# Lessons for Future Research: Two Experiments Failed to Reproduce a Relationship Between Achievement Motivation and Autobiographical Memory Distortion

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Preregistration of Experiment 2, as well as the materials, and the datasets for both experiments can be found at the Open Science Framework: https://osf.io/seuby/

**Abstract**

Previous research (Sharman & Calacouris, 2010) found that participants' achievement-motivation was associated with the inflation of memory and confidence for unlikely achievement-related events in childhood. Similarly, other research has shown correlations between achievement motivation and grade inflation. In the current studies, we experimentally investigate the effect of false feedback and achievement-motivation on memory distortion for an unlikely childhood event (e.g., inventing an important device). In Experiment 1, we found that false feedback did have an effect, but contrary to previous research, self-reported achievement-motivation was not a statistically significant correlate of memory distortion. In Experiment 2, we again found a main effect for false feedback, no main effect of motivation, and an interaction. Both Experiments did not find, as earlier research had, a significant relationship between achievement-motivation and achievement-related memory distortion. We suggest others use different methods to ours when attempting to demonstrate a causal relationships between motivation and false memories.

*Keywords:* memory distortion, motivation, false feedback, suggestion, misinformation, post event information, achievement

# Lessons for Future Research: Two Experiments Failed to Reproduce a Relationship Between Achievement Motivation and Autobiographical Memory Distortion

It is well established that false feedback, also known as suggestion, misinformation, or post-event information, can create memory distortions. But it is not yet firmly established whether motivations can also cause memory distortions. The effect of motivation on memory errors is an important question with clear applications for the real world. For example, it is possible that various motivations produce memory distortions in psychotherapy or in eyewitness testimony in court. Or perhaps in the case of Brian Williams' reported memory errors of a helicopter ride in Iraq in 2003 (West, 2015), we might wonder if some motivation, perhaps ambition or some other social motivation, might have exacerbated these errors. William's apparent embellishments include description of being under fire in a helicopter, a potential false memory that may be related to a self-enhancing motivation, though there are other possible explanations (e.g., a conscious misrepresentation). Similarly, Hillary Clinton appeared to misremember landing under sniper fire in Bosnia, again a self-enhancing error that we cannot be sure was a conscious or unconscious error (Healy & Seelye, 2008). Although there is research illuminating the relationship between motivation and memory (McClelland, Scioli, & Weaver, 1998; Woike, Mcleod, & Goggin, 2003; Woike, 2008; Woike, Bender, & Besner, 2009; Murayama, & Elliot, 2011) it is surprising that there is little research focusing on the effect of motivation on memory *distortion*. A combination of theory and past research might suggest that underlying motivations would affect memory distortions. In this current study, we build on work by Sharman and Calacouris (2010) and experimentally investigate how the motivation to achieve affects memory distortions in a false feedback (suggestion) paradigm.

Research on the effect of motivation on cognition in general might hold promise for finding a link between motivation and memory distortions. Motivation guides what we pay attention to (Lang, Bradley, & Cuthbert, 1997), and attention is important for episodic memory for a given stimulus. In addition, Kunda (1990) outlines research showing that people are motivated to evaluate evidence in such a way as to reach a conclusion that most closely matches their motivations. Similarly, Ditto and Lopez (1992) found that motivations seemed to directly affect the amount of active cognition (scrutiny) participants used when examining information they either liked or disliked. Information that conflicted with participants' motives was met with effortful attempts to find fault in the information, compared to information they preferred. Ditto, Pizarro, and Tannenbaum (2009) argued that motivation also affects moral reasoning, further demonstrating motivation's role in cognition. Likewise, motivation has been linked to other biases, such as hindsight bias (e.g., Hell, Gigerenzer, Gauggel, Mall, & Müller, 1988; Pezzo & Pezzo, 2007). Such research into motivation and general cognition makes it reasonable to hypothesize that motivation might also affect other specific aspects of cognition, such as memory distortions.

Though the relationship between motivation and false memories has not yet been fully researched, there are numerous past articles on the relationship between motivation and memory. In this research, implicit motives (sometimes measured via Picture Story Exercises, Ramsay & Pang, 2013; Schultheiss, Liening, & Schad, 2008; including the Thematic Apperception Test, Gruber & Kreuzpointner, 2013) and explicit motives (measured by asking participants directly how much they feel a need for achievement, affiliation, etc.), are measured in conjunction with measures of memory. For example, in McClelland et al. (1998) found that in older adults implicit motives for affiliation, power, and achievement were associated with better recall of written

material. Woike et al. (2003) indicated differing effects on memory depending on whether the motivation was implicit or explicit. Interestingly, they found that explicit achievement (but not affiliation) motives were associated with higher recall of memories that relate to the self-concept—and therefore linked to autobiographical memory. Autobiographical memory has been framed as being a type of recall that is particularly linked to the self-concept (e.g., see Conway, 2005; Conway & Pleydell-Pearce, 2000), Woike (2008) similarly found that explicit motives modulate recall of events linked to the self-concept, as well as routine experiences that represent typical self-attributed behaviors that facilitate the person's own current goals.

There is some research that indirectly suggests that motivation can distort memory. For example, Bahrick, Hall, and Berger (1996) found that college students, when asked to recall their high school grades, tended to inflate them upwards. This could be due to a motivation on the part of the students. Importantly, the students knew that the researchers would have access to their actual grades, making it probable that some students inflated their grades fully believing they were being accurate. Lower grades were much more likely to be inflated upwards, while higher grades were likely to be reported more accurately—suggesting a self-serving bias or a motivation was likely a factor. In other research, Kennedy, Mather, and Carstensen (2004) found that older people had a self-serving positive bias in their recall of autobiographical memories. The implication being that the motivation to remember a positive life led to memory distortions. However, these studies were correlational—they did not manipulate motivation in an experiment to show that motivation *causes* memory distortions.

There has also been some direct research looking at motivation and memory distortion. Sharman & Calacouris (2010) used the imagination inflation paradigm (Garry, Manning, Loftus, & Sherman, 1996) which involves participants going through a guided imagery exercise that

subsequently inflates memory of an unlikely event. They found that the self-reported explicit achievement motivation of participants was associated with larger memory distortions for achievement-related childhood events (e.g., inventing an important device). Following an imagination inflation technique with some false suggestions that certain events occurred in childhood, participants who scored higher on measures of achievement motivation tended to overinflate memory of, and confidence in, their achievement of an unlikely achievement related event in childhood. They also examined affiliation motivation, but found a negligible correlation with affiliation-related autobiographical memory (cf. Woike et al., 2003). Although Sharman and Calacouris' (2010) results were correlational, it is nonetheless one of the few articles to establish a relationship between motivation and false memories of autobiographical events.

Motivation, according to the cognitive appraisal theory of emotion, can be defined as the disposition to reach a goal (see Lazarus, 1991). Achievement-motivation is a specific type of motivation that measures the tendency to want to reach standards of excellence and do things progressively better (McClelland, 1985). Murray (1938) considered the need to achieve as a "consistent trait of personality" (p. 61). McClelland, Atkinson, Clark, and Lowell (1953) expanded upon Murray's conceptualization of need for achievement to develop achievement motive research. Subsequently, Jackson (1967) used Murray's conceptualization to create the need for achievement subscale on the Personality Research Form (PRF; see also Jackson, 1987). Singer (1990) described the need for achievement as life goal to "create a lasting and notable accomplishment," and measured this by participants self-reporting the extent to which they desired that goal. Having reviewed past literature on motivation and false memory, identified a gap in the literature, and defined explicit achievement motivation more specifically, we next describe the current studies.

**The Present Experiments**

Here, we built on Sharman and Calacouris' (2010) study, using some of the same questionnaires they did, we used a similar false-feedback (suggestion) memory distortion paradigm to the one they used, although we did not utilize the imagination inflation exercise that they used. We chose to remove the imagination inflation aspect so that we could extend previous research by more clearly distinguishing what was causing changes in false memory rates. The false-feedback technique we employ involves telling participants that an unlikely event probably happened to them in the past (see Bernstein, Laney, Morris, & Loftus, 2005). We investigated whether self-reported achievement motivation (explicit) had a similarly positive association with memory inflation for achievement-related events in childhood. Memory inflation means the pretest to posttest increase in self-reported memory of the event. In Experiment 1, we investigated the effects of both false feedback and achievement-motivation on memory distortion. In Experiment 2, we used an experimental design to compare the respective causal effects of motivation and false feedback on memory distortion. We analyzed the main effects and interactions of the independent variables false feedback and motivation, on the dependent variable memory distortion. Based on past research on the misinformation effect and false-feedback studies (see Loftus, 2005, for a review), we hypothesized that:

**Hypothesis 1.** False feedback will have a significant effect on memory distortion.

**Hypothesis 2.** In congruence with Sharman and Calacouris' (2010) findings, we also hypothesized that base rate achievement-motivation would correlate with memory distortions.

**Hypothesis 3.** Based on past correlational studies, we further hypothesized that manipulating motivation would demonstrate a causal relationship with memory distortions.

## Experiment 1

In this study we examined the relationship between self-reported achievement-motivation and memory distortion of unlikely events in childhood. We gave participants false-feedback that an unlikely event did likely happen. The choice of which event a subject received false information about was based on what the participant had initially reported little memory of and low confidence in. We did this over two sessions, one week apart.

## Method

**Participants.** Two hundred and twenty undergraduates participated online for course credit at a large research university in the Southwestern United States. Of these, 15 participants were subsequently excluded from analysis because they failed to correctly answer questions checking that they were paying attention and reading the questions, leaving 205 participants in our analysis. Of these 205, 17.1% were freshmen, 19.5% sophomores, 36.6% juniors, and 26.8% seniors; participants were over 18, but age was not recorded in the dataset due to a technical error. Of the 205 adults, 171 were female (83.4%), 33 (16.1%) were male, and 1 (.005%) did not indicate their gender. Ethnicity was distributed as follows: 109 (53.2%) Asian, 34 (16.6%) Latino or Hispanic, 34 (16.6%) White, 1 (.5%) African American, and 27 (13.2%) indicated two or more ethnicities. These studies were approved by the Institutional Review Board (UCI IRB HS# 20141084).

**Design.** Subjects participated in two sessions, one week apart. Participants were informed they were free to withdraw from the study at any time. Pretest measures for motivation, as well as memory of and confidence for various childhood events were taken in Session 1. In Session 2 participants were randomly assigned into motivation manipulations and later given false-feedback about a childhood event for which they had indicated low memory of and confidence of in Session 1. After posttest measures of self-reported achievement-motivation were completed,

the participants indicated posttest ratings of how clear their *memory* was of childhood events, and how *confident* they were that those events happened. Considerations of power determined that to distinguish an effect size of $r = .2$, a target sample size of at least 97 in each condition would be advisable (see Cohen, 1988; table on p. 102, with power = .8). Our actual sample analyzed was 205, close to the planned 194.

**Materials and procedure.**

***Session 1.***

*Life Events Inventory.* In Session 1, participants first answered demographic questions, then completed a Life Event Inventory (Garry et al., 1996) containing 11 achievement-related items (e.g. "you invented an important device" and "You won a 'most valuable player' (or similar) sports award") and 11 items not related to achievement. Following each item, participants were asked to rate their confidence ("Please rate how confident you are that the event happened to you before the age of 10" on an 8-point scale with anchors "definitely did not happen" and "definitely did happen") and their memory ("Please also rate your memory for the event" with anchors "No memory of event at all" and "Clear & complete memory of event").

*Achievement-motivation.* The participants then answered (pre-test) questions assessing their achievement-motivation, such as a single item Life Goals Sentence (Singer, 1990); "I would like to create a lasting and notable accomplishment", using a 21 point Likert scale with three anchors *–10 = Extremely undesirable*, *0 = Neutral,* and *10 = Extremely desirable*). Then they completed 16 items of the Personality Research Form-E (PRF-E, Jackson, 1987), responding with ''true'' or ''false'' to statements describing an achievement motive (e.g., "I will not be satisfied until I am the best in my field of work" and "My goal is to do at least a little bit more than anyone else has done before"). Both these measures assessed achievement-motivation.

*Personality measures.* Partly to match the cover story that this study was about personality, questionnaires measuring tendencies to fantasize, absorb, and dissociate were completed. Fantasy proneness, which is the tendency to fantasize, was measured by the Creative Experience Questionnaire (Merckelbach, Horselenberg, & Muris, 2001). The Tellegen absorption scale measured the degree to which subjects are open to absorbing and self-altering experiences (Tellegen & Atkinson, 1974). The Dissociative Experiences Scale (Wright & Loftus, 1999), which measures the tendency for memory lapses and feelings of being dissociated from reality, was also completed. These personality measures were important as they were subsequently referred to in the false feedback paradigm in Session 2.

***Session 2.***

*Motivation manipulation.* At the beginning of Session 2, subjects were randomly assigned into two groups. In one group of subjects, we attempted to temporarily induce an increase in achievement-motivation ("Motivation Up" condition) while another group attempted to induce a decrease ("Motivation Down" condition). In particular, subjects who were in the Motivation Up condition received a paragraph suggesting that recent research indicated that those with high achievement-motivation went on to have happier, more lucrative and successful lives, less social exclusion, and better romantic relationships. The Motivation Down manipulation suggested the opposite (unhappier, less lucrative and successful, and so on).

Each subject was then asked to provide reasons for and to give examples of how achievement-motivation is associated with life happiness and success (Motivation Up) or failure (Motivation Down). For example, each of the subjects was asked to give two reasons for and one example of how achievement-motivation led to less social exclusion, better romantic relationships, and more lucrative careers. This procedure was adapted from a previous study in

which participants were induced to temporarily change their self-perceived levels of extraversion or introversion (Kunda & Sanitioso, 1989; also by linking them to academic success, as we did in the current study). See Appendix A in the Supplemental Material to see the paragraph and questions used.

*False Feedback (Suggestion).* Subsequently, subjects were told that sophisticated computer software had taken their last weeks' personality measures and had predicted that they were likely to experience a list of four childhood events (cf. materials first used in from Bernstein et al., 2005). Three of the suggested events in the list were true, and the remaining event was false. The false event was related to a childhood achievement experience (e.g. "I invented an important device"). The criterion to choose the one false item and the three genuine items depended on subjects' responses in the LEI in Session 1, where a genuine event was defined as the highest combined score of confidence and memory on a particular item, and a false event was the lowest combined scores. Using this method, we created an individualized profile consisting of a set of four childhood events for each subjects, and each subject would receive his or her own falsely suggested event. Subjects were then asked to type out in sentences how each of the suggested events in their profiles happened when they were 10 years old or younger. An example of a profile that subjects might receive was given in Appendix B in the Supplemental Material.

*Post-test motivation and Life Events Inventory.* At the end of Session 2, the participants again answered the same questions as in Session 1 to assess their achievement-motivation and their confidence of and memory for events listed in the Life Events Inventory (see Bernstein et al., 2005 for a full description of this procedure).

*Debriefing.* Participants were informed that the research they had read in the vignette on achievement-motivation was in fact fake, and that some participants had also been given some false feedback about the likelihood of occurrence of autobiographical events.

## Results

**Motivation Manipulation Check. We first test whether our attempted motivation manipulation did in fact effect two measures of motivation.** The motivation manipulation did succeed in increasing one measure of achievement-motivation, but not the other. The Motivation Up condition had significantly higher posttest scores on the Life Goals Sentence ("I would like to create a lasting and notable accomplishment"; $M = 7.16$, $SD = 3.37$) than did the Motivation Down condition ($M = 5.65$, $SD = 4.50$), $t(203) = 2.71$, $p = .007$. This relationship held when adjusting for pretest scores on the Life Goals Sentence ($\beta = .179$, $p = .005$). However, our motivation manipulation had no significant effect on the posttest PRF-E measure of achievement-motivation, $t(203) = .371$, $p = .711$. This relationship was still not statistically significant when adjusting for pretest PRF-E, $\beta = .016$, $p = .776$).

A possible explanation for these results is that these two measures may be tapping different aspects of achievement-motivation—indeed there was no significant correlation between the PRF-E and the Life Goal Sentences, $r = .009$, $p = 0.903$.

**2 x 2 ANOVAs.**

***Confidence.*** A 2 (motivation up, motivation down) x 2 (pretest confidence, posttest confidence of the critical item) mixed ANOVA revealed the same pattern of results as seen above. That is, false feedback significantly increased confidence that the critical item happened $F(1, 203) = 258.0$, $p < .001$, $\eta_p^2 = .560$. Confidence rose from Session 1 to 2 by $M = 3.26$, $SD = 2.85$. But there was no significant effect of motivation condition, $F(1, 203) = 0.06$, $p = .807$, $\eta_p^2$

< .001. The Motivation Up condition did not induce significantly higher *confidence* that the critical item occurred ($M$ = 3.45, $SD$ = 2.93), compared to the Motivation Down condition ($M$ = 3.09, $SD$ = 2.78). There was no interaction between motivation condition and pretest/posttest confidence, $F(1, 203) = 0.89$, $p = .346$, $\eta_p^2 = .004$. Modifying this ANOVA into an ANCOVA with fantasy proneness, dissociative experiences, and absorption, as covariates yielded the same pattern of results, with each of these three variables being nonsignificant covariates of confidence that the critical item happened (fantasy proneness, $F(1, 200) = 0.27$, $p = .603$; dissociative experiences, $F(1, 200) = 2.47$, $p = .118$; absorption $F(1, 200) = 0.01$, $p = .906$).

***Memory.*** In a similar analysis focusing instead on *memory* ratings on the critical item, a 2 (motivation up, motivation down) x 2 (pretest *memory*, posttest *memory* of the critical item) ANOVA revealed the same pattern of results as seen above. That is, false feedback did increase memory ratings of the critical item, $F(1, 203) = 170.5$, $p < .001$, $\eta_p^2 = .457$. Change in memory for the event rose significantly by $M$ = 2.69 ($SD$ = 2.88) Likert scale points from Session 1 to 2. There was no significant effect of motivation condition, $F(1, 203) = 0.94$, $p = .333$, $\eta_p^2 = .005$. The Motivation Up condition did not have a significantly higher inflation of *memory* for the critical achievement-related item ($M$ = 2.74, $SD$ = 2.97), compared to the Motivation Down condition ($M$ = 2.64, $SD$ = 2.80). There was no interaction between motivation condition and pretest/posttest memory, $F(1, 203) = .34$, $p = .341$, $\eta_p^2 = .002$). The means and standard deviations of both the confidence and memory ratings for the critical lure item are given in Table 1. . Changing this ANOVA into an ANCOVA with fantasy proneness, dissociative experiences, and absorption, as covariates yielded the same pattern of results, with each of these three variables being nonsignificant covariates of memory of the critical item (fantasy proneness, $F$(1,

200) = 0.002, $p$ = .962; dissociative experiences, $F(1, 200) = 0.76$, $p$ = .385; absorption $F(1, 200) = 0.46$, $p$ = .497).

The results of these ANOVAs are that as hypothesized, false feedback appeared to have a significant effect on the inflation of memory and confidence. Our attempts to manipulate motivation did not lead to significant effects on memory distortion.

**Correlation between baseline motivation and inflation of confidence and memory.** Pretest achievement-motivation measures did not significantly correlate with inflation of *confidence* that the critical achievement-related event took place (LGS: $r$ = .039, $p$ = .576; PRF-E: $r$ = .016, $p$ = .819) or inflation of *memory* (LGS: $r$ = .020, $p$ = .775; PRF-E: $r$ = .044, $p$ = .534). Neither of the two measures of pretest achievement-motivation (Life Goal Sentence, PRF-E) correlated with the pretest measures of memory and confidence in inventing an important device (an unlikely achievement-related event; $r$s < .105, $p$s > .134). Similarly, pretest motivation measures did not predict pretest confidence ($r$s < .078, $p$s > .264) or memory ($r$s < .102, $p$s > .134) of inventing a useful device.

Table 2 reveals neither baseline measure of achievement-motivation predicted confidence inflation. However, Table 3 shows that in a regression analysis with memory inflation of inventing an important device that baseline achievement-motivation (Life Goals Statement) was a marginal predictor of confidence inflation.

**Excluding those who guessed the purpose of the study.** At the end of the study we asked participants "what do you think the study is about?" and although none guessed the hypotheses exactly, we identified 14 out of the 205 in the analysis who we categorized as guessing it was about false memories or memory distortions. Excluding these individuals from the analyses shown above revealed the same patterns as shown above. Most importantly, the

non-significant relationship was maintained between achievement motivation and confidence and memory of an achievement-related false memory. For example, after excluding these 14 cases, pretest achievement-motivation measures did not significantly correlate with inflation of *confidence* that the critical achievement-related event took place (LGS: $r = .019$, $p = .789$; PRF-E: $r = .019$, $p = .799$, $N = 191$) or inflation of *memory* (LGS: $r = .015$, $p = .842$; PRF-E: $r = .042$, $p = .560$, $N = 191$).

**Discussion**

We found that Hypothesis 1 was supported: false feedback had a significant effect on memory and confidence inflation. Hypothesis 2 was not supported: achievement-motivation did not show a reliable association with inflation of confidence, and was only was marginally associated with memory inflation (nonsignificant). We found no evidence for Hypothesis 3: our attempts to manipulate motivation experimentally had a mixed effect on self-reported achievement-motivation, and did not have a significant effect on memory distortions. It was surprising that our results did not support what we expected based on Sharman and Calacouris (2010). False feedback had a much larger effect on memory distortions than did achievement-motivation. On finding that there was no main effect for motivation, we wondered if motivation might at least interact with false feedback. One limitation with Experiment 1 is that our design did not allow for a clean analysis of the interaction between motivation and false feedback. This is because in Experiment 1, we assigned as many as 9 different critical items in the false-feedback to various participants, and these items were not chosen randomly. Another concern is that our initial finding was a Type 2 error—a failure to detect a relationship between motivation and false memories that does, in fact, exists. Therefore, before we concluded that the relationship found in Sharman and Calacouris' (2010) does not conceptually replicate, we attempted a

modified experiment. We designed a follow-up study to build on what we learned from Experiment 1, by attempting to increase the strength of the motivation manipulation, introducing self-esteem as a possible moderator, and randomly assigning false feedback (suggestion).

## Experiment 2

In this experiment we used random assignment for both independent variables (achievement-motivation and false feedback), with control groups for both so that we were able to examine not only main effects with some causal certainty, but also the interaction of motivation and false feedback. As in Experiment 1, we re-tested the three former main hypotheses. Because we had failed to find the expected relationship between motivation and memory distortion in Experiment 1, and because we were unconvinced that motivation plays no role at all, we investigated an additional hypothesis to the original 3 hypotheses given earlier:

**Hypothesis 4.** Does achievement-motivation interact with false feedback in the formation of memory inflation?

In attempting to explain the lack of a relationship between motivation and false memory in Experiment 1, we hypothesized that there may be moderators or confound variables that are masking an effect. For example, we hypothesized that self-esteem may be a factor that was potentially masking a relationship. Specifically, we hypothesized that those with low self-esteem would be more vulnerable to the effects of motivation and false memory, compared to those with high esteem. We theorized that those scoring high in self-esteem may have less doubt and be less swayed by outside influence, and thus be less vulnerable to succumbing to memory distortions as a result of motivational changes. We therefore hypothesized that self-esteem could be a variable creating noise that may be masking significant effects. For this reason, we added self-esteem as a covariate to Experiment 2 to explore whether controlling for self-esteem revealed significant

relationships between motivation and false memory that we did not find in Experiment 1. In the analysis, we also examine whether fantasy proneness would be a moderator of the relationship, due to its role as a moderator in previous memory distortion studies (e.g., Patihis et al., 2013; Patihis & Loftus, 2016). Examining such possible moderators is an attempt to find possible variables that might explain the negligible relationship between achievement motivation and memory or confidence inflation.

## Method

### Participants

Three hundred and sixty-six undergraduates participated online for course credit at a large research university in the Southwest of the United States. Of these 310 were female (84.7%) and 56 (15.3%) were male. Most participants were college aged ($M_{age}$ = 21.1, *SD* = 4.53; range 18–57). Ethnicity was distributed as follows: 169 (46.2%) Asian, 87 (23.8%) Latino or Hispanic, 67 (18.3%) White, 9 (2.5%) African American, and 34 (9.3%) indicated two or more ethnicities. This study was approved by the Institutional Review Board (UCI IRB HS# 20141084).

### Design

The design was a 2 (motivation manipulated up, control) x 2 (false feedback of inventing device, no false feedback) experiment with the dependent measures being the self-reported clarity of the memory of inventing an important device and the confidence that the event happened (which were measured both pretest and posttest). Considerations of power determined that to distinguish an effect size of $r$ = .2, a target sample size of at least 97 in each condition would be advisable (see Cohen, 1988; table on p. 102, for power = .8), and in this study there are

4 conditions (2 for false feedback, 2 for motivation). Our actual sample analyzed was 366, close to the planned 388 (4 x 97).

**Materials and Procedure**

Participants had to complete the questions online at the timeslot they had signed up for (they could choose timeslots that fell between 8am and 6pm weekdays). One week later, the participants completed Session 2 at the same hour that they had the previous week. Participants could use a computer at a place of their choosing, and were instructed on how to avoid distractions. These materials and procedure are similar to Sharman and Calacouris' (2010) study, except we employed no imagination inflation exercise.

**Session 1.** This session included the same pre-test questions for the Life Events Inventory, achievement-motivation, and personality scales as in Experiment 1. In Experiment 2, we added the Rosenberg 10 item self-esteem questionnaire (Rosenberg, 1965).

**Session 2.** One week after Session 1, at the same hour of day, participants completed the second questionnaire.

***Motivation Manipulation.*** At the beginning of Session 2, participants were randomly assigned into either the Motivation Up condition or the Control group (motivation not manipulated). This involved the same paragraph and questions used in Experiment 1, although we added two more questions to attempt to deepen their engagement with the idea that achievement-motivation leads to happiness and success (see Appendix A in Supplemental Material for the materials used). In the Motivation Up condition the goal was to raise participants' achievement-motivation, at least transiently for the experiment. In this condition, as in Experiment 1, participants first read a paragraph stating that research had demonstrated social and health benefits of having high achievement-motivation (this supposed research was in fact

made up, and was revealed as such during debriefing). Participants were then asked to write out reasons, with examples, for why high achievement-motivation is good for happiness, relationships, and why it helps avoid loneliness and social exclusion.

***Post Test Achievement-motivation.*** Participants then filled out questions assessing achievement-motivation—as before with the Life Goals Statement and 16 achievement-related items on the PRF-E.

***False feedback (Suggestion) Manipulation.*** Participants then received a personal profile similar to the false feedback in Experiment 1. In Experiment 1, we found that one of the most consistent and effective critical items was "you invented an important device." So, participants in Experiment 2 were randomly assigned to either the False feedback condition (they were told that based on their personality questionnaires it is probable that "you invented an important device") or the No False feedback condition. This false feedback item ("you invented an important device") was embedded within these other more plausible items (see Appendix B in Supplemental Materials). The No False feedback condition received the same three likely events, and one other item unrelated to our critical item.

***Life Events Inventory.*** Toward the end of Session 2, participants filled out in the Life Events Inventory, giving their rating of their confidence and memory of 22 life events before the age of 10. The critical item was "You invented an important device."

***Debriefing.*** Participants were informed of the fact that the research on achievement-motivation was in fact fake, and that they had also been given some false feedback.

**Results**

**Motivation Manipulation Check: Effect on Posttest Motivation Measures. Here, we test whether our attempted motivation manipulation did in fact affect any of our two**

**measures of motivation.** The Motivation Up condition was not significantly higher on the posttest Life Goal Sentence ($M$ = 7.45, $SD$ = 3.56), compared to the Control group ($M$ = 7.19, $SD$ = 3.82), $t(364) = .687$, $p = .266$. This was also true when controlling for pretest Life Goal Sentence in an ANCOVA, $F(1, 362) = .069$, $p = .793$.

Similarly, the Motivation Up condition did not have reliably higher posttest PRF-E scores (controlling for pretest PRF-E) compared to the Control group, $F(1, 363) = .124$, $p = .724$. Changes in PRF-E scores (posttest-pretest) were not significantly higher in either the Motivation Up condition ($M$ = .07, $SD$ = 1.84) or the Control Group ($M$ = -.06, $SD$ = 1.81), $t(364) = .687$, $p = .492$.

**Confidence: 2 x 2 x 2 ANOVA.** A 2 (motivation up, control) x 2 (false feedback of inventing a useful device, no false feedback) x 2 (pretest confidence, posttest confidence of the critical item) mixed ANOVA was performed. As predicted by Hypothesis 1, false feedback significantly increased confidence that the critical item (inventing an important device) happened $F(1, 362) = 14.0$, $p < .001$, $\eta_p^2 = .037$. We found only partial but incomplete support for Hypothesis 3 with regard to confidence ratings: although there was a significant effect of motivation condition, $F(1, 362) = 9.58$, $p = .002$, $\eta_p^2 = .026$, there was no significant interaction between motivation condition and confidence (pretest to posttest), $F(1, 362) = 1.98$, $p = .161$, $\eta_p^2 = .005$. There was no significant interaction between false feedback and motivation, $F(1, 362) = 4.01$, $p = .431$, $\eta_p^2 = .002$. There was a significant main effect for the repeated measures variable confidence (pretest, posttest), $F(1, 362) = 35.5$, $p < .001$, $\eta_p^2 = .089$. There was a significant interaction between false feedback condition (misled, not misled) and confidence (pre, post), $F(1, 362) = 63.2$, $p < .001$, $\eta_p^2 = .149$. There was also a significant three way interaction between false feedback condition, motivation condition, and confidence of inventing a useful device

(pretest, posttest), $F(1, 362) = 10.1$, $p = .040$, $\eta_p^2 = .012$. The means and standard deviations of the confidence ratings for inventing a useful device are given, organized by experimental condition, in the top half of Table 4.

**Memory: 2 x 2 x 2 ANOVA.** In a similar analysis focusing instead on *memory* ratings on the critical item, A 2 (motivation up, control) x 2 (false feedback of inventing a useful device, no false feedback) x 2 (pretest memory, posttest memory of inventing a useful device) mixed ANOVA revealed that false feedback significantly increased memory of inventing an important device, $F(1, 362) = 16.4$, $p < .001$, $\eta_p^2 = .043$. Thus Hypothesis 1 was again supported. There was no support for Hypothesis 3 in relation to memory ratings: there was no significant main effect of motivation condition, $F(1, 362) = 3.09$, $p = .080$, $\eta_p^2 = .008$, and no significant interaction between motivation condition and memory ratings (pretest to posttest repeated measures), $F(1, 362) = 0.05$, $p = .825$, $\eta_p^2 < .001$. There was no significant interaction between false feedback and motivation, $F(1, 362) = 0.01$, $p = .909$, $\eta_p^2 < .001$. There was a significant main effect for the repeated measures variable memory of inventing a device (pretest, posttest), $F(1, 362) = 6.75$, $p = .010$, $\eta_p^2 = .018$. There was a significant interaction between false feedback condition (misled, not misled) and memory of inventing a device (pre, post), $F(1, 362) = 24.7$, $p < .001$, $\eta_p^2 = .064$. There was a marginally significant three way interaction between false feedback condition, motivation condition, and memory of inventing a useful device (pretest, posttest), $F(1, 362) = 3.85$, $p = .051$, $\eta_p^2 = .011$.The means and standard deviations of the memory ratings for the inventing a useful device item are given by condition, in the bottom half of Table 4.

**Confidence Inflation.** We performed a 2 x 2 ANCOVA with false feedback and motivation as the independent variables, the change in confidence of inventing an important

device as the dependent variables, while controlling for the covariate of baseline (pretest) achievement-motivation (PRF-E). The overall model was statistically significant $F(4, 361) = 19.1$, $p < .001$, $\eta^2 = .175$, $R^2 = .168$, adjusted $R^2 = .166$. We found a main effect for false feedback on confidence inflation $F(1, 361) = 61.8$, $p < .001$, $\eta^2 = .146$. We found no main effect of motivation manipulation on confidence inflation $F(1, 361) = .067$, $p = .796$, $\eta^2 < .001$. In accordance with Hypothesis 4, Figure 1 shows the significant interaction between false feedback and motivation, $F(1, 361) = 4.31$, $p = .039$, $\eta^2 = .012$.

**Memory Inflation.** Similarly, **w**e performed a 2 x 2 ANCOVA with false feedback and motivation as the independent variables, the change in *memory* of inventing an important device (posttest – pretest) as the dependent variable while controlling for the covariate of baseline (pretest) achievement-motivation (PRF-E).

The overall model was statistically significant $F(4, 361) = 7.38$, $p < .001$, $R^2 = .076$, adjusted $R^2 = .065$. We found a main effect for false feedback on memory inflation $F(1, 361) = 24.3$, $p < .001$, $\eta^2 = .063$. We found no main effect of motivation manipulation on confidence inflation $F(1, 361) = .067$, $p = .796$, $\eta^2 < .001$. In congruence with Hypothesis 4, we found a significant interaction between false feedback and motivation, $F(1, 361) = 3.85$, $p = .050$, $\eta^2 = .011$ (see Figure 2).

The nature of these interactions appear to indicate that the motivation manipulation had little effect in the absence of false feedback, but the motivation manipulation did appear to enhance inflation of confidence and memory when false feedback was present.

**Hierarchical Multiple Regression Model with Confidence Inflation as the Dependent Measure.** We conducted this analysis to investigate which variables are associated with confidence distortion while adjusting for other variables. We were particularly interested to see if

measures of achievement-motivation were associated. The hierarchical regression in Table 5 summarizes the predictors of confidence inflation for inventing an important device. In all three models, false feedback was a significant predictor, as expected.

***Does Baseline Motivation Predict Confidence Inflation?*** Model 3 in Table 5 reveals that baseline achievement-motivation (both PRF-E and LGS) is a marginal but nonsignificant predictor of increasing confidence. This offers no support for Hypothesis 2.

***Other Factors.*** Model 3 reveals that fantasy proneness is a significant predictor of confidence inflation, and self-esteem as a marginal positive predictor of confidence.

**Hierarchical Multiple Regression Model with Memory Inflation as the Dependent Measure.** The hierarchical regression in Table 6 summarizes the predictors of memory inflation for inventing an important device. In all three models, false-feedback was a significant predictor, as expected.

***Does Baseline Motivation Predict Memory Inflation?*** Models 2 and 3 in Table 6 reveals that baseline achievement-motivation was not a significant predictor of increasing memory of inventing an important device. This provides no evidence for Hypothesis 2.

***Other Factors.*** Model 3 reveals that self-esteem was a marginal positive predictor of memory inflation of inventing an important device.

**Excluding those who guessed the purpose of the study.** At the end of the study we asked participants "what do you think the study is about?" and although no one guessed the study was about motivation and memory distortion, we identified 9 out of the 366 in the analysis who we categorized as guessing it was about false memories or memory distortions. Excluding these individuals from the analyses shown above revealed the same patterns as shown above. Most importantly, as before we found negligible/small relationships between measures of achievement

motivation and confidence/memory inflation of an achievement-related item involving inventing an important device (range: $r$ = -.058 *to* r = .101, *ps* ranging from .057 to .479).

**Discussion**

In Experiment 2 we found that our attempts to increase the strength of the motivation manipulation (compared to Experiment 1) failed to significantly change self-reported achievement motivation, despite the addition of additional writing prompts. The results also again failed to conceptually replicate Sharman and Calacouris' (2010) finding of a significant relationship between achievement-motivation and autobiographical memory distortions. This lack of a significant relationship held even when controlling for hypothesize covariates, such as self-esteem. Whether the relationship between achievement-motivation and memory and confidence inflation is zero or very small is unclear—but what is clear in our samples is that the relationship is not moderate to large.

We found a significant interaction between the motivation and false feedback manipulations on both memory and confidence inflation. However, because the motivation manipulation did not significantly raise achievement motivations, interpretation of these interactions is difficult. Nevertheless, these results may suggest that future research could investigate whether motivation affects memory distortions via interactions with misinformation more powerfully than without misinformation.

## General Discussion

Over two experiments we found false feedback to be a statistically significant predictor of memory and confidence distortion, and a larger factor compared to achievement-motivation. To our surprise, in Experiment 1, achievement-motivation did not have a significant relationship with confidence inflation of achievement-related events. In contrast, Sharman & Calacouris

(2010) found that the other measure of achievement motivation, PRF-E (not LGS), predicted memory *and* confidence inflation in an imagination paradigm. Interestingly, we found no significant relationship between the two measures of achievement motivation, while Sharman and Calacouris found a small relationship ($r$ = .30). A possible explanation for these results is that these two measures are likely measuring different aspects of achievement-motivation, which in our case led to a negligible effect size, and a small-to-moderate effect size in Sharman and Calacouris.

Experiment 2 again found little evidence for a relationship between motivation and memory or confidence inflation, which was contrary to both our predictions based on the limited past research. However, we did find that false feedback and motivation interacted with both memory and confidence inflation. In other words, the Motivation Up manipulation had little effect in the absence of false feedback, but when participants did receive false feedback the motivation manipulation appeared to enhance memory and confidence distortion. Contrary to our hypothesis, Experiment 2 showed that self-esteem was not a mediator that was masking motivation effects in Experiment 1. It remains to be seen in future research if motivational manipulations interact with false feedback in the same way. We can only speculate that motivation has an effect on memory distortions not so much in a direct way, but by interacting with misinformation. Our results were difficult to interpret in this regards, due to the negligible effect of our motivation manipulation on self-reported motivation. Future research must address these limitations, although it is unclear whether using similar methodology to ours or Sharman and Calacouris' (2010) would be fruitful.

In addition, both measures of baseline motivation (pretest LGS & PRF-E) were nonsignificant, but marginal predictors of confidence inflation for inventing an important device,

but not of memory inflation. Contrast this with the results of Experiment 1 that a baseline measure of motivation was marginally associated with memory but not with confidence inflation. While the effect of false feedback was strong and consistent, the relationship with motivation and memory distortion was weak and inconsistent. From these results we posit that false feedback is the more powerful factor in memory distortions, compared to motivations, although this idea requires further testing.

There are some limitations to these studies. One limitation of these studies is that the effect of the motivation manipulation was negligible. This may be informative for future researchers. Future studies could experiment with manipulations that more powerfully affect motivation, with the understanding that some trait-like motivations may be somewhat difficult to manipulate. An example of an alternative way to prime achievement motivation might include Woike et al.'s (2009) technique of having those in the experimental group write about a vivid achievement memory. It should also be noted that baseline achievement-motivation was at best a weak correlate of memory distortion, so future research could perhaps find other measures of achievement-motivation, or focus on a different type of motivation. Another limitation is the generalizability of the findings on account that half of participants self-identified as Asians. Due to possible differences in orientation to achievement motivations and/or individualism vs. collectivist approaches to individual acheivement, future research could investigate different samples in terms of ethnic percentages. In addition, the students in our sample were at a selective university, and there may have been a ceiling effect on achievement motivation, and future research could sample a less academically selective group of people. Another potential concern is that the results were skewed by participants who guessed the purpose of the study, but analyses excluding individuals who indicated some understanding of the purpose of the study

yielded similar results to the results before exclusion. Another concern may be that we only targeted one false item in both study 1 and 2, with the possibility that just one measure of false memory may decrease chances of finding significant results. Future research could investigate using more than one false-item, though that would run the risk that participants become increasingly suspicious with numerous false suggestions.

The lack of an association between two variables in correlational data naturally gives pause as to whether finding a causal relationship in experimentation will be fruitful. Instead, because there are a number of paradigms to induce memory distortion and motivation, we recommend future research investigate different methodologies to the one we employed. In addition, the lesson we wish to share with future researchers is that attempts to manipulate achievement motivation as we did may fail, and that the relationship between achievement motivation and memory distortion of achievement-related autobiographical memories may be weaker than previously thought in this particular domain. This is not to minimize the quality of our research: we feel it was well planned and executed. However, it simply did not bear the fruit that we intended: we did not establish a causal link between achievement motivation and achievement-related autobiographical memory distortions. Future research should first establish a strong correlation between a measure of motivation and a measure of memory distortion, and once that relationship has replicated, then attempt to manipulate motivation in an experiment to establish a causal link. Nevertheless, an alternative approach would be to check whether the subtle differences between our experiments and Sharman and Calacouris' study led to a negligible relationship in our experiments. It is possible that running participants in lab would have yielded a significant association. Therefore we wouldn't want to rule out an exact replication of Sharman and Calacouris (2010), and if replicated, we would concede there may be

reliable relationship between achievement motivation and achievement-related memory distortion in that domain.

In two experiments, the current research explored the relationship between motivation and memory distortion. Contrary to previous findings (Sharman & Calacouris, 2010), we found a negligible relationship between achievement motivation and achievement-related autobiographical memory distortion. This result suggests that the relationship between motivation and memory distortion, albeit theoretically sound, may be weaker than previously thought. Future research could explore reasons why the relationship between motivation and memory distortion is inconsistent across studies. Such research is especially important to clarify the theoretical link between motivation and memory distortion.

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Table 1

*Means and Standard Deviations of Confidence and Memory Scores of Inventing a Useful Device (Pretest and Posttest measures), by Motivation Condition*

| | Motivation Down Condition | | | Motivation Up Condition | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *n* | *M* | *SD* | *n* |
| Pretest Confidence that Critical Item Happened | 1.50 | 1.23 | 105 | 1.26 | 0.77 | 100 |
| Posttest Confidence that Critical Item Happened | 4.57 | 2.79 | 105 | 4.71 | 2.86 | 100 |
| Pretest Memory of Critical Item | 1.68 | 1.73 | 105 | 1.34 | 1.12 | 100 |
| Posttest Confidence of Critical Item | 4.20 | 2.65 | 105 | 4.10 | 2.73 | 100 |

Table 2

*Experiment 1: Two-Model Hierarchical Linear Regressions with Change in Confidence of Inventing an Important Device as the Dependent Measure*

| Model | Independent Variables in Model | β | *p* | VIF |
|---|---|---|---|---|
| 1 | Motivation Manipulation | -.017 | .802 | 1.005 |
| | **False Feedback Invented Device** | **.324** | **.000** | **1.005** |
| 2 | Motivation Manipulation | -.018 | .785 | 1.006 |
| | **False Feedback Invented Device** | **.322** | **.000** | **1.006** |
| | Pretest Achievement Motivation (LGS)) | .093 | .163 | 1.001 |
| | Pretest Achievement-motivation (PRF-E) | .009 | .897 | 1.001 |

*Note.* Dependent Variable = Change in confidence of inventing an important device (posttest minus pretest scores on Life Events Inventory item). **Boldface** = significant predictors. *Italic* = marginal predictors. LGS = Life Goals Statement. PRF-E = Personality Research Form-E.

Table 3

*Experiment 1: Two-Model Hierarchical Linear Regressions with Change in Memory of Inventing an Important Device as the Dependent Measure*

| Model | Independent Variables in Model | β | *p* | VIF |
|---|---|---|---|---|
| 1 | Motivation Manipulation | -.035 | .607 | 1.005 |
| | **False Feedback Invented Device** | **.259** | **.000** | **1.005** |
| 2 | Motivation Manipulation | -.037 | .587 | 1.006 |
| | **False Feedback Invented Device** | **.256** | **.000** | **1.006** |
| | *Pretest Achievement Motivation (LGS)* | *.119* | *.080* | *1.001* |
| | Pretest Achievement-motivation (PRF-E) | .015 | .831 | 1.001 |

*Note.* Dependent Variable = Change in memory of inventing an important device (posttest minus pretest scores on Life Events Inventory item). LGS = Life Goals Statement. PRF-E = Personality Research Form-E .

Table 4

*Means and Standard Deviations of Confidence and Memory Scores of Inventing a Useful Device (Pretest and Posttest Measures), by False Feedback Condition and Motivation Condition*

| | | Motivation Control Condition | | | Motivation Up Condition | | |
|---|---|---|---|---|---|---|---|
| | | *M* | *SD* | *n* | *M* | *SD* | *n* |
| *Confidence:* | | | | | | | |
| Invented Device False Feedback | Pretest Confidence that Critical Item Happened | 1.86 | 1.61 | 84 | 1.89 | 1.89 | 103 |
| | Posttest Confidence that Critical Item Happened | 3.06 | 2.59 | 84 | 3.89 | 2.88 | 103 |
| Control (No False Feedback) | Pretest Confidence that Critical Item Happened | 1.68 | 1.70 | 97 | 2.49 | 2.30 | 82 |
| | Posttest Confidence that Critical Item Happened | 1.53 | 1.42 | 97 | 2.18 | 1.98 | 82 |
| *Memory:* | | | | | | | |
| Invented Device False Feedback | Pretest Memory of Critical Item | 2.24 | 2.20 | 84 | 2.27 | 2.36 | 103 |
| | Posttest Memory of Critical Item | 2.94 | 2.56 | 84 | 3.54 | 2.61 | 103 |
| Control (No False Feedback) | Pretest Memory of Critical Item | 1.82 | 1.96 | 97 | 2.41 | 2.31 | 82 |
| | Posttest Confidence of Critical Item | 1.74 | 1.84 | 97 | 1.88 | 1.74 | 82 |

Table 5

*Experiment 2: Three Hierarchical Linear Regression Models with Change in Confidence of Inventing an Important Device as the Dependent Measure*

| Model | Independent Variables in Model | β | *p* | VIF |
|---|---|---|---|---|
| 1 | Motivation Manipulation | .062 | .204 | 1.009 |
| | **False Feedback Manipulation** | **.379** | **.000** | **1.009** |
| 2 | Motivation Manipulation | .076 | .123 | 1.020 |
| | **False Feedback Manipulation** | **.367** | **.000** | **1.028** |
| | Pretest Achievement Motivation (LGS)) | -.077 | .122 | 1.052 |
| | *Pretest Achievement-motivation (PRF-E)* | *.093* | *.063* | *1.072* |
| | Self Esteem Rosenberg | .069 | .169 | 1.078 |
| 3 | Motivation Manipulation | .069 | .159 | 1.031 |
| | **False Feedback Manipulation** | **.371** | **.000** | **1.032** |
| | *Pretest Achievement-motivation (LGS)* | *-.088* | *.078* | *1.072* |
| | *Pretest Achievement-motivation (PRF-E)* | *.093* | *.064* | *1.075* |
| | *Self Esteem (Rosenberg's)* | *.092* | *.075* | *1.132* |
| | **Fantasy Proneness (CEQ)** | **.107** | **.031** | **1.046** |
| | Age | -.027 | .593 | 1.056 |

*Note.* Dependent Variable = Change in confidence of inventing an important device (posttest minus pretest scores on Life Events Inventory item). **Boldface** = significant predictors. *Italic* = marginal predictors. LGS = Life Goals Statement. PRF-E = Personality Research Form-E . CEQ = Creative Experiences Questionnaire.

Table 6

*Experiment 2: Three Model Hierarchical Linear Regression with Change in Memory of Inventing an Important Device as the Dependent Measure*

| Model | Independent Variables in Model | β | *p* | VIF |
|---|---|---|---|---|
| 1 | Motivation Manipulation | .027 | .600 | 1.009 |
| | **False Feedback Manipulation** | **.254** | **.000** | **1.009** |
| 2 | Motivation Manipulation | .030 | .563 | 1.020 |
| | **False Feedback Manipulation** | **.240** | **.000** | **1.028** |
| | Pretest Achievement Motivation (LGS)) | .030 | .573 | 1.052 |
| | Pretest Achievement-motivation (PRF-E) | .024 | .648 | 1.072 |
| | Self Esteem Rosenberg | .082 | .121 | 1.078 |
| 3 | Motivation Manipulation | .021 | .681 | 1.031 |
| | **False Feedback Manipulation** | **.242** | **.000** | **1.032** |
| | Pretest Achievement-motivation (LGS) | .025 | .638 | 1.072 |
| | Pretest Achievement-motivation (PRF-E) | .026 | .622 | 1.075 |
| | *Self Esteem (Rosenberg's)* | *.104* | *.056* | *1.132* |
| | Fantasy Proneness (CEQ) | .070 | .179 | 1.046 |
| | Age | -.061 | .246 | 1.056 |

*Note.* Dependent Variable = Change in memory of inventing an important device (posttest minus pretest scores on Life Events Inventory item). LGS = Life Goals Statement. PRF-E = Personality Research Form-E . CEQ = Creative Experiences Questionnaire

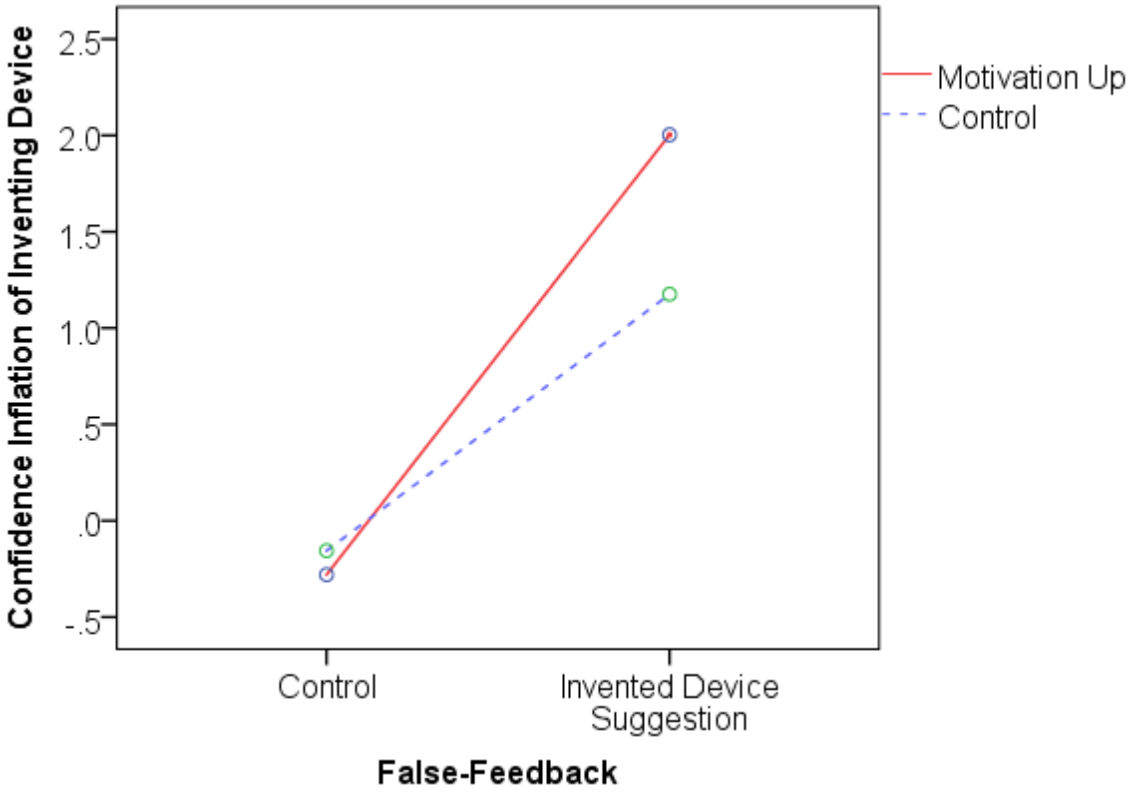


*Figure 1.* The significant interaction between false feedback and motivation manipulations on change in confidence from pretest to posttest of inventing an important device before age 10.

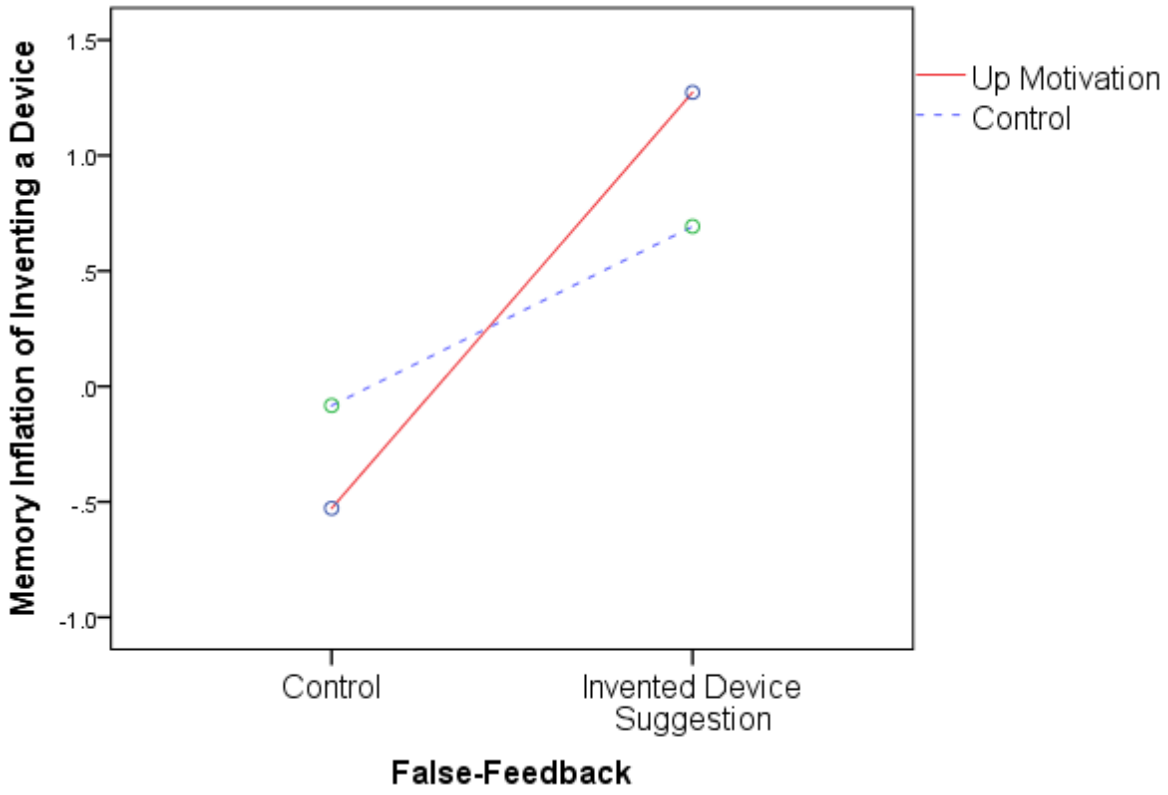


*Figure 2.* The significant interaction between false feedback and motivation manipulations on change in memory of inventing an important device before the age of 10 (from pretest to posttest).