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# Understanding overconfidence: Theories of intelligence, preferential attention, and distorted self-assessment☆

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## HIGHLIGHTS

- Those who view intelligence as fixed account for most of the "overconfidence effect."
- Overconfidence is preserved, in part, by attending to easy more than difficult tasks.
- Growth mindsets lead to openness to difficulty and, in turn, greater self-insight.
- Teaching a growth mindset makes students open to difficulty and less overconfident.
- Overconfidence is maintained through preferential attention to ease over difficulty.

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## ABSTRACT

Knowing what we don't yet know is critical for learning. Nonetheless, people typically overestimate their prowess—but is this true of everyone? Three studies examined who shows overconfidence and why. Study 1 demonstrated that participants with an entity (fixed) theory of intelligence, those known to avoid negative information, showed significantly more overconfidence than those with more incremental (malleable) theories. In Study 2, participants who were taught an entity theory of intelligence allocated less attention to difficult problems than those taught an incremental theory. Participants in this entity condition also displayed more overconfidence than those in the incremental condition, and this difference in overconfidence was mediated by the observed bias in attention to difficult problems. Finally, in Study 3, directing participants' attention to difficult aspects of the task reduced the overconfidence of those with more entity views of intelligence. Implications for reducing biased self-assessments that can interfere with learning were discussed.



## 1. Introduction

Learning any new task requires understanding the gap between what one currently knows and what one hopes or needs to know. While such self-insight is valuable, a wealth of research suggests that it is often elusive. Self-assessments often correlate poorly with objective measures of skill in a variety of domains, such as intellectual abilities (e.g., Borkenau & Lieber, 1992), social skills (e.g., DePaulo et al., 1997), and job performance (e.g., Bass & Yammarino, 1991; for a review, see Dunning, 2005). Most examples of error-prone self-assessment reveal overconfidence. Indeed, a perusal of the confidence literature can lead one to fear crossing the street as users of nearly every mode of transportation display overconfidence. Drivers (Marttoli & Richardson, 1998), motorcyclists (Rutter et al., 1998), and even bungee jumpers (Middleton et al., 1996) tend to overestimate their ability to travel safely in their preferred manner.

Overconfidence carries important consequences. For example, overconfidence often leads students to make poor study choices and, consequently, impedes learning (Dunlosky & Rawson, 2012). Furthermore, one person's overconfidence can carry significant consequences for others. People base important health and financial decisions on advice offered by doctors and lawyers. This practice seems suspect in light of evidence that both doctors (Tracey et al., 1997) and lawyers (Loftus &

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Wagenaar, 1988) tend to be overconfident with respect to their job-related knowledge and skills. It therefore seems crucial that researchers understand the roots of overconfidence in order to devise strategies for improving self-insight.

In the present paper, we seek to better understand a specific type of overconfidence—overplacement. Overplacement refers to overly positive perceptions of how one compares to others (Moore & Healy, 2008). Past research suggests that overplacement stems, in part, from the desire to view the self positively (Blanton et al., 2001). However, there is often an indirect path from this self-enhancement goal to overconfidence in self-assessments. It would be hard to truly believe that one is brilliant based only on the fact that this belief feels nice to maintain. Instead, motivated processes are likely to be most effective when they are hidden from view (Gilovich, 1991). Thus, self-enhancement motives often influence self-judgments indirectly by shaping the way that we attend to, interpret, and remember information (Kunda, 1990).

Little is known about who is most overconfident and why. In this paper, we draw from the literature on theories of intelligence to identify the very individuals who might be most likely to self-enhance and, as a result, to show the most overconfidence. Past research suggests that the tendencies to avoid difficulty and react poorly to challenge are more characteristic of people holding one theory of intelligence over another (e.g., Hong et al., 1999, Nussbaum & Dweck, 2008). We examine whether overconfidence is most prevalent among those whose theory of intelligence leads them to forego learning opportunities in order to maintain positive beliefs regarding their competence. Moreover, we build on this literature to propose a novel contributor to overconfidence—a biased tendency to allocate attention away from difficulty. Indeed, we will propose that people holding one intelligence theory may account for much, if not most, of the overconfidence effect.

Some people hold a more *incremental* view of intelligence—characterized by the belief that intelligence is malleable and can be developed over time—while others hold a more *entity* view—characterized by the belief that intelligence is fixed and unchangeable (for reviews, see Dweck, 1999, 2006). We predict that people's beliefs about intelligence will impact the degree to which they engage in self-enhancing behavior, as opposed to behavior that indicates greater openness to negative information (cf. Leonardelli & Laken, 2010 for a related idea). We know from past research that incremental theorists' belief that they can improve their intelligence leads them to adopt learning goals in which they strive to improve their abilities (Dweck & Leggett, 1988). This orientation toward learning, we argue, should make incremental theorists open to both positive and negative feedback, which should result in relatively accurate views of the self. In contrast, entity theorists' belief that intelligence is fixed leads them to adopt goals characterized by efforts to validate, rather than improve, their intelligence (Nussbaum & Dweck, 2008). We argue that this orientation will leave entity theorists with greater motivation to maintain positive views of their intelligence compared to incremental theorists. As such, entity theorists may engage in acts that leave them feeling (over)confident more often than their incremental theory peers. Building on this work, we suggest that entity theorists will seek to maintain overly positive self-views by means of preferential attention to the experiences of implicit positive feedback and ease compared to experiences of effort and difficulty.

Prior research offers preliminary evidence that the perception of a trait as fixed might inspire avoidance of negative feedback. For example, Dunning (1995) demonstrated that participants who had performed poorly on a test of a purportedly fixed trait showed less interest in additional feedback compared to participants who had performed well. An entity theory of intelligence also promotes lessened attention to explicit corrective feedback or errors, compared to an incremental theory (e.g., Mangels et al., 2006).

The current investigation builds on this work to illuminate a previously unknown mechanism that might contribute to differences in overconfidence. We examine whether motivations to avoid negative feedback might lead entity theorists to allocate less attention to difficult problems and more attention to easy problems on intellectual tasks, compared to incremental theorists. No research has previously explored how attention allocation might influence overconfidence. We examine whether this biased pattern of attention allocation leaves entity theorists with more overconfident self-assessments than their incremental theorist peers. We focus on people's attention to the immediate self-generated feedback from feelings of ease or difficulty, understanding or confusion, rather than explicit feedback regarding success or failure. Facing difficulty while completing a task can serve as a cue that one is performing poorly, constituting implicit failure feedback. Similarly, experiences of ease when performing a task serve as implicit cues that one is succeeding or performing quite well. Indeed, superficial manipulations designed to inspire feelings of difficulty leave entity theorists, but not incremental theorists, feeling less confident about their performance (Miele & Molden, 2010). As such, we suggest that entity theorists are likely to avoid difficult aspects of tasks that might require them to face up to the possibility that they are not performing well and, by extension, might not be smart. In short, relative to incremental theorists, we expect that entity theorists will allocate their attention in motivated ways—toward easy task aspects and away from difficult task aspects—and that, as a result, they will hold overconfident beliefs regarding how well they have performed on an intellectual task.

## 2. The present investigation

The present research explores who shows overconfidence and why. Study 1 examines whether those with more of an entity theory show greater overplacement (overestimation of their percentile score) than those with stronger incremental theories. Study 2 experimentally manipulates intelligence theories and examines whether a biased pattern of attention allocation mediates a tendency for greater overplacement in the entity compared to the incremental condition. Finally, Study 3 features a manipulation of participants' attention allocation to examine whether directing attention to difficult items eliminates the overplacement effect among entity theorists.

## 3. Study 1: intelligence theories and overconfidence

Study 1 addressed the relationship between theories of intelligence and overconfidence. We predicted that participants with stronger entity views would account for much of the commonly found pattern of overplacement.

### 3.1. Methods

#### 3.1.1. Participants

Fifty-three[1] university students participated in exchange for extra credit in their psychology courses (62% female).

#### 3.1.2. Procedure

Several days before the main experiment, participants completed a web-based 8-item measure of their theories of intelligence (Dweck, 1999). They rated their agreement with statements such as "You have a certain amount of intelligence, and you can't really do much to change it" and "You can always substantially change how intelligent you are" on a 6-point scale from "strongly disagree" to "strongly agree."

[1] No participants were excluded from analyses across the three studies. We used a rule of thumb of 25 participants per cell to determine the sample size for Studies 1 and 3. Each sample is slightly larger than planned because of imperfect enforcement of the stopping rule. For Study 2, we doubled our rule of thumb for a goal of 50 participants per cell to ensure sufficient power for the mediational analyses. Study 2 has slightly fewer than 50 participants per cell because our access to participants had ended for the semester.

In the main session, participants completed a 10-item multiple-choice test of antonym problems. Test items were selected from a GRE test preparation guide (Educational Testing Service, 1996) with the goal of creating a test that was of moderate difficulty (see Supplementary Material). Upon completing the test, participants were asked to indicate their confidence by rating how their performance compared to that of other participants in the study. Specifically, they were asked to estimate their percentile score by choosing a number between 0% (worse than all other students) and 99% (better than all others). The 50th percentile was described as representing the average performance of all students from that university participating in the study during that semester. It is worth noting that this procedure allows for greater precision than the measures more commonly used to assess overplacement. Participants in many overplacement studies are asked to rate how their traits or abilities compare to those of the average person. These studies include no objective measure of those traits or abilities to serve as a basis of comparison. Our strategy of including measures of subjective and objective performance on an intellectual task provides the information necessary to identify precisely which participants are overconfident.

### 3.2. Results and discussion

We first examined whether our sample, on average, was overconfident and found that it was. A paired t-test demonstrated that the average estimate, $M = 66.19$ ($SE = 2.87$), was significantly greater than the true average score, $M = 50.0$ ($SE = 3.86$), $t(52) = 3.73$, $p < .001$, $d = 0.75$.

We next calculated a theory of intelligence score for each participant by averaging across responses to the eight items, reverse scoring as necessary. Scores can theoretically range from 1 (strong agreement with an entity theory of intelligence) to 6 (strong agreement with an incremental theory). The mean score in this sample was 3.44 ($SE = 0.12$) (see Supplementary Material).

To examine the relationship between intelligence theories and overconfidence, we conducted a regression analysis predicting participants' confidence estimate from their intelligence theory score, controlling for their actual percentile score.[2] This analysis revealed that participants with more entity views of intelligence offered more overconfident estimates than participants who more strongly endorsed an incremental theory, $\beta = -.51$, $t(50) = -4.27$, $p < .001$, see Fig. 1.[3] Participants with stronger entity theories clearly displayed overconfidence, estimating their performance to be in the 76th percentile, $M = 76.78$, $SE = 3.49$. In contrast, those with stronger incremental theories offered estimates that were more accurate, $M = 55.59$, $SE = 3.49$. Study 1 offers initial evidence that overconfidence, typically thought to be a general phenomenon, might be most common among entity theorists.

## 4. Study 2: theories of intelligence and attention allocation

Study 2 was designed to explore a novel mechanism underlying the relationship between theories of intelligence and overconfidence—differences in how people allocate attention to different aspects of a task. We argue that an entity theory might lead participants to allocate their time in a biased way—toward the experiences of ease on intellectual tasks generated while answering easy questions and away from the feelings of difficulty characteristic of attempting difficult questions. In contrast, those with more incremental theories might allocate their time in ways less driven by a motivation to avoid difficulty. Further, we argue that entity theorists' biased pattern of attention allocation is likely to lead them to be more overconfident than incremental theorists.

Studies 2 and 3 were designed as a two-step experimental test of causal mediation as recommended by Spencer et al. (2005). This approach requires one experiment in which the proposed independent variable (i.e., participants' intelligence theories) is manipulated in order to assess its impact on the proposed mediator(s) (time devoted to completing easy and difficult questions) and dependent measure (confidence). Combined with the second step in Study 3—an experimental manipulation of the proposed mediator designed to examine its impact on the dependent variable—this approach can provide strong evidence of causal mediation.

Consistent with this approach, Study 2 directly examined the causal relationship between intelligence theories, attention allocation, and overconfidence (or, more precisely, overplacement) by experimentally manipulating participants' intelligence theories. We predicted that those in the entity theory condition would devote less time to difficult aspects of the task and more time to easy aspects compared to those in the incremental condition. We also expected that those in the entity condition would show greater overconfidence than those in the incremental condition. Finally we predicted that a difference in attention allocated to difficult and easy problems would mediate the relationship between intelligence theories and overconfidence.

### 4.1. Methods

#### 4.1.1. Participants

Ninety-four university students participated in exchange for extra credit or a cash payment (61% female).

#### 4.1.2. Procedure

Participants were randomly assigned to read one of two popular science news-style articles successfully used in past research to experimentally manipulate theories of intelligence (e.g., Hong et al., 1999). They were asked to read the article in order to help with research on reading comprehension. Participants randomly assigned to the *Incremental Article* condition read an article designed to convey to them that intelligence is malleable. This article described "scientific evidence" from cross-sectional research and twin studies supporting this malleable view of intelligence. Those in the *Entity Article* condition read an article written in the same style but purporting to offer scientific support for the conclusion that intelligence cannot be shaped.

As part of a "second study," participants were asked to take a test of antonym problems similar to that in Study 1. We created this 15-item test using item difficulty data provided by the GRE preparation guide described above (see Supplementary Material). We selected five questions likely to be relatively easy for our sample, five questions likely to be very difficult, and five filler items likely to be of moderate difficulty. The computer interface presented one test item per page and tracked the time that participants spent on each problem. Participants were given unlimited time to complete the test. A navigation bar at the bottom of each page allowed them to move on to additional questions as well as return to any previously displayed questions and change their answers if they wished. In this way, participants could devote as much time as they liked to completing test problems and going back to review their responses at will, much as they can on the pen and paper tests that are common in educational settings. Upon completing the test, participants were asked to estimate their percentile score using the same measure as in Study 1.

[2] In all analyses predicting estimated percentile scores, we control for participants' actual scores. We do this because percentile estimates have a ceiling of 100. Thus, an individual scoring in the 95th percentile can be, at most, overconfident by 5 percentile points while lower-scoring individuals are able to display much more overconfidence. Controlling for participants' actual score allows us to avoid an artificial appearance of differences in overconfidence that are a direct result of participants' actual score.

[3] Note that lower intelligence theories scores correspond with stronger entity views of intelligence. Across all studies, there were no interactions between gender and intelligence theories on overconfidence (see Supplementary Material).

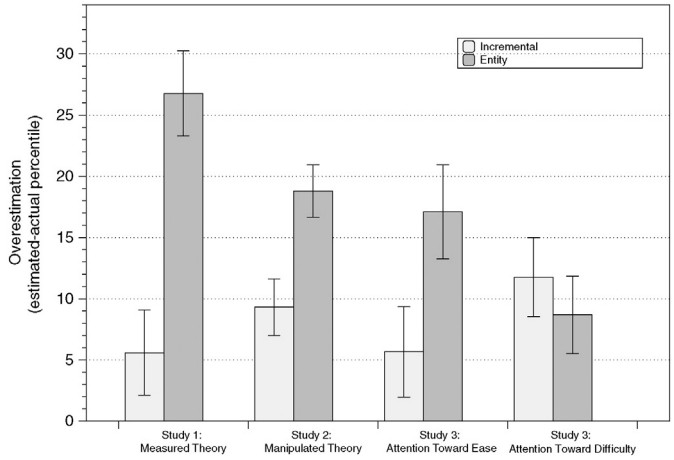


**Fig. 1.** The effect of naturally occurring (Studies 1 and 3) and manipulated (Study 2) theories of intelligence on overconfidence. Note: The means displayed in this figure represent difference scores between participants' average confidence judgments and actual scores, estimated from analyses that control for actual score. The means in Studies 1 and 3 represent one standard deviation above (incremental theorists) and below (entity theorists) the mean on intelligence theories. Study 2 shows means for participants in the Incremental and Entity Article conditions. Error bars represent 1 SE. Also note that, in Study 3, one condition oriented participants' attention toward easier problems and the other oriented their attention toward difficult ones (a manipulation designed to eliminate the overconfidence of entity theorists).

### 4.2. Results and discussion

#### 4.2.1. Item difficulty

A paired t-test confirmed that participants answered a higher percentage of the easy test items correctly, $M = 96.81$ ($SE = .87$) range = 90.4%–98.9%, than the difficult test items, $M = 47.87$ ($SE = 2.73$) range = 29.79%–71.28%, $t(94) = 18.73$, $p < .001$, $d = 2.42$.

#### 4.2.2. Attention allocation

We next examined the time in seconds that participants spent on easy items, difficult items, and on the 15-item test as a whole. Data were log-transformed to correct for positive skew (see Supplementary Material). We then computed two composite scores representing the mean log-transformed seconds spent on difficult items and, separately, the mean log-transformed seconds spent on easy items. Finally, we summed the time that participants devoted to each item and calculated the log-transformed total number of seconds taken to complete the test.

To test our prediction about attention allocation, we conducted a mixed-model ANCOVA predicting participants' time on easy and difficult items from their article condition, controlling for the overall time taken to complete the test.[4] This analysis revealed the predicted interaction between article condition and attention allocated to easy and difficulty items, $F(1,91) = 13.13$, $p < .001$, $\eta_p^2 = 0.13$. To aid in interpretation, we converted the log-transformed means resulting from our analyses into raw means representing the number of seconds allocated to problems. Simple effect analyses suggested that participants in the *Entity Article* condition allocated significantly less attention toward difficult items, $M = 15.70$ ($SE = 1.026$) than those in the *Incremental Article* condition, $M = 17.22$ ($SE = 1.023$), $F(1,91) = 6.48$, $p < .05$, $\eta_p^2 = 0.07$. In addition to attending *less* to difficult items, *Entity Article* participants allocated *more* attention to easy items, $M = 20.94$ ($SE = 1.028$), than *Incremental Article* participants, $M = 18.54$ ($SE = 1.026$), $F(1,91) = 9.22$, $p < .005$, $\eta_p^2 = 0.09$. In both conditions, participants allocated more time to easy than difficult items. However, this difference was only marginally significant for participants in the *Incremental Article* condition, $F(1,91) = 3.29$, $p < .10$, $\eta_p^2 = 0.04$. In contrast, the large effect size displayed by participants in the *Entity Article* condition, $F(1,91) = 43.36$, $p < .001$, $\eta_p^2 = 0.32$, was more than 8 times the size of the effect observed in the *Incremental* condition.

#### 4.2.3. Overconfidence

Was this difference in allocation of attention accompanied by a difference in overconfidence? To answer this question, we conducted an ANCOVA with participants' intelligence article condition predicting their estimated percentile score, controlling for participants' actual score. This analysis revealed a main effect suggesting that participants in the *Entity Article* condition offered more overconfident estimates of their percentile score, $M = 68.80$ ($SE = 2.32$), than did *Incremental Article* participants, $M = 59.31$ ($SE = 2.13$), $F(1,91) = 9.03$, $p < .005$, $\eta_p^2 = 0.09$, see Fig. 1.

#### 4.2.4. Mediation

Finally, we used Hayes' (2013) Process script, Model 4, to run a bias-corrected bootstrapping analysis based on 10,000 samples examining whether differences in attention allocation to easy and difficult items (entered as separate, parallel mediators) mediated this observed effect of article condition on participants' estimated percentile score. Participants' total time to complete the test as well as their actual percentile score were added to the model as covariates. Consistent with the analysis above, we found a direct effect of article condition on confidence, $ab = -11.19$ ($SE = 3.21$), $t(93) = -3.49$, $p < .001$ ($-17.57$, $-4.81$). This analysis also revealed a confidence interval for the indirect effect of the article condition on participants' confidence estimates through attention to difficult problems ($ab^1 = 1.79$, $SE = 1.25$) that was above zero (0.12, 5.44, see Fig. 2). In contrast, the confidence interval for the indirect effect of condition on confidence through attention to easy problems ($ab^2 = 0.17$, $SE = 1.28$) contained zero ($-1.89$, 3.52). Together, these analyses provide support for our hypothesis that participants in the *Entity Article* condition show greater overconfidence than those in the *Incremental* condition, in part, because those in the *Entity* condition allocated less attention to difficult items than their peers in the *Incremental* condition.

By experimentally manipulating participants' theories of intelligence, Study 2 provides evidence of a causal relationship between an entity view of intelligence and overconfidence. Further, Study 2 provides insight into a mechanism underlying this relationship. Participants in the *Entity* condition allocated less time to difficult problems and more time to easy problems than those in the *Incremental* condition. Further, bootstrapping analysis suggests that this effect of article condition on overconfidence was mediated by differences in allocation of time to difficult (but not easy) problems. In light of evidence that, across many domains, bad is stronger than good (Baumeister et al., 2001), it is perhaps not surprising that differences in attention to a negative stimuli (the struggle accompanying difficult problems) in this study had a larger impact on overconfidence than attention to easy problems.

## 5. Study 3: manipulating attention

If, as we argue, entity theorists maintain overly positive views of their performance by directing their attention away from difficulty, we should be able to reduce their overconfidence by requiring them to attend to difficult items. Study 3 builds on the previous study by providing the second step of the two-step experimental strategy for assessing mediation promoted by Spencer et al. (2005). This second step requires experimentally manipulating the proposed mediator in order to assess its impact on the dependent variable. Following this recommendation, we manipulated participants' attention to difficult versus easy aspects of the task and examined the effect of this

[4] The overall time that participants spent on the antonym test in Study 2 ranged from 159 to 929 s. We thought it important to control for participants' overall test time in all analyses predicting attention allocation because test time likely correlates with individual differences (e.g., in motivation, verbal ability, and/or conscientiousness) that are irrelevant to the central questions of this paper.

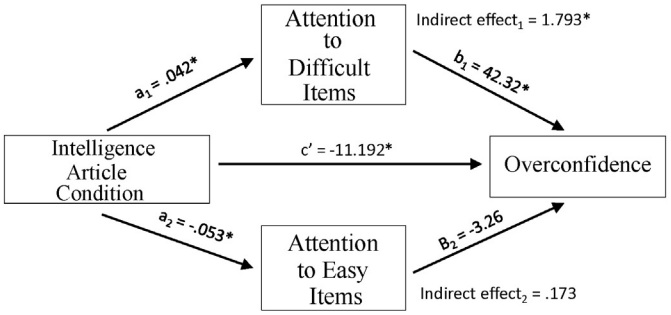


**Fig. 2.** The indirect effects of article condition on overconfidence through allocation of attention to difficult and easy problems (Study 2).
Note: The standardized coefficients for each direct effect were drawn from the described bootstrapping analysis. This analysis revealed an indirect effect of the article condition on participants' overconfidence through attention to difficult items. There was *not* evidence of a comparable indirect effect through participants' attention to easy items. * indicates $p < .05$.

manipulation on participants' confidence. As noted, we predicted that requiring greater attention to difficult items would reduce or eliminate the overconfidence of entity theorists. However, we did not expect that this manipulation would influence the (already accurate) self-assessments of incremental theorists, because incremental theorists are less likely than entity theorists to interpret difficulty as a reflection of their abilities (Miele & Molden, 2010).

### 5.1. Methods

#### 5.1.1. Participants

Participants were 104 university students (56% females) who participated in exchange for either a cash payment or credit in their psychology course.

#### 5.1.2. Procedure

Participants were asked to complete the 4-item short version of the Theories of Intelligence scale (Dweck, 1999).[5] They then completed a 20-item multiple-choice general knowledge quiz made up of 10 questions we expected to be quite easy for them and 10 questions expected to be very challenging (see Supplementary Material). After completing this test, participants were asked to review each of the 20 items while completing a task designed to direct their attention either toward easy more than difficult problems (*Attention Toward Ease* condition) or toward difficult more than easy problems (*Attention Toward Difficulty* condition). Specifically, participants in the *Attention Toward Ease* condition were asked to complete a time-consuming task when reviewing easy items. They were asked to carefully retype the text for each of the 10 easy questions and to proofread their work to ensure that they had copied the text exactly. However, when reviewing the 10 difficult test questions, participants in this condition were asked to perform a secondary task that would take very little time—to simply name the text color. Participants in the *Attention Toward Difficulty* condition received the opposite direction — to complete the time-consuming task of retyping each of the 10 difficult test questions and to simply name the text color of each easy item. After completing this review task, participants were asked to estimate their percentile score on the test using the same measure as in the previous studies.

### 5.2. Results and discussion

To begin, a paired t-test revealed that easy questions were answered correctly, on average, 87.2% of the time ($SE = 1.12$) whereas difficult questions were answered correctly only 44.2% of the time ($SE = 1.73$), $t(103) = 23.16$, $p < .001$, $d = 2.35$.

Next, we conducted a regression analysis predicting participants' performance estimates from their condition, intelligence theory, and the interaction between condition and intelligence theory, controlling for actual percentile score. This analysis revealed a significant interaction between condition and intelligence theory, $\beta = -.68$, $t(99) = -2.19$, $p < .05$. Simple slope analyses revealed that, in the *Attention Toward Ease* condition, participants with stronger entity views of intelligence were more overconfident, $M = 67.10$ ($SE = 3.81$), than their more incremental peers, $M = 55.66$ ($SE = 3.81$), $\beta = -.30$, $t(99) = -2.51$, $p < .05$. However, among those in the *Attention Toward Difficulty* condition, participants with stronger entity theories were no more confident, $M = 58.68$ ($SE = 3.21$), than their incremental peers, $M = 61.76$ (SE = 3.20), $\beta = .10$, $t(99) = .67$, $p = .51$. It seems that the excess confidence that entity theorists enjoyed in the *Attention Toward Ease* condition was missing among their entity counterparts in the *Attention Toward Difficulty* condition, $\beta = .88$, $t(99) = 2.21$, $p < .05$.

Consistent with our predictions and with Studies 1 and 2, participants with more entity theories of intelligence offered more overconfident estimates of their performance than their more incremental peers. However, Study 3 included a condition that, for the first time in this investigation, led to humility among entity theorists. When participants with a stronger entity view of intelligence were required to attend to difficult problems, their confidence came down to the level displayed by their incremental peers. We find this pattern particularly impressive when compared to the patterns of overconfidence in Studies 1 and 2. A clear pattern can be seen in Fig. 1 whereby entity theorists show greater overconfidence than incremental theorists across each study and in each condition, with the sole exception of when they are faced with the *Attention Toward Difficulty* condition in Study 3. These findings provide further evidence that entity theorists may maintain overconfident views, in part, because of a tendency to allocate their attention away from experiences of difficulty. When they were forced to attend to difficulty in Study 3, we saw a significant drop in the confidence that was so plentiful in the earlier studies.

## 6. General discussion

People tend to display overconfidence across many domains (Dunning, 2005). The present research capitalized on theories of intelligence to illuminate who contributes most to this robust overconfidence effect and to understand the mechanism by which this happens. Across three studies, we demonstrated that a belief in intelligence as fixed promotes greater overconfidence than the opposite belief—that intelligence can be improved. These studies also identified and offered important insight into a previously unstudied cause of overconfidence. Study 2 provided evidence that this difference in overconfidence stems, in part, from differences in attention allocation. Participants who were randomly assigned to a condition in which they were taught an entity (vs. incremental) view of intelligence subsequently allocated less time to difficult problems and, as a result, made more overconfident assessments of performance. To further establish this mechanism, in Study 3, we manipulated participants' attention toward more difficult or toward easier problems. As predicted, when attention was directed toward easier problems (a condition meant to mimic entity theorists' natural attention allocation tendencies), those with stronger entity views of intelligence showed greater overconfidence than their more incremental peers. However, when attention was directed toward difficult problems, the confidence estimates of those with stronger entity theories fell to the same level as those of their more incremental peers.

Together, these studies provide intriguing new evidence that the overconfidence effect may be less universal than previously thought. Each study revealed a general overconfidence effect, but further analyses revealed that participants who endorse an entity theory accounted for the lion's share of that effect. Importantly, this work also offers

[5] The test used in Study 3 took longer to complete than the tests in the previous studies. We balanced this longer test with a short measure of intelligence theories.

insight into a previously unknown contributor to overconfidence—a motivated pattern of attention allocation that encourages overconfident perceptions of performance. This finding furthers our understanding of how the motivation to self-enhance can foster overconfidence indirectly, through behavioral biases including biased patterns of allocation of attention. Although the overconfidence effect was originally thought to be driven by self-enhancement motives (e.g., Alicke, 1985, Dunning et al., 1995), much of the recent work on overconfidence has highlighted non-motivational mechanisms including the competence level needed to understand one's level of incompetence (e.g., Dunning et al., 2003, Ehrlinger et al., 2008), reliance on chronic self-views (Ehrlinger & Dunning, 2003), and the informational differences between the self and others (Chambers & Windshitl, 2004). This focus on non-motivational mechanisms inspired Brown (2012) to subtitle a paper on overconfidence "Motives (Still) Matter." The present investigation reveals an important mechanism—biased allocation of attention—through which motives (still) matter in explaining overconfidence.

Although this was not the primary goal of these studies, the present research also provides intriguing evidence of two effective strategies for reducing overconfidence. As demonstrated in Study 2, one effective strategy for inspiring improved accuracy in self-assessments is to teach people an incremental view of intelligence. Recently, researchers have developed interventions designed to teach incremental views (aka "growth mindsets") to improve outcomes in the classroom (e.g., Blackwell et al., 2007), management (Heslin et al., 2005), and weight loss (Burnette & Finkel, 2012). One additional benefit of these interventions might be to discourage overconfidence and inspire greater self-insight among intervention recipients. In addition, Study 3 demonstrates that directing people's attention toward the most difficult aspects of a task can inspire more accurate self-assessments among those who typically showed the most overconfidence (entity theorists). Future research could further explore whether interventions that teach an incremental mindset and/or direct attention to difficulty might reduce overconfidence in the classroom and workplace.

Finally, perhaps the most important avenue for future research is to explore how the observed differences in attentional practices, and in overconfidence, can illuminate ways to improve students' and employees' learning trajectories. We would expect that a tendency to allocate relatively more time toward easy tasks over difficult tasks could lead to a decrement in sustained learning over time. First, mastery requires time and attention directed specifically toward those aspects of a task that are more difficult (Ericsson et al., 1993). Thus, people's reluctance to focus attention on difficult aspects of a task may limit their ability to improve. In addition, overconfidence might keep students from feeling that they need to devote time toward additional learning (Finn, 2008; Metcalfe & Finn, 2008). Indeed, past research does suggest that incremental theorists show greater learning over time, relative to entity theorists, in the face of academic challenges (Blackwell et al., 2007). We look forward to future research that examines the degree to which sustained learning is hindered by patterns of biased attention allocation and overconfidence as well as research that examines ways of overcoming these biases.

## Appendix A. Supplementary Material

Supplementary material to this article can be found online at http://dx.doi.org/10.1016/j.jesp.2015.11.001. Data and experimental materials can be found online at https://osf.io/fm5c2/.

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