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Fluency and positivity as possible causes of the truth effect

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ABSTRACT

Statements' rated truth increases when people encounter them repeatedly. Processing fluency is a central variable to explain this truth effect. However, people experience processing fluency positively, and these positive experiences might cause the truth effect. Three studies investigated positivity and fluency influences on the truth effect. Study 1 found correlations between elicited positive feelings and rated truth. Study 2 replicated the repetition-based truth effect, but positivity did not influence the effect. Study 3 conveyed positive and negative correlations between positivity and truth in a learning phase. We again replicated the truth effect, but positivity only influenced judgments for easy statements in the learning phase. Thus, across three studies, we found positivity effects on rated truth, but not on the repetition-based truth effect: We conclude that positivity does not explain the standard truth effect, but the role of positive experiences for truth judgments deserves further investigation.

1. Introduction

"62,400 repetitions make one truth!" Aldous Huxley, *Brave New World*

When people hear or see statements repeatedly, their subjective belief increases that these statements are true. For example, when people hear the statement "In Malaya, if a man goes to jail for being drunk, his wife goes too." a second time, their rating of this statement's veridicality increases (Hasher, Goldstein, & Toppino, 1977). This "truth effect" is a robust psychological phenomenon (Bacon, 1979; see review by Dechêne, Stahl, Hansen, & Wänke, 2010). Processing fluency, in this case, the experienced ease with which statements are processed, has been suggested as one of the truth effect's determinants (Reber & Schwarz, 1999; Unkelbach, 2007; Unkelbach & Stahl, 2009); when people hear or see statements repeatedly, these statements are more fluently processed than new statements. However, processing fluency is also a source of positive experiences (e.g., Reber, Winkielman, & Schwarz, 1998; Winkielman & Cacioppo, 2001; see Reber, Schwarz, & Winkielman, 2004, for a review), and people might judge statements as true due to these positive experiences, and not due to processing fluency per se. The present research investigates fluency and positivity as possible determinants of the truth effect.

1.1. What causes the truth effect?

Arkes, Boehm, and Xu (1991) discussed two reasons why repetition leads to judged truth: referential validity and familiarity. If statements are remembered, memory acts as a reference, and this reference leads to higher truth ratings (see also

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Brown & Nix, 1996). The present research's focus is the second, non-referential part of the truth effect (Begg, Anas, & Farinacci, 1992).

To explain the non-referential part, Reber and Schwarz (1999) were the first to test the idea that repetition increases statements' processing fluency, leading to an increase in rated truth. They presented statements in colors of varying contrast, which made them easy or difficult to process, without actual repetition. Indeed, easily processed statements were judged to be true with greater likelihood than difficultly processed statements. The authors argued that fluency influences truth judgments just as processing fluency also influences feelings of familiarity (Whittlesea, Jacoby, & Girard, 1990) and feelings of knowing (Koriat, 1993).

Building on a Brunswikian cue-learning framework (Brunswik, 1957; Brunswik & Kamiya, 1953), Unkelbach (2007) then argued that processing fluency is a proximal cue that people use to judge distal, otherwise non-accessible criteria such as truth, because processing fluency is an ecologically valid cue. People use fluency because they learn that there is an environmentally positive correlation between truth and fluency (Reber & Unkelbach, in press; Unkelbach, 2006).

It is important to note that the Brunswikian perspective does not define whether the truth effect is implicit/automatic or explicit/controlled: Similar as converging lines on a piece of paper convey a sense of depth (depth is another visually inaccessible criterion that needs to be inferred from proximal cues), fluency and/or positivity may convey a sense of truth. The immediate experience is based on automatic perception-like processes; however, people can control the influence or interpret the fluency experience differently. Just as people *know* that the sense of depth caused by two converging lines is misleading, they might know that the feeling of truth is misleading; however, the experience itself stays, although people do not have to act upon it.

Building on this Brunswikian perspective, Unkelbach and Stahl (2009) then formalized a comprehensive multinomial model that included as determinants of judged truth knowledge about the topic, source recollection, differential fluency due to truth, differential fluency due to prior presentation, and guessing. The validity of the model's assumptions and the model parameters' expected reactions were demonstrated in two experiments. However, these experiments also revealed a weakness in the theorizing about the truth effect. The assumed ecological correlation between fluency and truth could be omitted completely if people judge positively experienced statements as true, similar to judged familiarity of sympathetic faces (Monin, 2003), or false memory for words associated with positive experiences (Garcia-Marques, Mackie, Claypool, & Garcia-Marques, 2004). As processing fluency leads to positive experiences (Reber et al., 1998; Zajonc, 1968), people might use statements' increased positivity to judge truth. Here, we will test whether positivity has similar effects on judged truth as it has on familiarity and recognition, and thus might be the central variable for explaining the non-referential part of the truth effect.

1.2. Theoretical and practical clarifications

We use "positivity" to refer to the subjective experience of positive feelings elicited by statements. For example, the statement "All sledge dogs survived on Shackleton's polar expedition" should elicit more positive feelings than the statement "All sledge dogs died on Shackleton's polar expedition". Thus, we use positivity to refer to positive feelings as we use the term fluency to refer to subjective experiences of processing ease.

However, to be dissociable, positivity and fluency must not be identical. This idea is presented by Mandler, Nakamura, and Van Zandt (1987), and elaborated by Schwarz (2010; see also Skurnik, Schwarz, & Winkielman, 2000; Unkelbach, 2006). According to this account, fluency experiences have different meanings in different contexts. Depending on the context, fluency leads to increased judged liking (i.e., to a positive experience; Reber et al., 1998), but also to increased brightness/darkness judgments (Mandler et al., 1987), and even to judged falseness (Unkelbach, 2007). In most cases, the context is provided by the judgment task, but also by expectancies or lay theories.

Yet, many studies suggest that positive experiences are an integral part of processing fluency (Winkielman & Cacioppo, 2001) – given that, we have to reframe the claim and ask whether processing fluency has an impact of truth independent from the positive experience associated with fluency. This would be similar to asking whether it is not an emotion's valence that causes an effect, but the associated arousal (which can be caused by very positive and very negative emotions; see Lang, Bradley, & Cuthbert, 2005).

In the remainder, we present three studies testing the impact of statement positivity and repetition-based processing fluency on truth judgments. Study 1 will investigate if statement positivity influences rated truth by manipulating statement valence. Study 2 will employ a standard truth paradigm, but with positive and negative statements. Study 3 will employ a cue-learning paradigm, investigating whether people can learn positivity as cue to judge truth.

2. Study 1

We manipulated statement valence by content; participants saw 60 statements which were all factually false in either a positive or a negative version, thereby controlling for semantic content, following a method by Ortony, Turner, and Antos (1983). For each statement, they rated truth, valence, elicited feelings, familiarity, memory for supporting facts, and relevance. If positivity influences rated truth, there are two possibilities: (1) a valence main effect – positive statements receive higher truth ratings than their negative alternatives, or (2), a truth-positivity correlation within participants – participants rate more positive statements as more true.

2.1. Method

2.1.1. Materials

We created 60 fictitious statements in a positive and negative statement alternative; both alternatives were matched with respect to content, length, and syntax, but differed markedly in their evaluative tone and connotative meaning (see Ortony et al., 1983). Examples are: "Each year over 100 people succeed (die) attempting to climb the 6163 m of Mount Chunasla", or "The divorce rate in Grenada is lower (higher) than in the rest of Spain."

We compiled a computer program that presented statements at the top of the screen with six horizontal rating bars below. The first rating was "How likely is this statement true?". The following ratings asked: "Do you find the content of the statement positive or negative?", "Does this statements create a good or a bad feeling?", "Does this statement feel familiar?", "Do you know facts supporting or contradicting this statement?", and "How relevant is the statement for you?". The endpoints of the rating bars were labeled accordingly.

2.1.2. Participants and design

Fifty Universität Heidelberg students participated for course credit (43 female, 7 male). Statement valence varied within participants: half of the statements were presented randomly as positive alternatives and the remaining half as negative alternatives. In addition, we manipulated one control variable: The truth rating bar's labels remained fixed for all participants, but the remaining rating bars' labels were switched for half the participants. Thus, half the participants had to move all cursor-positions in the same directions to rate statements for example to be very true and very positive (i.e., to the right side). The remaining half had to move the cursor-position into the opposite direction to indicate positive valence, familiarity, and so forth, but the cursor-position for truth would remain on the right side.

2.1.3. Procedure

Participants arrived in groups of up to three. The experimenter seated them in individual computer-equipped cubicles and started the experiment. Instructions informed participants that they should judge a large number of statements according to six criteria (i.e., truth, valence, feeling, familiarity, factual support, and relevance). It was stressed that the study was concerned with their subjective assessment. If they had no more questions, they started with the ratings. Each statement appeared at the top of the screen, with the six questions and the respective rating bars below. For half of the participants, the labels for the last five questions were switched as described above. Everything remained on screen until participants clicked a "Continue" – button. Then, the statement and rating scales disappeared and after a 1 s interval, the next statement appeared. Statement order was randomized anew for each participant and on each trial it was randomly determined whether a positive or negative statement alternative would follow. Upon completing the ratings, the experimenter thanked and debriefed participants.

2.2. Results

We dropped seven non-native German speaking participants from the data set, leaving 43 participants in the analysis.[1] The rating range was from 0 to 100 and higher numbers indicate higher values on the criterion. For significant effects, we report the respective *p*-values and for comparisons with one numerator-*df* we report d^*, which is Cohen's *d* corrected for sampling error (Rosenthal, 1994; Thompson, 2002).

We computed participants' mean ratings separately for positive and negative statements. Valence and feeling ratings were analyzed using a 2 (label switch: normal vs. switched) by 2 (statement valence: positive vs. negative) ANOVA, with repeated measures on the latter factor. Positive statements were clearly rated more positive ($M = 73.35$, $SD = 7.08$) than negative statements ($M = 21.97$, $SD = 8.26$), $F(1, 41) = 579.30$, $p < .001$, $d^* = 7.41$. The same was true for elicited feelings. Positive statement elicited more positive feelings ($M = 65.68$, $SD = 7.73$) than negative statements ($M = 27.22$, $SD = 9.89$), $F(1, 41) = 250.40$, $p < .001$, $d^* = 4.87$. Switching scale labels' positions had no effects, all *F*s < 1.8, *ns*.

Having established that statements were perceived as positive and negative, and that they elicit the respective feelings, we compared positive and negative statements' truth ratings. Across participants, however, positive statements were not rated more true ($M = 54.22$, $SD = 6.64$) than negative statements ($M = 53.06$, $SD = 7.75$), $F(1, 41) = 1.82$, *ns*. Yet, the crucial variation for the truth effect is the perceived differential between old and new statements (Dechêne, Stahl, Hansen, & Wänke, 2009). Thus, a strong test is provided by the correlation between rated positivity/positive feeling and rated truth within participants.

We therefore computed correlations between rated truth and rated valence within participants across 60 statements. The mean correlation between rated valence and rated truth was small ($M = .063$, $SD = .146$), but significant, $t(42) = 2.81$, $p < 01$. The mean correlation between rated feeling elicited by a statement and rated truth was also small ($M = .073$, $SD = .144$), but again, significantly different from zero, $t(42) = 3.31$, $p < .01$. These correlations are done across positive and negative statements, but for negative statements, "more positive" actually means "less negative". Thus, we repeated the analysis

[1] For all reported experiments, we excluded non-native speakers from data analyses for obvious reasons: If statement comprehension is difficult to begin with, effects of fluency and positivity are more difficult to observe. However, including the respective data in the analysis does not alter the results.

separately for positive and negative statements. For positive statements, we found highly significant correlations with truth, both for valence ($M = .155$, $SD = .185$) and elicited feeling ($M = .226$, $SD = .225$), both $ts(42) > 5.00$, $ps < .001$. For negative statements, no such relations emerged for valence ($M = -.001$, $SD = .180$), and even reversed for elicited feelings ($M = -.079$, $SD = .152$), $t(42) = -3.40$, $p < .01$.

2.3. Discussion

Participants classified statements clearly as positive and negative and reported the adequate feelings response. Yet, there was mixed evidence for a relation between positivity and rated truth. There was no main effect of valence on truth ratings, that is, positive statements were not rated to be truer than negative statements. However, within participants, participants judged more positive statements and statements that elicited more positive feelings as more true. These correlations were largely caused by positive statements; there were basically no or even slightly reversed correlations for negative statements. This makes complete sense, as negative statements would elicit no positive feelings, but only less negative feelings. Thus, Study 1 shows a reliable tendency to rate positively experienced statements as more true. Study 2 will investigate whether this statement valence influence is found in a repetition-based truth study.

3. Study 2

Study 2 uses a standard setup for a truth experiment, as for example reported by Begg and colleagues (1992); in their experiments, participants saw an initial presentation of statements. After a filler task, participants judged statements in a second presentation round; half were "old", that is, from the initial presentation, and half were "new", that is, they had not appeared in the experimental session before. Typically, old statements are rated to be truer or judged to be true with higher probability than new statements.

The present experiment deviates in two points from the standard design. First, statements included the clearly valenced statements from Study 1. Second, we included an instruction manipulation from Unkelbach and Stahl (2009, Exp. 2): Participants received three different instructions before the second presentation: (1) that the first phase contained only *true* statements, (2) that the first phase contained only *false* statements, or (3) no information about the statements' truth status.

These instructions served as the context in which fluency was interpreted: when told that all *old* statements are *true* (*false*), then any cue that suggests a statement is *old* can be used to infer that the statement is *true* (*false*). For positivity, this leads to the following predictions: If repeated statements are experienced positively, then statement positivity is a cue that suggests that the statement is old. This cue can then be used to infer that the statement is true (in the "old = true" condition) or false (in the "old = false" condition). Critically, this prediction also extends to new statements: If "positive" signals "old", then positive new statements should be judged true in the "old = true" condition, and judged false in the "old = false" condition.

The main dependent variable was the mean probability to judge a statement as true. We used the positive/negative statements from Study 1 and the neutral statements from Unkelbach and Stahl (2009).

3.1. Method

3.1.1. Participants and design

Fifty-nine Universität Heidelberg students (46 female, 13 male) participated for partial course credit and were randomly assigned to one of the three instruction versions ("old = true" vs. "old = false" vs. no information provided).

3.1.2. Materials

We used 120 statements for this experiment. Sixty were neutrally rated statements from previous experiments (Unkelbach & Stahl, 2009), of which 30 were factually true and 30 were factually false. These statements have been extensively pretested to assure that most people do not know their factual truth status. Examples of true statements are "The protein Fibrinogen is synthesized in the human liver." or "A Wobbler is a bait used for fishing." False statements are "The Pentameter is the metre of classical Greek compositions." or "It is mathematically impossible to prove the Four-Colors-Theorem." The remaining 60 statements were those from Study 1; each participant was randomly assigned 30 positive and 30 negative statements.

3.1.3. Procedure

Experimental sessions included up to four participants. In the first phase, the program presented 60 randomly selected statements. The selection was done under the constraints that 15 factually true and 15 factually false statements were presented along with 15 positive and 15 negative statements (all false). Statements were onscreen for 3.5 s with a 1 s break between statements. Presentation order was randomized. Then, participants did a filler task for 15 min. The following judgment phase presented 120 statements in a random sequence; these 120 statements consisted of 30 true, 30 false, 30 positive, and 30 negative statements; half were present at the initial phase and thus old and the remaining half was new. Before the judgment phase and depending on the instruction condition, participants were informed that "...all statements of the earlier presentation were true (false)"; in the control condition, no information about the initial presentation was provided. Participants judged truth by pressing one of two clearly marked keys ("true" vs. "false"). Key assignment was

Table 1
Mean probabilities from Experiment 2 to judge a statement "true" as a function of statement status and instruction about old statements (standard deviations in parentheses).

Instruction	Statement status	Neutral (factually true)	Neutral (factually false)	Positive (factually false)	Negative (factually false)
"Old = true"	Old	.813 (.238)	.804 (.152)	.791 (.217)	.809 (.208)
	New	.307 (.192)	.289 (.216)	.267 (.221)	.316 (.242)
"Old = false"	Old	.148 (.122)	.193 (.155)	.152 (.151)	.144 (.150)
	New	.548 (.209)	.611 (.160)	.593 (.222)	.622 (.166)
Control	Old	.752 (.185)	.722 (.230)	.693 (.207)	.722 (.227)
	New	.378 (.210)	.393 (.193)	.411 (.200)	.463 (.238)

counterbalanced. The program recorded the responses and response latencies. Finally, experimenters thanked and thoroughly debriefed participants.

3.2. Results

Eight non-native speakers were removed before analyses. Fifteen participants remained in the "old = true", 18 participants in the "old = false", and 18 participants in the control condition.

3.2.1. Manipulation checks

Next, we established that old statements could be processed faster than new statements by analyzing the response latencies.[2] Overall, participants responded faster to old ($M = 2543$, $SD = 788$) than to new statements ($M = 3436$, $SD = 859$), $F(1, 48) = 159.44$, $p < .001$, $d^* = 3.60$. This pattern might come about artificially because instructions allowed fast decision based on recognition. Therefore, we also analyzed the control condition separately and the effect was even stronger, ($M_{old} = 2680$, $SD = 782$ vs. $M_{new} = 3574$, $SD = 782$), $F(1, 17) = 124.75$, $p < .001$, $d^* = 5.30$. Having established that prior presentation led to faster processing, Table 1 presents the mean probabilities to judge statements as "true" as a function of instruction provided. To simplify the analysis, we report the results for neutral statements and positive/negative statements separately.

3.2.2. Positive and negative statements

We analyzed the means from Table 1 using a 2 (statement valence: positive vs. negative) × 2 (repetition status: old vs. new) × 3 (instruction: "old = true" vs. "old = false" vs. no information) ANOVA with repeated measures on the first two factors.[3] This ANOVA showed no effect of statement valence, nor any valence interactions with repetition or instructions.

However, the analysis showed a standard truth effect; participants judged old statements "true" with higher probability ($M = .537$, $SD = .348$) than new statements ($M = .454$, $SD = .247$), $F(1, 48) = 6.49$, $p < .05$, $d^* = 0.67$. This effect was qualified by an interaction: In the "old = true" condition, participants judged old statements "true" with higher probability ($M = .800$, $SD = .204$) than new statements ($M = .316$, $SD = .242$). This pattern was reversed for participants in the "old = false" condition, ($M_{old} = .148$, $SD = .622$ vs. $M_{new} = .622$, $SD = .166$), $F(1, 31) = 99.61$, $p < .001$, $d^* = 3.51$. The control condition showed only the standard truth effect ($M_{old} = .707$, $SD = .215$ vs. $M_{new} = .437$, $SD = .218$), $F(1, 17) = 11.94$, $p < .01$, $d^* = 1.55$.

3.2.3. Neutral statements

We analyzed the neutral statements from Table 1 using a 2 (repetition status: old vs. new) × 2 (factual truth: true vs. false) × 3 (instruction) ANOVA with repeated measures on the first two factors. This analysis also shows a truth effect; overall, participants judged old statements "true" with higher probability ($M = .558$, $SD = .341$) than new statements ($M = .428$, $SD = .226$), $F(1, 48) = 15.00$, $p < .001$, $d^* = 1.07$. This repetition effect was also qualified by an interaction with the instruction factor. Participants in the "old = true" condition were more likely to judge old statements "true" ($M = .809$, $SD = .183$); they also were more likely to judge new statements "false" ($M = .298$, $SD = .197$). Conversely, participants in the "old = false" condition were more likely to judge old statements "false" ($M = .170$, $SD = .125$) and new statements, to a lesser extent, "true" ($M = .580$, $SD = .175$), $F(1, 31) = 94.93$, $p < .001$, $d^* = 3.42$.

We also replicated Unkelbach and Stahl (2009, Exp. 2), as the instructions interacted with statements' factual truth status: Participants in the "old = true" condition judged factually true statements with higher probability as "true" than factually false statements ($M_{true} = .560$, $SD = .127$ vs. $M_{false} = .547$, $SD = .125$). Participants in the "old = false" showed the reverse pattern ($M_{true} = .348$, $SD = .117$ vs. $M_{false} = .402$, $SD = .081$), $F(1, 31) = 4.42$, $p < .05$, $d^* = 0.65$. In other words, participants applied the instructions about the "oldness" of statement to their factual truth status. This experienced equivalence of repetition and truth was the main argument in Unkelbach and Stahl (2009) to prove that people cannot distinguish between fluency due to truth and fluency due to repetition.

[2] Response latencies are commonly used to index processing fluency, although the relation between objective measures of processing speed and the subjective fluency experience is far from perfect (see Reber, Wurtz, & Zimmermann, 2004).

[3] For the use of standard ANOVA algorithms instead of logistic regression, see Lunney (1970).

The control condition showed only the standard truth effect. Participants judged old statements as true ($M = .737$, $SD = .187$) and new statements as false ($M = .385$, $SD = .198$), $F(1, 17) = 26.26$, $p < .001$, $d^{*} = 2.36$, all other Fs < 1, *ns*.

3.3. Discussion

The present experiment found neither a valence main effect nor a valence interaction with instructions. While arguments resting on null results are problematic, it is important that we replicated the standard truth effect. In addition, participants applied the instructions symmetrically; when instructed that "old = true" they also judged new statements as "false" and when instructed that "old = false", they judged new statements as true. This symmetrical pattern is predicted by differential in processing fluency accounts of the truth effect (Dechêne et al., 2009; Hansen, Dechêne, & Wänke, 2008).

Moreover, the experiment replicated the results from Unkelbach and Stahl (2009, Exp. 2) that people cannot distinguish between fluency due to truth and fluency due to repetition. Although there was no main effect for factual truth status (i.e., participants could not distinguish between factually true and false statements), judgments about true and false statements were differentially influenced by the instructions. Given that true statements are easier to process due to coherence and prior exposure (Reber & Unkelbach, in press). And people learn that processing fluency indicates falsehood (i.e., because all old statements are false), they judge factually false statements (that are harder to process) as true and factually true statements (that are easier to process) as false.

In summary, Study 2 replicated the truth effect and provided further evidence that people cannot distinguish between fluency due to truth and fluency due to repetition. However, there was no support for positivity influences on truth judgments. Nevertheless, it is possible that the instruction manipulation and the close succession of presentation and judgment phase prevented influences of valence on judged truth. As recognition memory was high, evinced by the interaction of statements' old-new status and the instruction manipulation, participants might not have relied on statement valence. To address this possibility, Study 3 created a context in which valence is useful as a cue to judge statements' truth.

4. Study 3

Study 3 used a paradigm reported in Unkelbach (2007). The author had participants re-learn the interpretation of processing fluency in the context of truth ratings. In one experiment, participants judged very easy statements ("A day has 24 h", "Gold is lighter than Aluminum") and received feedback about the correctness of their judgments. For some participants, true statements were presented in high-contrast colors and false statements in low-contrast colors. Then, in a test phase, they judged repeated and new statements of identical contrast. After learning that high contrast (i.e., high fluency) indicates truth and low contrast (i.e., low fluency) falsehood, participants judged repeated statements as true and new statements as false (i.e., the standard truth effect); conversely, after learning that high contrast indicates falsehood and low contrast veridicality, participants judged repeated statements as false and new statements as true (i.e., a reversed truth effect, as observed here in Study 2 with explicit instructions), showing the equivalence of repetition and color-contrast.

In Study 3, we adapted this paradigm. After the same presentation phase as in Study 2, participants read 60 very easy statements of clear valence. In a *positive = true* condition, 30 positive statements were true and 30 negative statements were false. In a *positive = false* condition, 30 positive statements would be false and 30 negative statements would be true. And in a *control* condition, valence and truth would be orthogonal (i.e., 15 positive/true, 15 positive/false, 15 negative/true, and 15 negative/false statements).

If positivity contributes to the truth effect, as suggested by Study 1, people should be able to learn and re-learn the interpretation of positivity. There are two possible effects: First, participants should judge positive and negative *new* statements in the test phase according to the correlation they learned in the training phase. Second, if repetition increases positivity, participants' tendency to judge *old* statements as true should also depend on the correlation in the training phase (i.e., old = -positive = false or old = positive = true).

4.1. Method

4.1.1. Participants and design

Forty-nine Universität Heidelberg students (29 female, 20 male) participated for payment of 5 Euro. They were randomly assigned either to the *positive = true*, *positive = false*, or the control condition. Statement status (old vs. new and positive vs. negative and true vs. false) in the test phase was manipulated within participants.

4.1.2. Materials

The same statements as in Study 2 were used. For the training phase, we created 60 new easy statements, half positive and half negative; statements existed in true and false versions. Examples of positive-true statements are "Paris is called the city of love" or "Walt Disney invented the comic character Mickey Mouse". Their false counterparts are "Rome is called the city of love" and "Andy Warhol invented the comic character Mickey Mouse". Examples of negative-true statements are "The Bubonic plague is also called the Black Death" and "Tsunamis are caused by seaquakes". The false counterparts are "The Bubonic plague is also called the Brown Death" and "Tsunamis are caused by hurricanes".

4.1.3. Procedure

Experimental sessions included up to four participants. The presentation phase was identical to Study 2. After a 20 min filler task, participants started the learning phase, in which they judged 30 positive and 30 negative statements. Depending on condition, these positive/negative statements were all true/false, or half were true and half were false. The program provided feedback after each judgment. The test phase followed immediately and was identical to Study 2: Participants judged 120 statements, presented in a new random order for each participant. These statements again constituted the within-participants manipulation of positive vs. negative or true vs. false statements by old/new status. After judging these 120 statements, participants were thanked, debriefed and paid.

4.2. Results

We dropped data from five non-native speakers. There were 15 participants in the *positive = true*, 13 in the *positive = false*, and 16 in the control condition. The main dependent variable is again the mean probability of judging a statement as true.

4.2.1. Manipulation checks

In the *positive = true* condition's training phase, participants judged almost all positive statements ‘‘true’’ ($M = .913$, $SD = .075$) and almost no negative statements ($M = .158$, $SD = .101$). The *positive = false* condition showed the reverse pattern; almost all negative statements were judged ‘‘true’’ ($M = .910$, $SD = .080$), and almost no positive statements ($M = .133$, $SD = .090$). Interestingly, in the control condition, participants judged positive statements with higher probability ‘‘true’’ ($M = .580$, $SD = .394$) than negative statements ($M = .540$, $SD = .380$), $t(15) = 2.29$, $p < .05$, $d^* = 1.02$.

In the test phase, participants responded faster to old statements ($M = 2594$, $SD = 627$) than to new statements ($M = 3282$, $SD = 460$), $F(1, 41) = 198.74$, $p < .001$, $d^* = 4.34$. Having established this processing advantage, Table 2 presents the mean probabilities of classifying statements as ‘‘true’’. As in Study 2, we report separate analyses for neutral true vs. false and the positive vs. negative statements.

4.2.2. Positive and negative statements

We analyzed the means from Table 2 using a 2 (statement valence: positive vs. negative) × 2 (repetition status: old vs. new) × 3 (training condition: *positive = true*, *positive = false*, *control*) ANOVA with repeated measures on the first two factors. There was no statement valence main effect nor did valence interact with the training condition. However, the ANOVA shows the standard truth effect: Old statements were judged to be true with higher probability ($M_{old} = .695$, $SD = .241$ vs. $M_{new} = .508$, $SD = .152$), $F(1, 41) = 38.04$, $p < .001$, $d^* = 1.88$.

4.2.3. Neutral statements

We analyzed the mean probabilities for the neutral statements using a 2 (repetition status: old vs. new) × 2 (factual truth: true vs. false) × 3 (training condition: *positive = true*, *positive = false*, *control*) ANOVA with repeated measures on the first two factors. This analysis also showed the standard truth effect. Participants judged old statements ‘‘true’’ with higher probability ($M = .701$, $SD = .231$) than new statements ($M = .540$, $SD = 168$), $F(1, 41) = 28.69$, $p < .001$, $d^* = 1.62$. In addition, participants judged factually true statements ‘‘true’’ with higher probability ($M = .642$, $SD = .209$) than factually false statements ($M = .600$, $SD = 223$), $F(1, 41) = 6.95$, $p < .05$, $d^* = 0.91$. As discussed in Unkelbach and Stahl (2009), these neutral statements were designed so that participants did not *know* the factual truth status, but could process true statement more easily than false statements. This is the fluency influence that interacted with the instruction manipulation in Study 2. As there is no such manipulation here, factual truth is found as a main effect. All other effects were non-significant, all *F*s < 2, *ns*.

4.3. Discussion

Study 3 showed a strong truth effect: Old statements were judged to be true with greater probability than new statements. In addition, we found an additive effect due to factual truth status. However, there were no statement valence effects; that is, positivity had no main effect, it did not interact with repetition (i.e., the old vs. new status), and it did not interact with the correlation between valence and truth conveyed in the training phase. The only valence-related effect was a main effect in the control condition's training phase; although valence and truth were orthogonal and the statements rather easy,

Table 2
Mean probabilities from Experiment 3 to judge a statement ‘‘true’’ as a function of statement status and training condition (standard deviations in parentheses).

Correlation	Statement status	Neutral (factually true)	Neutral (factually false)	Positive (factually false)	Negative (factually false)
‘‘Positive = true’’	Old	.644 (.228)	.622 (.232)	.618 (.205)	.640 (.226)
	New	.524 (.151)	.458 (.171)	.471 (.156)	.458 (.100)
‘‘Positive = false’’	Old	.790 (.184)	.677 (.297)	.733 (.223)	.728 (.321)
	New	.538 (.148)	.497 (.143)	.564 (.148)	.585 (.144)
Orthogonal control	Old	.758 (.215)	.717 (.216)	.733 (.245)	.721 (.234)
	New	.596 (.186)	.613 (.169)	.533 (.177)	.454 (.144)

participants judged positive statements "true" with greater probability than negative statements. Thus, as in Study 1, we found a valence influence on judged truth, but not in the area of repetition-based truth judgments.

5. General discussion

The present experiments are motivated by the observation that positivity could substitute processing fluency as the explanatory construct for the truth effect. In Study 1, participants' ratings of valence and elicited feelings indeed correlated positively and substantially with their truth ratings. This provided initial support for possible positivity contributions to the truth effect. The following two experiments investigated valence influences in standard truth-effect experiments. Studies 2 and 3 replicated the repetition-based truth effect, but both studies failed to find positivity effects in the studies' test phases. While we were able to replicate some critical findings in support of processing fluency as the underlying process (i.e., factually true statements were judged "false" when participants were told that old statements are false), we did not find systematic evidence for positivity influences. There was no amplification of the truth effect for positive statements, there was no interaction with the instructions in Study 2, and participants failed to learn or failed to apply the correlation of truth and valence in Study 3. Accordingly, we conclude that the repetition-based truth effect is caused by processing fluency, over and above accompanying positive experiences. The functional equivalence of fluency due to factual truth and fluency due to repetition in Study 2 testifies this relation.

A caveat is that this conclusion relies on null results; maybe we did not operationalize positivity adequately or the experimental context was not suited to capture positivity influences. However, we found reliable positivity effects on rated truth in Study 1 and the training phase of Study 3. One explanation for the disparity between studies is that repetition-based fluency and positivity might have independent influences on rated truth. For example, a simple matching mechanism of "good equals truth" could be responsible for the pattern in Study 1 and Study 3's training phase. Positive statements or positive experiences might induce a tendency to respond "yes, true". Such response biases have been systematically investigated in the area of mood-congruency (Fiedler, Nickel, Muehlfriedel, & Unkelbach, 2001), or the influence of attractiveness on familiarity ratings (Corneille, Monin, & Pleyers, 2005). In the context of repeated statements, however, we might have been unable to detect this influence and found only the regular repetition-based truth effect.

In relation to our theoretical argument, we would conclude that it is not the valence-aspect of the fluency experience that leads to a truth effect. Yet, if we follow the reasoning put forward by Mandler and colleagues (1987), there is another intriguing possibility: If statements are processed fluently, they might either be positive or true, but not both. The processing experience elicited by a statement could be due to its positivity or its truth, but if the former is correct, positivity "explains" the experience, and fluency is no longer interpreted or attributed to truth (Schwarz, 2010; Unkelbach, 2006). Conversely, if statements are regarded as "true", people should not experience them positively. This account could explain why we found no positivity effects in the standard truth paradigm used here. In this judgment context, fluency might be interpreted as truth, and not necessarily experienced as positive. If it is not interpreted as positive, then there should be no positivity influences on the truth effect, at least no fluency-related positivity effects. However, when the judgment task is evaluative, fluency should lead to positive experiences and positive evaluations.

At present, it remains an open empirical question whether positivity is an integral part of the fluency experience, or whether positive feelings follow from fluency in respective judgment contexts. For the repetition-based truth effect, we believe, based on the present data, that positivity plays no central role. However, the interesting question of how and when statement valence and the feelings elicited by statements influence truth judgments deserves further investigation.

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