**Supplemental Online Material for**

**“What Can Be Learned from Growth Mindset Controversies?”**

This online supplement includes the following information:

* Appendix 1: The Mindset Meaning-System Index (MMI) and the brief fixed mindset measure.
* Appendix 2: New data collected to understand why the performance avoidance goals administered by Burgoyne et al. (2020) were not correlated with mindset.

**Appendix 1: The Mindset Meaning-System Index**

**Brief Mindset Meaning Index**

Here are the items that were included in the Brief Mindset Meaning System Index. To create an index, z-score each item and then take the unweighted average. These measures were included in three previously-published studies (Rege et al., in press; Yeager et al., 2016, 2019). In two of the studies (Rege et al., in press, and Yeager et al., 2019) we also measured learning goals with a behavioral task assessing challenge-seeking for the purpose of learning, called the make-a-math-worksheet task. We recommend these items (and the worksheet task) for studies of adolescents that wish to include a brief and validated measure of the mindset meaning system. Below, higher values should be positively correlated with a fixed mindset.

**Effort belief.** When you have to try really hard in a subject in school, it means you can’t be good at that subject.

* Strongly disagree (1)
* Disagree (2)
* Mostly disagree (3)
* Mostly agree (4)
* Agree (5)
* Strongly agree (6)

**Goals: Performance-avoidance.** One of my main goals for the rest of the school year is to avoid looking dumb in my classes.

* Strongly disagree (1)
* Disagree (2)
* Mostly disagree (3)
* Mostlyagree (4)
* Agree (5)
* Stronglyagree (6)

**Challenge-seeking for the purpose of learning: hypothetical choice.** Imagine that, later today or tomorrow, your math teacher hands out two extra credit assignments. You get to choose which one to do. You get the same number of points for trying either one.

One choice is an easy review—it has math problems you already know how to solve, and you will probably get most of the answers right without having to think very much. It takes 30 minutes.

The other choice is a hard challenge—it has math problems you don’t know how to solve, and you will probably get most of the problems wrong, but you might learn something new. It also takes 30 minutes.

If you had to pick right now, which would you pick?

* The easy math assignment where I would get most problems right. (1)
* The hard math assignment where I would possibly learn something new. (0)

**Response to challenge: Helpless attributional style.** Pretend that, later today or tomorrow, you got a **bad** grade on a very important math assignment.

Honestly, if that happened, how likely would you be to think these thoughts?

"This means I’m probably not very smart at math."

* Not at all likely to think this (1)
* Slightly likely to think this (2)
* Somewhat likely to think this (3)
* Very likely to think this (4)
* Extremely likely to think this (5)

**Response to challenge: Resilient attributional style.** [Same prompt as the item above]

"I can get a higher score next time if I find a better way to study."

* Not at all likely to think this (5)
* Slightly likely to think this (4)
* Somewhat likely to think this (3)
* Very likely to think this (2)
* Extremely likely to think this (1)

**Measure of Fixed Mindset**

Here are the items that were used to assess students’ mindsets in the three previously-published studies (Rege et al., in press; Yeager et al., 2016, 2019). Higher values correspond to more of a fixed mindset. We recommend these three items for any study wishing to use a brief and validated mindset measure.

1. You have a certain amount of intelligence, and you really can’t do much to change it.
2. Your intelligence is something about you that you can’t change very much.
3. Being a “math person” or not is something that you really can’t change. Some people are good at math and other people aren’t.

Response options for each item:

* Strongly disagree (1)
* Disagree (2)
* Mostly disagree (3)
* Mostly agree (4)
* Agree (5)
* Strongly agree (6)

**Appendix 2: Comparison to Burgoyne et al. (2020)**

A recent paper by Burgoyne et al. (2020) examined the correlation between mindset and several components of the mindset meaning system, such as performance avoidance goals, and it found weaker results than we reported in the large studies using standardized measures, reported in Table 1 in the paper. In the paper, we speculated that the discrepancy in results might be explained by the measure of performance avoidance goals used by Burgoyne et al. (2020), which may not have tapped into mindset theory’s predictions. Here we present evidence in support of those speculations.

As evidence for our argument, we cited a well-known meta-analysis of performance avoidance goals measures, which concluded that research on achievement goals has often used “the same label for different constructs” (Hulleman et al., 2010, pg. 422). In particular, Hulleman et al. (2010)—and, earlier, Grant and Dweck (2003)—showed that there are two very different types of performance goal measures: those focused on *appearance/ability* (i.e. validating and demonstrating one’s abilities in front of or relative to others) and those focused on living up to a *normative standard* (e.g. doing well, or not doing poorly, in school) (also see Grant & Dweck, 2003). Only the appearance/ability performance goals have been predicted (and found) to tap into the helplessness that characterizes a fixed mindset response to difficulty. These are goals which cause people to focus on maintaining an image as a smart (or not dumb) person, rather than on learning. In Blackwell et al. (2007), this goal is measured with an item like this: “*It's very important to me that I don't look stupid in [this math] class.*” In our standardized MMI measure, we assess this goal with a single item: “*One of my main goals for the rest of the school year is to avoid looking dumb in my classes.”* People with this kind of avoidance goal forego learning experiences that are accompanied by difficulty, and over time tend to perform worse. A fixed mindset should therefore be positively correlated with appearance/ability performance goals.

Normative performance avoidance goals tap into a general motivation to do well or not do poorly. They do not reference people’s standing relative to others, and do not reflect the fixed mindset worry about revealing one’s low, fixed ability. Burgoyne et al. (2020) measured normative performance avoidance goals according to the Hulleman et al. (2010) categorization, with these items adapted from Elliot & Church (1997): “*I often think to myself, ‘What if I do badly (in this class, in this game, in this sport, etc.)*?’” “*I worry about the possibility of performing poorly*” and “*My fear of performing poorly is often what motivates me.*” As mentioned, these items are not expected to correlate strongly with mindset. Indeed, people with a growth mindset want to avoid doing poorly, in part because their performance might be a reflection that they had not learned all that they would like to have learned. That is, mindset should not be correlated with an overall desire to do well and not poorly, but rather with a tendency to draw a certain inference about the *meaning* of high or low performance.

To understand whether the difference in goals items could, indeed, explain the difference in results, we were able to use some survey space in a recent study we conducted to administer the normative-focused goal measures reported by Burgoyne et al. (2020). It was informative to administer both kinds of measures in the same study, using the same procedures and data, because the Burgoyne et al. (2020) study differed in several other ways from the large studies we reported in Table 1. We used adolescents and they used college students, we used goals items directly tied to a context and time period (i.e. school this year) and their items were generic (simply saying *I worry about the possibility of performing poorly*). We used a 3-item fixed mindset scale and they used an 8-item scale (4 growth items and 4 fixed items). Here, we report data using both appearance/ability and normative goals, with both the 3- and 8-item growth mindset scales, in a sample of adolescents, and with all goals items referencing school.

Our study was conducted recently by the Character Lab Research Network (CLRN). CLRN independently collected data for us from *N* = 1,582 U.S. 8th to 12th graders in the Fall of 2020 (pre-registration and additional analyses here: [osf.io/3mtcz](https://osf.io/3mtcz)). We note that we only had the space to include a few additional items, so we could not replicate the entire Burgoyne et al. (2020) study procedures. The present analysis can only speak to the potential differences in the performance avoidance goals results. For additional analyses of the new data, including new exploratory analyses, see <https://osf.io/krjv5/>. A preview of what was learned from these analyses appears at the end of this document.

**Measures**

***3-item mindset scale.***

You have a certain amount of intelligence, and you really can’t do much to change it.

Your intelligence is something about you that you can’t change very much.

Being a “math person” or not is something that you really can’t change. Some people are good at math and other people aren’t.

***8-item mindset scale.***

You have a certain amount of intelligence, and you can’t really do much to change it.

Your intelligence is something about you that you can’t change very much.

To be honest, you can’t really change how intelligent you are.

You can learn new things, but you can’t really change your basic intelligence.

No matter who you are, you can significantly change your intelligence level. (R)

You can always substantially change how intelligent you are. (R)

No matter how much intelligence you have, you can always change it quite a bit. (R)

You can change even your basic intelligence level considerably. (R)

***Normative-focused performance-avoidance goals (from Elliot & Church, 1997)[[1]](#footnote-1)***

I often think to myself, "What if I do badly in school?"

I worry about the possibility of getting a bad grade in school.

My fear of performing poorly in school is often what motivates me.

***Ability-focused performance avoidance goals (from the MMI).*** One of my main goals for the rest of the school year is to avoid looking dumb in my classes.

**Overview of Analyses**

All analyses were conducted using the stan program in R (Gelman et al., 2015) with a weakly informative prior of *R*2 = .04. The fully Bayesian approach can give us information about quantity of interest—the magnitude of the correlation in this sample—and also give us interpretable probabilities and uncertainty intervals when conducting hypothesis tests of a difference among the correlations. Further, the Bayesian approach allows us to compare each correlation to the threshold of *r* = .20 set by Burgoyne et al. (2020). The posterior distributions for the correlations are plotted in Figures S1 and S2.

**Results Using the 3-item Fixed Mindset Measure**

First, we analyzed the data using the 3-item fixed mindset measure as a predictor, which is what we used in our studies of the Mindset Meaning-system Index. Burgoyne et al. (2020) reported a small correlation of *r* = .04 with normative-focused performance avoidance goals. We replicated that weak correlation (Figure S1A): *r* = .08 [95% posterior density interval: .03, .13] with their performance goal measure. There was a 100% posterior probability that the correlation was weaker than *r* = .20 (which Burgoyne et al. 2020 called an “inferiority test”). Next, we found that the single MMI item assessing ability-focused performance avoidance goals was meaningfully correlated with fixed mindset, *r* = .25 [.20, .30] (Figure S1C). There was a 98% posterior probability that the correlation we observed was greater than *r* = .20 (i.e. in a “superiority test”). Therefore we showed that we could replicate our significant correlation with appearance/ability-focused goals and replicate the predicted null correlation with normative-focused performance avoidance goals when using the 3-item mindset scale.

***Figure S1. Posterior distributions for correlations between fixed mindset (3-item measure) and performance goals measures (B to C) compared to (A) simulated correlation of r = .20.***



**Results Using the 8-item Mindset Measure**

Next, we analyzed the data using the same 8-item mindset measure reported by Burgoyne et al. (2020). This composite was created by taking the unweighted average of 4 fixed mindset items and 4 growth mindset items (reverse-coded). We replicated the Burgoyne et al. (2020) small correlation with appearance-focused performance avoidance goals; we find that it is almost perfectly zero (see Figure S2B). There is an approximately 100% probability that the correlation with the normative-focused performance avoidance goals was smaller than a correlation of *r* = .2.

We next used the same 8-item mindset scale to estimate the correlation with the standardized performance avoidance goals item. Figure S2C shows that the correlation of *r*=.20is slightly smaller than the *r* = .25 reported in Figure S1, which used the fixed-framed items only. But the correlation is also clearly overlapping with posterior distribution of the simulated correlation of *r* = .20, posterior probability that the mindset correlation is less than the simulated correlation = 48%, which is consistent with a conclusion of no difference from *r* = .20

***Figure S2. Posterior distributions for correlations between fixed mindset (8-item measure) and performance goals measures (B to C) compared to (A) simulated correlation of r = .20.***

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**Summary**. We found null or small correlations between mindset and normative-focused performance avoidance goals (not wanting to do poorly) either way mindset was operationalized. We further found correlations that were the same as or greater than the criterion of *r* = .20 when ability-focused performance avoidance goals (wanting to avoid negative ability judgments) were used, regardless of how mindset was measured. The mindset measure used by Burgoyne et al. (2020), however, yielded somewhat smaller correlations. Overall, the conclusion from this analysis is that Burgoyne et al. (2020) used items to assess performance goals that are not a test of the mindset meaning system hypothesis.

**Additional Analyses**

Our pre-registration focused on the performance-avoidance goals analysis just described ([osf.io/3mtcz](https://osf.io/3mtcz)). As a secondary matter we were also able to administer one other scale from the Burgoyne et al. (2020) study: the Elliot & Church (1997) mastery-approach (or learning) goals, and our measure of challenge-seeking (Appendix 1), which is a learning-oriented behavioral intention. These results were more ambiguous and complex and are reported in a memo on these secondary analyses here: <https://osf.io/krjv5/>.

In Table 1 in the paper, we showed that the learning goals correlations were the weakest in the MMI and were consistently lower than .2. In the CLRN data we find the same thing, and the correlation with mindset even lower, and significantly lower than .2. This was true for the 3-item and the 8-item mindset measure. We note that these are correlations between a single, dichotomous choice (between a hard or an easy assignment) and a 3-item scale, and that measure was designed initially as a manipulation check (for Yeager et al., 2016), not to maximize raw correlations.

Interestingly, we also found that we failed replicate the Burgoyne et al. (2020) finding that mindset was uncorrelated with the Elliot & Church (1997) learning goals. When using the 8-item measure, fixed mindset was correlated with learning goals at *r* = -.21, which is not weaker than |*r*| = .20 in an “inferiority test.” Therefore Burgoyne’s null correlation of learning goals with mindset was not replicated in our data.

1. The full scale from Elliot & Church (1997) also included one item which appeared to be an ability-focused performance avoidance goal. Burgoyne et al. (2020) do not report whether they measured that question and did not post or disclose the item-level data, having only posted the full composite. Therefore we cannot evaluate whether that single ability-focused item was correlated with mindset in their data, as would be expected by theory. [↑](#footnote-ref-1)