animal looks like a panther” from the following premises:

Alice and Benjamin are looking at an animal in a zoo. Generally speaking, if an animal looks like a panther, then it is a panther. Alice tells Benjamin that this animal is not a panther.

However, they no longer endorsed this conclusion when the words “Alice tells Benjamin that” were omitted from the

problem. Furthermore, a second experiment established that the endorsement of the Modus Shmollens inference is due to the derivation of a pragmatic inference. Since negation is often used in conversation to correct some inaccurate belief of the listener, reasoners who saw the conversational version of the problem were likely to agree that, according to Alice, Benjamin thought the animal was a panther. This pragmatic inference, in turn, was responsible for their endorsement of the Modus Shmollens conclusion.

These two experiments serve as a powerful demonstration of conversational influences on reasoning, but also as a demonstration of their limits. Only a weak pragmatic effect was found when the problem was not explicitly framed as a conversation: Most participants could apparently disregard the pragmatic reading of the negation (or possibly never considered it at all) when the problem did not mention an explicit conversational setting. Just as background knowledge effects can be limited by instructions that emphasize the logical nature of the task (see Chapter 6 in Evans & Over, 2004), conversational effects are limited when the task does not explicitly refer to a conversational setting (see also Experiment 4 in Stevenson & Over, 2001).

Indeed, the information we use as an input to our reasoning comes from a variety of sources in addition to discourse; for example, memory, perception, or prior inferences. Most of us know that Shere Khan is not a panther, although we may have come to this knowledge through many different routes. Some were just told that Shere Khan was not a panther (discourse). Some remember that fact from the book (memory). Some discover it when watching the movie (perception). Some may reason that it cannot be a panther because Bagheera is already a panther, and there is only one panther in the story (inference). Conversational effects are unlikely to occur in all but the first case.

Conversational effects do arise sometimes, however, and theories of conditional reasoning should account for such logically unexpected inferences as Modus Shmollens. In the final section of this article, we will consider two routes thereto: the dual-negation, single-process route; and the single-negation, dual-process route. Before that, we will discuss the fact that our two experiments used epistemic conditionals, and consider whether the pragmatics of negation is likely to influence reasoning with other types of conditionals.

Beyond epistemic conditionals

Our two experiments demonstrated that a majority of reasoners endorsed the conclusion “ p is true” from premises of the form “if p then q ; Person A tells Person B that q is not the case,” where the conditional “if p then q ” is of the *epistemic* type. With such conditionals, p is seen as diagnostic of the truth of q , rather than, e.g., a cause for the occurrence of q . We first wish to consider the possibility that some reasoners might have reversed the epistemic conditionals into their causal form, and derived conclusions from this causal interpretation. For example, reasoners presented with the problem:

Émilie and Fabrice are talking about one of their

professors. Generally speaking, if a professor has a Swedish name, then she is a Swede. Émilie tells Fabrice that the professor is not a Swede,

might have reversed the direction of the conditional from epistemic to causal:

Émilie and Fabrice are talking about one of their professors. Generally speaking, if a professor is a Swede, then she has a Swedish name. Émilie tells Fabrice that the professor is not a Swede.

From such an interpretation, the conclusion “the professor has a Swedish name” is no longer a Modus Shmollens conclusion; but it is not a logically valid conclusion, either. In fact, it is a fallacy nearly as odd and as undocumented as Modus Shmollens, one that we might call *Shnying the Antecedent*: If p , then q ; not- p ; therefore, q . Thus, if indeed some participants reversed our epistemic conditionals into their causal form, their reasoning showed the same spectacular conversational effects than other participants’.

We now briefly consider the possibility to observe Modus Shmollens inferences outside the epistemic or causal domain, or more precisely, in the deontic domain. It seems plausible that the conversational negation of an interdiction will trigger the pragmatic inference that some reason exists in the context for the listener to believe the interdiction was in effect (see Verstraete, 2005, for the pragmatic expectations raised by denying an obligation or a permission). For example, consider the following problem, involving a deontic conditional:

Carole and Didier are talking about one of their classmates. Generally speaking, if one is a Muslim, one is forbidden to eat pork. Carole tells Didier that their classmate is not forbidden to eat pork.

The chain of reasoning here is very similar to the one we have considered in detail in this article. For Carole’s negative statement to be felicitous, she must believe that Didier thought their classmate was forbidden to eat pork. One salient reason for Didier to think so (and one that is explicit in the problem) would be that their classmate is a Muslim. Hence, it seems conversationally reasonable to assume that the classmate is a Muslim. But this, of course, is the deontic variant of Modus Shmollens: “if p then forbidden(q); it is not the case that forbidden(q); therefore, p is the case.”

Dual-negation or dual-process?

We have demonstrated a spectacular difference between the conditional consequences of a negated proposition (“it is not the case that q ”) and the conditional consequences of a negative utterance (“Person A tells Person B that it is not the case that q ”). Although this result readily makes sense from a pragmatic perspective, it is difficult to see how current theories of conditional reasoning will integrate it within their pragmatic layer. We now suggest that accounting for Modus Shmollens will necessitate taking either one of two routes: the dual-negation, single-process route; or the single-negation, dual-process route.

There are two perspectives one can take towards the fact that negated propositions have different consequences than negative utterances. The first perspective explains these different consequences by assuming different representations for conversational and logical negation; the second one assumes that conversational and logical negations are represented the same, but processed by two different mechanisms.

As an account of conditional reasoning, Mental Model Theory (Johnson-Laird & Byrne, 2002; see also Bonnefon, 2004; Evans, Over, & Handley, 2005) takes a representational stance to pragmatic effects. If a set of premises yields different conclusions as a function of whether one of its premises is part of a conversation, then it must be that this premise is not represented by the same mental models when it is part of a conversation. We thus need to assume that different mental models will stand for the problem “if p then q ; it is not the case that q ” and for the problem “if p then q ; Person A tells Person B that it is not the case that q .” Since the conditional is the same in both problems, its models should be the same. Therefore, the difference between the two problems must boil down to a difference between the models of “it is not the case that q ” and the models of “Person A tells Person B that it is not the case that q .”

The model of “it is not the case that q ” is simply $\neg q$, where \neg is a negation tag. What then can be the models of “Person A tells Person B that it is not the case that q ?” There are no epistemic operators such as *Assert*($\neg q$) or *Know*($\neg q$) in Mental Model Theory, which would help to distinguish conversational premises from non-conversational premises. Consequently, it seems that there is only one way to distinguish “it is not the case that q ” from “Person A tells Person B that it is not the case that q ,” namely, to use a distinct tag for negations that are used in a conversational setting (e.g., $\sim q$ instead of $\neg q$). Obviously, the fact that this seems to be the only solution to the problem does not mean it is a good solution. First, everything has still to be done to define how models tagged with a conversational negation marker combine with other models. Second, proponents of Mental Model Theory (Barouillet & Lecas, 1998) have already raised objections to the use of propositional negation markers within models, and it might not be a good step to introduce several such markers where one is already problematic.

An alternative to postulating two types of negation that go through one reasoning process is to consider that negation will go through a different reasoning process as a function of whether it occurs in a conversational context or not.

The dual-process approach to reasoning (Best, 2005; Evans, 2005; Evans & Over, 1996, 2004; Klaczynski & Daniel, 2005; Klaczynski, Schuneman, & Daniel, 2004; Schroyens, Schaeken, & Handley, 2003; Sloman, 1996, 2002; Stanovich, 1999; Thompson, Evans, & Handley, 2005) assume that inferences can reflect, at different times, the operation of one set of mental processes (System1) or the other (System2). The fast, association-driven System1 is triggered whenever it encounters information it can process and is rather undemanding of cognitive resources. The analytic and reason-oriented System2 must be deliberately engaged and controlled, is slow, and demanding of capacity. System1

operates on contextualized tasks, taking into account semantic content and, most importantly for our present purpose, conversational principles. The operation of System2, in contrast, depends on the decontextualization of the task, and on the activation of abstract rules of inference.

Within this framework, we can explain our main finding as a difference between the System1 and the System2 processing of negation. When a fact q is denied in a conversational context, System1 automatically looks for a fact p that is usually diagnostic of (associated with) fact q , and comes to the conclusion that p might well be the case. Of course, this search process can be influenced by directly providing reasoners with a candidate fact p , as we did when we presented participants with problems of the form: “If p , then q ; Person A tells Person B that it is not the case that q .” In such a situation, System1 finds that p is an acceptable conclusion, and all happens as if reasoners endorsed the Modus Shmollens fallacy.

Now, when a fact q is denied outside of a conversational context, either (a) System1 processing of conversational inferences is not triggered, since the situation does not meet the requirements for such a processing, or (b) System1 does process the pragmatic inferences from negation, but its output is inhibited by a System2 effort at decontextualization, which is made easier by the absence of a conversational context. In both cases, reasoners will resist the Modus Shmollens fallacy. They may even draw the logically valid Modus Tollens conclusion, if they have some ready access to an abstract strategy for *reductio ad absurdum*.

Last words

Starting from the pragmatic reading of negation as a denial of expectation, we have provided a powerful demonstration of how conversational principles can influence conditional inference. Merely introducing a premise $\neg q$ as being uttered by one individual to another was enough for participants’ inferences to swing from Modus Tollens to its conversational counterpart, Modus Shmollens. We have suggested to consider this result from a dual-process perspective. When facts are denied as part of a conversation (negative utterances), System1 conversational/associative processes fire and lead reasoners to endorse Modus Shmollens. When facts are denied outside of a conversational context (negated propositions), System1 does not fire (or its output is inhibited), and reasoners resist Modus Shmollens.

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Appendix

Material used in the Experiments

Swedish prof

Émilie and Fabrice are talking about one of their professors. [Generally speaking, if a professor has a Swedish name,

then she is a Swede.] [Émilie tells Fabrice that] the professor is not a Swede.

CONCLUSION: The professor has a Swedish name?

Mick Jagger

Géraldine and Henri are listening to a record. [Generally speaking, if Mick Jagger is singing on a record, then it is a Rolling Stones record.] [Géraldine tells Henri that] this record is not a Rolling Stones record.

CONCLUSION: Mick Jagger is singing on this record?

Garlic soup

Carole and Didier are eating a soup. [Generally speaking, if a soup tastes like garlic, then there is garlic in the soup.] [Carole tells Didier that] there is no garlic in the soup.

CONCLUSION: The soup tastes like garlic?

Panther

Alice and Benjamin are looking at an animal in a zoo. [Generally speaking, if an animal looks like a panther, then it is a panther.] [Alice tells Benjamin that] this animal is not a panther.

CONCLUSION: The animal looks like a panther?