The Effects of Difficulty and Individual Differences in Mindset on Persistence

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Abstract: Persistence was studied by examining difficulty and individual differences in mindset. Participants engaged in solving five geometric tracing puzzles presented in an increasingly difficult order, the first three solvable, the fourth unsolvable, and the fifth solvable. The task was to trace each line of the puzzle without retracing any lines or lifting the marker off the page. Assessed using Dweck's (2000) Mindset Questionnaire (fixed or growth), participants who believed intelligence is adaptable persisted longer on the unsolvable puzzle before giving up than their fixed mindset counterparts. Results also suggest that growth mindset individuals have greater persistence following failure than their fixed mindset counterparts. This study highlights the importance of studying the combinations and interactions of many characteristics to explain persistence.

Some individuals are better at persisting than others, especially when situations are or become more difficult. Defined as the ability to continue action despite challenges, persistence is used to measure broad constructs, such as individual tolerance for frustration (Glass et al., 1969), self-control (Baumeister et al., 2007), and ego-depletion[1] (Baumeister et al., 1998).

Few studies research what contributes to persistence, but rather use persistence to study other constructs. Individual differences such as working memory capacity, the ability to hold and manipulate recent information, personality traits (extraversion or introversion), and experience (novel or expert) are of interest when studying persistence. Contrary to previous self-control literature, Lurquin (2013) found that an individual cognitive ability alone (working memory capacity) does not fully explain persistence. Rather, research reveals that persistence is affected by the interaction of characteristics such as motivation and task difficulty (Feather, 1961) and working memory capacity and explanatory style[2] (Lurquin, 2013). The purpose of the current research is to examine persistence itself, specifically by examining the effects of having a growth mindset in difficult situations.

Measures of persistence in the literature have predominantly used difficult or unsolvable tasks (Dvorak & Simons, 2009; Baumeister et al., 1998). Glass, Singer, and Friedman (1969) posed a set of unsolvable geometric tracing puzzles to participants suggesting they trace each line without lifting their pen or retracing any line twice. Participants were unaware these puzzles were unsolvable. Adjusting previous methods, Lurquin (2013) presented participants with several geometric tracing puzzles ordered by increasing difficulty, of which one was unsolvable. Importantly, the unsolvable puzzle was not last, but fourth, to examine participants' responses following failure. While Lurquin studied working memory capacity and explanatory style to explain persistence, the current study used difficulty (puzzle type) as an independent variable.

Self-control is an important construct to define, as it has an important influence on persistence and its relationship to difficulty. In definition, it is the conscious, deliberate control of the self that influences future success and happiness (Baumeister et al., 1998). Self-control includes making decisions, such as avoiding situations, making conscious choices, and managing feelings. Previous research suggests that participants perform worse on second tasks of self-control after exerting energy on a

[1] Ego depletion: According to Baumeister et al. (1998), "The core idea behind ego depletion is that the self's acts of volition draw on some limited resource, akin to strength or energy and that, therefore, one act of volition will have a detrimental impact on subsequent volition."

[2] Explanatory style refers to "the adoption of a positive or negative attribution to an event" (Feiring et al., 2002).

previous task (Baumeister et al., 1998). With this knowledge established, we expected previous task exertion to influence persistence. However, in this study, we sought to examine how the individual characteristic mindset and task difficulty interact to encourage better self-control recovery and even longer persistence.

According to Dweck (2000), mindset—which is often described as "fixed" or "growth"—refers to the beliefs we have regarding the nature of our abilities and characteristics. Armor and Taylor (2003) revealed a relationship between mindset and self-regulation, a form of self-control. This relationship suggests the importance of mindset as a variable due to its correlation with individual behavior and self-control. It is suggested that individuals with a growth mindset will persist longer than those with a fixed mindset.

Based on persistence literature, the following hypotheses were developed: *H1*: Individuals with a growth mindset will persist longer than those with a fixed mindset on the unsolvable puzzle. *H2*: Individuals with a growth mindset will solve the fifth solvable puzzle faster following failure on the unsolvable one.

Method

Participants

Thirty-six participants (23 women, 13 men; 18-22 years old) received partial course credit to participate. Participants were primarily White (86.1%). Other racial identities represented included Asian (8.3%) and Black/African American (5.6%). All participants were treated in accordance with the ethical principles of the American Psychological Association.

Persistence Task

As in Lurquin (2013), participants engaged in solving five geometric tracing puzzles: four solvable (Puzzles 1, 2, 3, and 5) and one unsolvable (Puzzle 4). Participants were under the impression that all puzzles were solvable. The five puzzles were placed individually in clear plastic sheets in a three-ring binder. As in Vohs et al. (2008), participants were encouraged to take the task seriously and were told that performance was linked to cognitive ability and future life success. Participants traced each line of a puzzle using a dry erase marker without lifting the marker from the page or retracing any line they had already drawn. While solving Puzzles 1–5 in order, participants were allowed to attempt each puzzle an unlimited number of times or skip any puzzle. Attempts were counted by recording the number of times a participant erased and began a puzzle again. Skips were identified when a participant flipped a page in the binder prior to solving a puzzle correctly. Once a puzzle was finished or skipped, participants could not return to it. The main measures of persistence were time and attempts on Puzzle 4, although data were collected for each individual puzzle. Time was measured in minutes, calculated from the moment a participant's marker touched a page to the time they flipped to the next puzzle. After Puzzle 5, participants notified the researcher if they finished or gave up.

Difficulty: Puzzle Type

In Lurquin (2013), participants rated how difficult each puzzle looked prior to attempting them. Results indicated that Puzzles 3, 4, and 5 were perceived as more difficult than Puzzles 1 and 2. Puzzle 4, which was actually unsolvable, was not perceived as more difficult than Puzzles 3 and 5. Following Lurquin's findings, we told participants that the puzzles were organized by difficulty, from easiest (Puzzle 1) to most challenging (Puzzle 5). We call this difficulty variable Puzzle Type. As a repeated-measures variable used in statistical analyses, Puzzle Type included the levels Unsolvable (Puzzle 4) and Solvable (Puzzle 5).

Persistence and Recovery from Failure

The term *recovery from failure* describes the participant's self-control behavior following unsuccessful attempts on Puzzle 4. Our self-control behavior of interest included the time to complete Puzzle 5.

Mindset

Individual variations in mindset were assessed using the Dweck Mindset Instrument (Dweck, 2000). Participants rated their agreement with statements on a Likert scale (1 = *strongly agree* to 6 = *strongly disagree*). The 16-item measure identified a mindset score on each of two subscales: Intelligence Mindset and Talent Mindset, including statements that were fixed or growth mindset oriented. A

sample statement from a fixed intelligence mindset is "you have a certain amount of intelligence and you can't really do much to change it." An example representing a growth talent mindset is "you can always substantially change how much talent you have." Some fixed items were phrased negatively so participants were not consistently agreeing or disagreeing with statements. Scores closer to six indicate more of a growth mindset while scores closer to one indicate more of a fixed mindset (Dweck, 2000). In a previous study, internal consistency was high (Cronbach's α = .82 to .97; Dweck et al., 1995). In preliminary analyses, mindset scores were treated as continuous variables. In analyses of variance (ANOVAs), levels of mindset were defined using median splits: less versus more intelligence growth mindset and less versus more talent growth mindset.

Mood

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), a 20-item survey, was used to measure positive and negative affect before the puzzle solving task. Participants described their feelings of current emotional states; for example, "upset" or "active" on a Likert scale (1 = *very slight or not at all* to 5 = *extremely*). In a previous study, internal consistency was high (Cronbach's α = .84 to .90; Watson et al., 1988). This measure was administered to ensure there was no correlation between mood and mindset type.

Procedure

In a randomized order, participants completed the basic demographics, mood, and mindset assessments. While engaged in solving the five geometric tracing puzzles, the participants' hands were videotaped and coded by time spent and number of attempts made on each puzzle. Researchers recorded whether each puzzle was solved correctly or skipped.

Results

Mindset

The mean score on the Intelligence Mindset subscale was 4.24 (*SD* = 1.05). The mean score on the Talent Mindset subscale was 4.38 (*SD* = 0.74).

PANAS

Positive affect scores ranged from 23.76 to 28.30 (*M* = 26.03, *SD* = 1.12), and negative affect scores ranged from 12.43 to 15.74 (*M* = 14.08, *SD* = 0.82). All correlations between scores on the intelligence mindset subscale, the talent mindset subscale, positive affect, and negative affect were not significant.

Time and Attempts

The average total time in minutes spent on all five puzzles was 21.13 (*SD* = 11.12). The time averages calculated for Puzzles 1-5 were: 0.91 (*SD* = 0.92), 2.48 (*SD* =1.68), 2.19 (*SD* = 1.46), 12.26 (*SD* = 10.27), and 3.29 (*SD* = 3.32).

The average attempts on all five puzzles was 31.33 (*SD* = 21.47). The attempt averages calculated for Puzzles 1-5 were: 1.92 (*SD* = 1.27), 3.22 (*SD* = 2.33), 2.58 (*SD* = 1.93), 19.39 (*SD* = 20.25), and 4.22 (*SD* = 2.96).

Solved Correctly and Skips

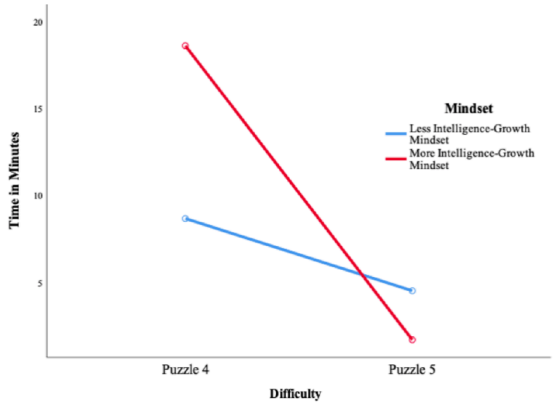
Researchers recorded whether puzzles were solved correctly or incorrectly. The number of skips were also recorded. Neither variable was correlated with mindset.

Persistence

Before conducting ANOVAs, we adopted a 2 (mindset: fixed, growth) x 2 (puzzle type: solvable and unsolvable) mixed factorial design with mindset as an independent-groups variable and puzzle type as a repeated-measures variable. Cases in which participants skipped Puzzle 5 were excluded from the two-way mixed ANOVAs. Analyses were conducted examining the effects of mindset and puzzle type on time and attempts.

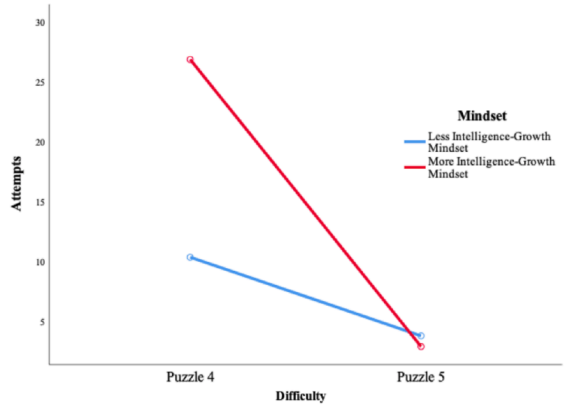
There was a significant main effect of puzzle type, $F(1, 21) = 26.89$, $p < .001$, $\eta^2 = .56$, and a marginally significant main effect of intelligence mindset, $F(1, 21) = 3.81$, $p = .06$, $\eta^2 = .15$, on time. There was a significant interaction between intelligence mindset and puzzle type on time, $F(1, 21) = 9.87$, $p = .005$, $\eta^2 = .32$. As seen in Figure 1, individuals spent more time overall on Puzzle 4 than Puzzle 5, and participants with more of an intelligence growth mindset lasted longer on Puzzle 4 before giving up than those with less of an intelligence growth mindset. Participants with more of an intelligence growth mindset solved Puzzle 5 faster than those with more of an intelligence fixed mindset. The main effect and interaction involving talent mindset on time were not significant.

Figure 1
Difficulty and Intelligence-Subscale Mindset on Time



With number of attempts as the outcome measure, there was a significant main effect of intelligence mindset $F(1, 21) = 5.30$, $p = .03$, $\eta^2 = .20$, on attempts, and a significant interaction between intelligence mindset and puzzle type on attempts, $F(1, 21) = 6.61$, $p = .02$, $\eta^2 = .24$. As shown in Figure 2, individuals had more attempts overall on Puzzle 4 than Puzzle 5, and those with more of an intelligence growth mindset attempted Puzzle 4 more times than those with less of an intelligence growth mindset. The main effect and interaction involving talent mindset on attempts were not significant.

Figure 2
Difficulty and Intelligence-Subscale Mindset on Attempts



Discussion

Findings suggest that individuals who believe intelligence is adaptable, holding a growth mindset, persist longer on unsolvable tasks before giving up than their fixed mindset counterparts. On the talent subscale, time and attempts did not vary due to the participant's level of growth mindset. It is suggested that results differed between the intelligence and talent subscales of mindset due to the described nature of the task. The researcher described the task to participants as intellectual and related to cognitive abilities. Individuals with a more growth intelligence mindset lasted longer before giving up on Puzzle 4 and were less negatively influenced by a more difficult puzzle following failure (Puzzle 5) than those with a more fixed intelligence mindset. Findings suggest individuals with more intelligence growth mindset recover better from failure, indicating higher resiliency.

Findings were congruent with results from Lurquin (2013) in that difficulty and mindset alone did not predict individual differences in persistence. The interaction between difficulty and mindset was significant, similar to the interaction between working memory capacity and explanatory style (Lurquin, 2013). Growth mindset, specifically an individual's belief that intelligence can change over time, best explained persistence in this study.

Limitations of the present research include the lack of account for possible ego-depletion effects. There may have been decreased self-regulation over time, as research identifies that energy on a previous task depletes energy for a subsequent task (Baumeister et al., 1998). Other limitations include mood changes, personal interest in the task, and knowledge of the task. Mood was assessed only before the task. Future studies should include a mood assessment during or after the task. Some individuals are more susceptible to enjoying puzzle-like tasks, and some participants might have known that Puzzle 4 was mathematically unsolvable. Though the internal validity of the present study seems strong, participants were of a convenience sample of college-aged students and results may differ with the general public.

These findings contribute to a better understanding of individual differences in persistence, specifically how difficulty and mindset interact within individuals. This study also supports and encourages additional research on the combination of individual characteristics that contribute to persistence. Future research may include additional characteristics, both cognitive and personal. Future examination of the intelligence versus talent subscales of mindset

and how they influence persistence differently is also warranted. These findings have relevance for applied settings, such as education and organization development, including training development, team building, orientation programs, and athletic training. Persistence research could also contribute to studies on mindfulness, self-growth, self-awareness, conversational skills, and even relationships.

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