

Should your Growth Mindset be Fixed?

Examining the Opportunity Costs of Adopting a Growth Over a Fixed Mindset

QX Teo

A Fable:



FINISH

“Slow and Steady Wins the Race”

- Persistence as a good thing:
 - The hardworking tortoise beating the lazy hare
- Grit (Duckworth, 2007):
 - “Passion and perseverance for long-term goals”
 - Cultivating Grit: “The Hard Thing Rule”
- How do we get children to persist?
 - Growth Mindsets!

Mindset Theory (Dweck 2006)

What do people believe about intelligence?

- Fixed Mindset: Innate ability, intelligence is a fixed quantity
- Growth Mindset: Intelligence is *malleable*

How do these people react to failure?

How do these people approach problems?

Fixed or Growth Mindset?

Studies show strong support for the Growth Mindset:

- Fixed mindset children were quicker to give up when faced with failure, attributing their failures to them not being “smart enough” (Diener et al., 1978, also Dweck and Repucci, 1973)
- Students in the University of Hong Kong were asked if they were interested in taking a high-quality remedial English course (Hong et al., 1999)
 - Fixed Mindsets were not enthusiastic, while Growth Mindsets were “willing to expose a deficiency for the sake of correcting it”.
- Correlational paths from mindsets to goals & responses, predicting changes in math grades over a two year period in 7th/8th grade (Robins and Pals, 2002, Blackwell, Trzesniewski & Dweck, 2007)

How is this knowledge used in the real world?

Eberly Center

Teaching Excellence & Educational Innovation

Design & Teach a Course

Technology for Education

Assess Teaching & Learning

Solve a Teaching Problem

The Simon Initiative

Who We Are

Promote a growth mindset

Dr. Carol Dweck, cognitive psychologist and leading expert on “mindset,” describes growth mindset as “the understanding that we can develop our abilities and intelligence.” The

- We see this even in the CMU setting!

Is this reflected in the real world?

- Not really!
- Anecdotally: see a healthy mix of both even in academically oriented fields (faculty, university students)
- How certain are we that growth mindset is truly favorable in all scenarios?
- If growth mindset is that favorable, why aren't more people in the world adopting it?

Fixed or Growth Mindset? (Revisited)

Are there instances where a fixed mindset may be favorable to a growth mindset?

- Tough problems: fixing a plumbing issue
- Impossible problems: Find an anagram of 'gref'

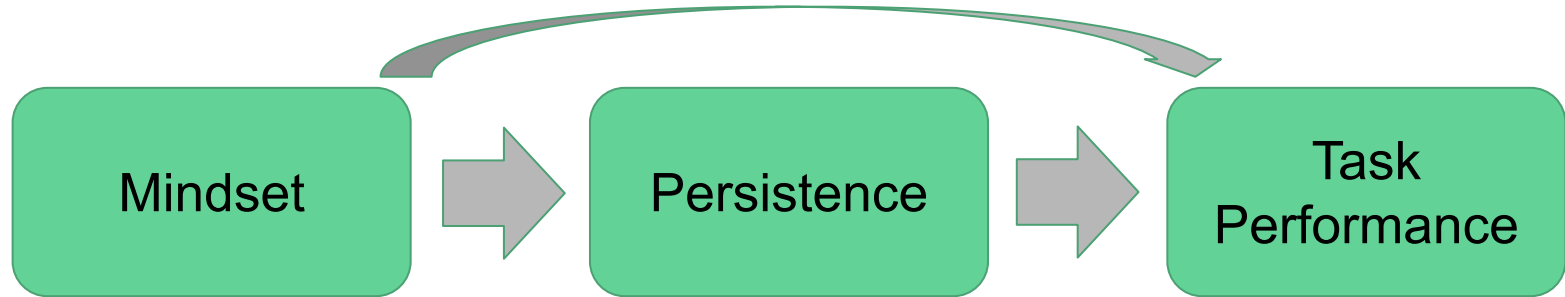
Are there other “opportunity costs” to pursuing a growth mindset?

- Improved achievement scores, but at a cost of mental/physical health, happiness?
- Revisiting the “Hard Thing Rule”

Research Questions

1. Confirm that there is a positive correlation between the degree of growth mindset and persistence in completing a task
2. Explore if there exist tasks in which persistence is counter-productive
3. Explore whether adopting a growth mindset is always preferable to a fixed mindset, identify scenarios in which adopting a fixed mindset may ultimately benefit the individual

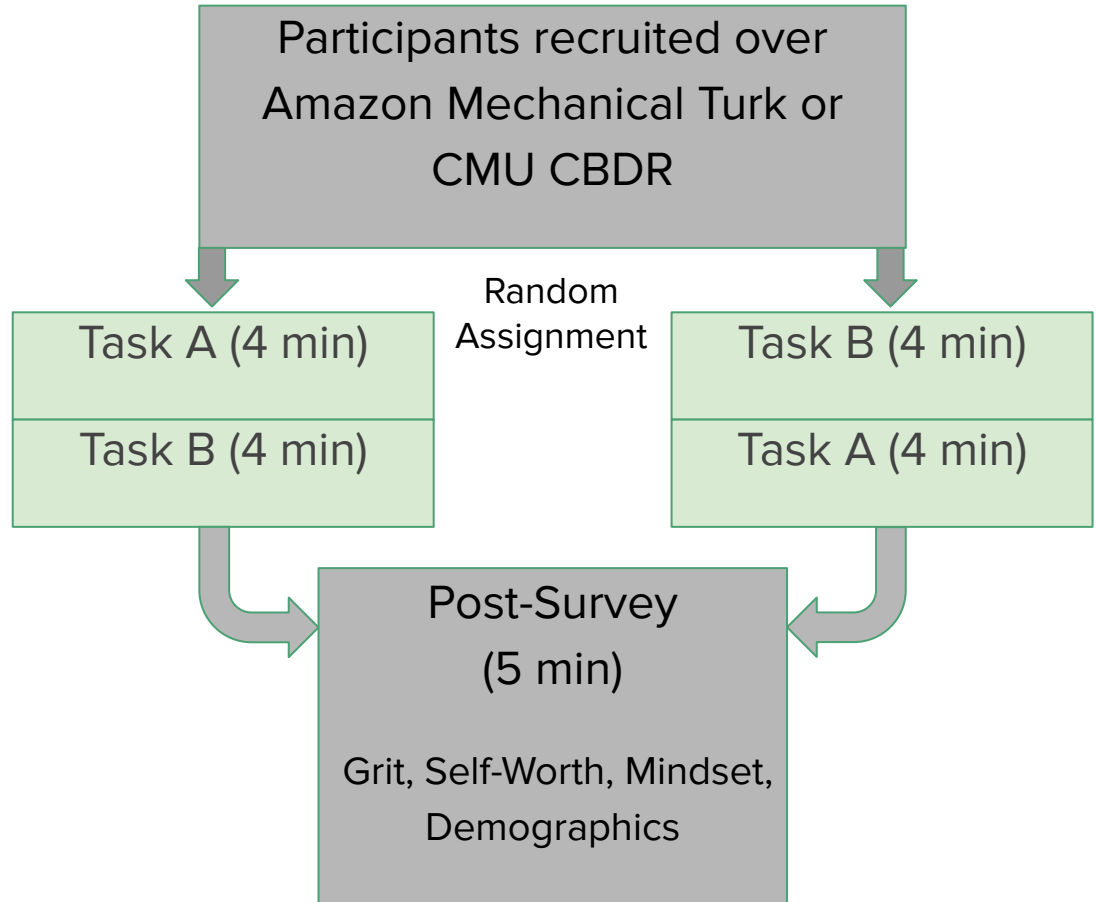
Theorized Pathways



- Analysis to focus on relationships between these three variables
 - Mindset: Measured by scale (Dweck, 1999)
 - Persistence: Measured through task design (e.g. how many questions were skipped)
 - Task Performance: $\text{Number of correct answers} - 0.5 * \text{Number of wrong answers}$

Study Design

- Conducted 3 studies, using 5 separate tasks.
 - 2 Tasks per study
- Given the COVID-19 situation, all studies were online (Qualtrics survey)
- Incentivised to do their best on the tasks (by cash performance bonus when possible)



Task 1 / 2: Listing Animals/Musicians (Todd et al., 2012)

- List as many animals/musicians as you can in 4 minutes
- Real data illustration:

Bear, Possum, Dog, Cat, Wolf, Leopard, Tiger, Lion, Mouse,
Rat, Shrew, Vole, Gopher, Snake, Rabbit, Sheep, Llama,
Alpaca, Camel, Donkey, Horse, Goat....

- Concept: List items in a sub-category until they run out, then switch to a different sub-category
- Persistence: How often participants switched categories, how long participants spent within a category before switching

Task 3: RAT Puzzles

- Find the word associated with each of the other 3 words
- Examples:
 - Cottage / Swiss / Cake Cheese
 - Master / Toss / Finger Ring
 - Tooth / Potato / Heart Sweet
- 60 questions in total, 1 per page, participants were allowed to skip at any time but can not return to previous questions
- Persistence: Number of puzzles participants skipped, time participants took before skipping

Task 4: Rebus Puzzles

- Find the popular phrase associated with this image.
- 30 questions in total, 1 per page, allowed to skip at any time but can not return
- Persistence: Number of puzzles participants skipped, time participants took before skipping



Feeling on top of the
world



Split second timing

Task 5: Anagrams

- Using the 9 characters shown below, find as many words of length ≥ 4 as you can in 4 minutes.
- 10 sets of 9 characters (6 consonants + 3 vowels), participants allowed to move on to the next set at any point in time
- Persistence: How long participants spend on each set of characters, whether participants decide to skip a set of characters before entering a single word
- Example: C U D S W F O E J
 - Defocus, Focused, Codes...

Results

1. Mindset x Persistence
“Does my mindset affect my level of persistence?”
2. Persistence x Performance
“Is persistence rewarded in this domain?”
3. Mindset x Performance
“Does my mindset lead to better results?”
4. Supplementary findings (Additional Slides)
 - a. Word2Vec Analysis of Semantic Similarity
 - b. Timing Analysis

Persistence (Skips/Switches) x Performance

Tasks are split between persistence worsening and improving performance:

- Worsening: Animals, Musicians, RAT
- Improving: Rebus, Anagrams

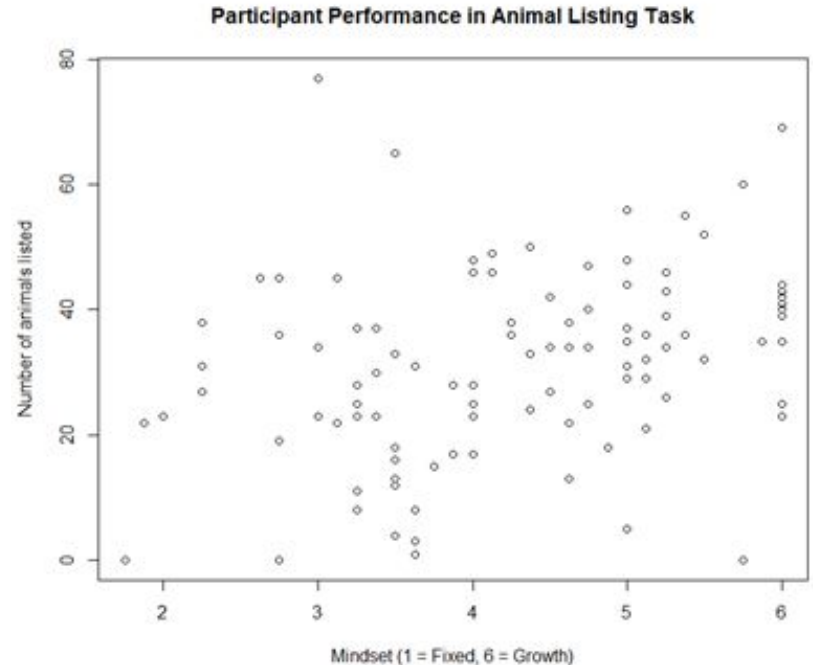
- Persistence may not always lead to better performance in tasks, despite what the literature says

Mindset x Performance

- All domains show no relationship between the two, except:
- Animals task: increase in 1 (out of 6) on the Growth Mindset scale is equivalent to 4.3 more animals listed (F = 10.75, p < 0.01)

Reasons:

- Task homogeneity: listing farm animals similar to listing pets, or marsupials



Summary of Results

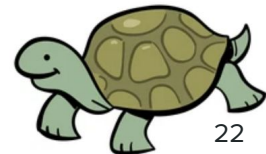
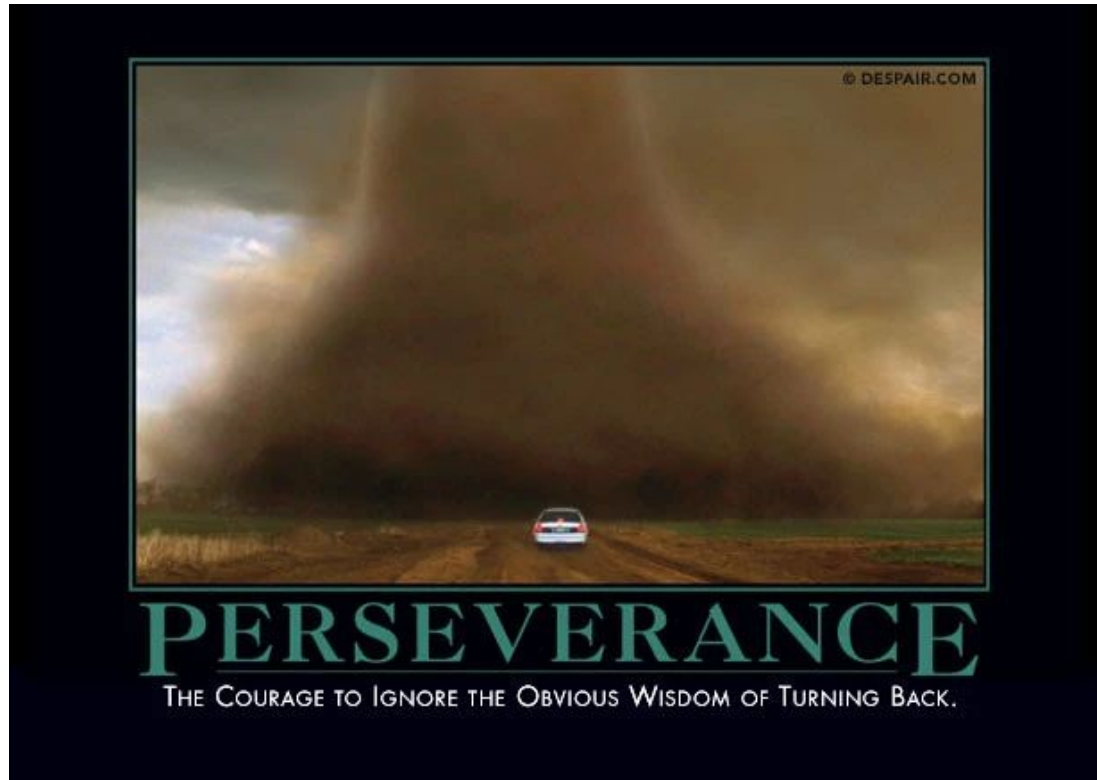
| Red = Positive Green = Negative | | Study 1 | Study 2 | | Study 3 | |
|---|--------|--------------------|---------------------|--------|-----------|----------|
| | | Animals | Musicians | RAT | Rebus | Anagrams |
| Mindset x Persistence (Skips) | Coeff. | 0.007 | +0.15 | -0.094 | 0.043 | 0.2 * |
| | p-val | 0.25 | 0.25 | 0.910 | 0.87 | 0.027 |
| Persistence (Skips) x Performance | Coeff. | 0.93 *** | 3.80 *** | 0.15 * | -0.41 *** | -1.55 ** |
| | p-val | < 10 ⁻⁶ | < 10 ⁻¹⁶ | 0.019 | < 0.001 | 0.005 |
| Mindset x Performance | Coeff. | +4.3 ** | +1.0 | 0.027 | 0.0882 | 0.641 |
| | p-val | <0.01 | 0.4618 | 0.96 | 0.87 | 0.287 |

- Mindset does not always translate to persistence, even when it is beneficial
- Persistence does not necessarily lead to improved performance
- Mindset does not always translate to improved performance

Discussion

- Further research on boundary conditions: When does having a growth mindset induce greater persistence?
- Lack of task diversity - giving participants incentive to switch
- Choice of task matters - can affect whether persistence is beneficial, whether mindset leads to persistence
- Possibility of better informing mindset interventions: When should we encourage students to persist?

Thank you!

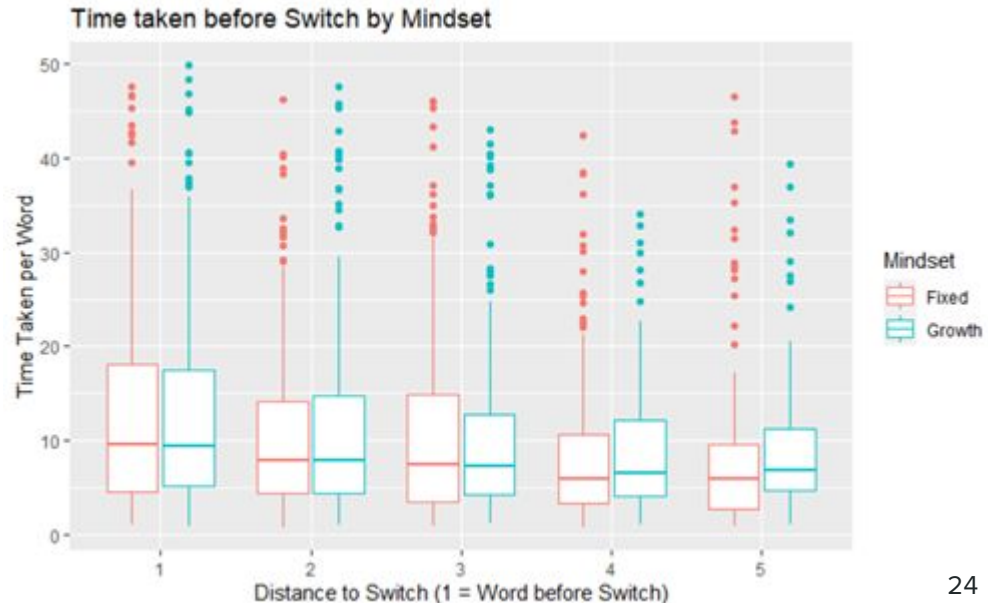


Timing Analysis

- How long participants spent on a question before deciding to skip
 - Those with a growth mindset would persist for longer before skipping
- Could not find evidence indicating that mindset had an effect on whether participants persist longer ($t = 0.616$, $p = 0.54$)

Timing Analysis

- How long participants spent coming up with successive words (listing/anagrams) before skipping
- Participants take longer on average leading up to a skip, but no noticeable difference in behavior between growth and fixed mindset individuals.



Word2Vec Analysis

- Measured word2vec cosine similarities between adjacent entries of a list.
- Using a heuristic from the field (Lundin et. al. 2020):
 - If $S(A,B)$ is the similarity between objects A and B, for 4 objects A, B, C, D, we say that a switch in category happened between B and C if:

$$(S(A,B) > S(B,C)) \text{ AND } (S(B,C) < S(C,D))$$

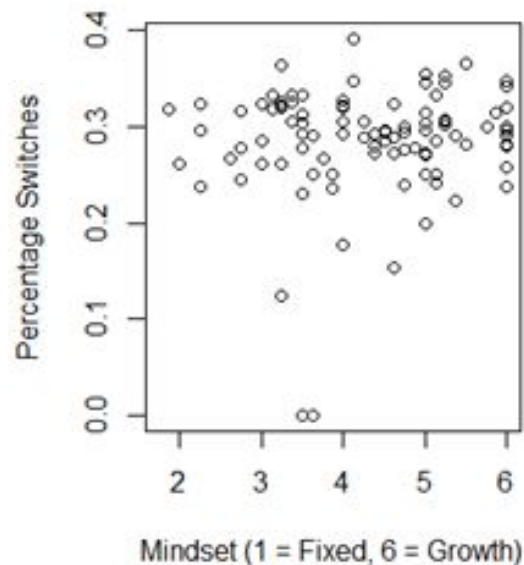
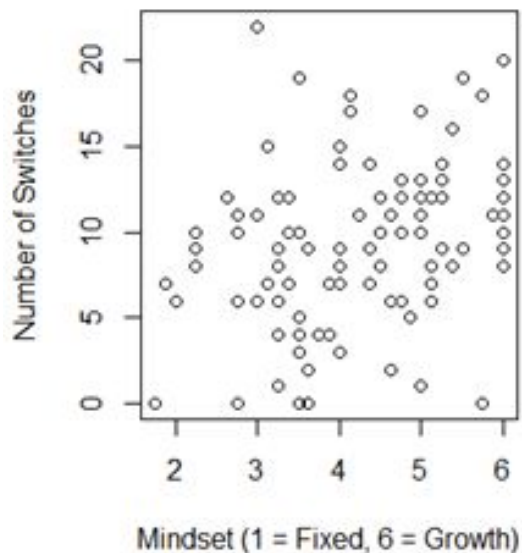
- Considering “Tiger, Lion, Rabbit, Hare”:
 1. Tiger + Lion are more similar than Lion + Rabbit AND
 2. Rabbit + Rat are more similar than Lion + Rabbit

Word2Vec Analysis

Participants with a growth mindset appear to switch more using the Word2Vec heuristic

- But: driven by relationship between Mindset and Performance
- Mindset had no effect on likelihood of switching

Switching Behavior by Mindset on Animal Listing Task



Robustness Analysis of Word2Vec Heuristics

Original: $(S(A,B) > S(B,C)) \text{ AND } (S(B,C) < S(C,D))$

- Differences might be too minute (e.g. all $S(x,y) < 0.2$)

Proposed alternative hypotheses:

$S(B,C) < k, k = 0.2, 0.25, 0.3$

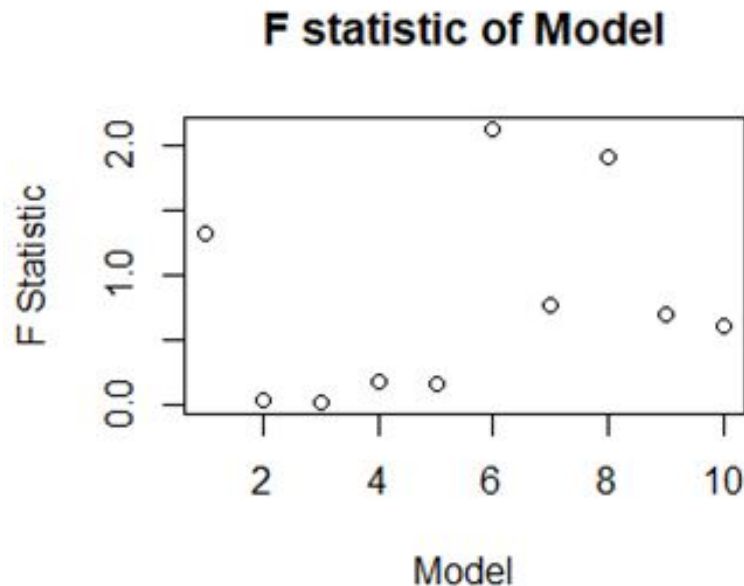
$(S(A,B) > k * S(B,C)) \text{ AND } (k * S(B,C) < S(C,D)), k = 1.2, 1.3$

$(S(A,B) > k + S(B,C)) \text{ AND } (k + S(B,C) < S(C,D)), k = 0.1$

(and combinations of the above)

Robustness Analysis of Word2Vec Heuristics

- None of the models produced significant relationship between mindset and persistence (Best model $F = 2.13$, $p = 0.15$)
- Extremely low adjusted R-squared (largest = 0.012) indicate that effect, even if present, is extremely weak



1. Original
2. 0.2 Threshold
3. 0.25 Threshold
4. 0.3 Threshold
5. 0.1 Buffer
6. 20% Buffer
7. 30% Buffer
8. 30% Threshold + Original
9. 30% Threshold + 0.1 Buffer
10. 30% Threshold + 30% Buffer