Social function. We measured all of the items using 7-point Likert scales ranging from 1 = *extremely unimportant/inaccurate* to 7 = *extremely important/accurate.* The items included the following:

1. My friends volunteer.
2. People I'm close to want me to volunteer.
3. People I know share an interest in community service.
4. Others with whom I am close place a high value on community service.
5. Volunteering is an important activity to the people I know best.

Protective function. We measured all of the items using 7-point Likert scales ranging from 1 = *extremely unimportant/inaccurate* to 7 = *extremely important/accurate.* The items included the following:

1. No matter how bad I've been feeling, volunteering helps me to forget about it.
2. By volunteering I feel less lonely.
3. Doing volunteer work relieved me of some of the guilt over being more fortunate than others.
4. Volunteering helps me work through my own personal problems.
5. Volunteering is a good escape from my own troubles.

Received April 25, 2003
Accepted September 16, 2004

The Journal of Social Psychology, 2005, *145*(2), 173–190

Interaction With a High- Versus Low-Competence Influence Source in Inductive Reasoning

FABRIZIO BUTERA
Laboratoire de Psychologie Sociale de Grenoble-Chambéry
Pierre Mendès France University, Grenoble, France

JEAN-PAUL CAVERNI
Laboratoire de Psychologie Cognitive
CNRS/University of Aix-Marseille, France

SANDRINE ROSSI
Groupe d'Imagerie Neurofonctionnelle
CNRS/University of Caen, France

ABSTRACT. Literature on inductive reasoning shows that when testing hypotheses, people are biased toward the use of confirmatory strategies (P. C. Wason, 1960). In the present article, the authors presented 2 studies showing how people use confirmation and disconfirmation strategies during actual interaction in problem solving. Study 1 showed that participants were able to learn to use disconfirmation when confronted with a low-competence, nonthreatening partner. When the partner was high in competence (thereby threatening the participant's competence), participants used confirmation, even when the partner used disconfirmation. In Study 2, the authors aimed at generalizing the aforementioned results by exploring the hypothesis that disconfirmation stems from the possibility of diverging from norms. Participants who were confronted with the violation of a conversational norm used a high proportion of disconfirmation, whatever the source of influence. When there was no violation but there was a low-competence partner, the proportion of disconfirmation was high; when there was no violation but there was a high-competence partner, the proportion of disconfirmation was low. The authors discussed the interpersonal functions of confirmation and disconfirmation.

Key words: competence threat, disconfirmation, inductive reasoning, social influence

WHAT HAPPENS WHEN PEOPLE REASON together? The present article presents two studies that show how people use hypothesis-testing strategies during actual interaction in problem solving that requires inductive reasoning. We will argue that the competence-related stakes involved in problem solving intervene in the differential use of hypothesis confirmation and disconfirmation.

Confirmation and Disconfirmation in Inductive Reasoning

Literature on inductive reasoning shows extensively that when testing hypotheses, people are biased toward the use of confirmatory strategies instead of more diagnostic, disconfirmatory strategies (cf. Wason, 1960). To illustrate this functioning, Wason devised a task, the 2-4-6 task, in which the experimenter asked the participants to discover the rule underlying a number triad (2-4-6); the experimenter determined the rule (ascending numbers), which was very general. Participants had (a) to think of a hypothesis, (b) to test it by submitting another number triad to the experimenter, who would tell them if the triad was, or was not, compatible with the rule, and (c) to determine the rule. The results of a vast amount of studies carried out with this classic paradigm have shown that, although disconfirmation is more diagnostic in this task because it allows ruling out specific hypotheses, confirmation is by far the most-used testing strategy, even by scientists (Mahoney, 1976; Mitroff, 1974).

In the cognitive psychology literature, investigators' explanations of this "confirmation bias" (or "error") form three trends. In one trend, investigators consider the confirmation bias as a form of positivity bias in people's reasoning, that is, as some cognitive difficulty in considering negative information (Evans, 1989, p. 42). In another trend, investigators explain that there is a general bias in information processing that leads individuals to focus on the first sufficient hypothesis, without taking into account the alternatives that could lead to the true hypothesis (McDonald, 1990; see also Green, 1990; Legrenzi, Girotto, & Johnson-Laird, 1993). In the third trend, investigators consider that, because people do not reason following a "mental logic" (the capacity to use the rules of logic without having studied it, as proposed by the Piagetian tradition), disconfirmation in hypothesis testing is just too difficult (e.g., Johnson-Laird, 1983; see also Johnson-Laird & Byrne, 2002).

Nevertheless, these trends have a common ground: They seem to agree that confirmation as a bias is due to a lack of activation, analysis, and articulation of alternative solutions to a problem (Green, 1990; Johnson-Laird, 1983; Kruglanski & Mayseless, 1988; McDonald, 1990; Trope & Mackie, 1987). In fact, Gorman and Carlson (1989) have noted that disconfirmation is indeed possible, but only when the reasoner is able to consider alternative solutions.

It should be noted that after Wason's (1960) pioneer work on inductive reasoning, investigators have found this bias in work on deductive reasoning (e.g., Evans, 1982; Wason, 1966), statistical reasoning (e.g., Kahneman, 2003; Kahneman, Slovic, & Tversky, 1982), decision making (e.g., Doherty, Mynatt, Tweney, & Schiavo, 1979; Maggi, Legrenzi, Mugny, & Butera, 2001), information selection (both for individuals, e.g., Jonas, Schulz-Hardt, Frey, & Thelen, 2001, and for groups, e.g., Frey & Schulz-Hardt, 2001), person perception (e.g., Snyder, 1981; Snyder & Swann, 1978; Zuckerman, Knee, Hodgins, & Miyake, 1995), stereotypes (e.g., Dumont et al., 2003; Leyens, Dardenne, Yzerbyt, Scaillet, & Snyder, 1999), and behavior (e.g., Haverkamp, 1993; Snyder & Haugen, 1994; Stukas & Snyder, 2002). In the present article, the scope of the presented studies is limited to inductive reasoning.

This work was supported by the Avenir program of the Rhône-Alpes regional council, the Swiss National Science Foundation, and jointly the French Centre National de la Recherche Scientifique (CNRS) and the University of Provence.

Part of this work was presented at the Second European Conference on Cognitive Science, Siena, Italy, October 1999, and at Thinking 2000, Durham, UK, August 2000.

We thank Vittorio Girotto for the fruitful discussions at the inception of this paradigm.

Address correspondence to Fabrizio Butera, University of Lausanne, ISSP—BFSH2, CH-1015 Lausanne, Switzerland; fabrizio.butera@unil.ch (e-mail).

Confirmation and Disconfirmation in Social-Influence Situations

Work on social factors affecting inductive reasoning (cf. Butera, Mugny, Legrenzi, & Pérez, 1996; Legrenzi, Butera, Mugny, & Pérez, 1991) has shown that confirmation and disconfirmation in inductive reasoning are not a bias and a diagnostic strategy, respectively, but that they are differentially used in specific situations of social influence. Indeed, most of the time, people test hypotheses in social-influence settings (e.g., at school, in research labs). It is also worth noting that the 2-4-6 task (Wason, 1960) has been traditionally used by researchers as a metaphor for scientific thinking (cf. Tweney, Doherty, & Mynatt, 1981), that is, thinking developed in a community where peer pressure is very frequent.

The general paradigm that investigators have used to study inductive reasoning within a social-influence setting has consisted of presenting the participants with a 2-4-6-like inductive reasoning problem together with the solution (namely, the hypothesis and new triad designed to test it) proposed by other people (the influence source). Typically, influence sources were either high in status (a high-competence source, a majority, an expert) or low in status (a low-competence source, a minority, a novice). Research within this paradigm has shown for hypothesis elaboration that confrontation with a high-status source induces imitation of the proposed hypothesis, whereas confrontation with a low-status source induces novel alternative hypotheses. Concerning hypothesis testing, it appears that high-status sources induce more confirmatory testing, whereas low-status sources induce more disconfirmatory testing (Butera & Mugny, 1992; Legrenzi et al., 1991). Moreover, further research has indicated that confirmation is more typical of confrontation with high-status sources because these sources exert a pressure toward considering one single answer. Conversely, disconfirmation is more typical of confrontation with low-status sources because they induce participants to be open to alternative solutions (Butera et al., 1996). Therefore, it appears that the use of confirmation and disconfirmation of hypotheses can depend upon the type of relation that one has with the source of influence. Specifically, high-status sources induce confirmatory testing as a

defensive strategy: The source's competence threatens the reasoner's competence insofar as it induces the perception of a negative interdependence between the reasoner and the source, that is, a conflict of competences (Butera & Mugny, 2001). This is a relational conflict, in that it focuses the cognitive activity on prevailing instead of on the task. This conflict appears to produce a self-serving, rather than diagnostic, processing of the task. Confirmation then appears to be a sort of hypothesis protection, because confirmation corresponds to adding support—evidence—for one's own hypothesis (Butera & Mugny, 2001). Conversely, low-status sources induce disconfirmatory testing as a research strategy. The source's (low) competence is not threatening, allowing a conflict of incompetences (Butera & Mugny, 1995; Maggi, Butera, & Mugny, 1996); unlike the aforementioned conflict, this is not a relational conflict but rather an epistemic conflict (which is based on the search of truth rather than on prevailing) between two incompetences: that of the reasoner (because of the uncertainty typical of problem solving) and that of the source (because of the status). Thus, the reasoner has to decenter (Butera & Buchs, in press) from the existing hypotheses and search among alternate hypotheses. Disconfirmation is therefore a way of testing the limits of validity of alternative hypotheses (Butera & Mugny, 1995).

To sum up, our general interpretation of the aforementioned results is that confrontation with a high-status source can threaten one's competence (Mugny, Butera, Quiamzade, Dragulescu, & Tomei, 2003). Such a threat would lead one to test one's own hypothesis through a strategy that seems to support the hypothesis: confirmation. In contrast, a low-status source is less likely to threaten one's competence, thereby allowing the opportunity to test the limits of the validity of one's own hypothesis through disconfirmation.[1]

Overview and Hypotheses

On the basis of the above considerations, we devised Study 1 to test the hypothesis that interaction with a high-status source would hinder the learning of the diagnostic testing strategy, whereas interaction with a low-status source would help it. This hypothesis contributes to the aforementioned literature in two ways. First, investigators (cf. Gorman & Gorman, 1984) have shown that disconfirmation can be taught by showing its utility, but only with the experimenter as a teacher and not in an interaction between reasoners. It is indeed conceivable that if a reasoner (the target) is in the presence of a person (the source) who is using disconfirmation, the reasoner should be able to learn and adopt this strategy. However, this requires the reasoner to be focused on the task, that is, on hypothesis testing. If it is true that a high-status source focuses the target on the relation rather than on the task, then this source should elicit confirmatory—self-serving—testing even when the source uses disconfirmation; conversely, if a low-status source allows focusing on the task, then the target should be able to learn the use of disconfirmation and therefore should display a higher rate of disconfirmatory testing.

To test this hypothesis, we adapted Butera et al.'s paradigm (Butera & Mugny, 1995; Butera et al., 1996; Legrenzi et al., 1991). Indeed, in previous use of this paradigm, the influence source was always evoked. In fact, participants always read a written account of what the source had supposedly said. Therefore, source and target were never in person-to-person interaction. Moreover, the source's solution was always one hypothesis and one test: Participants had no opportunity to see the evolution of the source's strategy. Thus, the second contribution of Study 1 is to study to what extent a target can learn disconfirmation from a source who uses it, in a paradigm where the target has to actually interact with the source during the whole length of the task. Accordingly, in Study 1, each participant had to solve the 2-4-6 task while being confronted with a confederate (allegedly an expert vs. a novice) who tested his or her hypotheses in front of the participant for the whole length of the task (see Method section).

Study 2's contribution was to generalize the hypothesis of Study 1 to the literature existing in cognitive psychology on the confirmation bias. In fact, as discussed in the present article's introductory section, numerous studies (cf. Evans, 1989) appear to indicate that people have a strong tendency to confirm their hypotheses, but without being confronted with a high-status source. However, we might argue that in all of these experiments, participants are exposed to a high-status person who might induce a certain degree of focusing: the experimenter. Of course, the experimenter does not say anything about the solution, but he or she gives an example of the rule to be discovered that the participant could take as the best example of the rule (the number triad), which by conversational reasons (cf. Grice, 1989; see also Girotto & Politzer, 1990) is rendered even more salient by the experimenter's high status. This inference might lead the participant to focus on that triad, to formulate a hypothesis that captures all the salient features of the triad (e.g., increasing even numbers, ascending by two, for 2-4-6), and to try to confirm it. In other words, the conversational rule of quantity (all the information given must be relevant; Grice), rendered even more normative by the experimenter's status, might lead the participants to a focused processing that leads to confirmation. Indeed, Rossi (1999) and Rossi, Caverni, and Girotto (2001) have shown that when the participants are told that 2-4-6 is not an example of the rule to be discovered (thereby violating the conversational rule), they solve the task better, finding a higher number of correct solutions. In Study 2 of the present research, with the same procedure as Study 1, we explored the parallel between the focusing induced by a high-status source and that induced by the constraining status of the example given by the experimenter. Again confronted with a high- versus low-competence source, we told participants that the example (2-4-6) was—versus was not—a good example of the rule to be discovered. We expected that the highest proportion of confirmatory testing would be found in the most constraining condition, that is, when the source was high in status and the participant was told that 2-4-6 was a good example of the rule.

STUDY 1

In Study 1, we had to set up a new paradigm that confronted participants with an actual source of influence through the entire process of rule discovery. Accordingly, participants were meant to solve an inductive reasoning task in the presence of another participant (a confederate of the experimenter) who was given the same task. Of course, we expected that the findings reviewed in the preceding introductory section would generalize to an actual interaction situation and that therefore, in this new setting, a low-competence source would induce a more frequent use of disconfirmation than would a high-competence source. More important, if this effect is due to the relational threat that is induced by the high-competence source, we should find that under this condition participants are less able to learn from the task, because they are more centered on the relational conflict than on the task. Accordingly, the confederate was instructed to use either a confirmatory strategy or a disconfirmatory strategy. In fact, although the use of disconfirmation is a rare behavior, it can be learned (cf. Gorman & Gorman, 1984). Therefore, if it is true that confrontation with a high-competence source induces a focus on the relational conflict, then participants of these conditions should use a "protective" testing strategy (confirmation), regardless of the strategy used by the source. Conversely, if confrontation with a low-competence source allows a focus on the task, then participants of these conditions should be able to learn from the source's strategy and to use disconfirmation more frequently when they witness it.

It is important to note that the use of disconfirmation is interpreted here as a form of learning, even though the permanence of this testing behavior was not studied in the present research. First, as already noted, disconfirmation is a very rare behavior; researchers have pointed out that merely showing it does not lead to adoption and that it is necessary to undergo a teaching process (Gorman & Gorman, 1984). Second, Butera et al. (1996) have shown that participants who used disconfirmation after being confronted with a low-status source of influence were able to appropriately use disconfirmation in a subsequent, unrelated task. Thus, we think that in the present paradigm, individuals will use disconfirmation when they have understood its function and utility.

Method

Participants

Participants were 40 undergraduates (7 men and 33 women, with median age of 22 years) at Grenoble University in France, who volunteered for the study. None of them was a psychology student. The experimenter contacted participants in the university hall and kindly asked them if they wanted to participate in a study on reasoning. No compensation was offered.

Materials and Procedure

We arranged circumstances so that two participants arrived at the lab at the same time: One of them was a naive participant and the other one a confederate of the experimenter. The confederate was randomly either a male or a female psychology student, especially instructed for this task. We told the two participants that because of a fictitious problem of a lack of rooms, the two participants had to run the experiment together. They were then given Wason's (1960) 2-4-6 problem: The experimenter explained that 2-4-6 is a triad of numbers that was generated by a rule that they had to discover; they would have to think of a hypothesis, write it on an ad hoc sheet, but do so separately without saying it aloud. Then they would have to propose another number triad to test the hypothesis: They would have to write it on the same sheet and to announce it to the experimenter, who would say if the triad is compatible with the rule to be found. Thus, there was only one rule to discover (the one underlying 2-4-6), but the participants could test their hypotheses with as many new triads as they wanted.

The two participants had to take turns in announcing the triads. This is important because for each announced triad, the naive participant was able to hear the confederate's testing triad. Of course, the confederate always announced the same sequence of triads and never came up with a hypothesis. The naive participant could announce as many hypotheses as he or she wanted to announce. The session ended when the naive participant discovered the rule, taking at most 20 min.

Experimental Design

The first independent variable was the influence source's alleged competence: We presented the confederate either as a novice in this task (a participant who had come to the lab for the first time and did not know Wason's [1960] task, just like the naive participant) or as an expert (the participant of a longitudinal study, who came to the lab every month).

The second independent variable was the source's testing strategy, either confirmatory or disconfirmatory. In the confirmatory conditions, the confederate announced a series of triads meant to confirm the most obvious rule for 2-4-6: ascending even numbers with an interval of two. This is the most obvious rule because it uses all the information contained in the triad, thereby obeying Grice's (1989) maxim of quantity. Examples of these triads are 8-10-12 and 100-102-104. In the disconfirmatory conditions, the confederate announced a series of triads meant to disconfirm the same rule, proposing triads such as 12-10-8 or 3-5-7.

Thus, the first study's design was a 2 (source's alleged competence: expert vs. same competence) $\times$ 2 (source's testing strategy: confirmation vs. disconfirmation) factorial design. The main dependent variable was the proportion of disconfirmatory triads used by the participants to test their hypotheses. Indeed, merely counting the number of disconfirmatory triads would have been inappropriate, because

the participants could propose as many triads as they wanted; thus, we computed the number of triads aimed at disconfirming the current hypothesis divided by the total number of proposed triads, that is, the proportion of disconfirmatory triads. We coded a triad as confirmatory when it fit the participant's current hypothesis (e.g., 20-22-24 for "+2") or as disconfirmatory when it did not fit the hypothesis (e.g., 1-2-3 for "ascending even numbers").

Results

Hypothesis Elaboration

Participants proposed a fair number of different hypotheses ($M = 4.88$, $SD = 1.74$), showing that they were actively searching among alternative hypotheses and were not stuck with a unique sufficient hypothesis. More important, an analysis of variance (ANOVA) showed that, in line with previous results, participants who were facing the novice source tested a higher number of different hypotheses ($M = 5.40$, $SD = 2.01$) than did participants who were facing the expert source ($M = 4.35$, $SD = 1.27$), $F(1, 36) = 3.813$, $p < .059$, $\eta^2 = .09$. Neither the main effect of the testing strategy nor the interaction effect reached significance, $ps > .30$.

Hypothesis Testing

Regarding the proportion of disconfirmatory testing that was used by participants, an ANOVA revealed two main effects and an interaction effect, as shown in Table 1. First, it appeared that participants confronted with a novice used disconfirmation significantly more ($M = 0.22$, $SD = 0.22$) than did those confronted with an expert ($M = 0.12$, $SD = 0.12$), $F(1, 36) = 4.992$, $p < .04$, $\eta^2 = .12$, supporting earlier results obtained by Butera, Gardair, Maggi, and Mugny (1998). Second, participants who were confronted with a confederate using disconfirmation used this strategy more frequently ($M = 0.25$, $SD = 0.20$) than did those who were confronted with a confederate using confirmation ($M = 0.08$, $SD = 0.09$), $F(1, 36) = 14.952$, $p < .001$, $\eta^2 = .29$. This effect is consistent with work showing that exposure to disconfirmation can enhance the use of this strategy (e.g., in training procedures; cf. Gorman & Gorman, 1984). Finally, the interaction effect, $F(1, 36) = 4.474$, $p < .05$, $\eta^2 = .11$, reveals that participants confronted with an expert used the same proportion of disconfirmation strategies regardless of the confederate's testing strategy, $p > .10$, whereas confrontation with a novice allowed participants to benefit from the source's disconfirmatory behavior, $t(36) = 4.230$, $p < .001$. Moreover, it is worth noting that when the confederate used disconfirmation, this strategy appeared in higher proportions in participants confronted with a novice than in those confronted with an expert, $t(36) = 3.076$, $p < .005$.

TABLE 1. Proportions of Disconfirmatory Triads in Study 1

	Novice source		Expert source	
Variable	*M*	*SD*	*M*	*SD*
Confirmatory source	0.08_a	0.07	0.08_a	0.11
Disconfirmatory source	0.35_b	0.22	0.16_a	0.12

Note. Means with different subscripts are significantly different. $N = 10$ in each condition.

Supplementary Analysis

Caverni and Rossi (1997; see also Caverni, Rossi, & Péris, 2000; Rossi, 1999) have shown that people's tendency to ignore disconfirmation can hide a strategy consisting of testing not only the current hypothesis but also the previous one, that is, the hypothesis tested by the previous triad. The present study supported Caverni and Rossi's (1997) hypothesis and replicated their results. Indeed, we computed a score accounting for the proportion of disconfirmations of the previous hypothesis, namely, the number of triads that the participant proposed to disconfirm the previous hypothesis divided by the total number of proposed triads. When comparing the disconfirmation rate measured with the first score and the disconfirmation rate measured with this new score, the overall disconfirmation rate rises from 0.17 ($SD = 0.18$) to 0.42 ($SD = 0.20$), $t(39) = 6.43$, $p < .001$. The present result is important for two reasons. First, it fits a line of research in the psychology of reasoning that, following Klayman and Ha (1987; see also Klayman, 1995), shows that it is possible to be disconfirmatory while using positive testing. In this line of research, investigators contend that confirmation of hypotheses is not an all-or-nothing matter. Second, the present result shows that although hypothesis testing is a high-level process, latent mechanisms can be at work. Study 2 will show the relevance of this result for our contention.

Discussion

The main effect of the source's status on the proportion of disconfirmation shows the generalizability of the findings obtained with the previous paradigm: Confrontation with a low-competence influence source does induce a higher use of disconfirmation than confrontation with a high-competence source. More important, it appears that confrontation with a high-competence source led to a "freezing" (cf. Kruglanski & Webster, 1996) of the reasoning activity, because

participants in this condition used the same amount of confirmatory tests, regardless of the source's strategy. It seems that these participants preferred to use triads that supported their own hypothesis than to use the information that came from across the table. Indeed, this seems to be a defensive behavior. When the participants were confronted with a low-competence source, they were able to use the confederate's testing strategy; in fact, when the low-competence source used disconfirmation, the participants used a higher proportion of disconfirmatory strategies than they did when confronted with a low-competence source using confirmation (and higher than did participants confronted with a disconfirming high-competence source). Therefore, it appears that in the low-competence source condition, participants were more open to alternative information. This appearance is also supported by the finding that these participants tested a wider variety of hypotheses than did participants confronted with a high-competence source.

Overall, these results seem to support the idea that influence of a less threatening source leads individuals to process the problem in a way that allows them to take more alternatives into account and to test not only the validity but also the limits of the validity of hypotheses. The fact that individuals cannot rely upon the credibility of a low-competence source induces them to explore the task in a more systematic way (Chaiken, 1980). As noted in the present article's introduction, Rossi (1999) made a similar point concerning the credibility of conversational rules (cf. Grice, 1989) in the standard 2-4-6 task. Participants in this task are so convinced that the proposed triad (2-4-6) is the perfect example of the rule that they focus on the dominant rule and then try to confirm it. Telling them that 2-4-6 is not a good example of the rule breaks the heuristic processing of the task and leads reasoners to use disconfirmation (Rossi et al., 2001). Thus, it seems that there is a parallel between relational paths and conversational paths to systematic information processing.

STUDY 2

In Study 2, we aimed at exploring this parallel. It is an important parallel, because it shows that reasoning strategies that are aimed at discovering the necessary hypothesis (and that are not satisfied by sufficient ones) stem from the possibility of divergence from norms: from social norms, in the case of interaction and social influence (norms such as the constraining power of competence); and from conversational norms in the case of language (as Rossi, 1999, demonstrated it). Therefore, investigators can expect that if individuals are confronted with the violation of a conversational belief (2-4-6 *is not* a good example of the rule), then they should use a high proportion of disconfirmation, whatever the source of influence. If there is no violation (2-4-6 *is* a good example of the rule), a low-competence source should keep the proportion of disconfirmation high and a high-competence source should keep it low.

Method

Participants

Participants were 40 undergraduates (5 men and 35 women, with median age of 21 years) at Grenoble University in France who volunteered for the study. None of them was a psychology student. Again, the experimenter contacted the participants in the university hall and kindly asked them if they wanted to participate in a study on reasoning. No compensation was offered.

Materials, Procedure, and Design

Materials and procedure were the same as in Study 1. Moreover, the first independent variable was again the influence source's alleged competence: The confederate was presented either as a novice or as an expert. However, in Study 2, the confederate's testing strategy was confirmation in all the conditions.

The other difference of Study 2 from Study 1 concerned the second independent variable, which in Study 2 was introduced when the experimenter explained the task. In half of the cases, the experimenter explained that 2-4-6 was a good example of the rule and that it had been chosen because it followed from the rule; in the other half of the cases, the experimenter explained that 2-4-6 was not a good example and that it had been chosen only to show the participants what is a triad.

Thus, Study 2's design was a 2 (source's alleged competence: expert vs. novice) × 2 (nature of the example: good vs. not good) factorial design. The main dependent variable was again the proportion of disconfirmatory triads used by the participants to test their hypotheses.

Results

Hypothesis Elaboration

Participants proposed again a fair amount of different hypotheses ($M = 4.63$, $SD = 1.60$), showing that they were actively searching among alternative hypotheses and were not stuck with a unique sufficient hypothesis. An ANOVA showed that, in line with results of Study 1, participants who were facing the novice source tested a higher number of different hypotheses ($M = 5.10$, $SD = 1.59$) than did participants who were facing the expert source ($M = 4.15$, $SD = 1.50$), $F(1, 36) = 4.056$, $p < .052$, $\eta^2 = .10$. Moreover and interestingly, a main effect of the nature of the example also appears: participants who were told that 2-4-6 was not a good example tested a higher number of different hypotheses ($M = 5.10$, $SD = 1.55$) than did participants who were told that it was a good example ($M = 4.15$, $SD = 1.53$), $F(1, 36) = 4.056$, $p < .052$, $\eta^2 = .10$. The interaction effect was not significant, $p > .10$.

Hypothesis Testing

Regarding the proportion of disconfirmatory testing used by participants, an ANOVA revealed only a marginal effect of the nature of the example: Participants who were told that 2-4-6 was not a good example tended to use a higher proportion of disconfirmatory tests ($M = 0.25$, $SD = 0.25$) than did participants who were told that it was a good example ($M = 0.12$, $SD = 0.17$), $F(1, 36) = 3.503$, $p < .07$, $\eta^2 = .08$. The expected interaction appeared to be insignificant ($F < 1$).

A possible explanation is that the manipulation of the nature of the example introduced a very strong normative pressure in both conditions; in fact, the experimenter introduced a very clear-cut judgment about what is good and what is not. Therefore, it is possible that this procedure rendered the participants more careful and attentive and diverted the use of disconfirmation to a more indirect level. To test this hypothesis, the same ANOVA was performed on the proportion of disconfirmation of the previous hypothesis, as in the supplementary analysis of Study 1 (cf. Caverni & Rossi, 1997). In fact, disconfirming the previous hypothesis can seem less evident than disconfirming the current hypothesis (especially because participants must publicly announce their triads), even for the participants, and therefore less threatening.

In Study 2 too, when computing a score accounting for the proportion of disconfirmation of the previous hypothesis, the overall disconfirmation rate rose over that of disconfirmation of the current hypothesis, from 0.19 ($SD = 0.22$) to 0.40 ($SD = 0.23$), $t(39) = 4.73$, $p < .001$. A 2 (source's status) × 2 (nature of the example) ANOVA revealed a main effect of the source's status and the expected interaction effect, as shown in Table 2. First, it appeared that participants confronted with a novice used disconfirmation significantly more ($M = 0.48$, $SD = 0.22$) than did those participants confronted with an expert ($M = 0.31$, $SD = 0.22$), $F(1, 36) = 7.066$, $p < .02$, $\eta^2 = .16$.

The interaction effect, $F(1, 36) = 7.023$, $p < .02$, $\eta^2 = .16$, specified that, as we expected, when the example was not supposed to be a good one, no significant difference appeared between participants who were confronted with the novice ($M = 0.41$) and those confronted with the expert ($M = 0.41$), $t < 1$. However, when the example was supposed to be a good one, a significant difference appeared between the novice condition and the expert condition, $t(36) = 3.754$, $p < .001$. Participants confronted with the novice ($M = 0.55$) kept a proportion of disconfirmation similar to the proportion in the not-a-good-example condition, $t(36) = 1.493$, $p > .10$. Participants confronted with the expert ($M = 0.21$) used significantly less disconfirmation in the good-example condition than in the not-a-good-example condition, $t(36) = 2.254$, $p < .03$.

TABLE 2. Proportions of Triads Disconfirming Participant's Previous Hypothesis in Study 2

Variable	Novice source		Expert source	
	M	*SD*	*M*	*SD*
Good example	0.55_a	0.23	0.21_b	0.16
Not a good example	0.41_a	0.20	0.41_a	0.22

Note. Means with different subscripts are significantly different. $N = 10$ in each condition.

Discussion

The first result in Study 2 that is worth noting is that the expected interaction effect was obtained not on the direct testing of the current hypothesis but on the indirect testing of the previous hypothesis. The explanation that we propose is that the constraining procedure consisting in giving a very definite judgment on the nature of the example could have threatened the participants and transferred the expression of the influence dynamics at a more indirect level. Of course, further research is needed to support this explanation. However, it appears to be a viable hypothesis because it is in line with a fundamental principle of social influence: If a dynamic is too conflictual to appear at a direct level, it will appear at a more indirect, more latent level (cf. Moscovici, 1980; Pérez & Mugny, 1996).

What the interaction effect shows is that, as long as there is a divergent, nonnormative element, the proportion of disconfirmation was high. If the example violated the conversational rules, then no significant differences appeared on the basis of the source's competence. If the source had low competence, no significant differences appeared on the basis of the nature of the example. Actually, the lowest proportion of disconfirmation (and the highest proportion of confirmation) appeared in the most normative, constraining (and threatening) condition, when the example was supposed to be good and the source was supposed to be an expert. This result is consistent with an effect obtained in Butera et al.'s (1996) experiment: The highest proportion of confirmation was obtained when the source was normative (in that experiment, it was a majority) and the participants believed that there was only one possible solution to a 2-4-6-like problem.

GENERAL DISCUSSION

Study 1 and Study 2 of the present research indicate three sets of conclusions regarding the intended contributions announced in the introduction. First, it appears that disconfirmation can be learned in an interaction between reasoners if the interaction takes place with a low-status, nonthreatening partner. Indeed, Study 1 showed that when the source is of high status, the use of disconfirmation

is very low, not only when the partner uses confirmation, but also when he or she uses disconfirmation. In the case of a low-status source, on the contrary, participants were able to take advantage of the example, and when the partner used disconfirmation, their use of this strategy significantly increased.

Second, it seems that the results regarding the effect of social influence on inductive reasoning obtained from an evoked influence source can be generalized to actual interaction. In fact, both Study 1 and Study 2 showed that in inductive reasoning, a low-competence source can lead to a wider elaboration of alternative hypotheses and to a larger use of disconfirmation than might a high-competence source. On the one side this result enhances the robustness of previous results, and on the other side it opens the way to a new paradigm that seems effective in studying social interaction in reasoning.

Third, confrontation with an expert proposing a model solution during problem solving appears to induce a threat to the reasoner. In fact, we can see the lower number of alternative hypotheses formulated in the expert conditions as representing a reduced processing of the task because of increased attention to the relational conflict—actually, that is, as a sort of "focusing effect" (Cherubini, Mazzocco, & Rumiati, 2003; Legrenzi et al., 1993). Therefore, the larger use of confirmatory testing appears to represent the participant's attempt to accumulate supporting evidence for his or her own hypothesis, thereby strengthening his or her own status in this conflict of competences. Study 1 showed that, even though the participant can learn the use of disconfirmation when exposed to a coactor using it, participants confronted with the disconfirmatory high-competence source kept using the confirmatory strategy, just as much as those participants confronted with the confirmatory high-competence source. Study 2 supported the possibility of a focusing effect induced by the relational conflict with a high-competence source. In fact, it is shown that—again—the high-competence source induced more confirmation than the low-competence source. However, this effect was reduced when the participant's protection of his or her own competence by attempting to confirm the dominant, most obvious hypothesis (ascending even numbers with an interval of two) was not a viable strategy, because 2-4-6 was not a prototypical example of the rule. In this case, decentering led participants to an increased use of disconfirmation, regardless of the source of influence. It therefore appears that participants use confirmation in constraining reasoning situations but that the use of disconfirmation can be increased by lowering the normativity of the situation, either by a less threatening source or by less constraining conversational rules.

In sum, confirmation of hypotheses is not necessarily a reasoning bias, an incoercible error (see also Klayman & Ha, 1987). Confirmation is one possible way of testing hypotheses that appears to be common, but especially so in specific situations. Confirmation seems indeed to be a strategy that people use to cope with particularly constraining situations, but it is possible to lower the constraint and use disconfirmation. A possible ad interim conclusion could be that

there are two components of confirmation: a reasoning component that operates to achieve the hypothesis testing itself; and a motivational component that operates to drive hypothesis testing toward a specific, desirable conclusion (e.g., the need to protect a specific hypothesis to show competence; see also Kruglanski, 1990). Therefore, instead of calling confirmation a *bias* (cf. Butera, Legrenzi, & Oswald, 1997; Caverni, Fabre, & Gonzalez, 1990), researchers should focus on the conditions favoring the appearance of confirmatory testing: After all, if there is a bias, it comes from the number of constraining and threatening situations in which we are put when we work.

NOTE

1. It is worth noting at this point that the earlier interpretations might seem inconsistent with some results of the literature on persuasion, showing that a high-status source has more influence than a low-status source (cf. French & Raven, 1959; Latané & Wolf, 1981). However, there is also a large body of work showing that a low-status source can have a deeper impact (cf. Doise & Mugny, 1984; Falomir, Butera, & Mugny, 2002; Moscovici, 1980; Nemeth, 1986). This line of work showed that, although a high-status source induces more compliance and more manifest attitude change, a low-status source can induce greater integration of information and faster cognitive development (Doise & Mugny, 1979, 1984), more internalized attitude change (Moscovici), and more creative and alternative solutions in problem solving (Nemeth). All these authors agree in pointing out the fact that, if a high-status source does not achieve a deep and long-lasting influence, it is because this source threatens the target: It has been shown that a high-status source imposes its point of view on the target, thereby preventing the target from learning (Doise & Mugny, 1984), focuses the target on social comparison with the source instead of focusing it on the message (Moscovici), and produces a high degree of stress in the target that results in convergent thinking (Nemeth).

REFERENCES

Butera, F., & Buchs, C. (in press). Reasoning together: From focusing to decentering. In V. Girotto & P. N. Johnson-Laird (Eds.), *The shape of reason*. Hove, England: Psychology Press.

Butera, F., Gardair, E., Maggi, J., & Mugny, G. (1998). Les paradoxes de l'expertise: Influence sociale et (in)compétence de soi et d'autrui [Paradoxes of expertise: Social influence and self and other's (in)competence]. In J. Py, A. Somat, & J. Baillé (Eds.), *Psychologie sociale et formation professionnelle: Propositions et regards critiques* (pp. 109–123). Rennes, France: Presses Universitaires de Rennes.

Butera, F., Legrenzi, P., & Oswald, M. (Eds.). (1997). Contexts and biases [Special issue]. *Swiss Journal of Psychology, 56*(2).

Butera, F., & Mugny, G. (1992). Influence minoritaire et falsification [Minority influence and falsification]. *Revue Internationale de Psychologie Sociale, 5,* 115–132.

Butera, F., & Mugny, G. (1995). Conflict between incompetences and influence of a low-expertise source in hypothesis testing. *European Journal of Social Psychology, 25,* 457–462.

Butera, F., & Mugny, G. (2001). Conflicts and social influences in hypothesis testing. In C. K. W. De Dreu & N. K. De Vries (Eds.). *Group consensus and minority influence: Implications for innovation* (pp. 160–182). Oxford, England: Blackwell.

Butera, F., Mugny, G., Legrenzi, P., & Pérez, J. A. (1996). Majority and minority influence, task representation, and inductive reasoning. *British Journal of Social Psychology, 35,* 123–136.
Caverni, J.-P., Fabre, J. M., & Gonzalez, M. (Eds.). (1990). *Cognitive biases.* Amsterdam: Elsevier (North Holland).
Caverni, J.-P., & Rossi, S. (1997). A nice bit of scandal: About a disconfirmation bias in the Wason's 2-4-6 problem. *Swiss Journal of Psychology, 56,* 239–242.
Caverni, J.-P., Rossi, S., & Péris, J. L. (2000). The alternatives taking into account in hypotheses testing: Two new paradigms for investigating strategies. In J. Garcia-Madruga, N. Carriedo, & M. J. Gonzalez-Labra (Eds.), *Mental models in reasoning* (pp. 133–141). Madrid, Spain: UNED.
Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology, 39,* 752–766.
Cherubini, P., Mazzocco, K., & Rumiati, R. (2003). Rethinking the focusing effect in decision making. *Acta Psychologica, 113,* 67–81.
Doherty, M. E., Mynatt, C. R., Tweney, R. D., & Schiavo, M. D. (1979). Pseudodiagnosticity. *Acta Psychologica, 43,* 111–121.
Doise, W., & Mugny, G. (1979). Individual and collective conflicts of centrations in cognitive development. *European Journal of Social Psychology, 9,* 105–108.
Doise, W., & Mugny, G. (1984). *The social development of the intellect.* Oxford, England: Pergamon Press.
Dumont, M., Yzerbyt, V., Snyder, M., Mathieu, B., Comblain, C., & Scaillet, N. (2003). Suppression and hypothesis testing: Does suppressing stereotypes during interactions help to avoid confirmation biases? *European Journal of Social Psychology, 33,* 659–677.
Evans, J. St. B. T. (1982). *The psychology of deductive reasoning.* London: Routledge & Kegan Paul.
Evans, J. St. B. T. (1989). *Bias in human reasoning: Causes and consequences.* Hove, England: Erlbaum.
Falomir, J.-M., Butera, F., & Mugny, G. (2002). Persuasive constraint and expert versus non-expert influence in intention to quit smoking. *European Journal of Social Psychology, 32,* 209–222.
French, J. R., & Raven, B. H. (1959). The bases of social power. In D. Cartwright (Ed.), *Studies in social power* (pp. 157–167). Ann Arbor: University of Michigan Press.
Frey, D., & Schulz-Hardt, S. (2001). Confirmation bias in group information seeking and its implications for decision making in administration, business and politics. In F. Butera & G. Mugny (Eds.), *Social influence in social reality* (pp. 53–73). Göttingen, Germany: Hogrefe & Huber.
Girotto, V., & Politzer, G. (1990). Conversational and world-knowledge constraints in deductive reasoning. In J. P. Caverni, J. M. Fabre, & M. Gonzalez (Eds.), *Cognitive biases.* Amsterdam: Elsevier (North Holland).
Gorman, M., & Carlson, B. (1989). Can experiments be used to study science? *Social Epistemology, 3,* 89–106.
Gorman, M., & Gorman, M. E. (1984). A comparison of confirmatory, disconfirmatory and control strategy on Wason's 2-4-6, task. *Quarterly Journal of Experimental Psychology, 36A,* 629–648.
Green, D. W. (1990). Confirmation bias, problem solving and cognitive models. In J. P. Caverni, J. M. Fabre, & M. Gonzalez (Eds.), *Cognitive biases* (pp. 553–562). Amsterdam: Elsevier (North Holland).
Grice, H. P. (1989). *Studies in the way of words.* Cambridge, MA: Harvard University Press.

Haverkamp. B. (1993). Confirmatory bias in hypothesis testing for client-identified and counselor self-generated hypotheses. *Journal of Counseling Psychology, 40,* 303–315.
Johnson-Laird, P. N. (1983). *Mental models.* Cambridge, England: Cambridge University Press.
Johnson-Laird, P. N., & Byrne, R. (2002). Conditionals: A theory of meaning, pragmatics, and inference. *Psychological Review, 109,* 646–678.
Jonas, E., Schulz-Hardt, S., Frey, D., & Thelen, N. (2001). Confirmation bias in sequential information search after preliminary decisions: An expansion of dissonance theoretical research on selective exposure to information. *Journal of Personality and Social Psychology, 80,* 557–571.
Kahneman, D. (2003). A perspective on judgment and choice. Mapping bounded rationality. *American Psychologist, 58,* 697–720.
Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases.* New York: Cambridge University Press.
Klayman, J. (1995). Varieties of confirmation bias. In J. R. Busemeyer, R. Hastie, & D. L. Medin (Eds.), *Decision making from the perspective of cognitive psychology* (pp. 385–418). New York: Academic Press.
Klayman, J., & Ha, Y.-W. (1987). Confirmation, disconfirmation and information in hypothesis testing. *Psychological Review, 94,* 211–228.
Kruglanski, A. W. (1990). Motivations for judging and knowing: Implications for causal attribution. In E. T. Higgins & R. M. Sorrentino (Eds.), *The handbook of motivation and cognition: Vol. 2. Foundation of behavior* (pp. 333–368). New York: Guilford Press.
Kruglanski, A. W., & Mayseless, O. (1988). Contextual effects in hypothesis testing: The role of competing alternatives and epistemic motivations. *Social Cognition, 6,* 1–20.
Kruglanski, A. W., & Webster, D. (1996). Motivated closing of the mind: "Seizing" and "Freezing." *Psychological Review, 103,* 263–283.
Latané, B., & Wolf, S. (1981). The social impact of majorities and minorities. *Psychological Review, 88,* 438–453.
Legrenzi, P., Butera, F., Mugny, G., & Pérez, J. A. (1991). Majority and minority influence in inductive reasoning: A preliminary study. *European Journal of Social Psychology, 21,* 359–363.
Legrenzi, P., Girotto, V., & Johnson-Laird, P. N. (1993). Focusing in reasoning and decision making. *Cognition, 49,* 37–66.
Leyens, J.-P., Dardenne, B., Yzerbyt, V., Scaillet, N., & Snyder, M. (1999). Confirmation and disconfirmation: Their social advantages. In W. Stroebe & M. Hewstone (Eds.), *European Review of Social Psychology* (Vol. 10, pp. 199–230). Chichester, England: Wiley.
Maggi, J., Butera, F., & Mugny, G. (1996). Conflict of incompetences: Direct and indirect influences on representation of the centimetre. *International Review of Social Psychology, 9,* 91–105.
Maggi, J., Legrenzi, P., Mugny, G., & Butera, F. (2001). Socio-cognitive biases in the choice of candidates. In F. Butera & G. Mugny (Eds.), *Social influence in social reality* (pp. 9–22). Göttingen, Germany: Hogrefe & Huber.
Mahoney, M. J. (1976). *Scientist as subject: The psychological imperative.* Cambridge, MA: Ballinger.
McDonald, J. (1990). Some situational determinants of hypothesis-testing strategies. *Journal of Experimental Social Psychology, 26,* 255–274.
Mitroff, I. (1974). Norms and counter-norms in a selected group of Apollo moon scientists: A case study of the ambivalence of scientists. *American Sociological Review, 39,* 579–595.
Moscovici, S. (1980). Toward a theory of conversion behavior. In L. Berkowitz (Ed.),