



Subtle priming of subtraction versus addition: a spill-over effect of math / *La inducción sutil de sumar vs. restar: un efecto indirecto de las matemáticas*

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Abstract: Studies on bias correction have often used blatant inductions to motivate people to reduce the mental impact of perceived biases. In the current research, we test a relatively unexplored, subtle way of inducing bias correction based on the activation of different calculative mindsets. Across two studies, participants were exposed to an advertisement introducing a new consumer product delivered by a credible or non-credible source. Then, as part of an ostensibly unrelated study, participants completed mathematical operations that involved subtracting or adding. Study 1 revealed that when participants were primed with an addition calculative mindset, an expert source elicited more favourable attitudes towards the product than a non-expert source. This pattern illustrates the traditional effect of source credibility on persuasion. In contrast, within the subtraction calculative mindset condition, persuasion was no different between an expert and a non-expert source. These results were obtained exclusively under high thinking conditions (e.g., for participants high in Need for Cognition). This finding can be interpreted as if the effect of source credibility was subtracted from the evaluative judgement. Study 2 replicated this two-way interaction using different materials and inductions. The present research has implications for bias correction, procedural priming, persuasion and beyond.

Keywords: attitudes; persuasion; credibility; priming; calculative mindset; need for cognition; bias correction

Resumen: Los estudios sobre la corrección de sesgos suelen recurrir a inducciones demasiado obvias para motivar a los participantes a reducir el impacto del sesgo percibido. En el presente trabajo probamos un modo más sutil y relativamente poco explorado de inducir la corrección de sesgos basado en la activación de distintos mecanismos mentales de cálculo. En dos estudios diferentes, los participantes fueron expuestos a un mensaje publicitario sobre un nuevo producto de consumo que podía ser presentado

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bien por una fuente creíble o bien por una fuente no creíble. Posteriormente, durante un ejercicio aparentemente no relacionado con el mensaje publicitario, los estudiantes realizaron operaciones matemáticas que podían consistir en sumas o restas. El Estudio 1 reveló que, cuando se inducía en los participantes una mentalidad de cálculo vinculada con sumar, la fuente experta suscitaba actitudes más favorables hacia el producto que la fuente no experta. Este resultado coincide con el efecto tradicional de la credibilidad de la fuente en la persuasión. Por el contrario, en la condición de mentalidad de cálculo vinculada con restar, no se observaron diferencias en el efecto de persuasión entre la fuente experta y la no experta. Estos resultados se hicieron evidentes en condiciones de alta elaboración cognitiva (es decir, en participantes con puntuaciones elevadas en ‘necesidad de cognición’). Una posible interpretación de este resultado es que el efecto de la credibilidad de la fuente fue sustraído o restado del juicio evaluativo. En el Estudio 2 se reprodujo esta interacción doble utilizando materiales e inducciones distintas. El presente trabajo tiene implicaciones en campos como el de la corrección de sesgos, la inducción procedimental, la persuasión y muchos otros.

Palabras clave: actitud; persuasión; credibilidad; inducción; mentalidad de cálculo; necesidad de cognición; corrección de sesgos

Highly credible sources are often more influential than sources with low credibility. A person’s credibility stems, among other things, from his or her reputation for having extensive knowledge, expertise, honesty and/or trustworthiness (e.g., Kelman & Hovland, 1953; see Briñol & Petty, 2009; Petty, Wegener, & White, 1998 for reviews). Although highly credible sources tend to be more effective at changing recipients’ attitudes, research has also shown that if recipients believe that their thoughts have been biased by the source of a message, they can adjust their judgements in a direction opposite to the implication of the biased thoughts (*correction processes*, Wegener & Petty, 1997). Correction processes take place when people perceive an influence as being unwanted, undesirable or inappropriate. In the context of persuasion, most research on correction processes has focused on source factors such as attractiveness and likeability, or recipient factors such as mood, which most people perceive to be biasing variables when they are unrelated to the merits of the proposal (Petty & Wegener, 1993; Petty, Wegener, & White, 1998; Wegener & Petty, 1995; Wilson & Brekke, 1994). However, some work has also demonstrated that in certain cases people can correct even for variables often perceived to exert legitimate influence, such as source credibility, when they are believed to have an unwanted, contaminating influence (Espinoza & Hamilton, 2009; Espinoza-Petersen & Hamilton, 2014).

Regardless of whether the biasing factor refers to attractiveness, credibility or any other factor that could be perceived as potentially biasing, prior research has generally shown that correction processes are more likely to occur when the amount of thinking is relatively high (e.g., Johar & Simmons, 2000)¹. This is because in order to calibrate judgements, people need to have enough motivation and ability to think about their own thought processes (Gilbert & Hixon, 1991;

Kruglanski, Orehek, Dechesne, & Pierro, 2010; Petty & Briñol, 2012; Wegener & Petty, 1997; Wilson & Brekke, 1994)². Research on correction processes often uses contextual information that draws attention to the potentially biasing information (e.g., Schwarz & Bless, 1992) or even explicit instructions in order to motivate people to correct for the perceived bias (e.g., Wegener & Petty, 1995). For example, Garcia-Marques, Silva, and Wegener (2019, this issue) asked participants to ‘ignore the person presented in the ad by forgetting them when you are evaluating the message’. As this example illustrates, correction paradigms frequently either make the biasing information particularly salient or employ relatively blatant instructions that initiate correction processes.

In contrast to this approach, this paper explores a more subtle way of eliciting correction. Specifically, we use a priming task involving a calculative mindset associated with subtraction (Wang, Zhong, & Murnighan, 2014). The key idea is that performing math operations involving subtraction (versus addition) can potentially lead to spillover effects and attenuate, eliminate or even reverse the impact of a source factor on attitudes in a persuasion context. So far, the concept of subtraction has been used as a metaphor in some models of correction, by implying that people attempt to remove, subtract, or take away their biased thoughts when forming their evaluations (Martin, Seta, & Crelia, 1990; Schwarz & Bless, 1992). In contrast, we take a more literal approach to the metaphor of subtraction by experimentally investigating whether people actually *do* remove, subtract, or take away the impact of a biasing factor after performing the mathematical operation of subtraction (versus addition). Furthermore, we propose that it may be possible to alter the effects of source credibility on persuasion by having participants engage in a math task that is unrelated to both the message content and message source.

Judgements are influenced by subtle primes and behavioural mindsets

Recent research has shown that the cognitive processes activated when a person performs a behaviour while pursuing a goal can subsequently spill over to guide the pursuit of a different goal (Wyer & Xu, 2010; Wyer, Xu, & Shen, 2012). For example, Wang, Zhong, and Murnighan (2014) activated a calculative mindset by asking participants to work on a series of math problems (versus verbal problems). Participants then played a modified ultimatum game, in which Player 1 decided how to allocate \$10 and Player 2 decided whether to accept Player 1’s proposal. Importantly, only Player 1 knew the value of the endowment. Hence, when making a proposal, this player could lie about the endowment’s value to increase the likelihood that Player 2 would accept the offer. Inducing a calculative mindset through a preceding math task led participants to behave in a more calculative and self-serving manner in the game (i.e., they were more likely to deceive the other player to obtain more benefit). This type of subtle, indirect effect is known as a spillover of behavioural mindsets (Xu & Schwarz, 2018).

In a related vein, an abundance of priming research has also demonstrated that subtle, procedural priming inductions can influence seemingly unrelated judgements (Hess, Gryc, & Hareli, 2013; Horcajo, Briñol, & Becerra, 2009; Maimaran & Wheeler, 2008). For example, priming entity protection through a series of geometrical images can influence willingness to disclose intimate self-knowledge (Landau et al., 2011), focusing on figures embedded in a picture versus the background can activate holistic versus analytic thinking (Monga & John, 2008), unpacking ideas in an upward versus downward direction can prime abstract versus concrete thinking (Freitas, Gollwitzer, & Trope, 2004), drawing long versus short lines can influence estimates of temperature (Oppenheimer, LeBoeuf, & Brewer, 2008), and participants primed with safety (i.e., via exposure to romantic stimuli) versus differentiation (i.e., via exposure to fearful stimuli) increased their appeal for scarce versus social goods (Griskevicius et al., 2009).

Finally, viewing pictures with captions designed to induce holistic versus piecemeal processing (i.e., using either an undifferentiated linguistic construction — e.g., ‘tray of tomatoes’ — or a differentiated one — e.g., ‘tray and tomatoes’) influenced performance on tasks requiring the integration of multiple items (Higgins & Chaires, 1980) (for a thorough review on different effects of different kinds of priming, see Janiszewski & Wyer, 2014).

Since prior research has revealed that procedural priming inductions can influence unrelated judgements, it seems plausible that priming a subtractive versus additive mindset through the completion of mathematical operations could also influence seemingly unrelated evaluations. Specifically, a procedural priming induction that involves subtraction versus addition may lead to the spillover of a behavioural mindset that causes participants to subtract the effects of a source cue (e.g., credibility) on persuasion. This relative subtraction would mean that the impact of the source factor on persuasion would be attenuated, eliminated or even reversed relative to an addition condition. If so, this would be consistent with a subtle means of inducing a relative judgemental discounting or correction.

Need for cognition moderates priming effects

Before turning to our studies, it is important to note that the impact of variables on judgement can be moderated by a person’s motivation to think (e.g., Cacioppo, Petty, Feinstein, & Jarvis, 1996; Petty, Briñol, Loersch, & McCaslin, 2009). The need for cognition (NC) refers to the tendency for people to vary in the extent to which they engage in and enjoy effortful cognitive activities (Cacioppo & Petty, 1982). Some individuals have relatively little motivation for cognitively effortful tasks and are described as being low in NC. Other individuals consistently engage in and enjoy cognitively challenging activities and are referred to as being high in NC. Importantly for the current research, prior studies have shown that NC can moderate the effect of primes that vary in the extent to which they are subtly or blatantly presented (DeSteno, Petty,

Wegener, & Rucker, 2000; Martin, Seta, & Crelia, 1990; Petty, DeMarree, Briñol, Horcajo, & Strathman, 2008). For example, in an experiment by Petty, DeMarree, Briñol, Horcajo, and Strathman (2008), participants were administered the NC scale, then given a word-completion task that primed the stereotype of skinheads. The prime was either blatant or subtle, as operationalized by the ratio of prime to filler words in the word-completion task. Following the priming task, participants read an ambiguous description of a person and rated him on two dimensions. The results showed that people high in NC assimilated the effect of subtle primes (positive primes led to positive evaluations and negative primes led to negative evaluations) but corrected the effect of blatant primes (positive primes led to negative evaluations and negative primes led to positive evaluations), whereas people low in NC assimilated the effect of blatant primes but were not affected by subtle primes (for a review on the processes by which high-NC individuals are more susceptible to subtle primes than low-NC individuals, see Petty, 2001). Building on prior research, we propose that NC can also moderate the effects of subtle primes in the context of bias correction.

Research overview

In two studies, we investigated whether primes that are unrelated to both the message source and message content (and thus relatively subtle) could induce a relative removal/addition to the effect of source information on persuasion, and whether this process is moderated by individual differences in amount of thinking. Experiment 1 examined whether, relative to an addition calculative mindset, priming a subtraction calculative mindset would lead message recipients to subtract out or correct for source expertise on attitudes towards phosphate laundry detergent. Specifically, we predicted that when recipients were primed with an addition math task, source expertise would replicate the traditional effect on attitudes (i.e., more favourable attitudes towards a high versus low credible source). However, when primed with a subtraction math task, the impact of credibility would be relatively attenuated, eliminated or reversed.

Furthermore, prior research indicates that subtle primes are more likely to have an effect on individuals who engage in careful thought (i.e., those high in need for cognition; Petty, DeMarree, Briñol, Horcajo, & Strathman, 2008) and in situations that require careful thinking (high elaboration conditions; Briñol & Petty, 2003). Thus, Experiment 1 tested Need for Cognition as a potential moderator of the subtle correction effect, and Experiment 2 required all participants to engage in high amounts of thinking. Experiment 2 was conducted to generalize the potential effects of math primes to a different characteristic of the source (trustworthiness) and to a different topic (genetically modified food). For both experiments, all measures and manipulations are disclosed, and no participants were excluded.

Experiment 1

Experiment 1 sought to provide initial support for our predictions about the relative effects on persuasion of calculative mindsets linked to subtraction and addition. Participants first read a text that contained arguments in favour of phosphate laundry detergents. Then, they were informed that either an expert or non-expert source advocated the message they had just read. Next, participants completed a series of mathematical equations, which served as our calculative mindset manipulation. Following this induction, they indicated their attitudes towards phosphate detergents. Attitudes served as the dependent measure for the study. Lastly, all participants completed the Need for Cognition (NC) scale, as well as an ancillary measure on the perceived difficulty of the priming task. Perceived difficulty was measured to ensure that if participants assigned to the subtraction condition did not use the credibility of the message source to inform their attitudes, this is likely because they were cognitively depleted from a more difficult task. The measure of individual differences in the enjoyment of thinking was expected to moderate the effects of math primes on persuasion. Relative to the participants primed with adding, we expected those primed with subtraction to be comparatively less affected by source credibility, especially when motivation to process is high (i.e., those high in NC).

Method

Participants and design

Two hundred and sixteen undergraduates at the Universidad Nacional de Educación a Distancia (77.3% women, $M_{\text{age}} = 38.81$ years, $SD = 10.31$) were randomly assigned to conditions in a 2 (Source expertise: high versus low) \times 2 (Calculative mindset: adding versus subtracting) between-participants factorial design, with Need for Cognition as an additional predictor variable. An a priori power analysis was conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to determine the sample size for Experiment 1. Given our expectation that the predicted two-way interaction between source credibility and priming would be moderated by an individual-difference variable, our calculations assumed a relatively small effect size for the three-way interaction (Cohen, 1988). Results of these analyses indicated that the desired sample size for linear multiple regression with an effect size between $f^2 = .030$ and $f^2 = .040$ and a power of .80 is between $N = 208$ and $N = 311$. In the end, we fell within that interval with a sample of 216.

Procedure

Participants were first told that they would be involved in two separate research projects. The first project was described as a study on consumer products requested by the business school. The second project was described as a study on mathematical skills. First, participants read a passage describing several benefits of using phosphate detergents. Some examples of the arguments include:

they are cheaper than detergents without phosphates, they clean clothes better, contaminate less, and are safer for the environment than non-phosphate detergents. These arguments were pretested to generate mostly positive thoughts towards phosphate detergents (Tormala, Briñol, & Petty, 2006, 2007). After reading the passage, participants were informed that phosphate detergents were advocated by a source either high or low in expertise. Next, in an ostensibly unrelated study, participants completed the mathematical equation task, which served as the calculative mindset manipulation. After the math task, participants indicated their attitudes towards phosphate detergents. Then, all participants completed the Need for Cognition scale and an ancillary measure on the perceived difficulty of the math task.

Independent variables

Credibility

Participants were told that the message was advocated either by a chemistry professor from Stanford University (high expertise) or by a convenience store employee in California (low expertise). Similar variations of source credibility have been used in prior research examining attitudes towards phosphate detergents (Tormala, Briñol, & Petty, 2006, 2007). Although this induction has been successfully used in prior research, we pilot tested the manipulation in a sample taken from the same population participating in the main study. Forty-three undergraduate students volunteered to participate in this pilot test. They first read the message in favour of phosphate-based detergents and then were randomly assigned to the high versus low credibility manipulation. Next, participants responded to the following item: ‘How knowledgeable do you think the person who advocates this message is?’ (1 = ‘Not knowledgeable at all’, to 7 = ‘Very knowledgeable’). Results indicated that participants assigned to the the high-credibility condition perceived the source to be more knowledgeable ($M = 5.82$, $SD = 1.46$) than participants assigned to the low-credibility condition ($M = 4.57$, $SD = 1.86$), $F(1, 42) = 5.98$, $p = .019$, $\eta^2 = .13$.

Type of calculative mindset

All participants were given nine basic mathematical equations in which either an addition or subtraction symbol was missing (e.g., $5 _ 2 = 3$). Participants were told to complete the equations by inserting the correct mathematical symbol. In the adding (subtracting) condition, participants received a set of equations in which the majority (7 out of 9) could only be completed correctly by inserting an addition (subtraction) symbol. The remaining two were completed by a division³.

Need for cognition scale

All participants completed the Spanish version of the 18-item Need for Cognition (NC) scale (Cacioppo & Petty, 1982; Falces, Briñol, Sierra, Becerra, & Alier, 2001). It includes items such as ‘I would prefer complex to simple

problems' and 'Thinking is not my idea of fun' (reverse scored). Each item is answered on a five-point Likert-type scale from 1 ('extremely uncharacteristic of me') to 5 ('extremely characteristic of me'). Items are summed (after reverse scoring) to determine a person's NC score.

Dependent variables

Attitudes

Participants reported their attitudes towards phosphate laundry detergents using four nine-point Likert-type scales (1 = 'Bad, Unfavourable, Harmful, Foolish'; 9 = 'Good, Favourable, Beneficial, Wise'). Item ratings were highly inter-correlated ($\alpha = .72$), thus were averaged to form one overall attitude index.

Perceived difficulty of the priming task

Participants reported how difficult it was for them to do the math using one Likert-type scale: 'To what extent did you consider the math operations task to be difficult?' (1 = 'Very easy'; 9 = 'Very difficult'). This measure was included to ensure that the math operations were equivalent in difficulty. This also ensured that any reduction in perceptions of source credibility for participants in the subtraction condition was not related to tiredness or depletion.

Results

Attitudes

Linear regression analyses were conducted to examine the effects of need for cognition (centered), source credibility (effect coded: -1 low credibility, 1 high credibility), calculative mindset (effect coded: -1 subtraction, 1 addition) and the interaction of the three variables on attitudes. No main effect of calculative mindset was found, $b = -.057$, $t(208) = -0.746$, $p = .456$, CI_{95} : [-0.207, 0.093]. Likewise, source credibility did not differentially influence attitudes, $b = .010$, $t(208) = 0.133$, $p = .893$, CI_{95} : [-0.140, 0.161].

More central to our predictions, the hypothesized three-way interaction between source credibility, calculative mindset and Need for Cognition was significant, $b = .47$, $t(208) = 2.51$, $p = .012$, CI_{95} : [0.102, 0.840]. As illustrated in [Figure 1](#) (top panel), for high-NC participants, an interaction between source credibility and calculative mindset emerged, $b = .43$, $t(208) = 2.99$, $p = .003$, CI_{95} : [0.147, 0.713]. Specifically, within the addition condition, a credible source elicited more favourable attitudes towards phosphate detergents than a non-credible source, $b = .57$, $t(208) = 3.01$, $p = .003$, CI_{95} : [0.200, 0.957]. In contrast, within the subtraction condition, there were no differences in attitudes between those who were assigned to a credible versus a non-credible source, $b = -.28$, $t(208) = -1.31$, $p = .190$, CI_{95} : [-0.702, 0.140]⁴. Regarding low-NC participants (see [Figure 1](#), bottom panel), no effect reached significance, [$t(208) < 0.60$, $p > .548$].

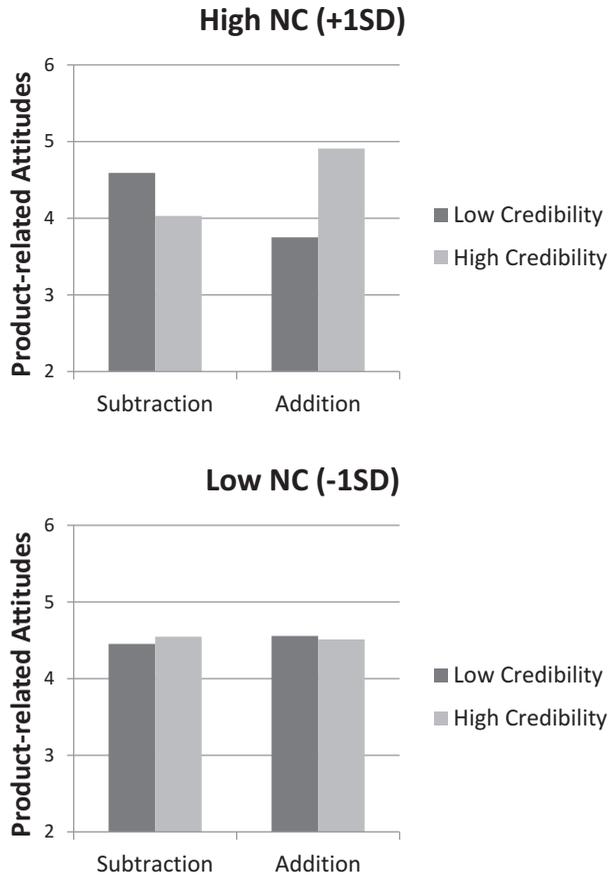


Figure 1. Product-related attitudes as a function of source credibility and type of calculative mindset for participants high (top panel) and low (bottom panel) in need for cognition.

Perceived difficulty of the priming task

Linear regression analyses were conducted to examine the effects of need for cognition (centred), source credibility (effect coded: -1 low credibility, 1 high credibility), calculative mindset (effect coded: -1 subtraction, 1 addition) and the interaction of the three variables on perceived difficulty. No effect reached significance, $b < .24$, $t(208) < 1.71$, $p > .088$.

Discussion

Experiment 1 revealed that when high-NC participants were primed with an addition task, a credible source elicited more favourable attitudes towards phosphate detergents than a non-credible source. In contrast, within the subtraction condition, no differences in attitudes emerged between those who were assigned

to a credible versus a non-credible source. Moreover, no interaction was found between source credibility and calculative mindset for low-NC participants⁵.

Although Experiment 1 suggested that correction effects may be elicited through subtle primes that are unrelated to the message source and the message content, it remains unclear whether our effects are idiosyncratic either to source expertise, to our particular materials or to this sample of participants. To address these issues, Experiment 2 constrained participants' elaboration to be high and sought to replicate these results using a different attribute of the source, a different topic and a different sample of participants.

Experiment 2

Experiment 2 was conducted with several goals in mind. First, we wanted to test whether creating high-thinking conditions (versus measuring individual differences in careful thought) could replicate the key effects obtained in Experiment 1 for high-NC individuals. Second, we examined the possibility of extending the effects of Experiment 1 to a different dimension of source credibility (trustworthiness rather than expertise) and to a different attitudinal topic (genetically modified food, GMF). Taken together, we tested whether the predicted two-way interaction on product-related attitudes could be generalized beyond the materials and the sample used in the first study.

The procedure was similar to that used in Experiment 1. That is, participants first read arguments in favour of genetically modified food, and then were informed that either a trustworthy or untrustworthy source advocated the message. Next, participants completed a series of mathematical equations, which served as our priming manipulation. Finally, participants reported their attitudes towards GMF. As in Experiment 1, we anticipated that the effect of source trustworthiness on attitudes would, relative to priming recipients with addition, potentially be attenuated, eliminated or reversed when priming recipients with subtraction.

Method

Participants and design

One hundred and five undergraduates at the Universidad Nacional de Educación a Distancia (79% women, $M_{\text{age}} = 39.67$ years, $SD = 9.97$) were randomly assigned to conditions in a 2 (Source credibility: high versus low trustworthiness) \times 2 (Type of Calculative mindset: adding versus subtracting) between-participants factorial design. We ran as many participants as available during the semester, and a sensitivity power analysis was conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). Results of the G*Power analysis indicated that the obtained sample ($N = 105$) with our 2×2 experimental design was able to detect effect sizes larger than $f = 0.27$ with a power of .80. The effect size obtained for the main result in Experiment 2 was indeed detectable by our sample ($f = 0.38$).

Procedure

Similar to Experiment 1, participants were first told that they would be involved in two separate research projects. The first project was described as a study on consumer products requested by the business school. The second project was described as a study on mathematical skills requested by the science department. First, participants read strong arguments that advocated using genetically modified food (GMF). Participants were asked to carefully read and think about the arguments because very few people were taking part in the study, thus their responses were especially important. Previous research has successfully used this kind of instruction to motivate participants to think (e.g., Briñol, Petty, & Stavraki, 2012; Petty & Cacioppo, 1979; Tormala, Petty, & Briñol, 2002). Some examples of the arguments include: GMFs grow larger and quicker, are cheaper, contaminate less and are less likely to carry diseases. Prior research has confirmed that these arguments generated mostly positive thoughts towards GMF (Luttrell, Petty, & Briñol, 2016). After reading the text, participants were told that the message was advocated by either a trustworthy or untrustworthy source. Next, participants completed an ostensibly unrelated study on mathematical skills, in which the calculative mindset manipulation was introduced. Finally, all participants reported their attitudes towards GMF.

Independent variables

Credibility

After participants read a message about GMF, they were told that it came from a high or low trustworthy source. In the high-trustworthiness condition, participants were told that the message was advocated by a local farmer from Texas. In the low-trustworthiness condition, participants were told that the message was advocated by a food engineer who works for Aventis, described as one of the largest transgenic nutrition and food-engineering companies in the world. The trustworthiness conditions were designed so that the sources were similar in perceived knowledge about the topic but differed in perceived trustworthiness. That is, because the food engineer could directly benefit by successfully advocating for a product designed and sold by his employer, this reflects a conflict of interest, and thus undermines source trustworthiness.

Although similar variations of source trustworthiness have been used successfully in prior attitude-change research (Briñol, Petty, & Tormala, 2004; Tormala, Briñol, & Petty, 2006, 2007), we pilot tested this induction in a separate sample of undergraduate students. Specifically, 36 participants volunteered to enrol in this pilot test. They first read the message in favour of GMF and then were randomly assigned to the high- versus low-trustworthiness manipulations. After reading the materials, participants responded to the following item: 'How honest do you think the person who advocates this message is?' (1 = 'Not honest at all', to 7 = 'Very honest'). Results indicated that participants assigned to the high-credibility condition perceived the source to be significantly

more honest ($M = 5.14$, $SD = 1.91$) than participants assigned to the low-credibility condition ($M = 3.59$, $SD = 1.96$), $F(1, 35) = 5.43$, $p = .026$, $\eta^2 = .14$.

Type of calculative mindset

The same manipulation used in Experiment 1 was used in Experiment 2⁶.

Dependent variable: attitudes

The same measure used in Experiment 1 was used in Experiment 2. Item-ratings were moderately intercorrelated ($\alpha = .53$), thus were averaged to form one overall attitude index.

Results

First, we examined the effects of source credibility and calculative mindset on attitudes towards GMF using an ANOVA with source credibility and calculative mindset as the independent variables and attitudes towards GMF as the dependent variable. A significant main effect of calculative mindset was found $F(1, 101) = 4.69$, $p = .033$, $\eta^2 = .044$. Specifically, attitudes were more favourable in response to a prime based on addition ($M = 4.13$, $SD = 1.24$) than subtraction ($M = 3.75$, $SD = 1.24$). Source credibility did not differentially influence attitudes $F(1, 101) = 1.06$, $p = .306$, $\eta^2 = .010$. However, consistent with our predictions, an interaction between source credibility and calculative mindset emerged, $F(1, 101) = 15.06$, $p < .001$, $\eta^2 = .13$. As illustrated in [Figure 2](#), within the adding condition, a credible source elicited more favourable attitudes towards GMF ($M = 4.51$, $SD = 1.08$) than a non-credible source, ($M = 3.85$, $SD = 1.29$), $F(1, 101) = 4.07$, $p = .046$, $\eta^2 = .039$, thus replicating the traditional source credibility effect. Within the subtraction condition, this

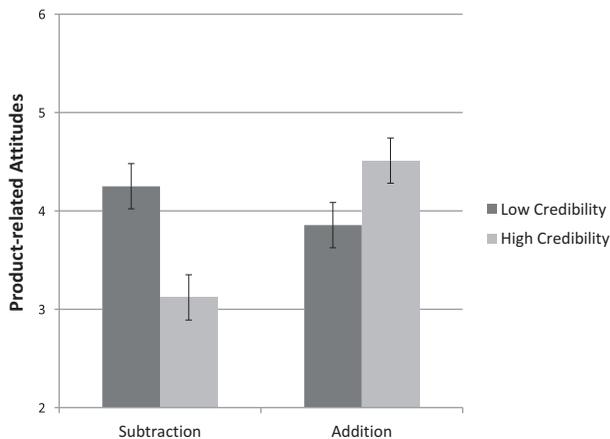


Figure 2. Product-related attitudes as a function of source credibility and type of calculative mindset (Experiment 2).

pattern was reversed such that attitudes towards the product were more favourable for the non-credible ($M = 4.25$, $SD = 1.12$) than credible source ($M = 3.12$, $SD = 1.11$), $F(1, 101) = 12.04$, $p = .001$, $\eta^2 = .107$.

Discussion

Experiment 2 demonstrated that the relative effects of the subtraction (versus addition) calculative mindset on persuasion not only extend to multiple attributes of credibility (i.e., source trustworthiness as well as expertise) but also generalize across different attitudinal topics (i.e., genetically modified food and phosphate laundry detergents).

General discussion

Previous research has shown that when forming evaluations of a target, the influence of source factors that people perceive as potentially biasing variables can be reduced, eliminated or even reversed through different bias-correction inductions (Martin, Seta, & Crelia, 1990; Schwarz & Bless, 1992; Wegener & Petty, 1995, among others). In the present research we argued that correction processes can also be induced through a subtle, content-independent induction.

Experiment 1 showed that for participants high in Need for Cognition, the traditional positive effect of source credibility (high/low) on message-related attitudes was eliminated when participants completed subtracting (versus adding) mathematical operations prior to attitude expression. Experiment 2 replicated this critical two-way interaction by creating conditions under which participants were engaged in careful thought. Additionally, Experiment 2 demonstrated the generalizability of this phenomenon by using a different manipulation of source credibility (trustworthiness versus expertise) and a different message topic (GMF versus phosphate detergents).

Although speculative, the results of both studies are consistent with the bias-correction literature and provided convergent evidence of a correction effect regardless of whether the credibility induction involved expertise (Experiment 1) or trustworthiness (Experiment 2). Some scholars might wonder whether the effects obtained in this research were due mostly to the manner in which either adding or subtracting affected the impact of source credibility on attitudes. Having a control group without calculative mindsets or without source credibility would contribute to making more precise conclusions.

Nonetheless, because Experiment 2 showed a reverse credibility effect in the subtraction condition, it suggests that the subtraction mindset likely produced an effect that would have differed from a no calculation control group since source effects are unlikely to be reversed unless there is a correction. Another potential limitation of the current research has to do with the lack of manipulation checks for either our credibility or our priming manipulations. Future research should include more measures relevant to the inductions and the proposed process.

Beyond including control groups and additional measures, future research in this area can benefit from examining the difference between traditional correction based on blatant instructions and subtle primes associated with correction. Blatant correction only removes the influence of variables whose effects on evaluations of a target are unwanted. In contrast, we expect that a subtle correction induction might remove the impact of any variable regardless of whether the effects of that variable on evaluations of a target are wanted or unwanted. For example, in the paradigm used in the present research, subtle primes produced a pattern of results consistent with an attenuation of the impact of source credibility. However, explicit instructions to correct might be less likely to lead to such an effect since source credibility is not expected to be perceived as a biasing factor for the attitudinal topics employed in these studies. Future studies should cross the impact of blatant versus subtle correction paradigms with source variables for which most people are unlikely to correct (such as source credibility and trustworthiness) versus source variables for which people tend to correct (such as source attractiveness).

Finally, the present research also suggests the possibility of reinterpreting some prior research that may have unintentionally primed the concept of subtraction, for example, through handwashing or removal of dirt (Lee & Schwarz, 2010), removing morality of decisions (Zhong & Liljenquist, 2006; Zhong, Strejcek, & Sivanathan, 2010), removing mistakes (Rutchick, Slepian, & Ferris, 2010) and even by separating from the self (Kross & Ayduk, 2017).

Notes

1. There are, however, some instances in which high-elaboration conditions lead people to estimate the persuasive impact of the source to be smaller; therefore, they correct less when asked to do so (for an example, see Espinoza-Petersen & Hamilton, 2014).
2. Even if correction usually starts as a thoughtful, resource-intensive process, it can, with enough practice, become routine and therefore less cognitively demanding (Wegener & Petty, 1997; see Maddux, Burden, Brewer, & Petty, 2005).
3. We coded the number of correct mathematical signs that participants guessed in the priming task. Linear regression analyses were conducted to examine the effects of need for cognition (centred), source credibility (effect coded: -1 low credibility, 1 high credibility), calculative mindset (effect coded: -1 subtraction, 1 addition) and the interaction of the three variables on the amount of correct answers. No effect reached significance, $B < .19$, $t(208) < 1.54$, $p > .13$. Additionally, more than 78% of the sample made fewer than two mistakes out of nine mathematical operations.
4. Put differently, and still among high-NC participants, within the high-credibility conditions, participants assigned to the addition calculative mindset reported more favourable attitudes than those assigned to the subtraction calculative mindset, $B = .44$, $t(208) = 2.19$, $p = .029$, CI_{95} : [0.044, 0.835]. However, within the low-credibility conditions, participants assigned to the addition calculative mindset reported significantly more unfavourable attitudes than those who were assigned to the subtraction calculative mindset, $B = -.42$, $t(208) = -2.04$, $p = .042$, CI_{95} : [-0.826, -0.015].

5. Based on some past research (e.g., Haugtvedt, Petty, & Cacioppo, 1992), one might have expected a larger effect of source credibility on the attitudes of low than high need for cognition individuals. The absence of such an effect might suggest that those with lower scores in NC did not pay enough attention to the materials to be affected by the inductions. Alternatively, the math problems may have been sufficiently taxing such that they reduced participant's retrieval of the source information prior to reporting their attitudes. Or, because the source followed the message, unlike the typical study in which the source preceded the message, perhaps low NCs had already formed an opinion based on the mere number of arguments prior to getting the source cue and did not recalculate their attitude following the source cue.
6. We coded the number of correct mathematical signs that participants guessed in the priming task. We ran an ANOVA with source credibility and calculative mindset as the independent variables and the number of correct answers as the dependent variable. No effect reached significance, $F < 0.902$, $p > .34$. Additionally, more than 80% of the sample made fewer than two mistakes out of nine mathematical operations.

fueron antes de informar sobre las actitudes. O bien, puesto que la revelación de la fuente fue posterior al mensaje, a diferencia de los estudios típicos en los que la fuente precede al mensaje, es posible que los participantes con NC baja ya se habían formado una opinión basada en el simple número de argumentos antes de obtener la información sobre la fuente y no revisaron su actitud después de obtener dicha información.

6. Codificamos el número de signos matemáticos correctos utilizados por los participantes en el ejercicio de inducción. Realizamos un ANOVA con la credibilidad de la fuente y la mentalidad de cálculo como variables independientes y el número de respuestas correctas como variable dependiente. Ninguno de los efectos era significativo, $F < 0.902$, $p > .34$. Además, más del 80% de la muestra cometieron menos de dos errores en las nueve operaciones matemáticas.

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References / Referencias

- Briñol, P., & Petty, R. E. (2003). Overt head movements and persuasion: A self-validation analysis. *Journal of Personality and Social Psychology*, *84*, 1123–1139.
- Briñol, P., & Petty, R. E. (2009). Source factors in persuasion: A self-validation approach. *European Review of Social Psychology*, *20*, 49–96. doi:10.1080/10463280802643640
- Briñol, P., Petty, R. E., & Stavraki, M. (2012). Power increases the reliance on first-impression thoughts. *Revista de Psicología Social*, *27*, 293–303. doi:10.1174/021347412802845513
- Briñol, P., Petty, R. E., & Tormala, Z. L. (2004). Self-validation of cognitive responses to advertisements. *Journal of Consumer Research*, *30*, 559–573. doi:10.1086/380289
- Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, *42*, 116–131. doi:10.1037/0022-3514.42.1.116
- Cacioppo, J. T., Petty, R. E., Feinstein, J., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*, 197–253. doi:10.1037/0033-2909.119.2.197

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.
- DeSteno, D., Petty, R. E., Wegener, D. T., & Rucker, D. D. (2000). Beyond valence in the perception of likelihood: The role of emotion specificity. *Journal of Personality and Social Psychology*, *78*, 397–416.
- Espinoza, F., & Hamilton, R. W. (2009). The illusion of avoiding bias. How correcting for perceived bias can make a recommendation more effective. *Advances in Consumer Research*, *36*, 623–624.
- Espinoza-Petersen, F., & Hamilton, R. W. (2014). Confidence via correction: The effect of judgment correction on consumer confidence. *Journal of Consumer Psychology*, *24*, 34–48. doi:10.1016/j.jcps.2013.06.001
- Falces, C., Briñol, P., Sierra, B., Becerra, A., & Alier, E. (2001). Validación de la escala Necesidad de Cognición y aplicación al estudio del cambio de actitudes. *Psicothema*, *13*, 647–653.
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *3*, 175–191. doi:10.3758/BF03193146
- Freitas, A. L., Gollwitzer, P. M., & Trope, Y. (2004). The influence of abstract and concrete mindsets on anticipating and guiding others' self-regulatory efforts. *Journal of Experimental Social Psychology*, *40*, 739–752. doi:10.1016/j.jesp.2004.04.003
- Garcia-Marques, T. M., Silva, P., & Wegener, D. T. (2019). Rebound effects in persuasion: Considering potential ironic effects of suppression and correction. *Revista de Psicología Social/International Journal of Social Psychology*, this issue.
- Gilbert, D. T., & Hixon, J. G. (1991). The trouble of thinking: Activation and application of stereotypic beliefs. *Journal of Personality and Social Psychology*, *60*, 509–517. doi:10.1037/0022-3514.60.4.509
- Griskevicius, V., Goldstein, N. J., Mortensen, C. R., Sundie, J. M., Cialdini, R. B., & Kenrick, D. T. (2009). Fear and loving in Las Vegas: Evolution, emotion, and persuasion. *Journal of Marketing Research*, *46*, 384–395. doi:10.1509/jmkr.46.3.384
- Haugtvedt, C. P., Petty, R. E., & Cacioppo, J. T. (1992). Need for cognition and advertising: Understanding the role of personality variables in consumer behavior. *Journal of Consumer Psychology*, *1*, 239–260. doi:10.1016/S1057-7408(08)80038-1
- Hess, U., Gryc, O., & Hareli, S. (2013). How shapes influence social judgments. *Social Cognition*, *31*, 72–80. doi:10.1521/soco.2013.31.1.72
- Higgins, E. T., & Chaires, W. M. (1980). Accessibility of inter-relational constructs: Implications for stimulus encoding and creativity. *Journal of Experimental Social Psychology*, *16*, 348–361. doi:10.1016/0022-1031(80)90027-X
- Horcajo, J., Briñol, P., & Becerra, A. (2009). Los efectos de la activación de estereotipos sobre la evaluación de candidatos en un contexto experimental de selección de personal. *Revista Latinoamericana de Psicología*, *41*, 349–359.
- Janiszewski, C., & Wyer, R. S. (2014). Content and process priming: A review. *Journal of Consumer Psychology*, *24*, 96–118. doi:10.1016/j.jcps.2013.05.006
- Johar, G. V., & Simmons, C. J. (2000). The use of concurrent disclosures to correct invalid inferences. *Journal of Consumer Research*, *26*, 307–322. doi:10.1086/jcr.2000.26.issue-4
- Kelman, H. C., & Hovland, C. I. (1953). “Reinstatement” of the in delayed measurement of opinion change. *Journal of Abnormal and Social Psychology*, *48*, 327–335. doi:10.1037/h0061861
- Kross, E., & Ayduk, O. (2017). Self-distancing: Theory, research, and current directions. *Advances in Experimental Social Psychology*, *55*, 81–136.
- Kruglanski, A. W., Orehek, E., Dechesne, M., & Pierro, A. (2010). Lay epistemic theory: The motivational, cognitive, and social aspects of knowledge formation. *Social and Personality Psychology Compass*, *4*, 939–950. doi:10.1111/spc3.2010.4.issue-10

- Landau, M. J., Vess, M., Arndt, J., Rothschild, Z. K., Sullivan, D., & Atchley, R. A. (2011). Embodied metaphor and the “true” self: Priming entity expansions and protection influences intrinsic self-expressions in self-perceptions and interpersonal behavior. *Journal of Experimental Social Psychology*, *47*, 79–87. doi:10.1016/j.jesp.2010.08.012
- Lee, S. W. S., & Schwarz, N. (2010). Washing away post-decisional dissonance. *Science*, *323*, 709. doi:10.1126/science.1186799
- Luttrell, A., Petty, R. E., & Briñol, P. (2016). Ambivalence and certainty can interact to predict attitude stability over time. *Journal of Experimental Social Psychology*, *63*, 56–68. doi:10.1016/j.jesp.2015.11.008
- Maddux, W. W., Barden, J., Brewer, M. B., & Petty, R. E. (2005). Saying no to negativity: The effects of context and motivation to control prejudice on automatic evaluative responses. *Journal of Experimental Social Psychology*, *41*, 19–35. doi:10.1016/j.jesp.2004.05.002
- Maimaran, M., & Wheeler, S. C. (2008). Circles, squares, and choice: The effect of shape arrays on uniqueness and variety seeking. *Journal of Marketing Research*, *45*, 731–740. doi:10.1509/jmkr.45.6.731
- Martin, L. L., Seta, J. J., & Crelia, R. A. (1990). Assimilation and contrast as a function of people’s willingness and ability to expend effort in forming an impression. *Journal of Personality and Social Psychology*, *59*(1), 27–37. doi:10.1037/0022-3514.59.1.27
- Monga, A. B., & John, D. R. (2008). When does negative brand publicity hurt? The moderating influence of analytic versus holistic thinking. *Journal of Consumer Psychology*, *18*, 320–332. doi:10.1016/j.jcps.2008.09.009
- Oppenheimer, D. M., LeBoeuf, R. A., & Brewer, N. T. (2008). Anchors aweigh: A demonstration of cross-modality anchoring. *Cognition*, *206*, 13–26. doi:10.1016/j.cognition.2006.12.008
- Petty, R. E. (2001). Subtle influences on judgments and behaviors: Who is most susceptible? In J. Forgas & K. D. Williams (Eds.), *Social influence: Direct and indirect processes* (pp. 129–146). Philadelphia, PA: Psychology Press.
- Petty, R. E., & Briñol, P. (2012). The elaboration likelihood model. In P. A. M. Van Lange, A. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (Vol. 1, pp. 224–245). London: Sage.
- Petty, R. E., Briñol, P., Loersch, C., & McCaslin, M. J. (2009). The need for cognition. In M. R. Leary & R. H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 318–329). New York, NY: Guilford Press.
- Petty, R. E., & Cacioppo, J. T. (1979). Issue involvement can increase or decrease persuasion by enhancing message-relevant cognitive responses. *Journal of Personality and Social Psychology*, *37*, 1915–1926. doi:10.1037/0022-3514.37.10.1915
- Petty, R. E., DeMarree, K. G., Briñol, P., Horcajo, J., & Strathman, A. J. (2008). Need for cognition can magnify or attenuate priming effects in social judgment. *Personality and Social Psychology Bulletin*, *34*, 900–912. doi:10.1177/0146167208316692
- Petty, R. E., & Wegener, D. T. (1993). Flexible correction processes in social judgment: Correcting for context-induced contrast. *Journal of Experimental Social Psychology*, *29*, 137–165. doi:10.1006/jesp.1993.1007
- Petty, R. E., Wegener, D. T., & White, P. H. (1998). Flexible correction processes in social judgment: Implications for persuasion. *Social Cognition*, *16*, 93–113. doi:10.1521/soco.1998.16.1.93
- Rutchick, A. M., Slepian, M. L., & Ferris, B. D. (2010). The pen is mightier than the word: Object priming of evaluative standards. *European Journal of Social Psychology*, *40*, 704–708.
- Schwarz, N., & Bless, H. (1992). Constructing reality and its alternatives: An inclusion/exclusion model of assimilation and contrast effects in social judgment. In

- L. L. Martin & A. Tesser (Eds.), *The construction of social judgments* (pp. 217–245). Hillsdale, NJ: Erlbaum.
- Tormala, Z. L., Briñol, P., & Petty, R. E. (2006). When credibility attacks: The reverse impact of source credibility on persuasion. *Journal of Experimental Social Psychology, 42*, 684–691. doi:10.1016/j.jesp.2005.10.005
- Tormala, Z. L., Briñol, P., & Petty, R. E. (2007). Multiple roles for source credibility under high elaboration: It's all in the timing. *Social Cognition, 25*, 536–552. doi:10.1521/soco.2007.25.4.536
- Tormala, Z. L., Petty, R. E., & Briñol, P. (2002). Ease of retrieval effects in persuasion: A self-validation analysis. *Personality and Social Psychology Bulletin, 28*, 1700–1712. doi:10.1177/014616702237651
- Wang, L., Zhong, C., & Murnighan, J. K. (2014). The social and ethical consequences of a calculative mindset. *Organizational Behavior and Human Decision Processes, 125*, 39–49. doi:10.1016/j.obhdp.2014.05.004
- Wegener, D. T., & Petty, R. E. (1995). Flexible correction processes in social judgment: The role of naive theories in corrections for perceived bias. *Journal of Personality and Social Psychology, 68*, 36–51. doi:10.1037/0022-3514.68.1.36
- Wegener, D. T., & Petty, R. E. (1997). The flexible correction model: The role of naive theories of bias in bias correction. In M. P. Zanna (Ed.), *Advances in experimental psychology* (pp. 141–208). San Diego, CA: Academic.
- Wilson, T. D., & Brekke, N. (1994). Mental contamination and mental correction: Unwanted influences on judgments and evaluations. *Psychological Bulletin, 116*, 117–142. doi:10.1037/0033-2909.116.1.117
- Wyer, R. S., & Xu, A. J. (2010). The role of behavioral mindsets in goal-directed activity: Conceptual underpinnings and empirical evidence. *Journal of Consumer Psychology, 20*, 107–125. doi:10.1016/j.jcps.2010.01.003
- Wyer, R. S., Xu, A. J., & Shen, H. (2012). The effects of past behavior on future goal-directed activity. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (pp. 237–283). Burlington: Academic Press.
- Xu, A. J., & Schwarz, N. (2018). How one thing leads to another: Spillover effects of behavioral mind-sets. *Current Directions in Psychological Science, 27*, 51–55.
- Zhong, C., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science, 313*, 1451. doi:10.1126/science.1130726
- Zhong, C., Strejcek, B., & Sivanathan, N. (2010). A clean self can render harsh moral judgment. *Journal of Experimental Social Psychology, 46*, 859–862. doi:10.1016/j.jesp.2010.04.003