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The relationship between intelligence and mindset

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ABSTRACT

Intelligence mindset refers to one's belief that either intelligence is a malleable trait that can improve with effort—a "growth" mindset—or is a relatively stable trait—a "fixed" mindset. According to proponents of mindset theory, holding a growth mindset is beneficial (e.g., greater academic persistence) while holding a fixed mindset is detrimental. Is there a relationship between one's intelligence mindset and one's intelligence? Proponents of mindset theory suggest that the answer is yes, and that this relationship differs by gender, with more intelligent females holding more of a fixed mindset (aka, the "bright girl effect"). However, investigations of all three factors—measured intelligence, intelligence mindset, and gender—have only been conducted with children and adolescents. Therefore, we tested whether, among adults, women have more of a fixed mindset than men, and whether women with higher intelligence are more likely to hold fixed mindsets. We found no evidence for women holding fixed mindsets more so than men. We found very limited evidence for a "bright woman effect": Three-way interactions between age, gender, and intelligence predicting mindset emerged, however, the relationships were not consistently driven by brighter women (young or old) holding more of a fixed mindset than their less intelligent female counterparts or men. Furthermore, we did not find evidence to support the notion that holding more of a growth mindset results in greater academic persistence. We conclude that neither gender nor intelligence is consistently associated with mindset.

1. Introduction

According to mindset theory (aka *implicit theories* or *self theories*; Dweck, 2000)—a theory popular both within academia and the media—individuals hold varying beliefs about whether traits, such as intelligence, are relatively stable or whether they can be changed with effort. Those who believe that intelligence and other traits are relatively stable are said to have a "fixed mindset" (or hold an "entity theory") while those who believe that abilities are changeable with effort are said to have a "growth mindset" (or hold an "incremental theory.")

According to this theory, holding a growth mindset is beneficial. For example, individuals with growth mindsets are more likely to exert effort to overcome a challenge, leading to greater academic achievement (e.g., Blackwell, Trzesniewski, and Dweck, 2007; Dweck and Leggett, 1988). In contrast, individuals with fixed mindsets are more likely to avoid challenges, assume failure is attributable to ability that cannot be changed, be debilitated by failure, fall into a helpless pattern, and lose their desire to learn (Dweck, 2000, 2007a, 2007b). Mindsets are assumed to develop from the type of praise a child receives from teachers and parents. Children who receive "process praise," that is, praise for effort and perseverance, will develop growth mindsets, while children who receive praise for their intelligence and abilities, will develop fixed mindsets (Dweck, 2007b, see also Mueller and Dweck, 1988).

2. The bright girl effect

Mindset theory also suggests that girls and women might be more likely to hold fixed mindsets than boys and men because, "[s]tarting in infancy, parents tend to give boys more process praise, an advantage that results in a greater desire for challenge, and a growth mindset, later on" (Dweck and Simmons, 2014, para. 13). For example, as reported in Dweck (1986), Licht and Shapiro (1982) found that girls were more likely to attribute failure to their ability. Similarly, Dweck (1986) also reports that, among a sample of bright junior high students, the girls were more likely than boys to hold a fixed mindset (Leggett, 1985).

Indeed, bright girls in particular are believed to be especially likely to hold fixed mindsets, because they are the most likely to be praised for their intelligence. For example, Halvorson (2011) pens, "more often than not, bright girls believe that their abilities are innate and unchangeable, while bright boys believe that they can develop ability through effort and practice" (para 6). She goes on to explain the presumed reason for this difference: girls often develop self-control earlier and are praised in terms of their attributes (e.g., being a good student,

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being smart), with the smartest girls receiving the most attribute praise. In contrast, boys of the same age are often more hyperactive and are praised for their efforts to sit still and pay attention.

Similarly, Dweck (2000) writes,

> Bright girls…are a group that does not want challenge (Licht and Shapiro, 1982). And when they are presented with a challenge or obstacles, they are a group that readily blames their ability and falls into a helpless pattern (Licht and Dweck, 1984a, 1984b; Licht, Linden, Brown, and Sexton, 1984; Licht and Shapiro, 1982…. (p. 53)

Thus, two assumptions have become suggested in the mindset literature and in the popular media. The first is that girls and women are more likely to have fixed mindsets than boys and men. The second is that girls and women with high IQs are especially likely to have fixed mindsets.

However, little evidence supports these assumptions. For example, in a recent behavioral genetics study, Tucker-Drob, Briley, Engelhardt, Mann, and Harden (2016) examined mindsets among 811 third-eighth grade twins and triplets. If girls are more likely to have fixed mindsets because parents praise girls and boys differently, we should observe a significant difference between girls' and boys' mindsets in the expected direction, and environmental effects should be greater than genetic influence. This pattern of results was not observed. They found that girls' and boys' mindsets were not significantly different from each other. Furthermore, they found that mindsets among monozygotic twins, who share 100% of their genes, were significantly correlated, but that mindsets were not correlated between same-sex or opposite-sex dizygotic twins, who only share about 50% of their genes. These results suggest that one's mindset is largely heritable and is not substantially influenced by one's home environment (e.g., praise from parents) or one's gender. However, Tucker-Drob et al. (2016) did not examine how IQ impacts gender differences in mindsets, which is an important part of the bright girl effect.

Dweck (2007b) cites studies as evidence of how IQ interacts with gender, resulting in the debilitating bright girl effect. Describing Licht and Dweck's (1984a) research on 5th-graders who received confusing materials at the start of a task, Dweck (2007b) states,

> What we found was that bright girls did not cope at all well with this confusion. In fact, the higher the girl's IQ, the worse she did. Many high-IQ girls were unable to learn the material after experiencing confusion. This did not happen to boys. (p. 47)

Dweck and Simmons (2014) add, “Notably, the highest IQ girls struggled the most” (para 10). However, the results of the Licht and Dweck (1984a) study do not support the conclusion that the brighter the girl the more likely she will to give up when facing challenges, a presumed trait of holding a fixed mindset. First, Licht and Dweck (1984a) excluded the brightest students from the sample, those scoring above the 95th percentile on a standardized test. Additionally, Licht and Dweck (1984a) only had IQ scores for a subset of the sample. For this reason, they asked children to rank how smart they thought they were relative to their classmates, and this—not children's actual IQ—was the measure Licht and Dweck (1984a) used to correlate with performance on the task. Most importantly, the correlation between this measure of intelligence and performance on the task after experiencing confusion was not significant. Thus, the conclusion that, “the higher the girl's IQ, the worse she did,” is not supported.

Three other studies are commonly cited and discussed as evidence for “the bright girl effect”: Leggett (1985), Licht and Shapiro (1982), and Licht et al. (1984). However, none of these studies were ever published and are not accessible. Thus, there is little, if any, available evidence to support the bright girl effect.

3. Is there a bright woman effect?

Among adult samples, investigations of gender and mindset have either observed that women and men have similar mindsets of intelligence on average (Heyman, Martyna, and Bhatia, 2002; Kornilova, Kornilov, and Chumakova, 2009; Yan, Thai, and Bjork, 2014) or that women have more of a growth mindset than men (Spinath, Spinath, Riemann, and Angleitner, 2003). Similarly, while research suggests that holding a fixed mindset negatively predicts academic achievement in children (e.g., Blackwell et al., 2007), these results run counter to the finding that adults with higher levels of education are more likely to hold a fixed mindset than their less educated counterparts (Yan et al., 2014).

The present set of studies seeks to examine claims about gender, intelligence, and mindsets among adult samples. In Study 1, in a college-age sample, we test the prediction that women endorse a more fixed mindset compared to men. We also test whether intelligence interacts with this relationship, specifically, whether more intelligent women are more likely to hold fixed mindsets. In Study 2, in an online sample, we test the same assumptions as in Study 1, and also examine whether age interacts with gender, mindset, and intelligence. In Study 3, we replicate Study 2, and also ask whether mindsets influence level of education attained. Data for all three studies are openly available at https://osf.io/r4x53/.

4. Study 1

4.1. Method

4.1.1. Participants

One hundred three (57 female) General Psychology I students at Case Western Reserve University participated in exchange for partial course credit as part of a larger study.

4.1.2. Materials and procedure

After completing a brief demographics questionnaire asking participants to indicate their sex and age, participants completed the following measures in the following order.

4.1.2.1. Intelligence mindset questionnaire. A questionnaire (Dweck, 2000) asking participants to respond to statements about intelligence was administered. Participants responded to eight statements (e.g., “Your intelligence is something about you that you can't change very much.”) “Strongly Agree,” “Agree,” “Mostly Agree,” “Mostly Disagree,” “Disagree,” or “Strongly Disagree.” Responses were coded as 1, 2, 3, 4, 5, or 6 respectively and reverse scored when appropriate such that higher scores reflect more of a growth mindset.

4.1.2.2. Talent mindset questionnaire. A questionnaire (mindsetonline.com) asking participants to respond to statements about talent was administered. Participants responded to eight statements (e.g., “Your talent in an area is something about you that you can't change very much.”) “Strongly Agree,” “Agree,” “Mostly Agree,” “Mostly Disagree,” “Disagree,” or “Strongly Disagree.” Responses were coded as 1, 2, 3, 4, 5, or 6 respectively and reverse scored when appropriate such that higher scores reflect more of a growth mindset.

4.1.2.3. Raven's Advanced Progressive Matrices. In this measure of fluid intelligence (Raven, Raven, and Court, 1962), participants are asked to recognize patterns, reason, and problem solve to the best of their ability. Participants were given 2 practice problems, feedback about why the correct answers were correct, and the chance to ask questions. Odd numbered items from the full scale were presented. Participants had 10 min to complete as many as possible.

4.2. Results

The mean age of the participants was 18.95 (SD = 1.82). Contrary to assumption, women did not hold more fixed mindsets than men. In

Table 1
Study 1 descriptive statistics.

	Females	Males	*t*	*p*
Intelligence mindset	4.20 (1.05)	3.71 (1.06)	2.30	0.023
Talent mindset	3.95 (1.16)	3.69 (1.22)	1.09	0.278
Raven's Adv. Matrices	0.65 (0.13)	0.67 (0.11)	− 0.77	0.445

Note. Standard deviations in parentheses. Higher mindset scores correspond to more of a growth mindset. Raven's Adv. Matrices = Raven's Advanced Progressive Matrices.

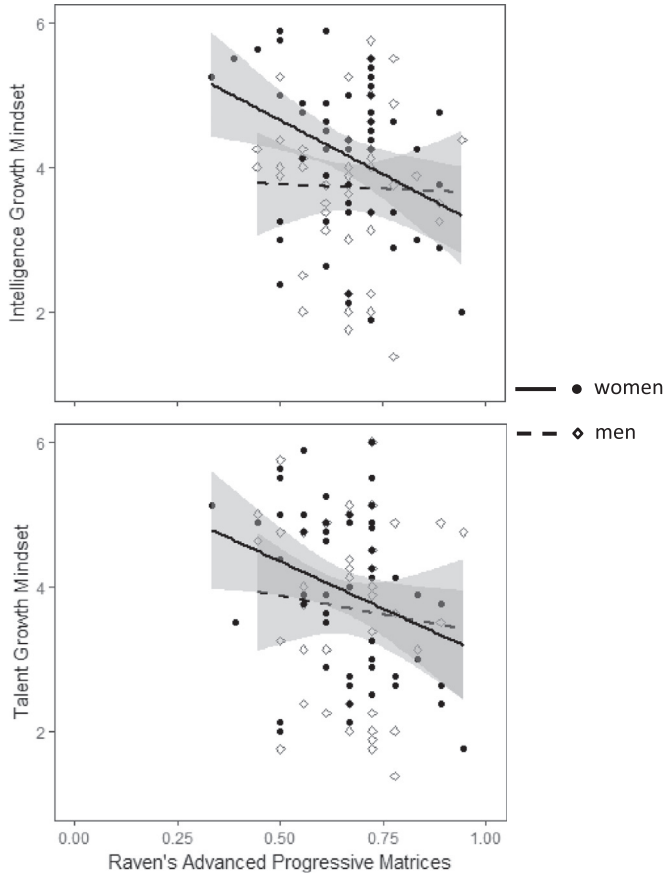

Fig. 1. Study 1 results. Relationships between intelligence and mindsets for women and men.

fact, women had greater growth intelligence mindsets than men. Scores on talent mindset and Raven's Advanced Progressive Matrices were similar for the females and males (Table 1).

To test whether a "bright woman effect" existed, we conducted correlational analyses between intelligence and mindset for women and men. For women, we observed negative correlations between intelligence and intelligence mindset ($r = -0.35$, $p = 0.007$) and between intelligence and talent mindset ($r = -0.28$, $p = 0.033$) indicating that the more intelligent the woman, the more likely she was to endorse a fixed mindset. For men, these relationships were not significant ($r = -0.03$, $p = 0.865$ and $r = -0.10$, $p = 0.528$). See Fig. 1.

However, correlation analyses divided by gender do not test whether the correlations between women and men are significantly different. To test whether there was a significant interaction between gender and intelligence predicting mindset, we conducted regression analyses. Raven's Advanced Progressive Matrices scores were centered. Men were coded as 0, women as 1. Neither intelligence nor the Gender × Intelligence interaction significantly predicted mindset. The only significant finding was a main effect of gender when intelligence mindset was the outcome variable, such that on average, women held more of a growth mindset than men. See Table 2.

Table 2
Study 1 regression analyses.

	Estimate	SE	Beta	*t*-Value	*p*-Value
Intelligence mindset					
Intercept	3.72	0.16		23.46	< 0.001
Gender	0.48	0.21	0.22	2.25	0.026
Raven's	− 0.36	1.41	− 0.04	− 0.25	0.801
Gender ∗ Raven's	− 0.43	1.81	− 0.04	− 0.24	0.815
Talent mindset					
Intercept	3.68	0.18		20.75	< 0.001
Gender	0.27	0.24	0.11	1.11	0.269
Raven's	0.58	1.58	0.06	0.37	0.712
Gender ∗ Raven's	− 0.24	2.03	− 0.02	− 0.12	0.905

Note. Raven's = Raven's Advanced Progressive Matrices. SE = standard error. Beta = standardized regression coefficient.

4.3. Discussion

Contrary to claims that women have more fixed mindsets than men, we found that women were significantly more likely to endorse a growth intelligence mindset relative to their male counterparts. The correlation between intelligence and mindset was significant for the women (but not the men), indicating that more intelligent women were more likely to hold fixed mindsets. However, when submitting the data to regression, the interaction between gender and intelligence was not significant. A limitation of this study is that the sample consisted of college students and a restricted range of intelligence. We thus sought to test these relationships with an online sample to examine a wider age and intelligence range.

5. Study 2

5.1. Method

5.1.1. Participants

One hundred forty-seven (72 female) MTurk workers completed the study in exchange for payment. MTurk workers are generally more representative of U.S. demographics than convenience face-to-face samples (Berinsky, Huber, and Lenz, 2012; Ross, Irani, Silberman, Zaldivar, and Tomlinson, 2010). While MTurk workers have likely participated in other online studies, the majority is not habitual study respondents and their presence in a sample has not been found to substantially or significantly affect the outcome (Berinsky et al., 2012). In sum, certain safeguards must be put in place when conducting online samples (e.g., instructional manipulation checks; Oppenheimer, Meyvis, and Davidenko, 2009). However, data generally support the notion that studies conducted on MTurk are no more susceptible to biases and demand characteristics than standard methods of data collection (Casler, Bickel, and Hackett, 2013).

5.1.2. Materials and procedure

Following a brief demographics questionnaire, participants completed the online version of the intelligence mindset questionnaire used in Study 1, followed by the talent mindset questionnaire used in Study 1, and then the same odd numbered Raven's Advanced Progressive Matrices problems used in Study 1. Participants had 10 min to complete as many as Raven's problems as possible. Prior to beginning the Raven's problems participants received 3 easy practice problems and feedback about why the correct answers were correct.

5.2. Results

Based on piloting, we found that participants needed approximately 20 min to read all instructions and complete the demographics questionnaire, the intelligence mindset questionnaire, the talent mindset

Table 3
Study 2 descriptive statistics.

	Females	Males	*t*	*p*
Age	42.60 (14.09)	38.02 (12.53)	1.93	0.056
Intelligence mindset	3.37 (1.24)	3.63 (1.20)	− 1.23	0.223
Talent mindset	3.55 (1.19)	3.68 (1.18)	− 0.62	0.535
Raven's Adv. Matrices	0.46 (0.21)	0.47 (0.19)	− 0.43	0.668

Note. Standard deviations in parentheses. Higher mindset scores correspond to more of a growth mindset. Raven's Adv. Matrices = Raven's Advanced Progressive Matrices.

questionnaire, the practice Raven's Advanced Progressive Matrices problems, and the Raven's Advanced Progressive Matrices problems. In line with recommendations to use safeguards when using MTurk, we removed participants (n = 9) who completed the study in < 5 min given that this rate made it unlikely that they could carefully read the instructions and respond to the survey and test items. Eleven more participants were removed for failing to correctly respond to the majority of the 3 practice problems; these practice problems were designed to be easy to answer correctly and thus, failing to correctly answer 2/3 or 3/3 indicated that either the test was too difficult to measure their intelligence or that they were not attempting to answer correctly. The average age for the remaining 127 participants (67 females) was 40.43 (SD = 13.52).

As can be seen in Table 3, age and scores on the mindset measures and intelligence measure were similar between females and males.

There were no significant correlations between mindset and intelligence for either females or males. To examine the effects of each predictor variable and their interactions we conducted regression analyses. Continuous variables were centered. Male was coded as 0, female as 1. As can be seen in Table 4, there were no main effects of gender, intelligence, or age for either type of mindset. However, there were significant 3-way Age × Raven's × Gender interactions for both mindset types. As illustrated in Fig. 2, for intelligence mindset and intelligence, the 3-way interaction appears to be driven by differences in the relationship between mindset and intelligence between genders at younger ages. Specifically, the more intelligent the relatively younger female, the more likely she is to hold a fixed mindset, whereas the more intelligent the relatively younger male, the more likely he is to hold a growth mindset. As age increases, the relationships between intelligence mindset and intelligence are buffered. For talent mindset and intelligence, the 3-way interaction appears to be driven by a reversal in the relationship between mindset and intelligence as age increases for women. Specifically, as with intelligence mindset, the more intelligent the relatively younger female, the more likely she is to hold a fixed mindset, but as age increases, the relationship between talent mindset and intelligence reverses for women such that the more intelligent the relatively older female the more likely she is to hold a growth mindset. The relationship between talent mindset and intelligence is considerably weaker for males and remains so regardless of age.

Table 4
Study 2 regression analyses.

	Estimate	SE	Beta	*t*-Value	*p*-Value
Intelligence mindset					
Intercept	3.57	0.16		22.14	< 0.001
Gender	− 0.17	0.22	− 0.07	− 0.75	0.452
Age	− 0.00	0.01	− 0.03	− 0.19	0.850
Raven's	0.28	0.84	0.05	0.34	0.737
Gender ∗ Raven's	− 0.95	1.09	− 0.12	− 0.87	0.388
Gender ∗ Age	0.01	0.02	0.07	0.49	0.626
Raven's ∗ Age	− 0.11	0.06	− 0.23	− 1.76	0.081
Gender ∗ Ravens ∗ Age	0.25	0.08	0.38	2.94	0.004
Talent mindset					
Intercept	3.64	0.16		22.78	< 0.001
Gender	− 0.05	0.22	− 0.02	− 0.25	0.807
Age	− 0.00	0.01	− 0.03	− 0.18	0.857
Raven's	− 0.28	0.83	− 0.05	− 0.34	0.734
Gender ∗ Raven's	0.82	1.08	0.11	0.76	0.452
Gender ∗ Age	0.01	0.02	0.04	0.30	0.768
Raven's ∗ Age	− 0.07	0.06	− 0.15	− 1.16	0.250
Gender ∗ Ravens ∗ Age	0.17	0.083	0.28	2.09	0.038

Note. Raven's = Raven's Advanced Progressive Matrices. SE = standard error. Beta = standardized regression coefficient.

5.3. Discussion

Similar to Study 1, we found that the higher young womens' scores on the Raven's Advanced Progressive Matrices were, the more of a fixed intelligence mindset they endorsed having. Unlike Study 1, we observed the opposite pattern for younger males, such that the higher their score on the Raven's Advanced Progressive Matrices, the more of an intelligence growth mindset they endorsed having. Also, while in Study 1 we found that women had more of a growth mindset on average than males (contrary to the mindset literature assumption), we found no difference between the genders in Study 2. Given the inconsistent patterns across age for the two mindset measures in Study 2 and the different patterns between the young men across the two studies, we conducted a third study.

6. Study 3

6.1. Method

6.1.1. Participants

Two hundred (99 female) MTurk workers completed the study in exchange for payment.

6.1.2. Materials and procedure

The materials and procedure were identical to Study 2 with the following exceptions. We moved the demographics questionnaire to the end of the study and additionally asked participants about the highest level of education they had achieved. We also did not allow participants to move past the Raven's Advanced Progressive Matrices until the 10-min time limit had expired.

6.2. Results

Given that we did not allow participants to advance until the 10 min expired on the Raven's Advanced Progressive Matrices and based on our pilot results indicating that the study takes approximately 20 min, we removed participants (n = 28) who completed the task in fewer than 13 min. That is, we assumed that it was unlikely participants were carefully reading and responding if spending fewer than 3 min total on the instructions, Raven's practice problems, intelligence mindset questionnaire, talent mindset questionnaire, and demographics questionnaire. As with Study 2, we additionally removed participants who incorrectly responded to the majority of the practice problems (n = 9). One hundred sixty-three participants (87 females) were included in the analyses.

The mean age was 37.26 years old (SD = 12.82). Education level was coded as the following: 0 = some high school, 1 = high school diploma, 2 = some college/associates degree, 3 = bachelor's degree, 4 = graduate degree. As can be seen in Table 5, measured variables were similar between females and males.

Correlation analyses revealed a significant negative relationship (r = − 0.33) between talent mindset and education level for males such that the more of a fixed talent mindset a male had, the greater his highest education level attained. To examine the effects of each predictor variable and their interactions we conducted regression analyses. Continuous variables were centered. Male was coded as 0, female as 1. As can be seen in Table 6, for intelligence mindset there were no main effects of gender, intelligence, age, or education. However, there was a

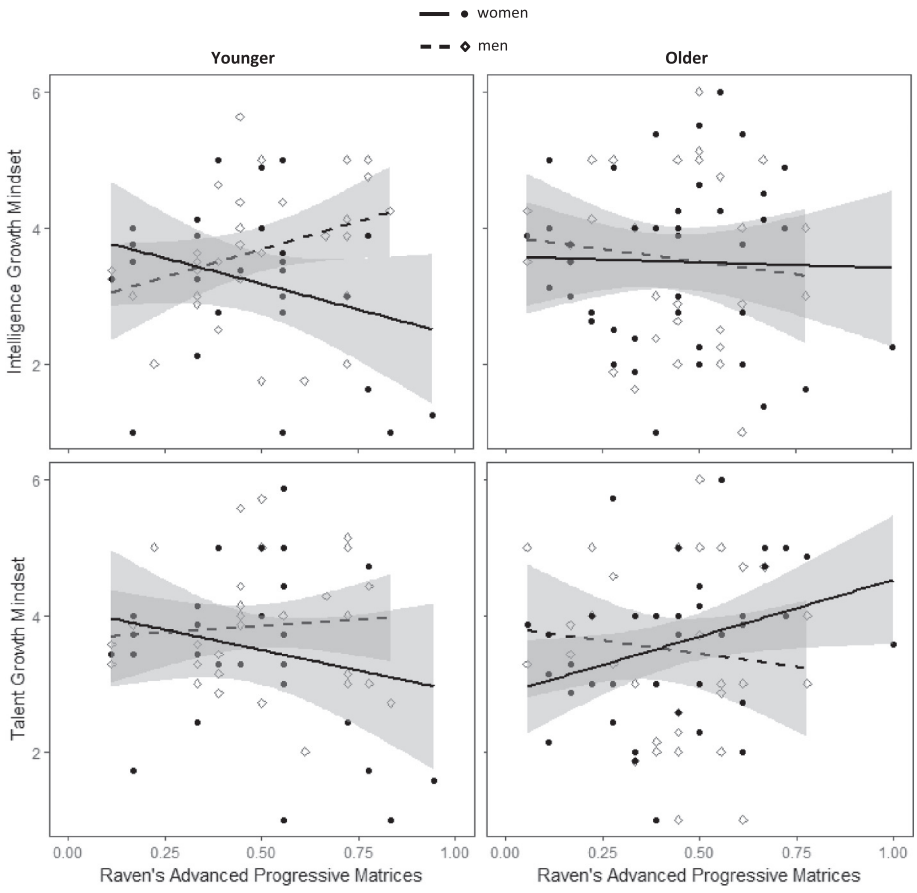

Fig. 2. Study 2 results. Relationships between intelligence and mindsets for women and men. Age is dichotomized for illustration purposes. Younger = younger than the median age. Older = equal to or older than the median age.

Table 5
Study 3 descriptive statistics.

	Females	Males	*t*	*p*
Age	36.80 (12.60)	37.78 (13.13)	− 0.48	0.631
Intelligence mindset	3.80 (1.19)	4.02 (1.12)	− 1.17	0.246
Talent mindset	3.89 (1.16)	4.04 (1.09)	− 0.88	0.379
Raven's Adv. Matrices	0.44 (0.21)	0.46 (0.21)	− 0.59	0.560
Education Level	2.51 (0.83)	2.51 (0.93)	− 0.05	0.957

Note. Standard deviations in parentheses. Higher mindset scores correspond to more of a growth mindset. Raven's Adv. Matrices = Raven's Advanced Progressive Matrices.

Table 6
Study 3 regression analyses.

	Estimate	SE	Beta	*t*-Value	*p*-Value
Intelligence mindset					
Intercept	4.07	0.13		30.32	< 0.001
Gender	− 0.25	0.18	− 0.11	− 1.35	0.180
Age	− 0.01	0.01	− 0.05	− 0.45	0.656
Raven's	− 0.34	0.66	− 0.06	− 0.52	0.604
Gender ∗ Age	0.02	0.01	0.14	1.24	0.216
Gender ∗ Raven's	0.86	0.89	0.11	0.96	0.338
Age ∗ Raven's	− 0.12	0.05	− 0.25	− 2.19	0.030
Gender ∗ Age ∗ Raven's	0.16	0.07	0.25	2.16	0.032
Talent mindset					
Intercept	4.08	0.13		30.86	< 0.001
Gender	− 0.19	0.18	− 0.09	− 1.07	0.286
Age	0.01	0.01	0.07	0.57	0.571
Raven's	− 0.67	0.65	− 0.13	− 1.04	0.298
Gender ∗ Age	0.00	0.01	0.03	0.27	0.784
Gender ∗ Raven's	0.88	0.88	0.12	1.01	0.316
Age ∗ Raven's	− 0.08	0.05	− 0.19	− 1.58	0.116
Gender ∗ Age ∗ Raven's	0.06	0.07	0.10	0.88	0.383

Note. Raven's = Raven's Advanced Progressive Matrices. SE = standard error. Beta = standardized regression coefficient.

significant Age × Raven's interaction and a significant 3-way (Gender × Age × Raven's) interaction. The interactions appear to be driven by a slight positive relationship between intelligence and growth mindset among younger participants and a strong relationship between fixed mindset and intelligence among relatively older male participants (see Fig. 3). None of the predictors or their interactions significantly predicted talent mindset.

According to the mindset literature, those with growth mindsets embrace challenge and thus have higher academic achievement than their fixed mindset counterparts who are debilitated by failure (e.g., Blackwell et al., 2007; Dweck, 2006) especially if female and especially if a bright female (Dweck, 2000; Dweck and Leggett, 1988). We therefore tested whether gender, age, intelligence, mindset, or any of their interactions (with the exception of crossing the two mindset measures) predicted highest level of education attained. As can be seen in Table 7, there were no significant effects. The largest effects (though not significant) were intelligence mindset, talent mindset, Gender × Intelligence mindset, Gender × Talent mindset, and Raven's × Intelligence mindset. As can be seen in Fig. 4, if anything, more of a fixed mindset was beneficial for achieving higher levels of education, and slightly more so for males. Additionally, if anything, more of a fixed intelligence mindset was beneficial for achieving higher levels of education for individuals below the median score for intelligence.

6.3. Discussion

Contrary to the assumptions of the mindset literature, we did not observe that women held fixed mindsets more so than men. Additionally, we did not observe a gender × intelligence interaction, which could have suggested that the brighter the female, the more

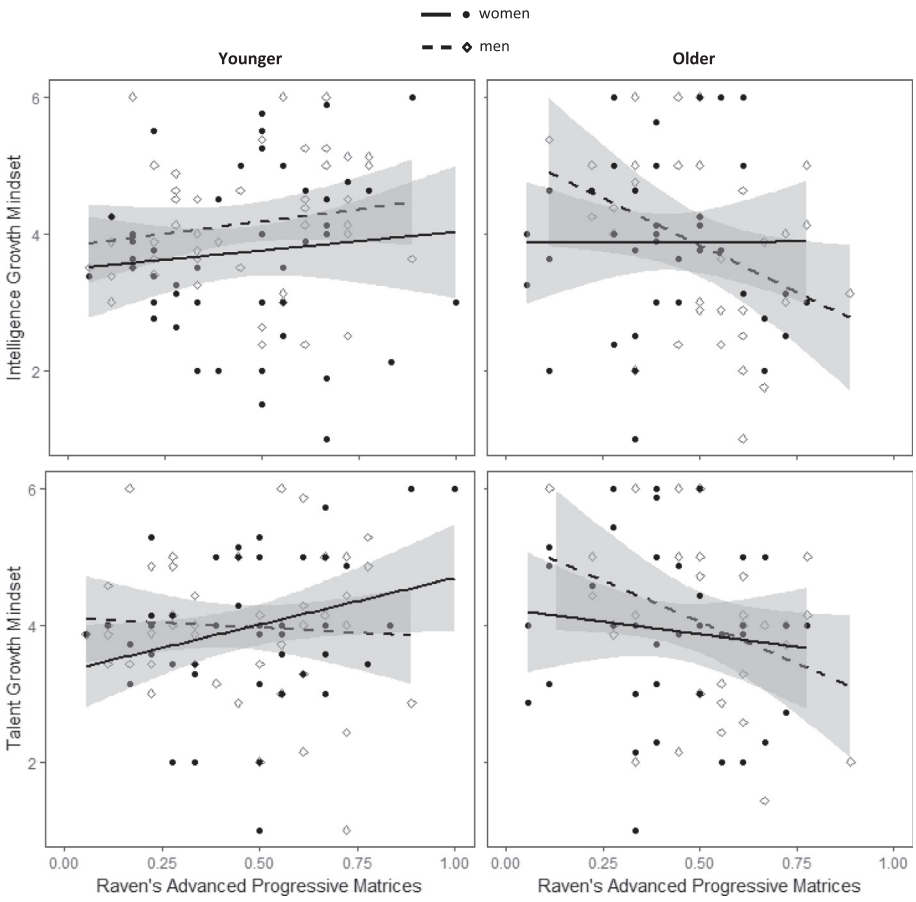

Fig. 3. Study 3 results. Relationships between intelligence and mindsets for women and men. Age is dichotomized for illustration purposes. Younger = younger than the median age. Older = equal to or older than the median age.

likely she was to hold a fixed mindset. We did observe a Gender × Age × Raven's three-way interaction for intelligence mindset, but not for talent mindset. We did not observe that the more of a growth mindset the higher the level of education attained. However, this measure was limited as a short ordinal scale rather than a truly continuous measure.

7. Synthesis of studies and general discussion

We sought to examine two key claims from the mindset literature: (1) women have more of a fixed mindset than men and (2) the more intelligent the female, the more likely she is to hold a fixed mindset. Across three studies, we found no evidence that adult females have

Table 7
Study 3 regression analyses predicting highest educational attainment.

	Estimate	SE	Beta	*t*-Value	*p*-Value
Intercept	2.53	0.10		23.19	< 0.001
Gender	− 0.01	0.14	− 0.01	− 0.09	0.928
Age	0.00	0.01	0.07	0.53	0.596
Raven's	0.17	0.53	0.04	0.31	0.755
Mindset: I	0.17	0.16	0.23	1.09	0.277
Mindset: T	− 0.38	0.15	− 0.23	− 1.62	0.107
Gender ∗ Age	− 0.00	0.01	− 0.01	− 0.08	0.936
Gender ∗ Raven's	0.78	0.71	0.14	1.09	0.277
Gender ∗ Mindset I	− 0.35	0.18	− 0.34	− 1.96	0.052
Gender ∗ Mindset T	0.28	0.18	0.28	1.62	0.107
Age ∗ Raven's	0.04	0.04	0.12	0.95	0.346
Age ∗ Mindset: I	− 0.00	0.02	− 0.03	− 0.11	0.916
Age ∗ Mindset: T	− 0.00	0.02	− 0.02	− 0.08	0.938
Raven's ∗ Mindset: I	0.81	0.43	0.20	1.87	0.063
Raven's ∗ Mindset: T	− 0.42	0.41	− 0.11	− 1.04	0.299
Gender ∗ Age ∗ Raven's	0.01	0.16	0.03	0.23	0.816
Gender ∗ Age ∗ Mindset: I	0.00	0.01	0.06	0.26	0.793
Gender ∗ Age ∗ Mindset: T	0.01	0.01	0.06	0.30	0.762
Age ∗ Raven's ∗ Mindset: I	0.00	0.09	0.00	0.01	0.993
Age ∗ Raven's ∗ Mindset: T	0.04	0.07	0.12	0.54	0.588
Gender ∗ Age ∗ Raven's ∗ Mindset: I	− 0.06	0.09	− 0.15	0.60	0.547
Gender ∗ Age ∗ Raven's ∗ Mindset: T	− 0.06	0.08	− 0.12	− 0.68	0.495

Note. Raven's = Raven's Advanced Progressive Matrices. Mindset: I = Intelligence mindset. Mindset: T = Talent mindset. SE = standard error. Beta = standardized regression coefficient.

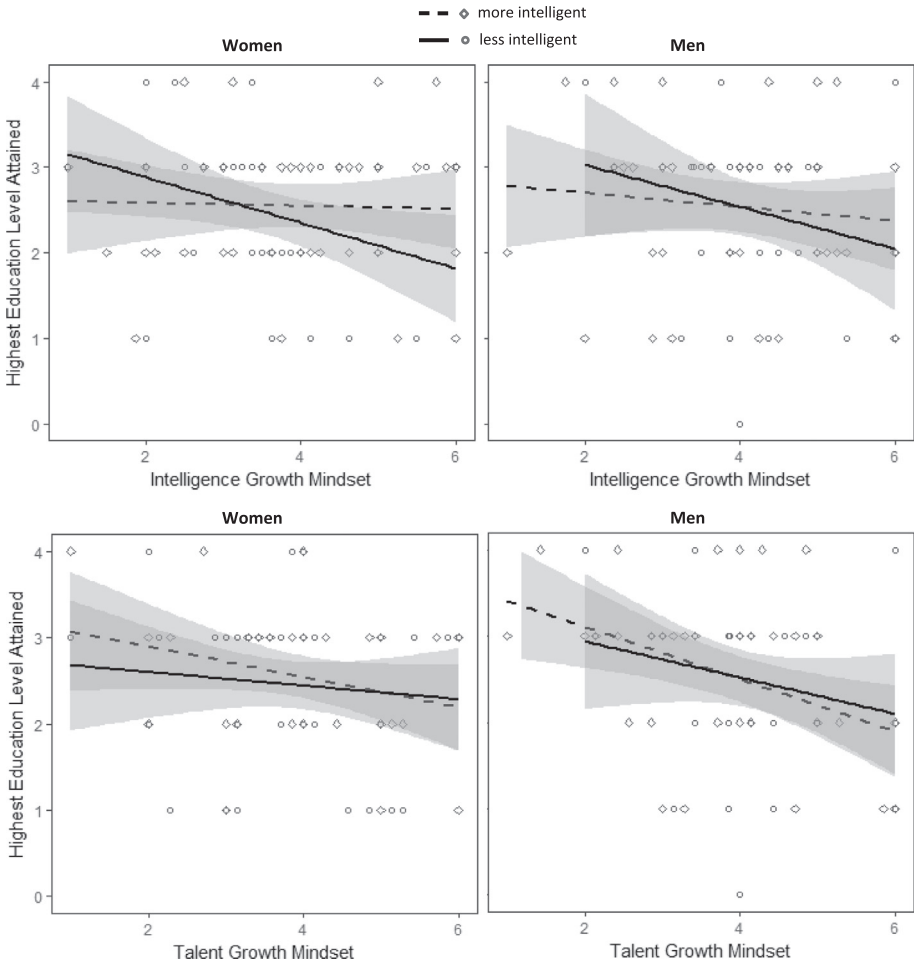

Fig. 4. Study 3 results. Relationships between mindsets and academic achievement for women and men. Intelligence is dichotomized for illustration purposes. Less intelligent = Raven's Advanced Progressive Matrices score below the median. More intelligent = Raven's Advanced Progressive Matrices score equal to or above the median.

more of a fixed mindset than adult males. Women either did not differ from men on average (Studies 2 and 3) or were more likely to hold growth mindsets (Study 1). Thus, across three studies with 393 participants in all we found either no evidence or contradictory evidence to the suggestion that females have more of a fixed mindset than males. These results replicate previous findings that women and men either do not differ on mindsets on average (Heyman et al., 2002; Kornilova et al., 2009; Yan et al., 2014) or that women have more of a growth mindset than men (Spinath et al., 2003). To synthesize the results from the three studies, we conducted fixed-effect meta-analyses on our results. The results indicated that there is no difference between women's and men's intelligence mindsets, $\overline{d} = -0.03$, 95% CI [−0.23, 0.17], $p = 0.774$, or between women's and men's talent mindsets, $\overline{d} = -0.03$, 95% CI [−0.23, 0.16], $p = 0.737$.

The other major question was whether the more intelligent the woman, the more likely she is to hold a fixed mindset. We examined this in two ways. First, we conducted correlational analyses between gender and mindset. We found significant, negative correlations, indicating that the more intelligent the woman the more of a fixed mindset she held, in Study 1, but not in Study 2 or Study 3. To synthesize the correlational results from the three studies, we conducted fixed-effect meta-analyses on our results. The results indicated that there is no relationship between women's intelligence and intelligence mindset, $\overline{r} = -0.12$, 95% CI [−0.26, 0.01], $p = 0.072$ or between women's intelligence and talent mindset, $\overline{r} = -0.11$, 95% CI [−0.24, 0.03], $p = 0.114$.

Second, we conducted regression analyses with all our variables and their interactions. We did not observe significant Gender × Raven's interactions on either mindset measure in any of the three studies. The fixed-effect meta-analysis results for the Gender × Raven's interactions were $\overline{B} = 0.06$, 95% CI [−1.20, 1.33], $p = 0.921$ for intelligence mindset, and $\overline{B} = 0.74$, 95% CI [−0.52, 2.01], $p = 0.249$ for talent mindset.

We did observe significant Gender × Age × Raven's interactions in both studies that included a wide age range (Studies 2 and 3). However, the patterns of results driving these interactions were inconsistent. When examining intelligence mindset, in Study 2 the three-way interaction was primarily driven by younger women's negative relationship between growth mindset and intelligence and by younger men's positive relationship between growth mindset and intelligence, and that both relationships buffered as age increased. However, in Study 3, the three-way interaction was primarily driven by relatively older men's strong negative relationship between mindset and intelligence whereas younger women and men both had weak, positive relationships between growth mindset and relatively older women showed no association whatsoever between these factors. When examining talent mindset, in Study 2 the three-way interaction was primarily driven by relatively younger women's slight negative relationship between mindset and intelligence that reversed as age increased. Men's relationship between these two factors was relatively weak across the age range. No Gender × Age × Raven's three-way interaction was observed in Study 3. While the three-way interaction was significant 3 of the 4 measures, the inconsistent patterns in the data suggest these results are spurious.

Finally, we tested the assumption that growth mindsets predict academic achievement. We found no evidence to support this hypothesis. While not significant, the pattern of results trended in the opposite direction such that fixed mindsets were associated with greater

academic achievement (though again, not significantly). However, our measure of academic achievement only captured level of education obtained, which might be closer to a measure of academic persistence than academic achievement given that we did not measure or control for the selectivity of the school, program, or grades received. Additionally, rank-ordering level of education is far from a rigorous measure. Thus, our lack of findings does not necessarily mean there is no relationship between growth mindset and academic achievement/academic persistence, only that it is not robust enough to be captured by this measure.

Our studies have a number of strengths and a number of limitations. Regarding strengths, we measured mindsets and intelligence across three samples, two of which had a wide range of ages and intelligence levels. The inconsistencies of results lead us to believe that either a) women are no more likely to hold fixed mindsets than men and there is no such phenomenon as the bright woman effect, or b) gender differences and/or the bright woman effect are only found under certain circumstances.

What might these circumstances be? These circumstances do not appear attributable to age, at least across adult development, as patterns of results interacting with age were inconsistent across studies. However, we only examined adults. While previous evidence for observing these effects among children was limited, it is possible that effects might only emerge for specific age groups and/or ranges of intelligence (e.g., gifted junior high students). Additionally, the studies do not have the advantages of longitudinal designs. Individuals may vary in their mindsets depending on life circumstances. For example, individuals facing challenges while working toward an achievement outcome might adopt a growth mindset, and then shift to a fixed mindset once they have secured their achievements in order to attribute their success to their abilities, and this shifting might interact with gender. Another possibility is that effects might emerge only when girls or women are under stereotype threat and when boys and men experience stereotype lift. There are many potential moderating factors that could influence the circumstances under which effects are observed. Alternatively, observed effects might be spurious. Regardless, our results suggest gender differences of mindset and the bright woman effect are not consistent phenomena.

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