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Reasoning Strategies Explain Individual Differences in Social Reasoning

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The dual-strategy model of reasoning suggests that when people reason they can either use (a) a statistical strategy which generates an estimation of conclusion likelihood using a rapid form of associative processing or (b) a counterexample strategy which identifies potential counterexamples to a conclusion using a more conscious working memory intensive process. Previous results suggest that strategy use is a strong individual difference that represents a broad distinction in the way that information is processed that goes beyond deductive reasoning. In 3 studies, we examined if this model could predict individual differences in the processing of social information by examining socially relevant cognitive biases. Study 1 found that strategy use predicted the extent of the self-serving bias. Study 2 found that strategy use predicted use of racist stereotypes even when need for closure was accounted for. Study 3 found that an essentialist prime resulted in a higher level of gender bias among statistical reasoners but that this prime had no effect on counterexample reasoners. These results indicate that the processing distinction between the 2 reasoning strategies underlies individual differences in social biases such as stereotypes, sexism, and racism.

Keywords: deductive reasoning, self-serving bias, sexism, essentialism, racism

Studies on human reasoning have consistently shown a large degree of variability in the way that people reason. For example, Kahneman and Tversky (1972, 1973; Tversky & Kahneman 1974) have provided strong evidence that heuristics such as representativeness influence judgments and often lead to illogical answers. The belief-bias effect is another example of reasoning where the logical answer is not systematically given as reasoners are influenced by knowledge and belief (Evans, Barston, & Pollard, 1983; Newstead, Pollard, Evans, & Allen, 1992). Understanding what determines this variability is a key component in understanding why people often reason badly. The present article examines whether the recently developed dual-strategy model (Markovits, Forgues, & Brunet, 2012; Verschueren, Schaeken, & d'Ydewalle, 2005) can account for individual differences in various social biases.

One of the most common ways of explaining variability in reasoning has been through dual process models. Several such models have been elaborated to explain performances in both logical and social reasoning (see Evans, 2008 for a review). Although there are important differences, most of these models suggest a distinction between Type I processes which are automatic, implicit, fast, and access associative knowledge and beliefs and Type II processes that are deliberate, slow, and rely strongly on working memory capacity. It is assumed that Type I reasoning usually leads to more nonlogical and heuristic based answers, while Type II reasoning tends to be more logical and rule based (Evans, 2008; Evans & Stanovich, 2013; Klaczynski, 2000; Thompson, Prowse Turner, & Pennycook, 2011). Final responses are the result of internal competition between responses generated by each of these processes. Though these models have been frequently used to explain variability in reasoning, they have also been criticized for a variety of reasons (e.g., Kruglanski & Gigerenzer, 2011). Among others, is the lack of a clear description of the specific processes involved in reasoning and decision-making as well as concrete ways to distinguish these processes.

In parallel to the examination of dual-process theories, a fundamental debate about just how people reason is taking place. Briefly, mental model theory suggests that people generate mental representations of inferences which are then scanned for potential counterexamples to a putative conclusion (Barrouillet, Gauffroy, & Lecas, 2008; Johnson-Laird, 1983, 2001; Johnson-Laird, Byrne, & Schaeken, 1992). By contrast, probabilistic theories claim that people consider information associated with the premises to evaluate the likelihood of a putative conclusion, which is then translated into a judgment of validity (Evans, Handley, & Over, 2003; Oaksford & Chater, 2009). These two models provide specific

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processes that are meant to underlie all human reasoning. However, there is an interesting parallel between the dual-process description and these two models, with probabilistic reasoning being more associative and intuitive while mental model-based processes are more conscious and working memory intensive. In fact, this parallel was the basis for an initial proposal made by Verschueren et al. (2005). They put forward a dual-process model which considers probabilistic reasoning as an instantiation of Type I processes and counterexample-based mental model approaches as an instantiation of Type II processes.

The dual-process framework suggests that both Type I and Type II processes operate with some degree of simultaneity within individuals. However, recent work by Markovits and colleagues has found that the distinction proposed by Verschueren et al. (2005), in fact, represents an important individual difference in reasoning. The dual-strategy model suggests that reasoners preferentially use one of two strategies which modify the way that problem parameters are analyzed (Markovits, Brisson, & de Chantal, 2015a, 2015b, 2017; Markovits, Brisson, de Chantal, & Singmann, 2018; Markovits, Brisson, de Chantal, & Thompson, 2017; Markovits, Brunet, Thompson, & Brisson, 2013; Markovits et al., 2012). Reasoners who preferentially use what has been referred to as a statistical strategy consider a wide range of explicit and implicit information, such as statistical empirical knowledge in order to produce a rapid estimation of conclusion likelihood. Reasoners who use what is referred to as a counterexample strategy focus on the potential presence of counterexamples in an explicit mental representation of key problem parameters. The distinction between statistical and counterexample strategies is rooted in divergent theories of reasoning, and it is useful to use an example to illustrate how these strategies differ. Take a classic deductive reasoning problem such as "If a rock is thrown at a window, the window will break. A window is broken. Was a rock thrown at the window?," which is an example of an affirmation of the consequent (AC) inference. A statistical reasoner will rapidly and intuitively search their memory for things that are associated with broken windows, such as storms, branches, and so forth. They will then estimate the relative likelihood of the window being broken by a rock compared to the other possible associated causes. In this particular case, this is relatively small and the conclusion will be considered to be unlikely. Critically, a statistical reasoner who judges a conclusion to be unlikely will tend to reject the conclusion, but will sometimes accept it. It is also useful to note that this strategy (despite the name) does not involve an explicit calculation of probabilities, but rather the use of associative processes to generate an intuitive estimation of likelihood based on a wide range of information. Thus, despite the name, use of a statistical strategy can sometimes result in very poor probabilistic reasoning, although this would depend on the interaction between problem parameters and the range of information accessed by use of this strategy. By contrast, a counterexample reasoner will generate a representation of the premises which involves a search for potential counterexamples (which are also things associated with broken windows). If at least one such counterexample is generated and incorporated into this representation, the conclusion will be denied. A counterexample reasoner who has a representation of a problem which includes a counterexample will always deny the conclusion. Thus, statistical reasoners access a broad array of associative knowledge in order to generate an intuitive estimation of conclusion likelihood. Counterexample reasoners generate a more focused representation of problem parameters that provides a dichotomous judgment.

Although dual-process theories and the dual-strategy model make somewhat orthogonal distinctions, it is useful to briefly examine the differences between the two. Dual-process theories assume that both Type I and Type II processes are internally activated within each individual reasoner. The clearest indicator of which kind of process might have the upper hand is the final response, which generally assumes that a heuristic response is generated when fast, Type I processing is predominant and that a logical response is generated when slower, Type II processing is predominant. However, the existence of recent studies that have shown that fast responding sometimes generates the logical response while slow responding can generate a heuristic response (e.g., Newman, Gibb, & Thompson, 2017) puts the usefulness of this criteria into doubt. The lack of a clear process-based model of dual process functioning also means that there are very limited ways of distinguishing responses produced by the two systems, which makes identification of individual differences problematic. While differences in cognitive capacity such as working memory are often used as indicators of individual differences in the relative weight of Type I versus Type II processing (Quayle & Ball, 2000; Stanovich & West, 1997, 2000), their characteristics are very general and, as has been argued by Barrett, Tugade, and Engle (2004), are in some important senses inconsistent with most dual-process theories. Thus, although dual-process theories and associated results clearly indicate the usefulness of a distinction between fast and slow processing, the question of how to characterize individual differences remains open within this perspective.

By contrast, the dual-strategy model provides an explicit description of individual differences based on differences in information processing. The existence of a generalized form of individual difference that would apply across a wide variety of situations would represent an important contribution to understanding variability. The distinction between dual process and the dual-strategy model is illuminated by recent results that have found that statistical reasoners produce more belief-biased responses than counterexample reasoners, but take more time to make inferences (Markovits, Brisson, de Chantal, & Thompson, 2017). Dual-process models associate such heuristic responses with Type I rapid processing, and the fact that statistical reasoners take more time to make heuristic responses is a clear indicator that differences in strategy use are not easily explicable within the dual-process framework. In addition, statistical reasoners have been shown to be more logical than counterexample reasoners in some circumstances (Markovits, Brisson, & de Chantal, 2017), which again is difficult to explain within a dual process model. Finally, the dual-strategy model also provides a process-based description of the way the two strategies function which has, in turn, allowed the development of a simple diagnostic instrument.

Specifically, Markovits and colleagues have developed a diagnostic task to identify the strategy preferentially used by participants (Markovits et al., 2012). In an imaginary abstract setting, participants are presented with 10 Affirmation of the consequent inferences (If P then Q, Q is true, suggested conclusion: P is true?). Each of these inferences are accompanied by explicit statistical information describing the number of counterexamples (how many times Q occurred without P). More specifically, five inferences

present around 10% counterexamples (with a very high likelihood of the conclusion being true) and five inferences present around 50% counterexamples (with a low likelihood of the conclusion being true). Critically, both the 10% and the 50% inferences allow for potential counterexamples. Participants who show a higher rate of acceptance for the more likely conclusions (i.e., 10% counterexamples) than for the less likely conclusions in a way that mirrors the difference in likelihood are deemed to have used a statistical strategy. Specifically, a participant is categorized as a statistical reasoner if the acceptance rate for the 10% inferences is at least two more than that for the 50% inferences (since 2 out of 5 responses corresponds to a difference of 40%). Participants who reject all the conclusions irrespective of their likelihood are deemed to have used a counterexample strategy. Previous studies have shown that between 65 and 80% of participants can be classed as using one of these two strategies by this method. The others are presumed to vary in strategy use.

A series of recent studies have provided very strong evidence that the dual-strategy model represents an important individual difference in reasoning. Strategy use predicts performance on other kinds of deductive reasoning problems (Markovits, Brisson, et al., 2018; Markovits et al., 2012). Strategy use has, in addition, been shown to predict the extent to which logical reasoning is affected by conclusion believability (i.e., the belief-bias effect; Evans et al., 1983; Markovits & Nantel, 1989; Newstead et al., 1992). Participants using a counterexample strategy are less influenced by belief or knowledge than those using a statistical strategy (Markovits, Brisson, de Chantal, & Thompson, 2017). Recent results also show that strategy use predicts belief-bias effects over and above the effect of working memory (de Chantal, Newman, Thompson, & Markovits, 2020). In these studies, counterexample reasoners generate more logical responses than statistical reasoners. It could be argued that counterexample reasoners are simply more "logical" than statistical reasoners. However, Markovits, Brisson and de Chantal (2017) have shown that counterexample reasoners generate more "nonlogical" responses than statistical reasoners in the right conditions. More specifically, they rejected a higher number of logically valid inferences than statistical reasoners when a few counterexamples were explicitly given. This led to the conclusion that the key distinction between the two strategies is the way that information is processed by each. Consistent with this analysis are the results of a recent study examining attentional differences using eye tracking (de Chantal et al., 2020). This found that when inferences presented a conflict between logical validity and belief, counterexample users focused significantly longer on premises than statistical reasoners whose attention was more divided between the premises and the conclusion.

This pattern of results shows that individual differences in strategy use have a clear influence on reasoning and suggests that this might represent a broader distinction in the way that information is processed which goes beyond the boundaries of deductive reasoning. More specifically, the statistical strategy processes a wide range of information in a more intuitive fashion. The counterexample strategy processes a smaller range of information using a more conscious form of representation. This suggests that strategy use might be a more general form of individual difference, one that can explain individual differences in more general forms of thinking. This hypothesis has been examined in two initial studies, and strategy use has indeed been found to modulate gender differences in the processing of negative emotion (Markovits, Trémolière, & Blanchette, 2018) and to predict differences in mental rotation (Markovits, 2019).

These results support the idea that the dual-strategy model captures an important difference in the way that people generally process information. In the following studies, we examine whether individual differences in strategy use are related to social reasoning, as measured by the tendency to use established social biases.

Social reasoning is one of the most difficult of the cognitive tasks that are required daily, since social situations generally include a very large amount of complex information. (Forgas, Williams, & Von Hippel, 2003). Nonetheless, a large amount of this information is often missing or incomplete, so we must draw conclusions under high uncertainty. Under such constraints, people tend to rely on fast and frugal heuristics to be efficient (Gigerenzer & Todd, 1999). These shortcuts allow individuals to bypass complex and extensive processing by using simpler rules (Hertwig & Herzog, 2009; Marsh, 2002). Although they can be useful and adaptive, Kahneman and Tversky (1972, 1973; Tversky & Kahneman 1974) have shown that they often lead to incomplete or biased reasoning. An example of such a heuristic is the reliance on stereotypes which are shared beliefs about a group's characteristics (Leyens, Yzerbyt, & Schadron, 1994) Stereotypes can be seen as intuitive rules made to make sense of such a large range of information, while allowing rapid processing (Bordalo, Coffman, Gennaioli, & Shleifer, 2016; Hamilton & Sherman, 2016; Macrae, Milne, & Bodenhausen, 1994). They thus depend on associative access and result in a fast and low-cost processing of information (Dijksterhuis & Van Knippenberg, 1999; Légal & Delouvée, 2015). Although they are efficient, they tend to lead to the endorsement of prejudices which are negative preconceived opinions of social groups based on broad generalizations (Fiske, 1998).

Therefore, prejudices as well as other social bias such as self-serving bias and essentialism, are at least partially determined by a general tendency to use a process of associative, intuitive access to stored information. This corresponds quite well to the kinds of processes that define the use of a statistical strategy in the dual-strategy model. Thus, we hypothesized that people using a statistical strategy should show a higher level of social bias than people using a counterexample strategy. The latter should show a smaller tendency to be influenced by those biases because of the value given to alternative explanations or exceptions. Three studies were conducted to examine these hypotheses and validate the dual-strategy model in the context of intraindividual (Study 1) as well as intergroup (Studies 2 and 3) social biases.

Study 1

This initial study examined the relations between strategy use and self-serving bias. This bias refers to the tendency to make more internal, global and stable attributions for successes than for failures and has been shown to be very robust. Indeed, a meta-analysis has confirmed a strong tendency for people to take credit for positive outcomes yet deny blame for negative ones (Mezulis, Abramson, Hyde, & Hankin, 2004). This seems to be even truer under personal threat (Campbell & Sedikides, 1999) and findings suggests that this bias is an unconscious and nonintentional way to protect one's self esteem rather than a deliberate attempt to do so (Shepperd, Malone, & Sweeny, 2008).

In the following study, participants were given both the strategy diagnostic (Markovits et al., 2012) and a measure of self-serving bias (Feather & Tiggemann, 1984), with order counterbalanced. We predicted that the use of a statistical strategy would be associated with a greater degree of self-serving bias than the use of a counterexample strategy.

Method

Participants. In total, 202 students, aged from 17 to 54 years (M_{age} = 25.85, SD = 7.62, 100 men and 102 women) participated in the study through an online platform. People who were native English speakers, living either in the United States, the United Kingdom, Australia, or Canada were recruited from the Prolific academic database. A power analysis indicated that 150 participants would be required to detect an effect size of .25 with a power of 95%. Since the diagnostic usually categorized between 70% to 80% of participants, we aimed for 200 participants in total.

Materials.

Strategy diagnostic. The reasoning strategy was assessed using the questionnaire developed by Markovits et al. (2012). In its introduction, the context of a newly discovered planet is portrayed to provide an abstract setting and eliminate the potential impact of prior knowledge and belief. This initial introduction is followed by 13 imaginary causal conditional inferences (if P then Q) which includes nonsense terms and statistical information regarding the number of times that Q followed P (P and Q) and the number of times that Q occurred without P (¬P and Q) out of 1,000 cases:

> By exploring a cave of Kronus, geologists have discovered a variety of very special stones, trolytes. Following a series of observations, they argue that on Kronus:
>
> If a trolyte is heated, then it will release philoben gas.
>
> On the last 1000 times they observed trolytes, geologists have made the following observations:
>
> 900 trolytes were heated and released philoben gas.
>
> 100 trolytes were not heated and released philoben gas.

Among the 13 inferences presented, three were decoys meant to contribute to variability in problem types and corresponded to valid modus ponens (MP; "if P then Q, P is true, therefore Q is true"). The other 10 were invalid AC inferences ("if P then Q, Q is true, therefore P is true") and served to the classification of the strategies. Five AC inferences presented approximately a 10% relative probability of Q occurring without P (100 ¬ P & Q) while the other five presented approximately a 50% probability (500 ¬ P and Q). Participants were asked to choose whether the suggested conclusion (P is true) could be logically drawn from the available information or not.

From this information, Mary reasoned as follows:

> If a trolyte is heated, then it will release philoben gas.
>
> Observation: A trolyte releases philoben gas.
>
> Conclusion: The trolyte was heated.

Self-serving bias. Participants' self-serving level was measured using the Balanced Attributional Style Questionnaire (BASQ) which is composed of 16 hypothetical situations with either positive or negative outcomes (Feather & Tiggemann, 1984). The BASQ is adapted from the Attributional Style Questionnaire (Peterson et al., 1982) and has similar psychometric qualities with good internal consistency (Cronbach's alpha for this sample; good outcomes = 0.81, bad outcomes = 0.72) and test–retest reliability (13 weeks interval; good outcomes = 0.61, bad outcomes = 0.53). Half of the situations refer to achievements ("You start a small business and it's a success") and the other half to affiliation ("You go out on a date and it all goes well"). Furthermore, every situation is presented as a positive outcome and as a negative outcome with the same context so that there are four positive affiliation and four positive achievement situations and those eight exact situations are also presented with a negative outcome ("You start a small business and it's a failure" and "You go out on a date and it all goes badly"). Therefore, all eight situations are perfectly balanced between good and bad outcomes for a total of 16 situations. This is the specific advantage of the BASQ compared with other measures of self-serving bias. This means that any attributional differences between positive and negative outcomes cannot be explained by item differences (for a full list of situations, see Appendix A).

Participants were given the following instructions:

> To summarize, we want you to:
>
> 1. Read each situation and vividly imagine it happening to you.
> 2. Decide what you feel would be the major cause of the situation if it happened to you.
> 3. Write the major cause in the blank provided.
> 4. Answer five questions about the cause.
> 5. Answer one question about the situation.
> 6. Go on to the next situation.

After having written the major cause which could explain the outcome presented, participants are asked to answer six questions on a seven-point scale about the internality, stability, globality and the importance of the attributed cause (for a full list of questions and the scale's labels, see Appendix B).

Procedure. Participants completed the form online with the order of the two tasks randomized. Afterward they were asked to provide demographic information (i.e., age, gender and education level). The complete questionnaire took 24 min on average and each participant received 2.50 pounds for their participation.

Results and Discussion

We first classified participants strategy use following the same procedure as in previous studies, for example, Markovits et al. (2012). More precisely, participants who rejected all 10 AC conclusions regardless of the proportion of alternatives to the antecedent (10% or 50%) were classified as using a counterexample strategy (N = 71, 35% of the sample). Those where the number of acceptances of the 10% problems was greater by at least two than the number of acceptances of the 50% problems were classified as

using a statistical strategy ($N = 69$, 34% of the sample). The remaining participants who did not correspond to either strategy criteria ($N = 62$, 31% of the sample), were assigned to the third category (Other) and were excluded from further analyses. It is important to note that this task is intended to specifically identify participants using a strategy in a stable manner and some results suggest that participants in this other category are less homogenous, with a subset that may be switching between strategies.

Therefore, the subsequent analyses were performed on the 140 remaining participants.

To compute participants' self-serving bias, a negative and a positive composite attributional-style score were calculated by summing up ratings of internality, stability, and globality for each of the eight situations ($3 \times 8 =$ based on 24 ratings). The negative composite score was then subtracted from the positive composite score to obtain a measure of participants' attributional differences between positive and negative events (self-serving bias). A highly positive score on this difference variable means a high self-serving bias while a low score means a small or nonexistent self-serving bias.

We first examined the potential impact of the order of presentation on the Strategy used by participants. A chi-square analysis was performed by comparing the proportion of both strategies when the self-serving measure was first (statistical: 36; counterexemple: 35) and when it was second (statistical: 33; counterexemple: 36). No significant difference was observed, $\chi^2(1, N = 140) = 0.12$, $p = .74$. We also examined the potential impact of gender on the strategy used. A chi-square analysis was performed by comparing the proportion of both strategies for men (statistical: 34; counterexemple: 42) and for women (statistical: 35; counterexemple: 29). No significant difference was observed, $\chi^2(1, N = 140) = 1.38$, $p = .24$.

We then examined the relation between strategy use and self-serving tendencies by performing an analysis of variance (ANOVA), with order and strategy as independent variables and self-serving score as the dependent variable. This gave a main effect of strategy, $F(1, 136) = 8.98$, $p = .003$ ($\eta^2\partial = .062$), with participants using a statistical strategy having a significantly higher self-serving score ($M = 19.73$, $SD = 2.34$) than those using a counterexample strategy ($M = 9.75$, $SD = 2.37$). This gave no effect of order, $F(1, 136) = 0.71$, $p = .40$, and no interaction between strategy and order, $F(1, 136) = 0.45$, $p = .50$.

The results of this first study are consistent with our hypothesis that the strategy used by participants refers to a broad distinction which affects judgments in distinct domains of information processing such as causal attributions. More specifically, we found that participants using a statistical strategy showed higher levels of self-serving bias than participants using a counterexample strategy.

Study 2

Study 1 provides some evidence that reasoning strategy captures an individual difference in sensitivity to the self-serving bias, which can be seen as an intrapersonal bias. In this second study, we extend this in two ways. First, we examine a form of bias that is interpersonal, specifically racism. Not only is racism a different form of bias, but it is one of the most morally and politically relevant social biases which has high repercussions for intergroup relations (Dovidio & Gaertner, 1986). We also examine the extent to which strategy use can predict levels of racism over and above the need for cognitive closure (Webster & Kruglanski, 1994), which has been shown to be a motivational factor strongly associated with susceptibility to social biases.

This represents a desire for predictability, decisiveness and order as well as a dislike of ambiguity. People high in need for closure would rather treat a possibility as a certainty than deal with confusion and ambiguous answers. Although need for closure can be influenced by situational variables like time and noise, it remains an important individual dispositional characteristic (Kruglanski & Webster, 1996). Some authors have suggested that, in fact, it corresponds to the cognitive style described by Allport (1954) and have demonstrated its relation with multiple measures of racism (Roets & Van Hiel, 2007, 2011a, 2011c). It has also been suggested that the dispositional need for closure explains individual differences in prejudice through the mediation of essentialist bias (Roets & Van Hiel, 2011a).

One possible way to explain the results of the initial study could be to claim that differences in strategy use might be strongly correlated with need for closure. It could be argued that, for example, the statistical strategy could be conceptualized as higher in need for quick and definitive answers which are unchallenged by exceptions and counterexamples, that is, that the strategy should be characterized by a higher degree of need for closure. By contrast, the information processing model that we have presented suggest that strategy use is primarily characterized by sensitivity to different ranges of information. The aim of the present study was to examine the hypothesis that strategy use explains individual differences in susceptibility to bias when need for closure is controlled for.

Method

Participants. A total of 204 participants aged from 18 to 64 years old ($M_{age} = 34.20$, $SD = 11.35$, 110 men, 91 women) were recruited from the Prolific academic platform to take part in the online survey. A power analysis indicated that 150 participants would be required to detect an effect size of .25 with a power of 95%. Since the diagnostic usually categorized between 70 and 80% of participants, we aimed for 200 participants in total. Participants were native English speakers, White and currently living in the United States. Participants could not have taken part in the previous study.

Materials.

Need for closure. Participants' need for cognitive closure was measured using Roets and Van Hiel's (2007) 41-item revised Need For Closure Scale. This scale is divided into five dimensions of need for closure including order (e.g., I think that having clear rules and order at work is essential for success), predictability (e.g., I do not like to go into a situation without knowing what I can expect from it), decisiveness (e.g., I would quickly become impatient and irritated if I would not find a solution to a problem immediately) ambiguity (e.g., I'd rather know bad news than stay in a state of uncertainty) and close-mindedness (e.g., reverse: Even after I've made up my mind about something, I am always eager to consider a different opinion; Roets & Van Hiel, 2011b). It has good psychometric properties with a satisfying internal consistency (Cronbach's alpha for this sample: 0.88). All items were

rated on a 6-point scale ranging from 1 (*Strongly disagree*) to 6 (*Strongly agree*; Roets & Van Hiel, 2007).

Racism. Participants' racism level was assessed using both subtle (Cronbach's alpha for this sample = .91) and blatant racism (Cronbach's alpha for this sample = .92) scales adapted from Pettigrew and Meertens (1995). Similarly, to Van Hiel and Mervielde's (2005) adaptation of the Subtle Racism Scale, both measures were first changed to fit with a North American context. Afterward, some items had to be reformulated so that participants could indicate how strongly they agreed or disagreed with each statement rather than answer either yes or no (subtle: e.g., "Immigrants living here teach their children values and skills different from those required to be successful in America"; blantant: e.g., "Immigrants have jobs that North Americans should have"). All items were rated on a 6-point scale ranging from 1 (*Strongly disagree*) to 6 (*Strongly agree*).

Strategy diagnostic. Once again, the same questionnaire described in Study 1 was used to assess participants' reasoning strategy (Markovits et al., 2012).

Procedure. Participants filled out the need for closure then the subtle and blatant racism scales prior to completing the Strategy Diagnostic Questionnaire. At the end of the survey they answered demographic questions (i.e., age, gender and education level). The mean duration of the survey was 15 min and participants received a compensation of 1.67 pounds.

Results and Discussion

Performance on the strategy diagnostic was first analyzed. As described for Study 1, participants who rejected all 10 conclusions were classified as using a counterexample strategy (N = 88, 43% of the sample). Whereas those whose acceptance of the 10% problems was greater by at least two than their acceptance of the 50% problems were classified as using a statistical strategy (N = 62, 30% of the sample) The remaining participants who did not correspond to either strategy criteria (N = 54, 27% of the sample), were assigned to the third category (Other) and were excluded from further analyses. Participants' mean scores were computed for the need for closure scale and both racism scales. Two participants scoring more than three standard deviations higher than the mean of blatant racism were identified as outliers and were not included in the analyses. Subsequent analyses were therefore made on the remaining 148 participants.

We initially examined correlations between need for closure, blatant and subtle racism, and strategy use (which was made into a dummy variable with counterexample = 0 and statistical = 1; Table 1). This showed no relation between need for closure and strategy, $r(146) = .055$, $p = .51$, and between strategy and subtle racism, $r(146) = .15$, $p = .066$. However, a statistically significant relation between strategy and blatant racism was found, $r(146) = .21$, $p = .01$. This also showed a significant relation between need for closure and blatant racism, $r(146) = .333$, $p = .001$, as well as with subtle racism, $r(146) = .365$, $p = .001$.

We then performed an analysis of covariance with racism score as the dependent variable (using the mean of both blatant and subtle racism), strategy (counterexample or statistical) as the independent variable, and need for closure as a covariate. This showed a significant effect of strategy with statistical users (M = 2.56, SD = .12) having a higher level of racism than counterexample users (M = 2.21, SD = .10), $F(1, 145) = 5.03$, $p = .026$. ($\eta^2\partial = .034$). Participants' need for closure was also significantly positively related to their level of racism, $F(1, 145) = 22.3$, $p = .000$. ($\eta^2\partial = .133$). We also ran this analysis with the outliers included and with a log transformation on the dependent variable and obtained similar results for need for closure, $F(1, 147) = 20.25$, $p = .000$, and strategy, $F(1, 147) = 3.90$, $p = .05$.

We also examined the potential impact of gender on the strategy used. A chi-square analysis was performed by comparing the proportion of both strategies for men (statistical: 25; counterexemple: 50) and for women (statistical: 36; counterexemple: 34). No significant difference was observed, $\chi^2(1, N = 148) = 4.96$, $p = .08$.

The results of this study were thus consistent with our hypothesis. First, in line with previous studies, there was a clear relationship between participants need for closure and their susceptibility to racist biases. However, as predicted, strategy use explained individual differences in susceptibility to racist biases even when need for closure was accounted for. In fact, the relationship between strategy use and need for closure was close to zero, indicating that they indeed represented qualitatively different sources of individual differences.

Study 3

The results of Studies 1 and 2 both show that individual differences in strategy use accounts for differences in the extent to which people are susceptible to common social biases. While these results are certainly consistent with the idea that strategy use influences the way that information is processed, they remain indirect. In the following study, we examine a more direct hypothesis that is based on the dual-strategy analysis of the way that information is processed. This suggests that the strategy used by participants will affect the way that new information consistent with an existing bias will be processed. More specifically, people

Table 1
Means, Standard Deviations, and Correlations With Confidence Intervals for Study 2

Variable	*M*	*SD*	1	2	3
1. Strategy	0.84	0.99			
2. NFC	3.92	0.60	.06 [−.11, .21]		
3. BR	1.98	1.06	.21* [−.01, .31]	.33** [.18, .47]	
4. SR	2.74	1.11	.15 [.05, .36]	.37** [.22, .50]	.80** [.73, .85]

Note. *SD* is used to represent standard deviation. The values inside the brackets represent a 95% confidence interval for the correlations. NFC = need for closure; BR = blatant racism; SR = subtle racism.
* $p < .05$. ** $p < .005$.

using a statistical strategy will integrate such information as an addition to their existing associative analysis, which will simply reinforce the bias. However, people using a counterexample strategy will tend to analyze this information for the presence of potential counterexamples, which should moderate the extent to which the existing bias is reinforced. In order to examine this hypothesis, we examine the essentialist bias, which is a measure of the extent to which people conceive social categories as having a distinct and immutable essence. First suggested by Allport (1954), many studies have demonstrated that conceiving social categories as immutable leads to higher levels of prejudice (for a review, see Dar-Nimrod & Heine, 2011). More specifically, essentialist thinking leads to an overestimation of the inductive and informative potential of a category regarding the conclusions that can be drawn about members of social groups (Haslam, Bastian, Bain, & Kashima, 2006). The essentialist bias predicts the endorsement of negative stereotypes independently of other individual variables which influence stereotypes (Bastian & Haslam, 2006). In addition, essentialist thinking serves as a justification of social inequalities. Indeed, if we strongly believe groups to be essentially distinct, it makes sense for them to have different status and resources (Hoffman & Hurst, 1990). Here, we specifically examine essentialist views of gender as it is probably the category most associated with this bias (Dar-Nimrod & Heine, 2011). Indeed, even 4-year-olds have some kind of essentialist vision of gender (Taylor, 1996). Studies have shown the specific impact of essentialist views on sexism or gender stereotype endorsement (Brescoll & LaFrance, 2004; Coleman & Hong, 2008; Keller, 2005).

Importantly, the degree to which people adopt an essentialist bias can be experimentally manipulated by making participants read fake scientific extracts describing the importance of genetic differences between groups, which leads to higher racism levels compared with the reading of neutral extracts (Keller, 2005). Our model predicts a clear difference in the way that the information contained in an essentialist prime will be processed. People using a statistical strategy will activate information associated with the content of the essentialist text, which should result in the activation of associated negative stereotypes and accentuate the effect of the prime. By contrast, people using a counterexample strategy will attempt to focus on key information in order to attempt to detect counterexamples, which should reduce the effect of the prime. Thus, our main hypothesis is that the effect of an essentialist prime on sexism will be stronger among statistical reasoners than among counterexample reasoners.

Method

Participants. A total of 336 participants aged from 17 to 58 (M_{age} = 24.52, SD = 7,17, 156 men, 175 women and four self-identified as other) were recruited from the prolific academic platform to take part in the online survey. Participants were native English speakers, currently students and living in the United Kingdom, Canada, Australia, or the United States. Participants could not have taken part in any of the previous studies. A power analysis indicated that about 200 participants would be required to detect an effect size of .25 with a power of 85%. The total number of participants was calculated to take into account participant loss.

Materials.

Essentialism induction. The priming of essentialist or flexible understanding of gender differences were adapted from Coleman and Hong's (2008) method. Participants were randomly assigned to one of the two conditions and read a text explaining these differences as strong, stable, and having genetic causes (essentialist induction) or a text insisting on the lack of evidence of observable differences between men and women (flexible or antiessentialist induction). It should be noted that we modified the antiessentialist text used by Coleman and Hong (2008), which focused on a sociocultural explanation to one that simply noted the lack of differences between men and women. Here is an extract taken from the essentialist induction that half the participants were assigned to:

> . . . To conclude, research findings from a wide range of studies, including large-scale longitudinal studies, rigorous experiments, education intervention programs and historical analyses, converge to one major conclusion: Gender characteristics and gender differences are important, often observed in scientific protocols and hard to change.

In contrast, here is an extract taken from the antiessentialist induction insisting on the lack of important differences between men and women:

> . . . To conclude, research findings from a wide range of studies, including large-scale longitudinal studies, rigorous experiments, education intervention programs and historical analyses, converge to one major conclusion: Gender characteristics and gender differences are minimal, rarely observed in scientific protocols and are changing over time.

Essentialist and antiessentialist induction check. Once participants had read their assigned text, they were asked to choose between three possible conclusions and identify the one corresponding to article extract meaning. This was meant to reinforce the induction as well as confirm that participants had attentively read the texts and understood the underlying message:

> Choose the appropriate conclusion of the study that was presented to you.
>
> A. There are few differences between men and women.
>
> B. There are many differences between men and women.
>
> C. It is unclear whether there are many differences between men and women or not.

Sexism scales. Sexism was measured using several sexism scales to ensure construct validity. The eight-item Modern Sexism Scale was used to assess denial of discrimination against women, antagonism felt against women's request and resentment felt against the accommodations made to help women (Swim, Aikin, Hall, & Hunter, 1995). This scale has good internal consistency (Cronbach's alpha for this sample: 0.85) and convergent validity: (correlates with hostile sexism, .31, and benevolent sexism, .42): that is, it is rare to see women treated in a sexist manner on TV.

Normally, this scale is used with a Likert scale going from 1 (*I strongly agree*) to 5 (*I strongly disagree*; Swim et al., 1995). In this study, we reversed the Likert scale so that it would go in the same

direction as the other sexism scale and not disturb the flow of the survey. It then went from 1 (*I strongly disagree*) to 5 (*I strongly agree*; 3 being a neutral point).

The level of sexism was also measured using the Ambivalent Sexism Inventory which consists of 22 items. Half of those items concern the benevolent aspect of sexism (e.g., "Women should be cherished and protected by men") and the other half the hostile sexism (e.g., "Women seek to gain power by getting control over men"; Glick & Fiske, 1996). This scale is embedded in a theoretical model of sexism which suggests that current forms of sexism include two main possible reactions to women. Hostile sexism would be used to punish the women who do not comply with the dominant gender roles, while benevolent sexism is used to compensate and reinforce the behavior of women who fit in the traditional model. This questionnaire has satisfying internal consistency (Cronbach's alpha from this sample: 0.79). Hostile sexism also correlates with negative stereotypes toward women and benevolent sexism with positive stereotypes (Fiske & North, 2015). As for the Modern Sexism Scale, participants answered using a Likert scale from 0 (*I disagree strongly*) to 5 (*I disagree strongly*).

Strategy diagnostic. The same questionnaire described in Study 1 was used to assess participants' reasoning strategy (Markovits et al., 2012).

Procedure. Tasks were given in different orders in order to investigate possible interactions between the essentialist prime and other components (Table 2 presents details). Participants were randomly assigned to one of these orders. The mean duration of the survey was 13 min and participants received compensation of 1.25 pounds.

Participants were assigned to one of the two induction conditions (essentialist or antiessentialist condition) and were all given the sexism scales and the strategy diagnostic (Table 3 for a complete recall of experimental conditions). They also answered a few demographic questions (i.e., age, gender and education level). After completing the survey, participants were debriefed, and it was revealed that the article extract they had read was false and written by the research team. Real information about the complex nature of gender differences was provided and participants were given the opportunity to renew or cancel their consent to participate. The complete duration of the survey was around 15 min and participants received compensation of 1.25 pounds.

Results and Discussion

As in the previous studies, participants were first classified as using either a counterexample strategy ($N = 100$, 30% of the sample), or a statistical strategy ($N = 142$, 42% of the sample). The remaining participants who did not correspond to either strategy criteria ($N = 93$, 28% of the sample), were assigned to the third category (Other) and were excluded from further analyses.

Table 2
Study 2: All Orders Assigned in Study 3

Tasks	Order 1	Order 2	Order 3
First task	Strategy	Induction	Induction
Second task	Induction	Strategy	Sexism
Third task	Sexism	Sexism	Strategy

Table 3
Study 3: Experimental Conditions Including the Order and the Induction Procedure Assigned

	Conditions					
Category	1	2	3	4	5	6
Induction	Ess	Anti-Ess	Ess	Anti-Ess	Ess	Anti-Ess
Order	1	1	2	2	3	3

Note. Conditions 1, 3, and 5 all include the essentialist (Ess) induction procedure described in Study 3. Conditions 2, 4, and 6 all include the antiessentialist (Anti-Ess) induction procedure describe in Study 3. The order variable is described in Table 1.

Furthermore, participants who identified their gender as other ($N = 4$) and those who did not correctly answer the manipulation check question ($N = 56$) were also excluded and the subsequent analyses were made on the remaining 182 participants.

We then analyzed responses to the sexism questionnaires. Since these have different scales (modern: 1–5, ambivalent: 0–5), each of the scores were converted into z scores.

To investigate the potential impact of task order on the strategy used by participants, a chi-square analysis was performed comparing the proportion of both strategies for each order (1 counterexample: 22, statistical: 40; 2 counterexample: 31, statistical: 37; 3 counterexample: 25, statistical: 27). No significant difference was observed, $\chi^2(2, N = 182) = 2.162$, $p = .34$. The same analysis was performed to compare the proportion of strategy users among both conditions (essentialist counterexample: 33, statistical: 43; or antiessentialist counterexample: 45, statistical: 61). Once again, no significant difference was observed, $\chi^2(1, N = 182) = .02$, $p = .90$, suggesting that the condition had no impact on the strategy used. We also performed another chi-square analysis to examine the proportion of both strategies depending on participants' gender. This time, we found a significant difference, $\chi^2(1, N = 182) = 7.31$, $p = .007$, with more women using a statistical strategy ($N = 65$) than a counterexample one ($N = 33$) and with men showing the opposite pattern (statistical: 39, counterexample: 45).

Since no such gender difference has been found in previous studies (e.g., Markovits, Brisson, de Chantal, & Thompson, 2017) and no significant differences were present in Studies1 and 2, we examined if this was related to the essentialist prime by splitting the data by condition and performing the same analysis with a Bonferonni adjustment ($p = .05/2$). Interestingly, the previous results were replicated among participants in the essentialist condition, $\chi^2(1, N = 76) = 10.31$, $p = .001$, but not among those in the antiessentialist condition, $\chi^2(1, N = 106) = .66$, $p = .42$ (Table 4). These results

Table 4
Strategy Use in Study 3 as a Function of Condition and Gender

		Gender	
Strategy	Condition	Men	Women
CE	Essentialism	24	10
	Antiessentialism	22	23
STAT	Essentialism	14	29
	Antiessentialism	25	35

Note. CE = counterexample; STAT = statistical.

suggest that the essentialist condition might result in a change in the strategy used by women and men. To further examine this possibility, we looked at strategy use in the essentialist condition for each of the three orders, since the first order had the strategy diagnostic before the prime. This showed the same gender difference in strategy use, but only for those in order 2, $\chi^2(1, N = 30) = 4.74$, $p = .029$, and 3, $\chi^2(1, N = 24) = 5.92$, $p = .015$, whereas no such difference was observed for those in order 1, $\chi^2(1, N = 22) = 2.00$, $p = .16$, These results are consistent with the idea that the essentialist condition produced a tendency toward statistical strategy use in women. These unexpected results will be further addressed in the discussion.

Finally, we investigated the relation between strategy use and the impact of the essentialist prime on the level of sexism. Since there was no specific hypothesis regarding the impact of sexism type, degree of sexism was calculated as the mean of both modern and ambivalent sexism scores. An ANOVA was performed with degree of sexism as dependent variable and gender, strategy, condition, and order as between-subject variables. This gave significant main effects of strategy, $F(1, 158) = 9.05$, $p = .003$ ($\eta^2\partial = .054$); gender, $F(1, 158) = 18.16$, $p = .000$ ($\eta^2\partial = .103$); and order, $F(2, 158) = 3.46$, $p = .034$. This also gave a significant Strategy × Condition interaction, $F(1, 158) = 4.19$, $p = .042$ ($\eta^2\partial = .026$), as well as a Condition × Gender × Order interaction, $F(2, 158) = 3.19$, $p = .044$ ($\eta^2\partial = .039$). There was no effect of condition, $F(1, 158) = .73$, $p = .40$, nor significant interactions between strategy and order, $F(2, 158) = .01$, $p = .99$; between Strategy × Condition × Gender, $F(1, 158) = .05$, $p = .83$; or between Strategy × Condition × Order, $F(2, 158) = .05$, $p = .95$.

Overall, men showed a higher level of sexism ($M = 0.19$, $SD = 0.10$) than did women ($M = -0.42$, $SD = 0.11$). Similarly, statistical reasoners also showed a higher level of sexism ($M = 0.10$, $SD = 0.09$) than did counterexample reasoners ($M = -0.33$, $SD = 0.11$). Contrast analyses of the critical Strategy × Condition interaction revealed that statistical reasoners in the essentialism condition had a higher sexism level ($M = 0.30$, $SD = 0.14$) than statistical reasoners in the antiessentialism condition (statistical: $M = -0.11$, $SD = 0.11$) $F(1, 158) = 5.41$, $p < .05$ ($\eta^2\partial = .042$). No significant difference was observed between both conditions for the counterexample reasoners (essentialism: $M = -0.42$, $SD = 0.19$; antiessentialism: $M = -0.25$, $SD = 0.12$; Figure 1). Post hoc analyses of the order effect and of the Condition × Gender × Order interaction showed no significant individual differences.

These results are consistent with our hypothesis. As predicted, statistical reasoners had a higher level of sexism after reading an essentialist explanation of gender differences than after reading an antiessentialist one. No such difference was found for counterexample reasoners.

General Discussion

Human reasoning on a wide variety of judgments and decisions is highly variable. One of the important questions raised by this variability is how and at what level it is possible to characterize individual differences. Many existing models of individual differences tend to rely on global differences in efficiency of cognitive processing. For example, many dual-process theorists suggest that individual differences in working memory or IQ are responsible for variability in many classical reasoning tasks (Quayle & Ball, 2000; Stanovich & West, 1997, 2000). This in turn suggests that people with higher capacity should uniformly be more logical thinkers. By contrast, the dual-strategy model of reasoning suggests the existence of a generalized individual difference in the way that information related to a specific problem is processed. More specifically, this model suggests that the use of a statistical strategy results in assessment of a conclusion's likelihood by rapidly processing a wide range of associatively available information. Use of a counterexample strategy results in an attempt to focus on a limited range of key information in order to detect

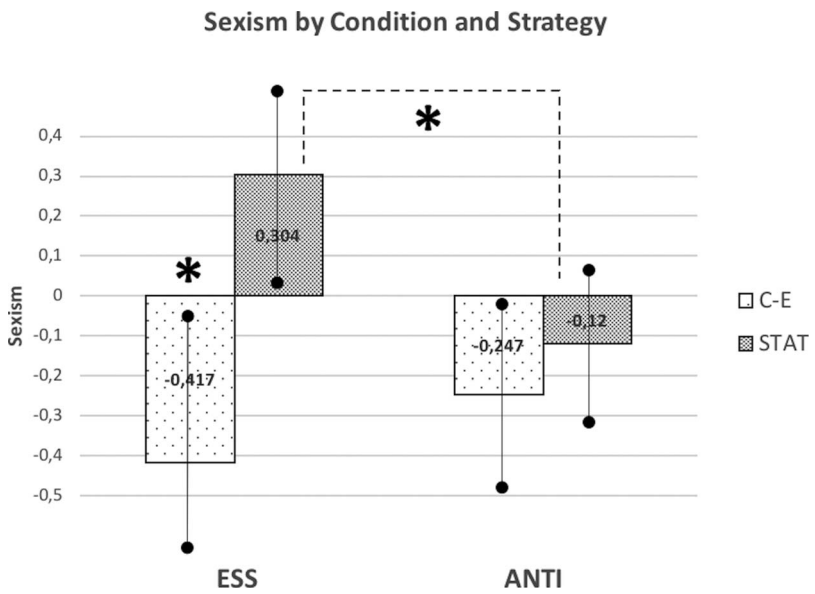

Figure 1. Sexism by condition and strategy. Displayed with confidence intervals. C-E = counterexample; STAT = statistical; ESS = essentialist. * $p < .05$.

potential counterexamples to a given conclusion. Importantly, differences in strategy use do not result in global differences in how logical or efficient people are assumed to be but can lead to nuanced predictions based on the processing demands of different situations. For example, this model was initially developed in the context of deductive reasoning problems. But, although several studies have shown that counterexample reasoners are often more "logical" than statistical reasoners, the opposite has also been shown to be the case in some circumstances (Markovits, Brisson, & de Chantal, 2017). This, in turn, clearly suggest that strategy use is not directly related to global factors such as working memory capacity. In fact, there is evidence that strategy use can predict the tendency to use the belief bias heuristic over and above any effects of working memory (de Chantal, et al., 2020).

Recent studies have generalized this processing difference to a wider range of phenomena. Of particular interest is a study that examines interactions between gender and the processing of negative emotions (Markovits, Trémolière, et al., 2018). This showed that the use of a statistical strategy allowed women to process negative emotions more efficiently than men, while no such difference was observed for those using a counterexample strategy. In this case, the kind of rapid associative form of information processing that characterizes the statistical strategy led to greater efficiency. The present series of studies starts with the hypothesis that in some cases this same form of information processing will actually create more biased thinking. We specifically hypothesized that the information processing mode that distinguishes statistical from counterexample reasoners would imply greater retrieval of stereotypes, and thus increase the level of bias.

The results of the present set of studies clearly support this hypothesis. Results from the first two studies showed that, compared to use of a counterexample strategy, use of a statistical strategy led to higher rates of social bias for both the self-serving bias, as well as for sexist and racist prejudices. The fact that the former is an example of intragroup judgments while the others are a form of intergroup judgment accentuates the generality of the effect of strategy use.

These results clearly show that statistical reasoners show higher levels of social biases than counterexample reasoners. Our model suggests that the best way of understanding this difference is to acknowledge that all people have a combination of both stereotypical schemas and information related to possible counterexamples to these stereotypes. When processing a social situation, both of these kinds of information will be accessed. However, the kind of reasoning strategy that is employed will affect the weight given to either stereotypical or counterexample information. Thus, counterexample reasoners (as the name suggests) will put relatively more weight on potential counterexamples, even if these are relatively rare. By contrast, statistical reasoners will put more weight on stereotypes, especially since these present as a broad indicator of the characteristics of a whole category of people. This suggests that the critical factor in this difference is the way that existing information is processed, rather than any intrinsic difference in internal levels of bias.

While Studies 1 and 2 support the general hypothesis that statistical reasoners will be more prone to biased social judgments than counterexample reasoners, Study 3 provides more direct evidence that strategy use produces important differences in the way that information is processed. Our hypothesis was that when reading the essentialist text, counterexample reasoners would tend to focus on potential counterexamples to the given conclusion, while reading the same text would result in statistical reasoners preferentially activating existing sexist stereotypes. This would lead to a greater increase in levels of sexism among statistical reasoners compared to counterexample reasoners. The results supported this hypothesis. After reading the control text, both strategy users showed a similarly low level of sexism (statistical: $M = -0.11$, $SD = 0.11$; counterexample: $M = -0.25$, $SD = 0.12$). Yet, when participants read the opposite information insisting on the significant and stable role of gender, only statistical users' level of sexism was significantly higher ($M = 0.30$, $SD = 0.14$) while counterexample reasoners showed no significant difference ($M = -0.42$, $SD = 0.19$) in their level of sexism.

One way of understanding these effects is that statistical reasoners translated the two texts as indicators of the relative likelihood of the existence of specific gender differences. For example, an item such as: "women, as compared to men, tend to have a more refined sense of culture and good taste" (Glick & Fiske, 1996), is more likely to be true if women are significantly different from men than if there are no real differences between them. Therefore, statistical reasoners evaluated the sexist statements in a manner consistent with the condition they were in and the likelihood information available.

By contrast, the essentialist prime had a very different impact on counterexample reasoners. In fact, reading the essentialist prime produced a decrease in sexism scores among these reasoners, although this difference was not significant. This is consistent with the idea that counterexample reasoners used the same information presented in the prime to attempt to produce potential counterexamples to traditional gender stereotypes.

These results also show that the essentialist bias, which consists of considering social categories as rigidly and essentially distinct, must be understood in the context of the processing differences embedded in the dual-strategy model. Indeed, in order to consider social categories as mutually exclusive, counterexamples have to be ignored. The present results show that counterexample reasoners who comprised one third of our sample were exempt from the typical effect of the essentialist prime.

Finally, another unexpected, but interesting, finding from Study 3 concerns the differences between the choice of strategy of men and women depending on their assigned condition. This indicated that the essentialism condition generated a relative increase in use of the statistical strategy among women while no such effect was found in the antiessentialism condition (see Table 3). The specificity of this effect is also denoted by the fact that no gender differences in strategy use were found in Studies 1 and 2. One possible explanation for this difference relies on the concept of stereotype threat, which refers to the feeling or knowledge that our social group could be negatively perceived and therefore discriminated against (Inzlicht & Schmader, 2012). This perceived threat is associated with resource depletion, stress, and decrease in performances among members of minority groups (Steele, Spencer, & Aronson, 2002). More importantly, women's performance seems to be impaired under gender stereotype threat (Nguyen & Ryan, 2008). Consequently, if the essentialism prime is seen as a potential threat for women, it is possible it could have affected their performance in the strategy task. This is, in turn, consistent with previous results that show that time pressure results in increased

use of a statistical strategy (Markovits et al., 2013). This, of course, remains a hypothesis which would require more research on the relation between strategy use and personal or social threat.

The results of these studies are clearly consistent with the idea that the dual-strategy model represents an important individual difference across a wide variety of types of judgment and contexts, including susceptibility to biases. However, it should be noted that the relationship between strategy use and other potential explanatory factors remains to be further clarified. For example, general cognitive abilities such as those measured by working memory, IQ, and the cognitive reflection task have been proposed as individual difference measures that are correlated with the ability to reason "logically." It is possible that the effect of strategy use could simply be the result of its relationship with these other factors, although as we have previously mentioned, the fact that strategy use does not always correlate with logical thinking makes this unlikely. Nonetheless, it is important to separate out these different effects. There is, in fact, some recent evidence that strategy use has a predictive value over and above these other variables. Strategy use has been shown to predict performance on belief biased reasoning when the effects of working memory are subtracted (de Chantal et al., 2020). In addition, Markovits, de Chantal, Dubé, Thompson, & Newman (2020) found that under time pressure, strategy use predicted levels of logical reasoning with belief biased problems while IQ did not. Work in progress has found that strategy use is a good predictor of heuristic reasoning across a variety of different reasoning tasks and judgments when controlling for fluid intelligence and cognitive reflection scores (Thompson & Markovits, 2020). Thus, while more work remains to be done, the available evidence is certainly consistent with the idea that strategy use corresponds to a unique individual difference.

One important limitation of the dual-strategy model in its existing form is the fact that the methodology used systematically excludes anyone not classed as either statistical or counterexample reasoners. It should be noted that this classification has a clear theoretical basis since it distinguishes between people who use a mental model based form of counterexample reasoning and those who use an associative, probabilistically based process to reason. Both for theoretical reasons and for continuity with previous studies, the Other category is not examined. However, around one third of all participants end up in the Other category, and it is useful to try to understand their characteristics. An ongoing large-scale study has attempted to examine this category. The preliminary results (Thompson & Markovits, 2020) suggest that there are at least two subcategories. One is composed of participants who appear to shift between a counterexample and a statistical strategy. The other is composed of participants who generally show low levels of cognitive ability and the corresponding difficulty in using a coherent approach to the diagnostic problems. This, in turn, would suggest that the overall performance of the Other category should be relatively but variably close to that of the statistical category in the present studies. An examination of the mean rates of bias in the three studies does indeed show this (self-serving bias: counterexample = 9.75, statistical = 19.84, other = 16.15; racism: counterexample = 2.19, statistical = 2.59, other = 2.57; sexism: counterexample = −.25, statistical = .00, other = .12). However, our preliminary data suggest that this equivalence is the result of lack of homogeneity of the Other category, and that further study is required to elucidate the specific characteristics of these subcategories.

Overall, the results of these three studies suggest that the specific fundamental processes that people use to reason should be considered when analyzing social reasoning such as the biases examined here. Even more intriguing is the idea that these processes determine how susceptible people are to biased arguments, something that has the potential to clarify how these arguments have their effect, and possibly how to avoid them.

Context

Previous results have shown that the dual-strategy model is a strong predictor of individual differences in deductive reasoning (Markovits et al., 2015a, 2015b; Markovits, Trémolière, et al., 2018; Markovits, Brisson, de Chantal, & Thompson, 2017; Markovits et al., 2013; Markovits et al., 2012). More recently, results showing that the distinction between statistical and counterexample reasoners is related to emotion processing (Markovits, Trémolière, et al., 2018) and mental rotation (Markovits, 2019) suggest that this difference may be due to a broad distinction in the way that information is processed. The main aim of the present studies was to investigate if the processing distinction underlying the dual-strategy model can be generalized to social reasoning.

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Appendix A

List of Hypothetical Situations Presented in the BASQ

Hypothetical Situations Presented in the BASQ

Type of situation	Outcome	
	Good	Bad
Achievement	You start a small business and it's a success.	You start a small business and it's a failure.
	You apply for a job that you want badly and you get it.	You have been looking for a job unsuccessfully for some time.
	You do very well in a sporting contest.	You do very poorly in a sporting contest.
	You score well in a final examination at school, college, or university.	You score poorly in a final examination at school, college, or university.
Affiliation	You go at a party at which most people are friendly towards you.	You go to a party at which hardly anyone speaks to you.
	You go on a date and it all goes well.	You go on a date and it all goes badly.
	Someone you know invites you to a party.	Someone you know fails to invite you to a party.
	A group that you like accepts you as a member.	A group that you like rejects you as a member.

Note. BASQ = Balanced Attributional Style Questionnaire.

Appendix B

List of Questions Asked for Each Situation Presented in the BASQ

Questions Asked for Each Situation Presented in the BASQ

Variable	Question	Labels
Internality	Is the cause (of the event) due to something about you or something about other people or circumstances?	Totally due to other people or circumstances = 1 Totally due to me = 7
Stability	In the future (when the event occurs) will this cause again be present?	Will never again be present = 1 Will always be present = 7
Globality	Is the cause something that just influences (the event) or does it also influence other areas of your life?	Influences just this particular situation = 1 Influences all situations in my life = 7
Importance	How important would this situation be if it happened to you?	Not at all important = 1 Extremely important = 7

Note. BASQ = Balanced Attributional Style Questionnaire.

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