Article

Personality and Social Psychology Bulletin
2020, Vol. 46(2) 204–215

Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0146167219853844
journals.sagepub.com/home/pspb
SAGE

Investigating the Robustness of the Illusory Truth Effect Across Individual Differences in Cognitive Ability, Need for Cognitive Closure, and Cognitive Style

Jonas De keersmaecker[1], David Dunning[2], Gordon Pennycook[3], David G. Rand[4], Carmen Sanchez[5], Christian Unkelbach[6], and Arne Roets[1]

Abstract

People are more inclined to believe that information is true if they have encountered it before. Little is known about whether this illusory truth effect is influenced by individual differences in cognition. In seven studies (combined $N = 2{,}196$), using both trivia statements (Studies 1-6) and partisan news headlines (Study 7), we investigate moderation by three factors that have been shown to play a critical role in epistemic processes: cognitive ability (Studies 1, 2, 5), need for cognitive closure (Study 1), and cognitive style, that is, reliance on intuitive versus analytic thinking (Studies 1, 3-7). All studies showed a significant illusory truth effect, but there was no evidence for moderation by any of the cognitive measures across studies. These results indicate that the illusory truth effect is robust to individual differences in cognitive ability, need for cognitive closure, and cognitive style.

Keywords

illusory truth effect, analytic thinking, intuition, cognitive ability, need for cognitive closure, reasoning

Received October 8, 2018; revision accepted April 2, 2019

Introduction

Throughout human history, communicators, including politicians and public influencers, have often deliberately repeated assertions to make them more believable (Hertwig, Gigerenzer, & Hoffrage, 1997). Although this strategy was already applied long before the birth of the field of psychology, psychological research has provided strong evidence that people tend to believe information more if it has been previously encountered. In their seminal work on this so-called "illusory truth effect," Hasher, Goldstein, and Toppino's (1977) participants rated the truth of various trivia statements. On three successive occasions with 2-week intervals, this task was repeated with a list of statements consisting of both repeated (i.e., present at the first rating) and new statements. Over time, statements that were repeated were more likely to be considered true compared with new statements. Since Hasher and colleagues' original experiment, numerous studies have replicated the illusory truth effect (see the quantitative meta-analysis by Dechêne, Stahl, Hansen, & Wänke, 2010).

The most widely accepted explanation of the illusory truth effect relies on processing fluency (Dechêne et al., 2010; Unkelbach & Greifeneder, 2013), referring to the metacognitive experience of the ease with which people process information (see Alter & Oppenheimer, 2009). Repeated statements are processed more fluently, and this experience of fluency in turn is used as a cue to infer validity (Begg, Anas, & Farinacci, 1992; Unkelbach, 2007). In their overview, Alter and Oppenheimer (2009) provided evidence that different variations of fluency manipulations have similar effects on human judgment. Accordingly, besides repetition, different manipulations of fluency, such as conceptual fluency (e.g., semantic priming; Kelley & Lindsay, 1993), perceptual fluency (e.g., contrast; Reber & Schwarz, 1999), and linguistic fluency (e.g., rhyming; McGlone & Tofighbakhsh,

[1]Ghent University, Belgium
[2]University of Michigan, Ann Arbor, USA
[3]University of Regina, Saskatchewan, Canada
[4]Massachusetts Institute of Technology, Cambridge, USA
[5]Cornell University, Ithaca, NY, USA
[6]Universität zu Köln, Germany

Corresponding Author:
Jonas De keersmaecker, Department of Developmental, Personality and Social Psychology, Ghent University, Henri Dunantlaan 2, B-9000 Ghent, Belgium.
Email: Jonas.Dekeersmaecker@UGent.be

2000) also evoke the tendency to judge information as being true. In addition, by demonstrating that the perirhinal cortex, which is associated with fluency, showed increased activity with truth ratings for repeated, but not for new, statements, Wang, Brashier, Wing, Marsh, and Cabeza (2016) provided neurological evidence for the role of processing fluency on the illusory truth effect.

Compatible with this dominant processing fluency explanation, Unkelbach and Rom (2017) recently introduced a referential theory to further explain the illusory truth effect. The theory holds that, when an individual processes information (e.g., Van Gogh painted Starry Night in Saint-Rèmy), the corresponding references that provide meaning to the different elements (e.g., Van Gogh, Starry Night, Saint-Rèmy), and their coherence constitute a localized information network in memory. According to this perspective, the judged truth of a particular statement is informed by both the availability of these corresponding references and their coherence. Confronted with the task to judge the validity of certain statements, repeated statements have, according to this account, already formed more coherently linked corresponding references due to prior processing, and have consequently a higher probability to be judged as true compared with new statements.

Given the intellectual capabilities of the human mind, the observation that exposure to information enhances the subjective truth of that information is striking. Not surprisingly, the illusory truth effect and its underlying mechanisms have received a lot of research attention (Dechêne et al., 2010). However, it remains unclear whether this effect is moderated by individual differences. As argued by Underwood (1975), the incorporation of an individual differences perspective advances psychological theorizing. Indeed, understanding which variables are and which are *not* related to the illusory truth effect will deepen our understanding on this important phenomenon. Here, we investigate the influence of three variables on repetition-induced truth that have already demonstrated their substantial impact on human judgment and decision making in other domains: cognitive ability (cf. intelligence), need for cognitive closure (NFC), and cognitive styles.

Cognitive Ability

According to both the referential theory and fluency explanation of the illusory truth effect, it is essential that the presented information is appropriately processed when it is first encountered, otherwise a localized information network will not emerge in memory, and the information will not be processed more fluently at the second encounter. In one of their experiments, Unkelbach and Rom (2017; Study 3) provided evidence for the role of encoding depth, by showing that experimental manipulations of encoding depth are positively related to the effect size of the illusory truth effect. Consequently, one might expect that individual differences in information processing capacity, which presumably facilitate encoding depth, are therefore also positively related to the illusory truth effect. There is consensus that information processing operates through the individual's working memory (see, for example, Anderson, 1996; Hunt, 2011), which is highly positively related to general intelligence (Conway, Jarrold, Kane, Miyake, & Towse, 2007; Kyllonen, 1996). In addition to adequately processing information, it is also essential that no information gets lost, that is, that memory remains intact over time (Unkelbach and Rom, 2017, see also Garcia-Marques, Silva, Reber, & Unkelbach, 2015). In their delineation of the illusory truth effect, Dechêne et al. (2010) argued, "By definition, the repetition-based truth effect is mediated by memory processes" (p. 239). Similar to information processing capacity, the ability to maintain information in memory and fluently use it later in the process of thinking is highly associated with general intelligence (see, for example, McGrew, 2005). Building on this research, one might expect that general cognitive ability (i.e., intelligence) should be positively related to the illusory truth effect.

NFC

Whereas cognitive ability may be associated with the ability to form coherently linked corresponding references in memory when first encountered, and subsequently processing information more fluently when encountered again later on, the individual's NFC may be associated with the *motivation* to use this information in the decision process. The NFC concept derives from Kruglanski's (1980) theory of lay epistemology and is defined as individuals' desire for firm answers to questions, and aversion toward ambiguity (Kruglanski & Webster, 1996). The motivation to obtain epistemic security plays an important role in knowledge formation and judgments processes (for an overview, see Roets, Kruglanski, Kossowska, Pierro, & Hong, 2015). Although situational forces such as fatigue can temporally impact the NFC, individuals show reliable differences in their dispositional NFC levels (Roets & Van Hiel, 2007; Webster & Kruglanski, 1994). In cases where closure is lacking, people high in dispositional NFC show elevated levels of both physiological and self-reported distress (Roets & Van Hiel, 2008). Theoretically, NFC instills the tendency to seize quickly on information that promises closure, and to freeze on acquired knowledge (Webster & Kruglanski, 1994). To resolve the need for closure, individuals high in NFC often use heuristics, simple cues, and readily available information (Roets et al., 2015). As such, confronted with the question whether a statement is true or false, individuals high in NFC may be more sensitive to elevations in the strength of coherent corresponding references and the accompanied processing fluency experience due to prior exposure, to obtain quick answers and epistemic security versus remaining in a state of uncertainty.

Cognitive Style

Besides cognitive ability and need for epistemic security, the way in which individuals tend to engage in problem-solving and decision making—that is, their *cognitive style*—might also be related to the susceptibility of the illusory truth effect. Various dual-process theories have been proposed in which it is argued that there are two different types of information processing (e.g., Epstein, 1994; Kahneman, 2011; for overviews, see Evans, 2008; Evans & Stanovich, 2013): "intuitive or experiential" thinking (often referred as Type 1) and "rational or analytic" (often referred as Type 2) thinking. Intuitive thinking is associated with automatic, heuristic, rapid, and associative processing, whereas analytic thinking is associated with extensive, deliberative, and relatively slow processing (Evans & Stanovich, 2013; Kahneman, 2011). Theoretically, responses are the result of a combination of these independent and interacting types of processing. Importantly, individuals show reliable individual differences in the use of these types of thinking (e.g., Pacini & Epstein, 1999; Stanovich, West, & Toplak, 2016). Although intuitive thinking might often result in satisfactory responses, it is also prone to cognitive biases and nonoptimal responses (see, Evans & Stanovich, 2013; Pretz, 2008). Dechêne and colleagues (2010) hypothesized that the truth effect might be more pronounced for individuals with a more intuitive style of thinking. Indeed, individuals with an intuitive style of thinking rely more on their automatically activated experiences in judgment formation and may therefore be more inclined to use the metacognitive experience of fluency as a cue for the truthfulness of a given statement. Individuals high in analytic thinking, however, tend to critically evaluate their initial responses that are associated with metacognitive feelings of rightness (Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2014; Pennycook, Fugelsang, & Koehler, 2015a) and are less prone to overconfidence (Pennycook, Ross, Koehler, & Fugelsang, 2017). Thus, increased analysis from relatively analytic people may make it less likely for them to judge repeated statements as true.

The Robustness of the Illusory Truth Effect

Although one may reasonably expect individual differences in cognitive ability, NFC, and cognitive styles to be related to the illusory truth effect based on the theoretical rationale presented above, there is also a theoretical argument to advance that the illusory truth effect should be relatively universal, and invariant to these key individual differences in human judgment and decision making.

The illusory truth effect relies on memory processes. However, many learning and memory theories differentiate between conscious or explicit, and unconscious or implicit learning and memory (e.g., Reber, 1989; Schacter, 1987). Although recent findings demonstrate that there are reliable differences in implicit learning, these differences are less related to cognitive ability compared with explicit learning (Kaufman et al., 2010). Importantly, Hasher and Zacks (1984) provided evidence that information about the frequency of occurrence of items and events is automatically and unconsciously encoded and stored into memory. Moreover, the illusory truth effect also occurs without explicit memory for the statements (Begg et al., 1992; Pennycook, Cannon, & Rand, 2018), suggesting that the effect can occur independent of conscious memory.

In addition, it has been demonstrated that the elderly, despite age-related declines in the efficiency of analytic and controlled processing mechanisms associated with deliberation, such as explicit learning and memory (Peters, Hess, Västfjäll, & Auman, 2007), are equally prone as the young to the illusory truth effect (Dechêne et al., 2010). This suggests that cognitive control might have little impact on the illusory truth effect. The work of Pennycook and colleagues (2018) also suggest that the illusory truth effect might operate relatively outside cognitive control. In particular, individuals have a strong motivation to reject stories that conflict with one's political ideology. Nevertheless, these authors found that the magnitude of the illusory truth effect did not significantly differ between political discordant statements and political concordant statements.

Moreover, the illusory truth effect also emerges in situations wherein individuals have actual knowledge about the truthfulness of the statements. Indeed, Fazio, Brashier, Payne, and Marsh (2015) showed that the individuals often fail to rely on stored, correct knowledge when judging repeated statements. Furthermore, even when people are explicitly informed about the correct answer ("true"/"false") at the time of judgment, repeated statements are more likely to be judged as true (Unkelbach & Greifeneder, 2018).

In sum, there is convergent evidence for the illusory truth effect's robustness, which seems to suggest that the effect is a relatively general cognitive process, and may thus be unaffected by cognitive ability, epistemic needs, or cognitive thinking styles. The present research aims to answer whether or not the illusory truth effect is influenced by these key individual differences in cognition.

The Present Research

We present seven studies including a combination of individual difference measures that have been established in the literature as being especially impactful on human judgment and decision making, and that have a convincing theoretical base as potential moderators of the repetition-based truth effect.

Study 1 examined whether the illusory truth effect was related to fluid intelligence, NFC, and experiential and rational processing styles. Study 2 examined the relationship between the illusory truth effect and cognitive ability, using a measure of verbal intelligence. Both Studies 3 and 4

Table 1. Sample Characteristics.

	N	Final *N*	Age	%Women–%men	Source
Study 1	216	207	18.84 (3.40)	79.7–20.3	Lab
Study 2	200	200	38.88 (12.15)	48.5–51.0	Mturk
Study 3	305	300	35.95 (11.02)	53.3–46.7	Mturk
Study 4	235	231	34.59 (10.89)	40.3–59.7	Mturk
Study 5	199	199	36.21 (10.75)	44.7–55.3	Mturk
Study 6	352	336	40.18 (12.36)	50.9–49.1	Mturk
Study 7	992	723	36.76 (12.22)	55.3–44.0	Mturk

Note. One participant in Study 2 indicated X as gender. Five participants did not indicate their gender in Study 7. Part of the data of Study 7 was previously used in Pennycook et al. (2018).

focused on the relationship between cognitive style and the illusory truth effect, using two different measures of individual differences in experiential and rational thinking. In Study 5, in addition to cognitive ability, we included a performance-based measure of processing style, as self-report measures and objective tasks tapping into the same cognitive constructs might differ in the size of their relationship with a third construct (Van Hiel, Onraet, Crowson, & Roets, 2016), or in some cases can even show reversed effects (De keersmaecker, Onraet, Lepouttre, & Roets, 2017). Therefore, Study 5 used the Cognitive Reflection Test (CRT; Frederick, 2005), which measures individual differences in the disposition, and ability to override intuition. In Study 6, we included both the CRT and a self-report measure of cognitive style. Finally, in Study 7, we used an existing dataset (Pennycook et al., 2018) to examine whether individuals who are inclined and able to override their intuition via analytic processing (measured through the CRT) are less prone to the illusory truth effect for information that is more societally relevant (i.e., politically charged news headlines).[1]

The present studies were conducted independently by four different research labs. First, we describe the sample, procedure, and used materials for each study. Thereafter, we provide a combined results section, including frequentist and Bayesian meta-analysis on the obtained effects between individual difference measures and the illusory truth.

Method

Participants

Sample characteristics are shown in Table 1. In Study 1, undergraduate psychology students participated in return for partial course credit. In Studies 2 to 7, Amazon Mechanical Turk (Mturk) workers participated in return for a financial compensation. In all studies, the final sample size included at least 199 participants, providing >80% power to detect effects of $r = .20$.

Participant exclusions. Study 1 consisted of two lab sessions. Nine participants who participated in the first experimental session did not show up in the second session. In Studies 3 and 4, there were, respectively, five and four participants excluded from the analyses because they indicated at the end of the experiment that one should not use their data; that is, they responded to the question: "If you were the researcher running this study, would you include your data in data analysis or should it be excluded due to you having been too distracted or inattentive? (Again, this does not affect your compensation, it just helps us analyze the data)" with "No." In Study 6, 16 participants were excluded from the analyses because they failed to correctly answer the control questions (see the "Procedure and materials Study 6" section). Finally, in Study 7, participants were removed for reported responding randomly ($N = 29$), skipping over the familiarization phase ($N = 1$), searching online for information ($N = 22$), or prior familiarity with stimulus material ($N = 217$, see the "Procedure and materials Study 7" section).

Procedure and Materials

All studies were designed to examine the between-item criterion of the illusory truth effect, that is, the comparison of truth judgments between repeated and new information (see Dechêne et al., 2010). In Studies 1 to 6, the truth effect was measured using trivia statements, selected from Unkelbach and Rom (2017; e.g., "Othello was the last opera of Verdi"). In Study 7, the truth effect was measured using political news headlines. Data of Studies 1 to 6 are available at https://osf.io/xbwmh/. Data of Study 7 are available at https://osf.io/txf46/.

Procedure and materials Study 1. Study 1 was conducted in the laboratory as part of a mass testing. Sessions included 35 to 40 participants under supervision of three research assistants. Participants participated in two experimental sessions, with an intersession interval of 5 to 7 days. In the first session, participants first completed a cognitive ability (i.e., intelligence) test. In this test, a shortened version of the Wilde Intelligence Test (see Kersting, Althoff, & Jäger, 2008), participants are presented with 45 problems assessing fluid intelligence. In particular, the problems tap into the abilities of general deductive reasoning, spatial reasoning, numeric reasoning, and perceptual speed. Participants are instructed to solve as many problems as they can in 12 min. This brief version has previously been used by De keersmaecker et al. (2017). Next, the 15-item NFC scale (Roets & Van Hiel, 2011) was administered on 6-point Likert-type scales (1 = *strongly disagree*, 6 = *strongly agree*). A sample item is as follows: "I don't like situations that are uncertain." Subsequently, participants were told that they participated in a study examining the affective responses on reading complex statements. Participants were informed that they would be presented with a series of trivia statements. The instructions stated, in underlined typography, that some of the statements were correct, and some of the statements were incorrect. Participants were instructed to just read the statements, which were presented one by one, and participants controlled the presentation time. After reading all the statements (20 statements: 10 correct statements, 10 incorrect statements), they were asked to complete a questionnaire that measures their affect (i.e., The Positive and Negative Affective Schedule [PANAS]; Watson, Clark, & Tellegen, 1988).

Five to 7 days later, in a second session, participants responded to Pacini and Epstein's (1999) measures of rational (10 items) and experiential (10 items) thinking (Rational Experiential Inventory [REI]) on 7-point Likert-type scales (1 = *strongly disagree*, 7 = *strongly agree*).[2] Sample items for rational and experiential thinking are "I enjoy intellectual challenges" and "I like to rely on my intuitive impressions," respectively. Next, participants saw 20 statements and were asked to indicate whether the statements were correct or incorrect (coded: *false* = 0, *true* = 1). The statements consisted of (in random order) five correct new statements, five incorrect new statements, five correct repeated statements, and five incorrect repeated statements. Repeated and new statements were counterbalanced between participants, to eliminate a potential effect of the statements' content.

Procedure and materials Study 2. Similar to Study 1, participants were told that the study examined how individuals emotionally respond to reading complex statements. After completing demographic questions, participants were presented with a series of 20 statements (10 correct statements, 10 incorrect statements) and completed the PANAS. Again, it was explicitly stated that the list contained both correct and incorrect statements. Next, as a measure of (verbal) cognitive ability, participants completed the Ammons Quick Test (QT; Ammons & Ammons, 1962). In this test, participants are presented with four pictures and 50 words. Participants are instructed to connect each of the 50 words to one of the four pictures. Finally, participants judged the correctness (coded: *false* = 0, *true* = 1) of 20 statements (in random order): five correct new statements, five incorrect new statements, five correct repeated statements, and five incorrect repeated statements. Repeated and new statements were counterbalanced between participants.

Procedure and materials Study 3. The experiment consisted of three consecutive phases. First, participants read 60 statements (30 correct statements, 30 incorrect statements). Second, participants judged the truthfulness of 120 statements (in random order: 30 correct new statements, 30 incorrect new statements, 30 correct repeated statements, and 30 incorrect repeated statements. Repeated and new statements were counterbalanced between participants) on a 7-point scale (1 = *certainly false*, 7 = *certainly true*). Finally, participants answered Pacini and Epstein's (1999) 40-item REI, and Betsch's (2004) 18-item preference for intuition and deliberation (PID) scale on 5-point Likert-type scales (1 = *completely false*, 5 = *completely true*). Sample items for intuition and deliberation are "My feelings play an important role in my decisions" and "Before making decisions, I first think them through," respectively.

Procedure and materials Study 4. Procedure and materials of Study 4 were similar to Study 3. After reading 30 statements (15 correct statements, 15 incorrect statements), participants judged the truthfulness of 60 statements (in random order: 15 correct new statements, 15 incorrect new statements, 15 correct repeated statements, and 15 incorrect repeated statements) dichotomously (coded: *false* = 0, *true* = 1). Repeated and new statements were counterbalanced between participants. Finally, participants completed the REI and the PID.

Procedure and materials Study 5. The procedure and materials of Study 5 were similar to Study 2, with the addition of Toplak, West, and Stanovich's (2014) extended CRT (seven items). The CRT is a performance-based test of cognitive reflection that shows moderate associations with self-report measures of rational thinking and experiential thinking (Pennycook, Cheyne, Koehler, & Fugelsang, 2016). Low scores on the CRT have been demonstrated to relate to the use of heuristics, and cognitive biases, above and beyond cognitive ability (Toplak, West, & Stanovich, 2011).

Procedure and materials Study 6. Similar to Studies 1, 2, and 5, participants read that the aim of the study was to examine emotional responses to reading a series of correct and incorrect complex statements. To safeguard data quality, after the presentation phase (20 statements: 10 correct statements, 10 incorrect statements), participants were presented with four statements (one new and correct, one repeated and correct, one new and incorrect, one repeated and incorrect) and were asked to indicate for each statement whether or not it had been presented to them in the previous phase of the experiment. Participants who failed to score above chance level were omitted from the sample ($N = 16$). These control question statements were not used in the test phase. Subsequently, participants completed the PANAS. Thereafter, participants completed the 20-item version of the REI that was used in Study 1 and Frederick's (2005) CRT (three items). Finally, participants judged the correctness (coded: *false* = 0, *true* = 1) of 20 statements (in random order: five correct new statements, five incorrect new statements, five correct repeated statements, and five incorrect repeated statements. Repeated and new statements were counterbalanced between participants) and responded to demographic questions.

Procedure and materials Study 7. Study 7 made use of an existing dataset (via Pennycook et al., 2018). Below, we only describe the variables and manipulations that are relevant for the present purposes. An elaborate description of the full procedure can be found in Pennycook et al. (2018). Materials consisted of 16 news headlines: half of which were accurate (*real news*) and half of which were inaccurate (*fake news*). The headlines were all political in nature and were pretested to be either "Democrat-consistent" or "Republican-consistent." Headlines as presented to participants can be found on the OSF page of the study.

Prior exposure was manipulated using a three-stage experiment. In the familiarization stage, participants were shown four fake and four real news headlines, half of which were Democrat-consistent and half of which were Republican-consistent. Participants were asked to indicate whether they had seen or heard about the stories before to isolate the analyses on items that were novel. Next, participants advanced to the distractor stage, in which they completed a set of filler demographic questions and the PANAS (Watson et al., 1988). In the third "assessment" stage, participants were presented with 16 news headlines (eight repeated headlines, eight new headlines) and rated each for accuracy on 4-point Likert-type scales (1 = *not at all accurate*, 4 = *very accurate*). Headlines were counterbalanced across participants and balanced with regard to political consistency. Following the assessment stage, participants were asked to indicate their prior familiarity (before the experiment) with the headlines that were *not* presented in the familiarization stage. This was done so that we could determine which news headlines people were exposed to prior to the experiment.

Participants then completed a reworded version of the original Frederick's (2005) CRT (via Shenhav, Rand, & Greene, 2012) and the four-item non-numeric CRT from Thomson and Oppenheimer (2016). The two versions were significantly correlated, $r(938) = .53$, and were combined into a single reliable scale of seven items. At the end, participants were asked about random responding, use of search engines, and whether they skipped through the familiarization stage.

Results

Illusory Truth Effect

Table 2 shows the differences between repeated and new statements in all seven studies; this difference was highly significant in all studies: Participants judged repeated information more often as true compared with new information. Effect size d was calculated with Dunlop, Cortina, Vaslow, and Burke's (1996) formula that takes into account the correlation between dependent variables in repeated measurement designs, $d = t_c\,[2(1 - r)/n]^{1/2}$ where t_c is the t statistic for correlated observations and r is the correlation between judgments of repeated and new information.

Table 2. Mean Truth Ratings for Repeated Information, New Information, Difference Score Between New and Repeated Information with Standard Deviation (*SD*) and Range, *t* Statistic for Correlated Observations and Degrees of Freedom (*df*), Level of Significance, and *d* for the Illusory Truth Effect in Studies 1 to 7.

	Repeated info	New info	Diff (*SD*) [Range]	t_c (*df*)	*p* <	*d*
Study 1	0.64	0.42	0.22 (0.29) [–0.70 to 0.80]	10.67 (206)	.001	1.15
Study 2	0.66	0.57	0.10 (0.28) [–0.50 to 0.80]	4.88 (199)	.001	0.45
Study 3	3.84	3.58	0.26 (0.31) [–0.60 to 1.33]	14.73 (299)	.001	0.58
Study 4	0.57	0.45	0.12 (0.22) [–0.33 to 0.73]	8.55 (230)	.001	0.61
Study 5	0.72	0.56	0.16 (0.29) [–0.60 to 0.80]	7.59 (198)	.001	0.77
Study 6	0.69	0.47	0.22 (0.35) [–0.60 to 1.00]	11.62 (335)	.001	0.99
Study 7	2.01	1.92	0.09 (0.48) [–1.50 to 1.92]	4.78 (722)	.001	0.17

Note. In Studies 1, 2, 4, 5, and 6, truth judgments were made dichotomously (*coded* 0 = *false*, 1 = *true*). In Studies 3 and 7, truth judgments were made on Likert-type scales (*coded* 1 = *certainly false*, 7 = *certainly true*, and 1 = *not at all accurate*, 4 = *very accurate*, respectively).

Illusory Truth Effect—Individual Differences

Preliminary analyses. Table 3 shows that the measures of the individual difference variables are reliable and show meaningful intercorrelations, which provide convergent validity of the measures. In particular, REI's measure of experiential thinking was strongly related to PID's measure of intuition, and REI's measure of rational thinking was strongly related to PID's measure of deliberation. In line with the dual process theory, the different self-report measures of experiential processing and analytic processing were not significant, or weakly related to each other. Furthermore, the CRT was significantly positively related to REI's measure of rational thinking, whereas both the self-reported and performance-based measures of rational thinking were significantly positively related to cognitive ability.

To examine whether the illusory truth effect is related to individual differences in cognitive ability, NFC, and cognitive styles, we computed a difference score between truth judgments of repeated statements and truth judgments of new statements, with higher values indicating a higher illusory truth effect. These differences scores (see Table 2) as well as the individual difference measures (see Table 3) had a sufficient range to allow meaningful correlations.

Main analyses. To maximize statistical power and precision, we conducted meta-analyses on the obtained effects. Therefore, bivariate correlations between the various individual difference variables and the illusory truth effect, operationalized

Table 3. Variable Means, Standard Deviations (*SD*), Ranges, Cronbach's Alpha, and Correlations of Individual Difference Measures in Studies 1 to 7.

Measure	*M* (*SD*)	Range	1	2	3	4
Study 1						
1. Fluid intel	18.16 (4.77)	7-33	—	—	—	—
2. NFC	3.47 (.65)	1.80-5.27	−.06	(.81)	—	—
3. REI: exp	4.85 (.99)	1.30-6.90	.09	−.03	(.82)	—
4. REI: rat	4.57 (.88)	2.00-6.90	.18***	−.07	−.01	(.89)
Study 2						
1. Verb intel	38.35 (8.85)	8-49	(.94)	—	—	—
Study 3						
1. PID: int	3.14 (.76)	1.00-5.00	(.85)	—	—	—
2. PID: del	3.94 (.54)	2.22-5.00	−.14*	(.81)	—	—
3. REI: exp	3.17 (.81)	1.20-4.95	.83***	−.12*	(.95)	—
4. REI: rat	3.72 (.73)	1.40-5.00	−.13*	.48***	−.05	(.94)
Study 4						
1. PID: int	3.02 (.80)	1.11-5.00	(.90)	—	—	—
2. PID: del	3.94 (.58)	1.44-5.00	−.16*	(.84)	—	—
3. REI: exp	3.20 (.59)	1.40-5.00	.66***	−.12	(.83)	—
4. REI: rat	3.41 (.73)	1.65-5.00	.02	.35***	.01	(.90)
Study 5						
1. verb intel	38.96 (8.35)	8-49	(.94)	—	—	—
2. CRT	4.41 (2.24)	0-7	.36***	(.80)	—	—
Study 6						
1. REI: exp	4.62 (1.12)	1-7	(.92)	—	—	—
2. REI: rat	5.18 (1.31)	1-7	.12*	(.95)	—	—
3. CRT	1.72 (1.22)	0-3	−.15**	.16**	(.77)	—
Study 7						
1. CRT	3.44 (2.12)	0-7	(.77)	—	—	—

Note. Fluid intel = fluid intelligence; NFC = need for cognitive closure; REI = Rational Experiential Inventory; REI: exp = REI: experiential; REI: rat = REI: rationality; verb intel = verbal intelligence; PID: preference for intuition and deliberation; PID: int = PID intuition; PID: del = PID: deliberation; CRT = Cognitive Reflection Test.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

as differences scores, were calculated.[3] The alternative method of using Repeated Measures analyses in which the interaction is tested between the individual difference variables and the within-subject truth rating of repeated information and truth rating of new information, are statistically equivalent, yielding identical results (see OSF page). We chose to use and report analyses based on the difference scores because these are easier to interpret, present a straightforward indication of the direction of the effects, and allow for straightforward meta-analyses. Figure 1 presents an overview of the individual results of each study, as well as frequentist meta-analytic integrations of these associations.

Cognitive ability. A measure of fluid intelligence was included in the lab experiment (Study 1), whereas a measure of verbal intelligence was administered in Studies 2 and 5. Bivariate correlation analyses revealed no significant associations between individual differences in either fluid or verbal intelligence and the effect size of the illusory truth effect (see Figure 1). A frequentist meta-analytic integration of the studies, using a DerSimonian-Laird approach with Metacor package (Laliberté, 2015) in *R*, provided no support for a significant association between general cognitive ability and the illusory truth effect (see Figure 1). To quantify the strength of evidence in favor of no relationship between cognitive ability and the illusory truth effect versus an association between cognitive ability and the illusory truth effect, a Bayesian meta-analysis was conducted with BayesFactor package (Morey, 2018) in *R*.[4] Results revealed a BF_{H0} of 20.97, suggesting that the data are 20.97 times more likely to have occurred under the null hypothesis (i.e., cognitive ability is not related to the illusory truth effect) than under the alternative hypothesis (i.e., bidirectional test: cognitive ability is related to the illusory truth effect).

NFC. Similar to fluid intelligence, an NFC measure was included in Study 1. Bivariate correlation analysis revealed no evidence for an association between NFC and the illusory truth effect (see Figure 1). Bayesian analysis favored the null hypothesis with a Bayes factor of $BF_{H0} = 10.51$.

Experiential processing. As measures of experiential processing, PID's preference for intuition measure was included in Studies 3 and 4, and the REI's experiential thinking style measure was included in Studies 1, 3, 4, and 6, leading to a total of six tests for the association between experiential processing and the illusory truth effect.

In both Studies 3 and 4, the relationship between PID's preference for intuition measure and the illusory truth effect was trivial and nonsignificant. The frequentist meta-analytic integration of both studies revealed no evidence for an association between PID's preference for intuition measure and the illusory truth effect (see Figure 1), and a Bayesian meta-analysis provided strong support for the null hypothesis, $BF_{H0} = 15.33$.

Similarly, REI's experiential thinking style measure was not significantly related to the illusory truth effect in Studies 3, 4, and 6. However, in Study 1, this relationship was positive and significant. A frequentist meta-analysis revealed an overall nonsignificant association between REI's experiential thinking style measure and the illusory truth effect (see Figure 1). In addition, a Bayesian meta-analysis strongly supported the null hypothesis, $BF_{H0} = 10.63$.

Analytic processing. As measures of analytic processing, PID's measure of preference for deliberation was included in Studies 3 and 4, the REI's rational thinking style measure was included in Studies 1, 3, 4, and 6, and the CRT was included in Studies 5 to 7, leading to nine separate tests for an association between individual differences in analytic processing and the illusory truth effect.

PID's measure of preference for deliberation was not significantly related to the illusory truth effect in both Studies 3

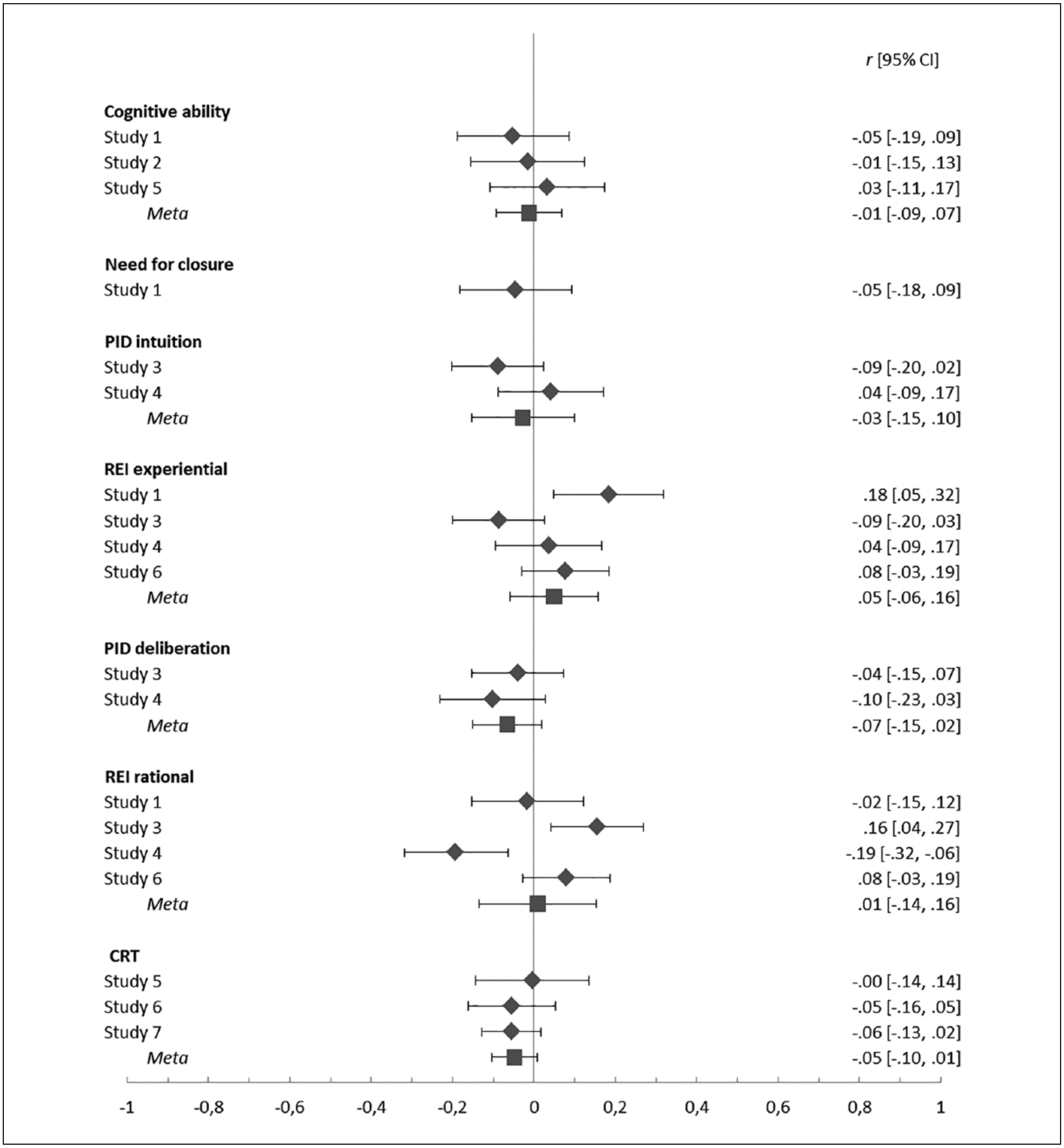

Figure 1. Bivariate correlation coefficients (*r*) and 95% confidence intervals (CI) for the relationship between individual differences and the illusory truth effect in Studies 1 to 7, and a meta-analytic integration (meta).
PID = preference for intuition and deliberation; REI = Rational Experiential Inventory; CRT = Cognitive Reflection Test.

and 4. The frequentist meta-analysis provided no support for an association between PID's measure of preference for deliberation (see Figure 1), and Bayesian meta-analysis supported the null hypothesis, $BF_{H0} = 6.52$.

Similarly, the REI's rational thinking measure was not significantly related to the illusory truth effect in Studies 1 and 6. However, this association was significant and positive in Study 3, and significant and negative in Study 4. Pooling the data, the frequentist meta-analysis revealed no significant association between REI's rational measure and the illusory truth effect (see Figure 1), and the Bayesian meta-analysis indicated that the null hypothesis was much more likely than the alternative hypothesis, $BF_{H0} = 21.04$.

Finally, also the associations between the behavioral measure of analytic processing, the CRT, and the effect size of the illusory truth effect were negligible and nonsignificant in Studies 5 to 7. Consequently, the frequentist meta-analysis revealed an effect size within a confidence interval that included 0 (see Figure 1). In addition, Bayesian meta-analysis favored the null hypothesis, $BF_{H0} = 7.81$.

General Discussion

The illusory truth effect, referring to people's tendency to believe repeated information more compared with new information, can have a profound impact on individuals (Brown & Nix, 1996) and society at large (Pennycook et al., 2018). Despite the theoretical and practical relevance of this effect, and its long research tradition, surprisingly little is known about individual differences that may influence people's susceptibility to the effect. The present research addressed this question, and investigated the influence of cognitive ability, need for closure, and cognitive thinking styles on the illusory truth effect in seven highly powered and systematic studies.

Previous research showed that these individual differences in cognition influence decision making and knowledge formation, and the integration of these different variables is in line with recent developments within the field (De keersmaecker, Bostyn, Fontaine, Van Hiel, & Roets, 2018; Pennycook, Fugelsang, & Koehler, 2015b; Roets et al., 2015; Stanovich et al., 2016). Building on this literature, the hypotheses followed that individuals with high levels of cognitive ability, due to better memory, and individuals high in NFC and experiential thinking, due to the reliance on easy cues in making judgments, would be more prone to the illusory truth effect, whereas individuals high in analytic thinking would be less inclined to judge repeated information as more true compared with new information.

However, various studies have suggested the robustness of the illusory truth effect. Indeed, the effect was found among the elderly (Dechêne et al., 2010), with statements that were politically discordant (Pennycook et al., 2018), with statements that individuals had no conscious memory of (Begg et al., 1992), with statements that individuals knew to be incorrect (Fazio et al., 2015; Unkelbach, 2007), and even in the presence of advice regarding the factual truth (both at encoding: Pennycook et al., 2018, and during judgment: Unkelbach & Greifeneder, 2018). As such, these studies suggested that the illusory truth effect is a relatively robust cognitive process, beyond the influence of cognitive ability, NFC, and specific cognitive thinking styles.

Across seven studies, the latter hypothesis was supported, and we found convergent evidence for the robustness of the illusory truth effect. In particular, in all seven studies, participants tended to believe repeated information more compared with new information, irrespective of the measured individual difference. In particular, pooling the data and using a meta-analytical approach, the illusory truth effect was not statistically significant related to individual differences in cognitive ability (Studies 1, 2, 5) or NFC (Study 1), nor was it related to two self-report measures of experiential processing (PID's preference for intuition: Studies 3, 4; REI's experiential processing: Studies 1, 3, 4, 6), or two self-report measures of analytic processing (PID's preference for deliberation: Studies 3, 4; REI's rational processing: Studies 1, 3, 4, 6). Also a behavioral measure of analytic processing, the CRT, did not relate in a meaningful way to the illusory truth effect (Studies 5 to 7). Moreover, (meta-analytic) Bayes factors strongly favored the null hypothesis over the alternative hypothesis regarding the associations between individual differences in cognition and the illusory truth effect.

In all studies, we relied on participants living in Western societies. Although we don't have a theoretical rationale to expect that the observed findings would be moderated by culture or society, we are not able to empirically test this possibility. Furthermore, six of our studies relied on samples collected through an open online platform (Mturk), and we were not able to monitor these participants during their participation. Nevertheless, it has been repeatedly demonstrated that running experiments through such online platforms can provide high-quality data (e.g., Buhrmester, Kwang, & Gosling, 2011; Horton, Rand, & Zeckhauser, 2011). Study 1 was conducted in the lab, which allowed a closer monitoring of the participants, although it should be acknowledged that these sessions tested 35 to 40 participants simultaneously.

The present results contribute to the referential theory and the processing fluency explanation of the illusory truth effect by showing that the use of coherently linked corresponding references and processing fluency in truth judgments is not related to individual differences in cognitive ability, need for epistemic security and different thinking styles. In particular, these novel findings are in line with the assertion that processing fluency is not a judgmental bias and flaw in the individual, but rather a cue to truth that is universal and epistemologically justified in most contexts (Reber & Unkelbach, 2010; Unkelbach & Greifeneder, 2013).

The consistent and strong emergence of the illusory truth effect in the present series of studies, and the relative lack of predictive value of individual differences in cognitive ability, need for epistemic security and cognitive styles, attests to the robustness of the effect. However, these findings do not necessarily mean that all individuals are equally prone to the illusory truth effect. Interesting in this regard is the work of Mitchell, Sullivan, Schacter, and Budson (2006), who found that the illusory truth effect for unknown trivia statements is less pronounced for individuals with a clinical diagnosis of Alzheimer's disease, who are characterized by specific cognitive and memory function impairment, compared with healthy individuals of the same age.

Given the importance and the strength of the illusory truth effect, we believe that a more advanced understanding of whether and how individual differences may moderate the effect is crucial. The current lack of scholarly attention to the investigation of individual differences in the illusory truth effect seems problematic, especially if this should be the result of publication bias against nonsignificant results. We believe that understanding which plausible variables do *not* affect the illusory truth effect, might be as informative as knowing which variables *do* influence the effect. In this regard, it is also important to understand why particular individual difference variables do or do not affect the overall illusory truth effect. Indeed, it may be possible that a particular variable has different effects on different aspects that are relevant for the illusory truth effect. For example, greater cognitive ability might increase the experience of fluency due to superior memory while having a negative effect on the reliance of fluency on judgments of truth. Although speculative at this point, testing such possibilities in adapted, more intricate experimental designs can provide further insight, not only into the role of individual differences but also into the mechanics behind the truth effect.

Another interesting avenue for future research would be to focus on individual differences that tap into implicit levels of cognition, such as implicit learning. The present series of studies focused on intelligence, epistemic needs, and cognitive styles. However, as argued by Kaufman et al. (2010), relative to explicit cognition, individual differences in implicit cognition is a neglected but potentially fruitful line of research for understanding human complex cognition, and might also further advance our understanding of how the truth effect operates.

Conclusion

In line with previous work, we found that individuals tend to believe repeated information more compared with new information. Across seven studies, this tendency was not reliably and substantially related to cognitive ability, NFC, experiential thinking, and both self-reported and performance-based measures of analytic thinking.

The absence of an association between these key individual difference variables in judgment and decision making and the illusory truth effect is theoretically intriguing, and raises the question about which alternative factors may underlie the observed variance of the illusory truth effect. Given the ease by which repetition can influence the perceived truth, and the potential power of misinformation, we hope that the present contribution will inspire other scholars to further examine the potential role of individual differences in the illusory truth effect, and we especially encourage them to also publish nonsignificant findings because the added value of these "non-relationships" are highly underestimated in the literature.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. Studies 2 and 5 were conducted while the manuscript was under first review, and were added in the revised version.
2. Based on the factor loadings of Pacini and Epstein (1999), the five most indicative items of Rational ability, Rational engagement, Experiential ability, and Experiential Engagement were selected.
3. Multiple regression coefficients with the simultaneous inclusion of all variables of each study yielded similar results and are available at OSF.
4. Bayes factors were calculated on *t* statistics with a scale factor of $\sqrt{2}\ /\ 2$ for the Cauchy prior (default option in BayesFactor).

Supplemental Material

Supplemental material is available online with this article.

ORCID iD

Gordon Pennycook https://orcid.org/0000-0003-1344-6143

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review*, *13*, 219-235.

Ammons, R. B., & Ammons, C. H. (1962). *Quick test*. Oxford, UK: Psychological Test Specialists.

Anderson, J. R. (1996). ACT: A simple theory of complex cognition. *American Psychologist*, *51*, 355-365.

Begg, I. M., Anas, A., & Farinacci, S. (1992). Dissociation of processes in belief: Source recollection, statement familiarity, and the illusion of truth. *Journal of Experimental Psychology: General*, *121*, 446-458.

Betsch, C. (2004). Präferenz für intuition und deliberation (PID) [Preference for intuition and deliberation]. *Zeitschrift Für Differentielle Und Diagnostische Psychologie*, *25*, 179-197.

Brown, A. S., & Nix, L. A. (1996). Turning lies into truths: Referential validation of falsehoods. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*, 1088-1100.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, *6*, 3-5.

Conway, A. R. A., Jarrold, C., Kane, M. J., Miyake, A., & Towse, J. N. (2007). *Variation in working memory*. New York, NY: Oxford University Press.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2010). The truth about the truth: A meta-analytic review of the truth effect. *Personality and Social Psychology Review*, *14*, 238-257.

De keersmaecker, J., Bostyn, D. H., Fontaine, J. R. J., Van Hiel, A., & Roets, A. (2018). Toward an integrated cognition perspective on ethnic prejudice: An investigation into the role of intelligence and need for cognitive closure. *Social Psychological and Personality Science*, *9*, 719-726.

De keersmaecker, J., Onraet, E., Lepouttre, N., & Roets, A. (2017). The opposite effects of actual and self-perceived intelligence on racial prejudice. *Personality and Individual Differences*, *112*, 136-138.

Dunlop, W. P., Cortina, J. M., Vaslow, J. B., & Burke, M. J. (1996). Meta-analysis of experiments with matched groups or repeated measures designs. *Psychological Methods*, *2*, 170-177.

Epstein, S. (1994). An integration of the cognitive and psychodynamic unconscious. *American Psychologist*, *49*, 709-724.

Evans, J. S. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology*, *59*, 255-278.

Evans, J.S., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, *8*, 223-241.

Fazio, L. K., Brashier, N. M., Payne, B. K., & Marsh, E. J. (2015). Knowledge does not protect against illusory truth. *Journal of Experimental Psychology: General*, *144*, 993-1002.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, *19*, 25-42.

Garcia-Marques, T., Silva, R. R., Reber, R., & Unkelbach, C. (2015). Hearing a statement now and believing the opposite later. *Journal of Experimental Social Psychology*, *56*, 126-129.

Hasher, L., Goldstein, D., & Toppino, T. (1977). Frequency and the conference of referential validity. *Journal of Verbal Learning and Verbal Behavior*, *16*, 107-112.

Hasher, L., & Zacks, R. T. (1984). Automatic processing of fundamental information: The case of frequency of occurrence. *American Psychologist*, *39*, 1372-1388.

Hertwig, R., Gigerenzer, G., & Hoffrage, U. (1997). The reiteration effect in hindsight bias. *Psychological Review*, *104*, 194-202.

Horton, J. J., Rand, D. G., & Zeckhauser, R. J. (2011). The online laboratory: Conducting experiments in a real labor market. *Experimental Economics*, *14*, 399-425.

Hunt, E. (2011). *Human intelligence*. New York, NY: Cambridge University Press.

Kahneman, D. (2011). *Thinking, fast and slow*. New York, NY: Farrar, Straus and Giroux.

Kaufman, S. B., DeYoung, C. G., Gray, J. R., Jiménez, L., Brown, J., & Mackintosh, N. (2010). Implicit learning as an ability. *Cognition*, *116*, 321-340.

Kelley, C. M., & Lindsay, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language*, *32*, 1-24.

Kersting, M., Althoff, K., & Jäger, A. O. (2008). *Wilde-intelligenz-test 2 (WIT-2)* [Wilde intelligence test 2 (WIT-2)]. Göttingen, Germany: Hogrefe.

Kruglanski, A. W. (1980). Lay epistemo-logic process and contents: Another look at attribution theory. *Psychological Review*, *87*, 70-78.

Kruglanski, A. W., & Webster, D. M. (1996). Motivated closing of the mind: "Seizing" and "freezing." *Psychological Review*, *103*, 263-283.

Kyllonen, P. C. (1996). Is working memory capacity Spearman's G? In I. Dennis & P. Tapsfield (Eds.), *Human abilities: Their nature and measurement* (pp. 49-75). Mahwah, NJ: Lawrence Erlbaum.

Laliberté, E. (2015). Package "metacor": Meta-analysis of correlation coefficients (Version 1.0-2). Retrieved from https://cran.r-project.org/web/packages/metacor/metacor.pdf

McGlone, M. S., & Tofighbakhsh, J. (2000). Birds of a feather flock conjointly (?): Rhyme as reason in aphorisms. *Psychological Science*, *11*, 424-428.

McGrew, K. S. (2005). The Cattell-Horn-Carroll theory of cognitive abilities. In D. P. Flanagan & P. L. Harrison, *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 136-181). New York, NY: Guilford Press.

Mitchell, J. P., Sullivan, A. L., Schacter, D. L., & Budson, A. E. (2006). Misattribution errors in Alzheimer's disease: The illusory truth effect. *Neuropsychology*, *20*, 185-192.

Morey, R. D. (2018). BayesFactor: Computation of Bayes factors for common designs (Version 0.9.12-4.2). Retrieved from https://rdrr.io/cran/BayesFactor/

Pacini, R., & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology*, *76*, 972-987.

Pennycook, G., Cannon, T., & Rand, D. G. (2018). Prior exposure increases perceived accuracy of fake news. *Journal of Experimental Psychology: General*, *147*, 1865-1880.

Pennycook, G., Cheyne, J. A., Barr, N., Koehler, D. J., & Fugelsang, J. A. (2014). Cognitive style and religiosity: The role of conflict detection. *Memory & Cognition*, *42*, 1-10.

Pennycook, G., Cheyne, J. A., Koehler, D. J., & Fugelsang, J. A. (2016). Is the cognitive reflection test a measure of both reflection and intuition? *Behavior Research Methods*, *48*, 341-348.

Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015a). What makes us think? A three-stage dual-process model of analytic engagement. *Cognitive Psychology*, *80*, 34-72.

Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015b). Everyday consequences of analytic thinking. *Current Directions in Psychological Science*, *24*, 425-432.

Pennycook, G., Ross, R. M., Koehler, D. J., & Fugelsang, J. A. (2017). Dunning-Kruger effects in reasoning: Theoretical implications of the failure to recognize incompetence. *Psychonomic Bulletin & Review*, *24*, 1774-1178.

Peters, E., Hess, T. M., Västfjäll, D., & Auman, C. (2007). Adult age differences in dual information processes: Implications for the role of affective and deliberative processes in older adults' decision making. *Perspectives on Psychological Science*, *2*, 1-23.

Pretz, J. E. (2008). Intuition versus analysis: Strategy and experience in complex everyday problem solving. *Memory & Cognition*, *36*, 554-566.

Reber, A. S. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General*, *118*, 219-235.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness and Cognition*, *8*, 338-342.

Reber, R., & Unkelbach, C. (2010). The epistemic status of processing fluency as source for judgments of truth. *Review of Philosophy and Psychology*, *1*, 563-581.

Roets, A., Kruglanski, A. W., Kossowska, M., Pierro, A., & Hong, Y. (2015). The motivated gatekeeper of our minds: New directions in need for closure: Theory and Research. *Advances in Experimental Social Psychology*, *52*, 221-283.

Roets, A., & Van Hiel, A. (2007). Separating ability from need: Clarifying the dimensional structure of the need for closure scale. *Personality and Social Psychology Bulletin*, *33*, 266-280.

Roets, A., & Van Hiel, A. (2008). Why some hate to dilly-dally and others do not: The arousal-invoking capacity of decision-making for low- and high-scoring need for closure individuals. *Social Cognition*, *26*, 333-346.

Roets, A., & Van Hiel, A. (2011). Item selection and validation of a brief, 15-item version of the need for closure scale. *Personality and Individual Differences*, *50*, 90-94.

Schacter, D. L. (1987). Implicit memory: History and current status. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *13*, 501-518.

Shenhav, A., Rand, D. G., & Greene, J. D. (2012). Divine intuition: Cognitive style influences belief in God. *Journal of Experimental Psychology: General*, *141*, 423-428.

Stanovich, K. E., West, R. F., & Toplak, M. E. (2016). *The rationality quotient: Toward a test of rational thinking*. Cambridge, MA: MIT press.

Thomson, K. S., & Oppenheimer, D. M. (2016). Investigating an alternative form of the cognitive reflection test. *Judgment and Decision Making*, *11*, 99-113.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition*, *39*, 1275-1289.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2014). Assessing miserly information processing: An expansion of the cognitive reflection test. *Thinking & Reasoning*, *20*, 147-168.

Underwood, B. J. (1975). Individual differences as a crucible in theory construction. *American Psychologist*, *30*, 128-134.

Unkelbach, C. (2007). Reversing the truth effect: Learning the interpretation of processing fluency in judgments of truth. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*, 219-230.

Unkelbach, C., & Greifeneder, R. (2018). Experiential fluency and declarative advice jointly inform judgments of truth. *Journal of Experimental Social Psychology*, *79*, 78-86.

Unkelbach, C., & Greifeneder, R. (2013). A general model of fluency effects in judgment and decision making. In C. Unkelbach & R. Greifeneder (Eds.), *The experience of thinking: How the fluency of mental processes influences cognition and behavior* (pp. 11-32). New York, NY: Psychology Press.

Unkelbach, C., & Rom, S. C. (2017). A referential theory of the repetition-induced truth effect. *Cognition*, *160*, 110-126.

Van Hiel, A., Onraet, E., Crowson, H., & Roets, A. (2016). The relationship between right-wing attitudes and cognitive style: A comparison of self-report and behavioral measures of rigidity and intolerance of ambiguity. *European Journal of Personality*, *30*, 523-531.

Wang, W. C., Brashier, N. M., Wing, E. A., Marsh, E. J., & Cabeza, R. (2016). On known unknowns: Fluency and the neural mechanisms of illusory truth. *Journal of Cognitive Neuroscience*, *28*, 739-746.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063-1070.

Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*, 1049-1062.