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The influence of responsibility and guilt on naive hypothesis-testing

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Three experiments were used to investigate individuals' hypothesis-testing process as a function of *moral* perceived utilities, which in turn depend on perceived responsibility and fear of guilt. *Moral* perceived utilities are related to individuals' moral standards and specifically to people's attempt to face up to their own responsibilities, and to avoid feeling guilty of irresponsibility. The results showed that responsibility and fear of guilt in testing hypotheses involved a process defined as *prudential mode*, which entails focusing on and confirming the worst hypothesis, and then reiterating the testing process. In particular, the results showed that responsible and guilt-fearing individuals: (1) tended to search prudentially for examples confirming the worst hypothesis and to search for counter-examples falsifying the positive hypothesis; (2) focused on the worst alternative, and tended to confirm it; (3) prudentially kept up the testing process, even if faced with initial positive evidence. Our discussion of the results emphasises how people are largely pragmatic in their hypothesis testing, using efficient cognitive strategies that focus on error minimisation rather than on truth detection. In a context of responsibility and guilt, the errors are linked to people's failure to face up to their own responsibilities, and are thus moral errors.

In cognitive psychology researchers have often used variants of the Wason hypothesis-testing problem (Wason's Selection task or WST; Wason, 1966) in order to investigate participants' reasoning strategy. The task consists in checking if a conditional rule of the form "*if p then q*" has been violated by any one of four instances about which the individual has incomplete information. Each instance is represented on a card. One side of the card shows whether the antecedent is true or false (i.e., whether *p* or *not-p* is the case), and the other side of the card shows whether the consequent is true or false (i.e., whether *q* or *not-q* is the case). People who are allowed to see only one side of each card are asked to say which card(s) must be turned over to

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verify if any of them violates the rule. The four cards that participants must choose represent the values of *p, not-p, q*, and *not-q*. From the point of view of formal logic, only the combination on the same card of a true antecedent (*p*) and a false consequent (*not-q*) can falsify a conditional rule: i.e., those cards with the potential to reveal a falsifying instance (Popper, 1959). However, as few as 4% of participants make this choice, other choices being far more common: *p* and *q* cards (46%); *p* card only (33%); *p, q*, and *not-q* cards (4%) (Johnson-Laird & Wason, 1970).

This strong and predictable effect has been widely interpreted as casting doubt on human rationality (Cohen, 1981; Manktelow & Over, 1993; Stich, 1985, 1990), and has formed the basis of several general theories about reasoning and rationality. In general, they all seem to agree in one way or another that individuals do not reason according to the normative rules of formal logic and that their answers are errors (e.g., Evans, 1989; Johnson-Laird & Byrne, 1991; Rips, 1994). Evans (1989), for example, attributes to a positive bias the modal response of selecting the cards *p* and *q*. This bias arises out of an attentional heuristic: those cards that are mentioned positively in the conditional statement are selected as presumably relevant. Other theories result from the content effect found through the Wason Selection Task. When the standard content (letters and numbers) is replaced with a certain kind of realistic content, the frequency of logically correct answers rises to about 80% (Cosmides, 1989; Gigerenzer & Hug, 1992; Griggs & Cox, 1983; Johnson-Laird, Legrenzi, & Legrenzi, 1972). If the rule is, for instance, "*if a person drinks alcohol, she must be over 19 years old*" participants tend to choose the cards "drinks alcohol" (*p*) and "is 16 years old" (*not-q*) as those that have to be checked, in accordance with the logically correct choice. The theory of pragmatic schemata of Cheng and Holyoak (1985, 1989) and the social contract theory of Cosmides (1989) explain these effects by content-specific rules.

Further studies clearly demonstrated that people's hypothesis-testing process is domain-specific and guided by perceived utilities: individuals' reasoning performances depend on the perceived relevance of the conditional rule to one's personal interests. (Evans & Over, 1996; Kirby, 1994; Manktelow & Over, 1991; Smeets, de Jong, & Mayer, 2000). A selection task may be facilitated or else made harder by this factor: what individuals say about the truth or falsity of conditional rules depends on their preferences among various possible outcomes or states of affairs. These preferences fix the utilities we attach to these outcomes or states of affairs. By implication, a positive hypothesis-testing strategy in reasoning (confirming information seeking), coexists with more normative test strategies (falsifying information seeking), and these variations in testing strategy (confirmation vs falsification) depend in the first instance precisely on the perceived utility of the outcomes. For instance, Smeets and colleagues (2000) showed that, in the context of a general threat, with a series of selection tasks containing safety rules (i.e., *if p then safe*) and danger rules (i.e., *if p then danger*), participants adopted a verificationistic strategy in the case of danger rules, and tended to look for falsifications in the case of safety rules. In potentially dangerous situations it is adaptive to rely on confirming information concerning danger rules. Given the rule, e.g., "*if the alarm bell rings, then there is a fire*" one is well advised to check whether the alarm is followed by the fire and whether the fire is indeed preceded by the alarm. The logical option of false alarm (the bell rings in the absence of a fire) is less relevant for survival. Thus, one's interests are better served knowing whether the bell sometimes rings when there is a fire, than whether the bell sometimes rings in the absence of a fire. The opposite is true for safety rules such as "*if the monkeys scream, then it is safe*". In this instance, it is adaptive to check whether it is indeed safe when the signal is present. That is, in case of safety rules, one's interests are better served by searching for potentially disconfirming information (Are there screaming monkeys, and is it perhaps not safe?). Thus, the hypothesis-testing process seems to be largely guided by individuals' perceived utilities.

In this perspective, we hypothesise that the individual's hypothesis-testing process varies as a function of *moral* perceived utilities, which in turn depend on the perceived responsibility and fear of guilt, i.e., the fear of behaving carelessly and causing unjustified damage to him/herself or to others, and/or a violation of a moral norm (Freeman, Pretzer, Fleming, & Simon, 1990; Mancini, 2001). *Moral* perceived utilities are those related to individuals' moral standards and specifically to people's attempts to face up to their responsibilities and essentially to prevent guilt due to irresponsibility. In daily life individuals are often required to take on some responsibilities and in situations characterised by responsibility they have to take important and crucial decisions, engaging in reasoning whose conclusions have important implications. For example, a doctor has to weigh up medical hypotheses and his/her conclusions are obviously important for the patient for whom he/she is responsible; a magistrate has to weigh up guilty/not guilty hypotheses concerning the accused person, and also in this case he/she is responsible for the judgement.

In a recent experiment, using a modified version of the Wason Selection Task, we demonstrated that this particular perceived utility, that is, facing up to one's own responsibilities (*moral* perceived utility), influences human reasoning strategies (Mancini & Gangemi, 2002). We argued that under conditions of responsibility, a normative goal is activated (i.e., for a doctor, to treat a patient). This goal prescribes which action or omission is requested (i.e., the treatments to give) in pursuing the required outcome (i.e., the patient's recovery).

The purpose of the present work was to investigate the specific role of perceived responsibility and fear of behaving guiltily in individuals' danger and safety hypothesis testing. In particular, we examined the process that allows our responsible and guilt-fearing individuals to check hypotheses about the congruency between the actual state of the world and the prescribed state (i.e., the congruency between the obtained outcome and the one prescribed by the norm). We argue that, in testing hypotheses, both responsibility and guilt involve a peculiar process that we define as a *prudential mode*.

In the *prudential mode* individuals:

- focus on the worst alternatives (e.g., the state of the world is inconsistent with that prescribed);
- search for examples confirming the focused worst hypotheses;
- search for counter-examples falsifying the positive hypotheses;
- consider insufficient counter-examples falsifying the worst hypotheses;
- tend to retain the worst hypotheses by carrying out the hypothesis-testing process.

In order to investigate whether perceived responsibility and fear of behaving guiltily influence the hypothesis-testing process in a prudential mode, we conducted three experiments.

EXPERIMENT 1

In this experiment we examined the effect of responsibility and fear of guilt on hypothesis-testing strategy. In particular, we investigated the influence of responsibility and guilt on the conditional rule control strategies (confirmation vs falsification) adopted by participants in the case of both the danger and the safety rule. To this aim, we compared participants' performances in a modified version of the Wason Selection Task in two different conditions: perceived responsibility plus guilt (PR + G); no-responsibility (NR). For each experimental condition we examined the responses of two different groups of participants submitted to two different conditional rules: danger rule/diagnosis (*if my patient's symptoms, then Ebola virus*); safety rule/diagnosis (*if my patient's symptoms, then influenza*).

We expected that under the PR + G condition, participants faced with a danger rule/diagnosis would activate a prudential confirming testing strategy, selecting only the *p & q* pattern. By contrast, we predicted that individuals assigned the safety rule/diagnosis would tend to search prudentially for falsifying information about it (*p & not-q* pattern). Finally, we predicted that under the NR condition, participants would indistinguishably adopt a confirmation and a falsification strategy for both the conditional rules (danger/safety rule).

Method

Participants. A total of 101 volunteers, recruited from northern, central, and southern Italy, participated in the experiment. Their average age was 31, the range being 20–50. None of them had any prior experience of the Wason Selection Task.

Participants were assigned randomly to one of the two experimental conditions (PR + G: n = 49; NR: n = 52) and tested in four groups. They had to solve the problem individually. For each condition, participants were randomly assigned to the two different rules/diagnoses (danger vs safety), as shown in Table 1. The design was 2 × 2 independent groups with the factors: Condition (PR + G; NR) and Diagnosis (danger; safety).

Materials and procedure. Participants received a paper with written instructions, a story and a modified WST (see Appendix A).

In the PR + G condition, the task instructions to activate responsibility and guilt in the participants were as follows:

> *You are the only doctor in your ward, and are solely responsible for several patients. In the few last months, although you had everything necessary, i.e. diagnostic equipment, time and medical know-how, you made several mistaken diagnoses due to superficiality, inattention and lack of commitment that led to serious consequences for your patients. You feel guilty about this and are fearful of making new serious mistakes.*

TABLE 1
Frequencies (and percentages) choice of each selection pattern across the two conditions of Experiment 1

		Pattern			
Condition/Rule	**No. Subjects**	**p & q**	**not- p & q**	**p & not-q**	**not-p & not-q**
PR + G (*n* = 49)					
Safety diagnosis	23 (47)	2 (9)	1 (4)	19 (83)	1 (4)
Danger diagnosis	26 (53)	22 (85)	2 (7.5)	2 (7.5)	0
NR (*n* = 52)					
Safety diagnosis	22 (42)	6 (27)	3 (14)	9 (41)	4 (18)
Danger diagnosis	30 (58)	7 (23)	9 (30)	8 (27)	6 (20)

The story contained one of the two following conditional rules/diagnoses:

- *if my patient's symptoms, then Ebola virus* (danger rule/diagnosis)
- *if my patient's symptoms, then influenza* (safety rule/diagnosis)

The story provided for the presence of four doctors. In line with our previous study (Mancini & Gangemi, 2002) we used a modified WST. Thus, in the present study, the four Wason selection cards were represented by four different persons ("doctors") to whom a set question could be addressed. The cards were all presented at the same time. Two doctors referred to the antecedent of the rule (*p* and *not*-*p*). In particular, for each of the two conditional rules/diagnoses, the propositions given by the two "antecedent doctors" were as follows:

> "p": *I have dealt with a sample composed of 100 patients presenting the same symptoms as your patient*
>
> "not-p": *I have dealt with a sample composed of 100 patients presenting different symptoms to those of your patient*

The other two doctors represented the consequents of the conditional rule (*q* and *not*-*q*). For each of the two conditional rules/diagnoses, the proposition representing the two "consequent doctors" were as follows:

> "q"*: All 100 patients included in my sample suffer from Ebola virus*
>
> "not q": *All 100 patients included in my sample suffer from influenza*

Moreover, for each doctor who represented the antecedents (*p* and *not*-*p*), participants could choose between two set questions representing the two consequents (*q* and *not*-*q*). More specifically, for each of the two conditional rules/diagnoses, the proposition representing the two consequent questions were as follows:

> "q": *Do patients suffer from Ebola virus?*
>
> "not q": *Do patients suffer from influenza?*

The same criteria apply to those doctors representing the consequents (*q* and *not*-*q*): for each conditional rule /diagnosis participants could choose between two possible antecedents (*p* and *not*-*p*):

> "p": *Do your patients show the same symptoms as mine?*
>
> "not p": *Do your patients show different symptoms than mine?*

Thus, each task consisted of a story, a conditional rule, and four doctors' experiences representing the antecedents and the consequents of the conditional rule.

The No Responsibility condition was very similar. However, it differed in that the two conditional rules, the four propositions representing the four doctors, and the four fixed questions were applied indirectly (i.e., *if patient's symptoms, then Ebola virus*). The NR condition also differed from the previous one in that the task instructions did not activate responsibility and guilt. In this condition, the story began as follows:

> *You are watching the serial "ER....". The main character is a doctor, alone in his ward, and has sole responsibility for several patients.*

The remaining instructions relating to the task were the same as in the PR + G condition.

In both conditions, participants were instructed to read the questions carefully and to indicate which doctor they definitely needed to ask only one of the two above-mentioned set questions in order to check the validity of the conditional rule.

The order of the four different cards (doctors) was random, and they were all presented at the same time.

Results

The performances in the modified WST were analysed in terms of the selection patterns that participants chose. In particular, for each of the two conditional rules/ diagnoses (danger vs safety), only the following selection patterns were obtained:

p & q
q & p
p & non-q
non-q & p
non-p & q
p & non-q
non-p & non-q
non-q & non-p

In reducing the selection patterns, those including the same antecedent and the same consequent of the conditional rule were scored as follows:

p & q or q & p = p & q
p & not-q or not-q & p = p & not-q

not-p & q or q & not-p = not-p & q
not-p & not-q or not-q & not-p = not-p & not-q

Moreover, in analysing the selection patterns across the two conditions, the participants' responses were grouped into two classes: for the danger conditional rule/diagnosis: *p & q* pattern vs other patterns; for the safety conditional rule/diagnosis: *p & not-q* pattern vs other patterns. In this way, the analysis was restricted for the danger conditional rule/diagnosis and for the safety conditional rule/diagnosis to the predicted *p & q / p & not-q* patterns, respectively, the only ones attesting a confirmation/falsification strategy, and to the other patterns, taken all together, attesting different kinds of strategies.

The response patterns selected by participants for the danger/safety conditional rules/diagnoses across the two conditions (PR + G; NR) are shown in Table 1. We will examine the results referring to the PR + G condition first. In this condition, as predicted, a large majority of participants (85%) who were presented with the danger rule/diagnosis, made a confirming rule choice (*p & q* pattern), at a level significantly superior to that of the other response patterns, $\chi^2(1, N = 26) = 12.46$, $p < .005$. Moreover, the confirming rule choice was significantly more prevalent here than in the safety rule/diagnosis, $\chi^2(1, N = 24) = 16.66$, $p < .001$.

In contrast, a falsifying rule choice (*p & not-q* pattern) was made significantly more often when participants were faced with safety rule/diagnosis. A clear majority of respondents (83%) preferred to select the falsifying pattern over the other patterns, $\chi^2(1, N = 23) = 9.78$, $p < .002$. Furthermore, as predicted, in the safety rule/diagnosis, the choice of the *p & not-q* pattern was significantly more prevalent here than in the other rule (safety rule/diagnosis), $\chi^2(1, N = 21) = 13.76$, $p < .001$.

As regards the NR condition, in the safety rule/diagnosis, as predicted, no differences were found between participants who chose the *p & not-q* pattern and those who selected the other patterns. In the danger rule/diagnosis, although the "other patterns" choice was significantly higher than the *p & not-q* pattern choice, $\chi^2(1, N = 30) = 8.53$, $p < .005$, a χ^2 performed on the frequencies choice of the three patterns included in the class "other patterns" revealed no significant differences among the preferences expressed by participants. Moreover, a χ^2 test on the frequency choices of all four patterns considered disjunctively revealed no significant differences among the choices made by participants.

By contrast, significant differences were found between the conditions PR + G vs NR in the response pattern selected by participants, for both the rules/diagnoses (safety rule/diagnosis: $\chi^2(1, N = 45) = 8.32$, $p < .005$; danger rule/diagnosis: $\chi^2(1, N = 56) = 20.95$, $p < .001$. Participants assigned to the PR + G condition and faced with the danger rule/diagnosis selected the confirming pattern at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 29) = 7.76$, $p < .005$. In the PR + G condition, individuals faced with the safety rule/diagnosis chose the falsifying pattern at a level significantly superior to that of the NR condition, χ^2 $(1, N = 27) = 4.48$, $p < .05$.

Discussion

We conclude from these results that reasoners' hypothesis-testing strategy is affected by their intentional states. Responsibility and fear of guilt influence the testing process in prudential mode. In a situation characterised by responsibility and guilt, participants become interested in searching for examples confirming the worst hypothesis (danger rule). By contrast, responsible individuals and guilt-fearing individuals faced with a positive hypothesis (safety rule) prudentially tend to search for falsifying information about it. Thus, in the danger rule/diagnosis the difference between the selected patterns (*p* & *q* pattern; other patterns) is consistent with the idea that responsibility and guilt draw the reasoners' attention to the importance of confirming the rule indicating a danger, presumably to prevent it more effectively. Conversely, in the case of the safety rule, individuals' interests are better served by selecting information that is potentially safety-disconfirming. In this case too the purpose is presumably to avoid harm and therefore to prevent guilt arising out of irresponsibility.

By contrast, non-responsible participants (NR condition) do not display the prudential hypothesis-testing process. They are not interested in seeking information that prudentially confirms or disconfirms a danger or a safety situation, respectively.

EXPERIMENT 2

This experiment was essentially a completion of Experiment 1. It further investigated the effects of responsibility and guilt on the prudential hypothesis-testing process. In particular, it examined the influence of responsibility and fear of guilt on the control testing process, as well as on hypothesis focusing and reiteration of the testing process, i.e., the persistence in preventive activities that characterised our prudent individuals. Thus, this study was to some extent a replication of Experiment 1, with the addition of two further components: (a) the participants had to choose the rule/diagnosis to check. In this way, we examined the influence of responsibility and fear of guilt not only on the hypothesis-focusing process. Participants were first requested to select one of two different conditional rules/diagnoses (danger vs safety) and then to check the validity of the focused rule/diagnosis; (b) participants had to decide whether to choose to carry on with the hypothesis-testing process or to quit it. In this way, we investigated the influence of responsibility and fear of guilt on the reiteration of the testing process.

Participants were assigned to the same experimental conditions as in the previous experiment (PR + G; NR), and also in this study they performed the modified Wason Selection Task. In addition, for each condition, participants were randomly assigned to one of two different initial diagnoses (benign initial diagnosis: influenza; malignant initial diagnosis: Ebola virus).

We expected that participants assigned to the PR + G condition would pursue the diagnostic testing process, focusing on the danger hypothesis and seeking to confirm information about it, regardless of the initial diagnosis (benign vs malignant). By contrast, we expected that, in the NR condition, there would be no differences among individuals who preferred to carry on with the testing process and those who chose to quit it, for both the initial diagnoses (benign vs malignant). Moreover, we expected that those participants who showed interest in pursuing the control process would focus on both diagnoses (danger/safety rules/diagnoses). Finally, for those who selected the danger rule/diagnosis, we predicted that they would check its validity by both confirming and disconfirming it.

Method

Participants. A total of 280 volunteers took part in this study. They were recruited from northern, central, and southern Italy. Their average age was 27, the range being 18–47. None of them had any prior experience with the Wason Selection Task.

Participants were randomly assigned to one of the two experimental conditions ($N = 140$) and tested in three groups. For each condition, participants were randomly assigned to the two different initial diagnoses (benign; malignant) as shown in Table 2. The design was 2×2 independent groups with the factors: Condition (PR + G, NR) and Initial Diagnosis (benign and malignant).

Materials and procedure. As in the previous experiment, participants received a paper with written instructions, a story, and a modified WST (see Appendix B). The task instructions and the procedure for both the experimental conditions (PR + G; NR) were the same as in Experiment 1, except that the story also contained one of the two following initial diagnoses:

- Ebola virus (malignant diagnosis)
- Influenza (benign diagnosis)

After having read the given diagnosis, participants were asked to say whether they preferred to continue the diagnostic process or not. In the case of an affirmative answer, participants were instructed to indicate which medical diagnosis expert system (Ebola virus expert system vs influenza expert system) they needed to ask a question in order to check the validity of the corresponding conditional rule:

- *if my patient's symptoms, then Ebola virus* (danger rule)
- *if my patient's symptoms, then influenza* (safety rule)

In both PR + G and NR conditions, after having chosen the medical diagnosis expert system and the corresponding rule/diagnosis, participants were submitted to a modified version of the WST, which was similar to those used in the previous experiment. It differed only in that participants were asked to indicate in which "scenario" (representing the four cards of the WST, and the four doctors of the previous studies) they definitely needed to ask only one of the two set questions, in order to check the validity of the focused expert system and rule/diagnosis.

In both conditions, participants were instructed to indicate whether they preferred to carry on with the diagnostic process, which expert system they chose to check the validity of the corresponding conditional rule, and finally which scenario and which question they selected in order to test the conditional rule.

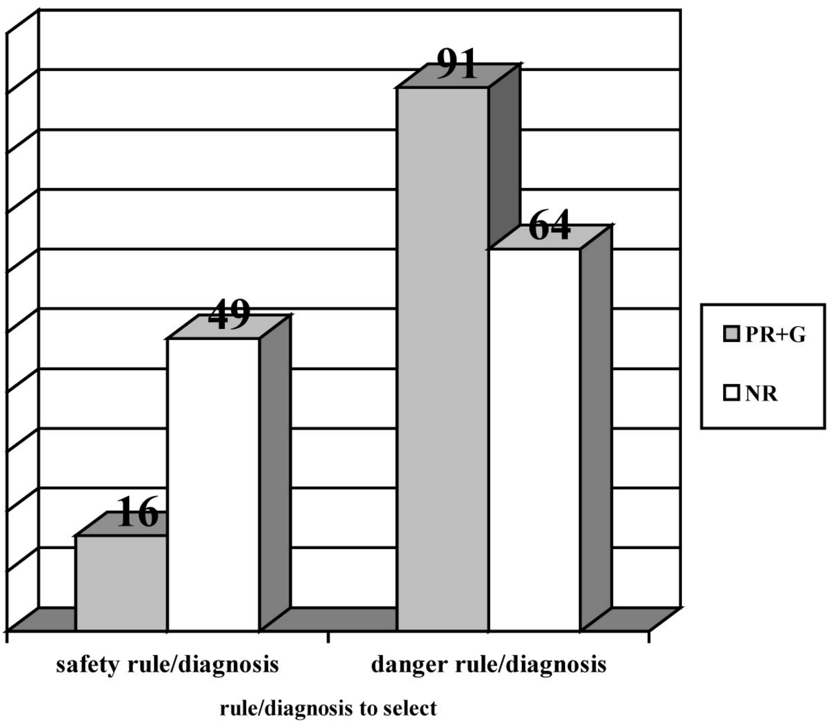
Results

Diagnostic testing process. The preferences expressed by participants for continuing/quitting the diagnostic process for the two different initial diagnoses (benign diagnosis vs malignant diagnosis), across the two conditions (PR + G; NR) are shown in Table 2. We will examine the results referring to the PR + G condition first.

As predicted, in the PR + G condition, the majority of participants (82%) preferred to carry on with the diagnostic testing process, $\chi^2(1, N = 140) = 57.86$, $p < .001$, regardless of the initial diagnosis. Participants' prudential preference for carrying on with the testing process occurred for

TABLE 2
Frequencies (and percentages) of preferences expressed by participants to continue/stop the diagnostic process across the two conditions of Experiment 2

		Carry on process	
Condition/Rule	**No. of Subjects**	**Yes**	**No**
PR + G			
Benign diagnosis	73 (52)	57 (77)	16 (23)
Malignant diagnosis	67 (48)	58 (86)	9 (14)
Tot.	140	115 (82)	25 (18)
NR			
Benign diagnosis	68 (49)	32 (47)	36 (53)
Malignant diagnosis	72 (51)	35 (48)	37 (52)
Tot.	140	67 (48)	73 (52)



1 **Figure 1.** Frequencies choice of each conditional rule/diagnosis in each condition of Experiment 2.

both initial diagnoses: benign diagnosis, $\chi^2(1, N = 73) = 23.07$, $p < .001$; malignant diagnosis, $\chi^2(1, N = 67) = 17.91$, $p < .001$.

As predicted, in the NR condition, a χ^2 analysis performed on the choices made by participants revealed no significant difference between those who preferred to carry on with the diagnostic process and those who chose to stop. A χ^2 analysis performed on both the initial diagnoses (benign vs malignant) failed to reach significance at the 5% level.

By contrast, significant differences were found between the conditions PR + G vs NR in the choices made by participants for both confirmed diagnoses, $\chi^2(1, N = 280) = 36.26$, $p < .001$. Participants assigned to the PR + G condition made a prudential choice, preferring to continue the process at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 182) = 12.66$, $p < .005$.

Focused rule. Participants' preferences for the two different conditional rules (danger rule *vs*. safety rule) across the two conditions (PR + G *vs*. NR) are shown in Figure 2.

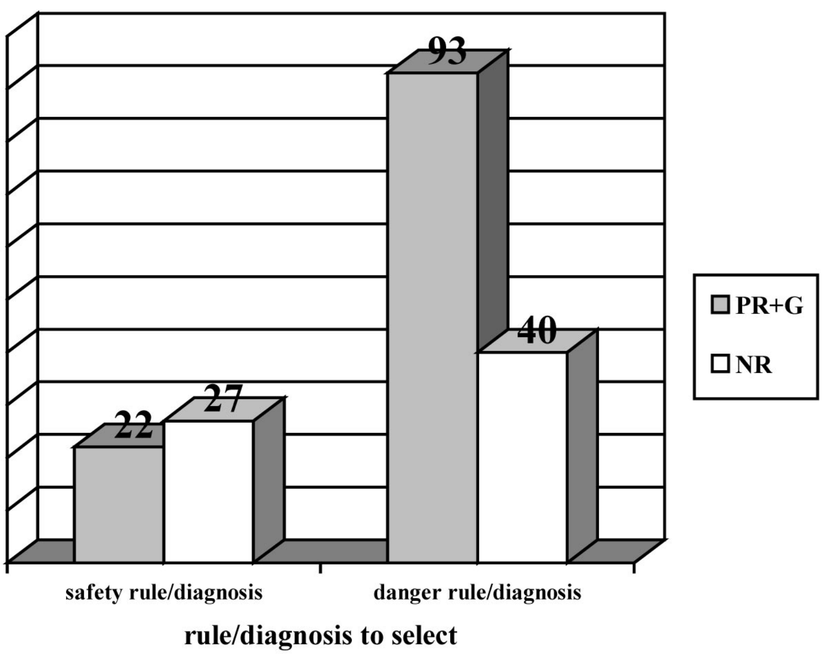


Figure 2. Frequencies choice of each conditional rule/diagnosis in each condition of Experiment 2.

In the PR + G condition, the preference expressed by participants was that predicted by our hypothesis. A large majority of participants (81%) made a prudential choice, selecting the Ebola virus expert system and the corresponding danger conditional rule at a level significantly superior to that observed for the safety rule, $\chi^2(1, N = 115) = 43.83$, $p < .001$.

In the NR condition, as predicted by our hypothesis, no differences were found among participants who focused on the danger rule and those who selected the safety rule.

By contrast, significant differences were found between the two conditions (PR + G vs NR) in the medical expert system and in the corresponding rule/diagnosis choice made by participants, $\chi^2(1, N = 182) = 9.72$, $p < .005$. In the PR + G condition, participants focused on the danger hypothesis at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 133) = 21.12$, $p < .001$.

Selection pattern. In this study, the performances in the modified WST were analysed as in the previous experiment. The response patterns selected by the participants for the danger conditional rule across the two conditions (PR + G; NR) are shown in Figure 3.

In the PR + G condition first, as predicted, a large majority of participants (75%) who chose to carry on with the diagnostic process, focusing on the danger rule (danger hypothesis), made a confirming rule choice (*p & q* pattern) at a level significantly superior to that of the other response patterns, $\chi^2(1, N = 93) = 23.75$, $p < .001$.

By contrast, in the NR condition, no significant differences were found between the two response patterns (*p & q* pattern vs other patterns) selected by participants who focused on the danger rule/diagnosis.

Significant differences were found between the conditions PR + G vs NR in the response pattern selection for the focused danger rule/diagnosis, $\chi^2(1, N = 133) = 4.24$, $p < .05$. Participants assigned to the PR + G condition selected the confirming pattern at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 93) = 23.75$, $p < .001$.

Discussion

The results once again show that responsibility and fear of behaving guiltily influence the individuals' hypothesis-testing process in a prudential manner. In the PR + G condition participants preferred prudentially to carry on with the diagnostic process, even if faced with an initial benign diagnosis. Furthermore, individuals who chose to continue with the testing process became interested in showing a prudential preference to focus on and to confirm the worst hypothesis (danger rule). Thus, individuals who preferred a prudential danger-focusing strategy by selecting the worst hypothesis

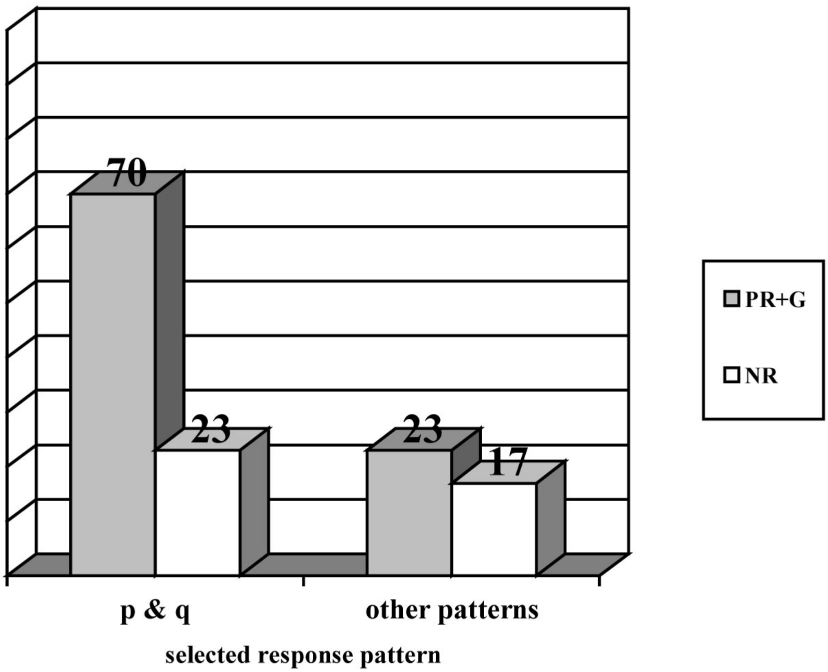


Figure 3. Frequencies of the response patterns selected by the participants for the danger conditional rule/diagnosis in each condition of Experiment 2.

(danger rule/diagnosis) preferred also a prudential danger-confirming strategy, choosing the *p & q* pattern.

By contrast, in the control condition (NR condition) participants did not perform the prudential hypothesis-testing process. No differences were found among participants who chose to carry on with the diagnostic process, and those who quit it, regardless of the initial diagnoses. Moreover, ‘‘non-responsible’’ participants who decided to continue with the diagnostic process, showed no interest in prudentially focusing only on the worst hypothesis. They selected both the medical systems and the corresponding rules/diagnoses. Furthermore, the individuals who focused on the worst hypothesis (danger rule/diagnosis) showed no interest in confirming it.

EXPERIMENT 3

The results of the previous experiments support our predictions: fear of behaving irresponsibly and above all guiltily influences individuals' hypothesis-testing process in a prudential manner: (1) guilt-fearing participants tend to search prudentially for examples confirming the worst hypothesis and search for counter-examples falsifying the positive hypothesis; (2) they focus on the worst alternative (danger rule), and tend to confirm it; (3) they prudentially keep on with the testing process even in the face of initial positive evidence.

It may be objected that two issues remain unresolved by this experiment: a methodological issue and a theoretical one. The methodological issue is related to our task, and specifically to the adaptation of the WST; the theoretical one is linked to the explanation of our results.

As regards the modified version of the WST, it could be argued that we have presented our participants with a medical diagnosis scenario that could require decision making under uncertainty, rather than propositional logic. According to Poletiek (2001), deciding on a diagnosis involves uncertainty, while the original WST is based on propositional logic (a proposition can only be completely true or false). Following this point of view, in our task *q* and *not-q* cases are not complementary. Our Doctor 1 and Doctor 2, who answer that patients suffer from Ebola virus, have not been asked whether *all* patients suffer from it. As a result, *some* patients could also suffer from influenza. Furthermore, it is possible that *any one* patient—or *all* of them—could be suffering from both diseases.

For this reason, one could argue that this makes participants' responses difficult to interpret as evidence of a hypothesis-testing strategy, and consequently, of our conclusion that guilt-fearing participants want to follow a prudential strategy and have the dangerous hypothesis confirmed.

As regards the theoretical issue, several researchers have highlighted that adding context to an abstract problem changes it in all sorts of ways, and hence performance may change for reasons other than context-triggering domain-specific reasoning schemata (Almor & Sloman, 2000; Liberman & Klar, 1996; Love & Kessler, 1995; Roberts, Welfare, Livermore, & Theadome, 2000; Sperber, Cara, & Girotto, 1995). In other words, it may be difficult to decide whether this change is specifically due to the activation of a domain-specific reasoning mechanism, or to extraneous manipulations giving rise to domain-free processes (Love & Kessler, 1995; Roberts et al., 2000). For example, Love and Kessler (1995) suggest that facilitation to abstract permission tasks depends on domain-free-processes, such as the introductory text emphasising that rule breakers are likely to occur, instead of on the activation of a permission schema.

On this basis, there could be alternative explanations of our results, which might not take into account the intervention of a specific intentional state in hypothesis testing. For example, one could hypothesise that in our experiments more harmful cases (i.e., danger diagnosis) might be more effective in capturing participants' attention and interest. In other words, people might be merely picking the cases depicting the least favourable situations: *p and q* pattern in case of the danger rule (*if my patient's symptoms, then Ebola virus*); *p and not-q* pattern in the case of the safety rule (*if my patient's symptoms, then influenza*).

Hence, it could be asserted that our data are consistent both with the argument that guilt-fearing people adopt a confirmatory strategy when there is a danger, and a falsificatory strategy when there is none (i.e., context-dependent reasoning strategy), and with the notion that people just pick cases (scenarios) in which the most unpleasant outcomes are specified (danger diagnosis) (i.e., attention-capturing qualities of noxious situations under specific conditions). Experiment 3 was conducted to resolve these two issues. Further, it allowed responsible and guilt-fearing individuals' hypothesis-testing process to be investigated. It was to some extent a replication of Experiment 1, but the task was partially modified for the following reasons:

1 to render our version of the WST more suitable for detecting participants' hypothesis-testing strategy;
2 to demonstrate that our results stem from a difference in reasoning strategies due to the activation of a specific intentional state, fear of guilt at having acted irresponsibly, and thus to dispel the theoretical confusion between *reasoning strategies* and *card* noxiousness.

As in the previous experiments, in this study we tested a group of volunteers assigned to two experimental conditions (PR + G; NR). For each experimental condition, participants were submitted to one of two different conditional rules (danger rule: *if type one symptoms, then blue antibody);* safety rule: *if type one symptoms, then red antibody*). The conditional rules take their name from the two diagnoses (danger vs safety) to which they are related. In this way, the consequents of the two conditional rules are now made equal in their power to capture participants' attention and interest.

As in the earlier experiments, we expected that, despite the changes in the task, under the PR + G condition, participants faced with a danger rule would activate a prudential confirming testing strategy, selecting only *p & q* patterns. By contrast, we predicted that individuals assigned to the safety rule would tend to search prudentially for falsifying information about it (*p & not-q* pattern).

Method

Participants. A total of 168 undergraduate students of the University of Palermo took part as volunteers in the experiment and were tested in large groups. Their average age was 25, the range being 21 – 34. Participants were assigned randomly to one of the two experimental conditions (PR + G:

n = 86; NR: n = 82). They solved the problem individually. None of them had any prior knowledge of the selection task. For each condition, participants were randomly assigned to the two different rules (danger vs safety), as shown in Table 3. The design was 2 × 2 independent groups with the factors: Condition (PR + G; NR) and Rules (danger; safety).

Materials and procedure. Participants were tested in four groups. They received a decisional task described in a booklet containing written instructions, a story, and a new modified WST. After completing the WST, participants were requested to expressly indicate which diagnosis they wanted to verify, to be sure which hypothesis (danger/safety) they focused on when they selected the scenarios. Finally, a questionnaire was administered in order to check the effectiveness of the manipulation of the instructions (induction of responsibility and fear of guilt). In the PR + G condition, the manipulation task instructions were the same as in the previous experiments. As in the earlier studies, the NR condition differed from the previous one in that the task instructions did not activate responsibility and guilt. In addition, in this experiment, in order to render the manipulation of nonresponsibility more effective, our participants were only told they had to read and solve a reasoning task.

After having read the appropriate instruction, all participants were told:

In front of you, you have the patient Brambilla, who shows type one symptoms (cough and fever) which seem compatible with the simple "influenza" syndrome diagnosis.

As you are about to dismiss the patient, the following thought comes to mind "and if it was a serious SARS case?".

In order to check you go to the library and look up a handbook of medical pathology.

TABLE 3
Frequencies (and percentages) choice of each selection pattern across the two conditions of Experiment 3

Condition/Rule	No. Subjects	Pattern: p & q	Pattern: p & not-q
PR + G (n = 86)			
Safety	46 (53)	10 (22)	36 (78)
Danger	40 (47)	36 (90)	4 (10)
NR (n = 82)			
Safety	40 (49)	28(70)	12(30)
Danger	42 (51)	12 (29)	30 (71)

Moreover, in order to clarify whether any patient can suffer from both diseases, all participants read:

> *You read that it is absolutely impossible for a patient to suffer from both influenza and SARS at the same time. Moreover, you read that type one symptoms (cough and fever) are always present in the case of both influenza and SARS, while type two symptoms (slow heavy breathing and hypothermia) are always absent.*

Finally, participants were told:

> *Lastly you find that in the blood of patients suffering from influenza, and only in this case, there are always RED antibodies while in the case of SARS patients, and only in such a case, there are always BLUE antibodies.*
>
> *Therefore, if RED antibodies, then influenza is certain, and if BLUE antibodies, SARS is certain.*

In this way, we related the following conditional rules to the danger (SARS) and the safety diagnosis (influenza):

- *if type one symptoms, then blue antibody* (related to the danger rule)
- *if type one symptoms, then red antibody* (related to the safety rule)

It is worth noting that, in this way, the consequents of the two conditional rules were made equal in their power to capture the participants' attention. Thus, the latter's preferences for a (confirming or falsifying) pattern could not be attributed to their interest in the more unpleasant outcomes specified in the consequent of the rule, i.e., to the attention-capturing qualities of noxious cards.

Participants were then submitted to the new modified WST. In this new version some changes had been made: (1) we now distinguished between *p* and *not-p* cases as follows:

> "p": Do *all* patients show *only* type one symptoms?
>
> "not-p": Do *all* patients show *only* type two symptoms?

In the previous experiments the *not-p* case was only the negation of *p*. (2) As shown above, doctors were now asked whether *all* their patients showed *only* type one symptoms or type two symptoms. In this way, we introduced the need for propositional logic into the task so as to be able to investigate hypothesis testing.

The remaining instructions relating to the WST were the same as in the previous experiments. In both conditions, participants were instructed to read the questions carefully and to indicate which doctor they definitely needed to ask only one of the two set questions in order to check the validity of the conditional rule. The order of the four different cards (doctors) was random, and they were all presented at the same time.

After completing the WST, in order to know which diagnosis participants had in mind during the task, they were asked: *Which disease did you focus on in order to check its occurrence, SARS or influenza?* In this way, we could explain the participants' choice of pattern as a function of differences in context-dependent hypothesis-focusing strategies. If the induction was effective, we predicted that PR + FG subjects would focus on the worst hypothesis, and would seek examples confirming the related rule (danger rule), as well as counter-examples disconfirming the safety rule.

Finally, a questionnaire was administered just to test whether the manipulation of the instructions was successful, and thus whether our predicted differences in reasoning strategies were actually activated by the induced intentional states (PR + G/NR). All participants were requested to fill in a four-item questionnaire about the following dimensions: (1) fear of guilt (preoccupation with mistakes) felt during the task (two items: *How afraid were you of making errors in deciding*? *How worried did you feel about taking hasty decisions*?); (2) responsibility felt during the task (two items: *How responsible did you feel for the choice you made*? *How responsible did you feel for the patient?*). Individuals rated their feelings of fear of guilt and responsibility by marking 100 mm Visual Analogue Scales as follows: ratings of guilt were made within the range 0–100, with anchors at 0 (not at all fearful of guilt) and 100 (totally fearful of guilt); ratings of responsibility were made within the range 0–100, with anchors at 0 (not at all responsible) and 100 (extremely responsible).

If the manipulation was effective, we expected that PR + FG subjects would report more fear of guilt (preoccupations with their guilty mistakes) and more perceived responsibility.

Results

Effects of experimental condition on perceived responsibility and fear of guilt. The analysis conducted on the manipulation check variables revealed that the manipulation of perceived responsibility and fear of guilt was effective. PR + FG participants perceived more responsibility, $t(166) = 13.822$; $p < .001$, and concern over their mistakes, $t(166) = 13.857$; $p < .001$, than individuals in the NR condition. These results show that participants in the PR + FG condition understood and followed instructions, and accordingly perceived more responsibility and concern over mistakes. Condition mean scores of the manipulation check variables are shown in Figure 4.

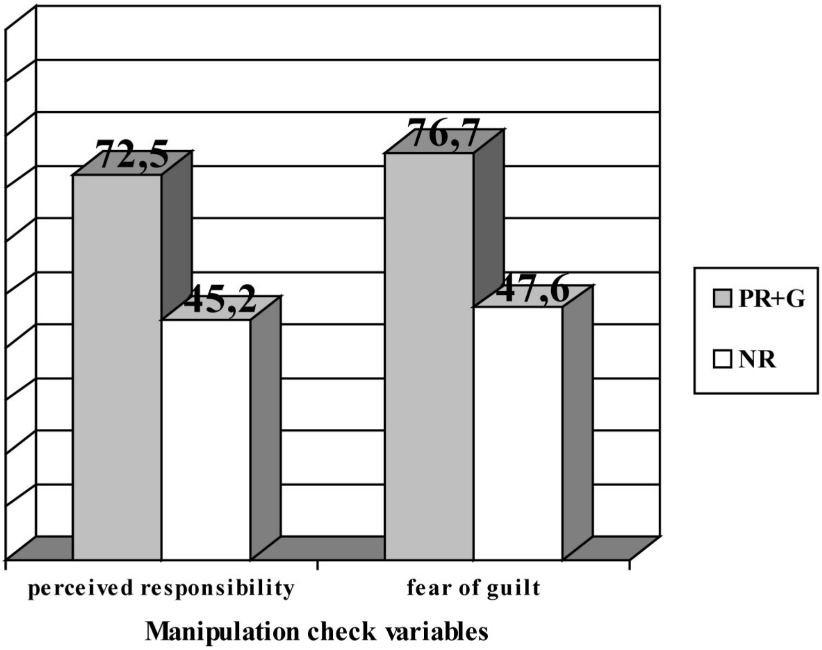


Figure 4. Mean scores of the manipulation check variables across the two conditions of Experiment 3.

Selection pattern. Participants' performances in the modified WST were analysed as in the previous experiments. The choice patterns selected by the participants for the danger/safety conditional rules across the two conditions (PR + G; NR) are shown in Table 3.

In the PR + G condition, as predicted, a large majority of participants (90%) who were presented with the danger rule made a confirming rule choice (*p & q* pattern) at a level significantly superior to that of the other response pattern, $\chi^2(1, N = 46) = 14{,}69$, $p < .001$. Moreover, the confirming rule choice was significantly more prevalent here than in the safety rule, χ^2 $(1, N = 46) = 14{,}69$, $p < .001$.

In contrast, a falsifying rule choice (*p & not-q* pattern) occurred significantly more often when participants were faced with the safety rule. A clear majority of respondents (78%) preferred to select the falsifying pattern over the other pattern, $\chi^2(1, N = 46) = 14.69$, $p < .001$. Furthermore, as predicted, in the safety rule the choice of the *p & not-q* pattern was significantly more prevalent here than in the other rule (safety rule), $\chi^2(1, N = 40) = 25{,}6$, $p < .001$. Finally, significant differences were found between the conditions PR + G vs NR in the response pattern selected by participants, for both the rules: safety rule, $\chi^2(1, N = 86) = 20.20, p < .001$; danger rule, $\chi^2(1, N = 82) = 31.85, p < .001$.

Participants assigned to the PR + G condition and faced with the danger rule selected the confirming pattern at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 48) = 12, p < .001$. In the PR + G condition, individuals faced with the safety rule chose the falsifying pattern at a level significantly superior to that of the NR condition, $\chi^2(1, N = 48) = 12, p < .001$.

Focused diagnosis. Participants' preferences for the two different diagnoses (danger vs safety) across the two conditions (PR + G vs NR) are shown in Figure 5.

In the PR + G condition, as predicted, no significant differences were found between guilty participants faced with the danger rule and those faced with the safety rule in the focused diagnosis. Both groups showed a greater

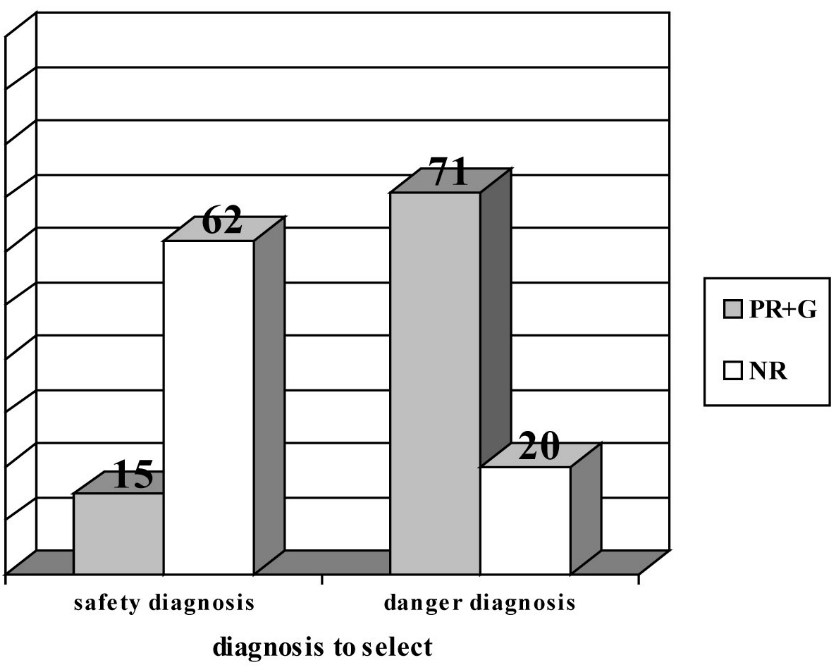


Figure 5. Frequencies choice of each diagnosis across the two conditions of Experiment 3.

interest in prudentially checking the occurrence of the worst diagnosis (SARS) at a level significantly superior to that observed for the safety diagnosis (influenza): danger rule, $\chi^2(1, N = 40) = 25$, $p < .001$; safety rule, $\chi^2(1, N = 46) = 14.69$, $p < .001$.

By contrast, in the NR condition, as hypothesised, no differences were found between participants who focused on the danger rule and those who selected the safety rule. Finally, significant differences were found between the two conditions (PR + G vs NR) in the diagnosis choice made by participants, $\chi^2(1, N = 168) = 57.208$, $p < .001$. In the PR + G condition, participants focused on the danger hypothesis at a level significantly superior to that observed in the NR condition, $\chi^2(1, N = 91) = 28.58$, $p < .001$.

Discussion

In this experiment, we modified the WST to render it more suitable for detecting participants' hypothesis-testing strategies and to clearly show that our data arise from a difference in reasoning strategies and not from card noxiousness. In this modified version of the WST, the consequents of both the safety/danger conditional rules were given equal power to capture the participants' attention. Despite this change, the present results further confirm the findings of the previous experiments. It appears, once again, that responsibility and fear of guilt influence individuals' hypothesis-testing process in a prudential manner. In the PR + G condition, participants adopt a prudential reasoning strategy, choosing *p & q* pattern in case of the danger rule, and the *p & not-q* pattern in case of the safety rule. That is, responsible individuals and guilt-fearing ones are interested in seeking examples confirming the worst hypothesis as well as counter-examples falsifying the safety hypothesis, i.e., they use different search strategies according to the context and to the kind of rule hypothesis.

We believe that these results can be interpreted as a demonstration of context-dependent reasoning strategy. Participants in the induced guilt condition prefer to confirm the danger conditional rule, although the *q* case does not explicitly specify any noxious possibility, i.e., a danger diagnosis. Guilty participants choose to disconfirm the safety conditional rule even if, also in this condition, the *not-q* case displays no noxious possibility.

To further confirm our reasoning strategy hypothesis, we found that the participants' search strategy was related to the hypothesis they pursued during the resolution of the task. Guilt-feeling participants who focused on the danger hypothesis to verify its occurrence searched for examples confirming the related rule, and for counter-examples falsifying the safety rule.

GENERAL DISCUSSION

An extensive empirical and theoretical literature indicates the influence of perceived utilities on the hypothesis-testing process, and in particular on the conditional rules testing process (e.g., Evans & Over, 1996). The present experiments tested the influence of *moral* perceived utilities on the same kind of processes. *Moral* perceived utilities are those related to individuals' moral standards and specifically to people's attempts to face up to their own responsibilities and to avoid feeling guilty at having acted irresponsibly.

In general, the results of these experiments reveal that individuals' hypothesis-testing strategies vary as a function of *moral* perceived utilities, which in turn depend on perceived responsibility and fear of guilt. They also show that, in testing hypotheses, both responsibility and fear of guilt involve a process that we define as *prudential mode*. The *prudential mode* entails focusing on and confirming the worst alternatives in checking hypotheses, and reiterating the testing process. Thus, we found that responsible and guilt-fearing individuals tended to prudentially search for examples confirming the worst hypothesis and to seek counter-examples falsifying the positive hypothesis (Experiment 1), focused on the worst alternative, and tended to confirm it, and finally considered as insufficient counter-examples falsifying the worst hypothesis and tended to retain it by carrying out the hypothesis-testing process (Experiment 2). These prudential performances arose out of context-dependent differences in reasoning strategies instead of out of domain-free processes (e.g., Almor & Sloman, 2000; Liberman & Klar, 1996; Love & Kessler, 1995; Roberts et al., 2000) (Experiment 3).

The effect of perceived responsibility and fear of guilt in Experiment 1 suggests that the reasoners' intentional states activated a prudential hypothesis-testing strategy. In a situation characterised by responsibility and fear of guilt, participants became interested in seeking examples confirming the worst hypothesis (danger rule). By contrast, responsible individuals and guilt-fearing individuals faced with a positive hypothesis (safety rule) prudentially tended to search for falsifying information about it. Thus, in a prudential way, responsible and guilty participants tended to select potentially confirming information in the case of the danger rule, and potentially disconfirming information in the case of the safety rule. This result is consistent with research results on deductive reasoning, and shows that both the context (i.e., context of threat) and the type of conditional rule (safety vs danger) have a strong impact on the reasoning strategy that participants tend to use when asked to judge its validity (e.g., Cheng & Holyoak, 1985; Cosmides, 1989; Smeets et al., 2000). A context of responsibility and guilt attracts the reasoners' attention to the importance of confirming the danger rule, of more effectively avoiding unjust harm; whereas, in case of the safety rule, individuals' interests are better served by selecting potentially safety-disconfirming information. Also in this case the purpose is to avoid any harm and therefore feeling guilty about irresponsibility. Thus, participants take account of their beliefs (e.g., they are going to cause harm due to their irresponsibility) and their goals (e.g., to avoid guilt due to irresponsibility), and manage hypotheses (safety versus danger) following the kind of strategy that helps them to achieve the goals (Baron, 2000).

The prudential danger-focusing strategy observed in Experiment 2 was influenced once again by the reasoners' intentional states. When the conditionals (safety versus danger) were presented in a context of responsibility and fear of guilt, then individuals selected the worst hypothesis (danger rule/diagnosis), much more frequently than when the conditionals were given in the no-responsibility context. Responsible and guilt-fearing individuals focused their attention exclusively on the worst hypothesis (danger rule/diagnosis), and became interested in searching for examples confirming it. This result is consistent with the suggestion that people show a sort of short-sightedness in the hypothesis-testing process, focusing on and confirming too specific a hypothesis (Girotto & Gonzalez, 2
2001). In our study, responsible and guilt-fearing individuals tended to consider only the hypothesis that best served their goal (e.g., to prevent feeling guilty due to irresponsibility) or that best fitted their beliefs (e.g., they were going to cause harm; the harm was imminent and probable), moreover they tended to seek evidence, and draw inferences in a way that favoured the hypothesis that already appealed to them, and thus the one they focused on (Baron, 2000). In this way, subjects put themselves in a position that makes it harder to revise a hypothesis. In our participants, this short-sightedness is directly linked to the contexts in which people have to reason, and thus to the active intentional state (Girotto & Gonzalez, 2001). 2

We also found that responsibility and fear of guilt affected the prudential choice to carry on the hypothesis-testing process regardless of the initial evidence (initial confirmed diagnoses: benign versus malignant). In the responsibility and guilt condition, our participants showed a prudential reiterating strategy significantly more often than in the non-responsibility condition. This prudential choice was not related to the initial information (benign versus malignant diagnosis). Responsible and guilt-fearing participants prudentially tended to keep on with the testing process even if faced with initial positive evidence (benign diagnosis). This finding supports the idea that perceived responsibility and fear of guilt motivate individuals to be more vigilant in accepting a positive hypothesis (in the experiment, the benign diagnosis) and in rejecting the worst hypothesis (malignant diagnosis), in order to avoid feeling guilty due to irresponsibility. Thus, they considered as insufficient the counter-example (the initial confirmed benign diagnosis) falsifying the worst hypothesis and tended to prudentially retain it by carrying on with the hypothesis-testing process. In other words, responsible and guilt-fearing participants tended to persist in preventive activities, seeking evidence and to draw inferences in a way that favoured the hypothesis that already appealed to them. Finally, also in this experiment, individuals who chose to keep on with the testing process became interested in showing a prudential preference to focus on and to confirm the worst hypothesis (danger rule).

It may be objected that there are possible alternative explanations of these results, which may not take account of the intervention of a specific context, intentional state, in hypothesis testing. Although adding context to WST can change performance, it may be difficult to decide whether these changes are specifically due to the activation of a domain-specific reasoning mechanism, or to unrelated manipulations causing domain-free processes (Love & Kessler, 1995; Roberts et al., 2000). Following this point of view, more noxious cases (i.e., danger diagnosis) might be more effective at capturing participants' attention and interest, and thus our results could arise from a selection of cards specifying the more noxious possibilities, rather than from a difference in reasoning strategies. In Experiment 3, to dispel this confusion, we modified the conditional rules so that their consequents were given equal power to capture the participants' attention. Each rule was related to one of two different diagnoses: one of danger and one of safety. Despite this change, our responsible and guilty participants kept on confirming the danger conditional rule, choosing the confirming pattern. Moreover, guilty participants kept on disconfirming the safety conditional rule, selecting the falsifying pattern.

We therefore argue that guilty participants' prudential choices actually arise from context-dependent reasoning strategies, rather than from the attention-capturing qualities of noxious cards.

Overall, the experiments reported here join a growing body of research that indicating that the hypothesis-testing process is influenced by individuals' preferences. Our participants' choices in the modified version of the Wason Selection Task support the earlier findings of Manktelow and Over (1991), Kirby (1994), and Smeets et al. (2000) that reasoning-testing strategies are also affected by perceived utilities: the perceived relevance of the conditional rule to reasoners' personal interests. As anticipated, the new aspect of our results is that the individuals' hypothesis-testing process varies as a function of *moral* perceived utilities, which are affected by perceived responsibility and guilt. Our data suggest that in a context of responsibility and fear of guilt, people become interested in focusing on and in confirming the worst hypothesis, e.g., the one attesting that harm will actually ensue and that it is imminent and probable. Moreover, the fear of behaving guiltily leads people also to show an interest in keeping on with the testing process in the case of evidence possibly falsifying this hypothesis. As a consequence of this testing method, responsible and guilt-fearing individuals tend to confirm that the state of the world is inconsistent with that prescribed.

Moreover, from a general point of view, our findings strengthen the conclusions previously drawn from studies manipulating responsibility, which found a relationship between personal responsibility, guilt, and exaggerated danger expectancies (Jones & Menzies, 1997; Ladouceur et al., 1995; Lopatka & Rachman, 1995; Menzies, Harris, Cumming & Einstein, 2000).

For instance, Ladouceur et al. (1995) induced volunteers to feel highly responsible by telling them that the errors they made during the experimental task (a classification task) would lead to harmful and unfair outcomes (participants were told they had great responsibility in a project related to a drug to treat a virus, since their results in the classification could directly influence the drug's manufacture). Experimental subjects had more checks, reported more concern with errors, and were also more inclined to expect to make errors, than control participants.

In a more recent experiment, Menzies et al. (2000) found a general tendency in individuals to regard an outcome as more aversive if they were personally responsible for that outcome. In particular, it was suggested that responsibility increases danger expectancies by affecting the perceived severity of outcomes (Jones & Menzies, 1997). In this study participants were asked to rate the likelihood and severity of 10 negative outcomes. A group of them completed a version of the questionnaire that presented the individual as responsible for the action likely to lead to a negative outcome (personally responsible group) (e.g., you forget to lock your father's car in a shopping centre car park. Later, while shopping, you worry that *the car may have been stolen*). The other group of participants completed a version of the questionnaire that presented someone else as responsible for the action likely to lead to a negative outcome ("other responsible" group) (e.g., your father forgets to lock his car in shopping centre car park. Later, while shopping, you worry that *the car may have been stolen*). The experimental group rated the severity of the potential negative outcome as greater than did the control group.

In both the experiments, it seems probable that the impact of responsibility and fear of guilt on danger expectancies depends on the hypothesised *prudential mode* in testing strategies. Individuals who are personally responsible for an outcome apply a prudential approach, which leads to "personally responsible" aversive events being viewed more negatively. In other words, they focus on and confirm the worst alternative, and prudentially keep on with the testing process in order to prevent any unjust harm and therefore guilt due to irresponsibility (cf. Ladouceur et al., 1995).

Taken together with other results in the recent literature, our findings offer a differentiated picture of the relationships among perceived utilities, attribution of responsibility and guilt, and reasoners' *moral* hypothesis-testing process. Following these results it seems reasonable to draw one conclusion: in general, human beings do not reason by detecting the "truth" value of hypotheses (*truth detection*). Rather it appears that people are pragmatic in their hypothesis testing, using efficient cognitive strategies that focus on error minimisation rather than on truth detection. The inference processes are first and foremost pragmatic mechanisms; as such, these inferential strategies are well suited to minimising costly errors, and these errors are closely related to the contexts (situational or dispositional) (Friedrich, 1993). Thus, people's strategies vary systematically and predictably as a function of different hypothesis-testing contexts and they are suitable for reducing costly errors. In our case, which is a context of responsibility and fear of guilt, the errors are those connected with people's failure to face up to their own responsibilities. Therefore, they are essentially moral errors, which involve moral guilt.

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APPENDIX A

Experiment 1. Example of a task.

Perceived Responsibility plus Guilt Condition (PR + G)

Danger rule/diagnosis

You are the only doctor in your ward, and you are solely responsible for several patients. In the last few months, although you had everything you needed, i.e., diagnostic equipment, time and medical know-how, you made several mistaken diagnoses due to superficiality, inattention and lack of commitment that led to serious consequences for your patients. You feel guilty about this and you are fearful of making new serious mistakes. You're treating a patient, who shows several symptoms which are compatible with the "diagnosis of influenza".

While you're dismissing him/her, you think: "*and if it was a rare case of Ebola virus infection, which is often fatal?*"

You want to be sure to prescribe the right therapy, so you go to the library, where you can use the latest Internet search engines, which allow you to check the diagnosis:

if my patient's symptoms, then Ebola virus

But you have only a very short time to do this, and so you can only ask four famous doctors, expert scientists in this field, a few set questions. Every doctor answers according to his own experience.

Doctor 1. I have dealt with a sample composed of 100 patients presenting the same symptoms as your patient.

You can ask him:

Do the patients suffer from Ebola virus?

or,

Do the patients suffer from influenza?

Doctor 2. I have dealt with a sample composed of 100 patients presenting different symptoms than your patient.

You can ask him:

Do the patients suffer from Ebola virus?

or,

Do the patients suffer from influenza?

Doctor 3. All 100 patients included in my sample suffer from Ebola virus.

You can ask him:

Do your patients show the same symptoms as mine?

or,

Do your patients show different symptoms than mine?

Doctor 4. All 100 patients included in my sample suffer from influenza.

You can ask him:

Do your patients show the same symptoms as mine?

or,

Do your patients show different symptoms than mine?

Which doctor will you consult and which question will you choose in order to validate or invalidate your diagnosis?

APPENDIX B

Experiment 2. Example of a task.

Perceived Responsibility plus Guilt Condition (PR + G)

Benign initial diagnosis

You are the only doctor in your ward, and you're solely responsible for several patients. In the last few months, although you had everything necessary, i.e., diagnostic equipment, time and medical know-how, you made several mistaken diagnoses owing to superficiality, inattention and lack of commitment that led to serious consequences for your patients. You feel guilty about this and you are fearful of making new serious mistakes.

You're treating a patient, who shows several symptoms that are compatible with the "diagnosis of influenza". While you're dismissing him/her, you think: "*and if it was a rare case of Ebola virus infection, which is often fatal?*"

The treatment of influenza is very simple: "bed, warmth, milk". It has no side effects, and therefore it is completely innocuous.

The therapy for Ebola virus infection entails several risks (numerous and risky side effects) and it is very painful for the patient.

You want to be sure to prescribe the right therapy and so you consult a medical differential diagnosis expert system.

After having entered the data, the expert system answers:

- We tend towards a diagnosis of influenza

Do you think it is still useful and necessary to carry on with the diagnostic process?

If so, how?

You have two medical diagnosis expert systems at your disposal:

1. the first system is expert in diagnosing influenza. Through this system you can test your hypothesis: *if my patient's symptoms, then influenza.*
2. the second system is expert in diagnosing Ebola virus. Through this system you can test your hypothesis: *if my patient's symptoms, then Ebola virus.*

After choosing and ticking which system you want to consult, you can ask it a few set questions.

Scenario 1. Same symptoms as your patient.

You can ask:

Do the patients suffer from Ebola virus?

or

Do the patients suffer from influenza?

Scenario 2. Different symptoms than your patient

You can ask:

Do the patients suffer from Ebola virus?

or

Do the patients suffer from influenza?

Scenario 3. Patients suffer from Ebola virus

You can ask:

Do the patients show the same symptoms as mine?

or

Do the patients show different symptoms than mine?

Scenario 4. Patients suffer from influenza

You can ask:

Do the patients show the same symptoms as mine?

or

Do the patients show different symptoms than mine?

Which scenario will you select and which question will you choose in order to validate or invalidate your idea?

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