Decremental mindsets and prevention-focused motivation: An extended framework of implicit theories of intelligence

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A R T I C L E   I N F O

A B S T R A C T

Implicit theories are an influential framework for understanding achievement motivation. Many studies have shown that incremental (positive-change) beliefs predict adaptive motivation and positive learning outcomes, whereas entity (no-change) beliefs predict maladaptive motivation and negative learning outcomes. This research explores a new construct regarding decremental (negative-change) beliefs – mindsets that intelligence can be reduced. Two studies with a total of 407 university students showed that decremental beliefs were endorsed at a moderate level and were independent from entity and incremental beliefs. Different from entity and incremental beliefs, decremental beliefs were not associated with self-esteem but were uniquely associated with effort beliefs about ability loss (i.e., lack of effort leads to a decline in ability) and prevention-focused goal orientations (i.e., maintaining current ability). Furthermore, beliefs about change (i.e., original implicit theories items that did not indicate the direction of change) were strongly associated with incremental but not decremental beliefs, suggesting that the conventional methodology captures primarily beliefs about positive change. We discuss the importance of adding decremental beliefs to understand implicit theories and achievement motivation in a more comprehensive manner.

1. Introduction

People endorse different mindsets (or implicit theories) about whether human attributes (e.g., intelligence, language aptitude, and personality) are malleable. Among different domains of implicit theories, implicit theories of intelligence are particularly important in understanding students' motivation and achievement (Dweck, 1999). Many studies have shown that incremental beliefs (i.e., lay theories that intelligence can be improved) are more adaptive than entity beliefs (i.e., lay theories that intelligence is stable) in achievement contexts (Dweck & Leggett, 1988; Molden & Dweck, 2006). Specifically, students who hold strong entity beliefs tend to attribute failure to lack of talent, set goals that focus on performance, have lower self-esteem, and in turn avoid and give up more easily in challenging situations. In contrast, students who hold strong incremental beliefs tend to attribute failures to lack of effort, motivate themselves to make improvements, engage in challenging tasks, have higher self-esteem, and eventually achieve better performance (e.g., Dickhäuser, Dinger, Janke, Spinath, & Steinmayr, 2016; McCutchen, Jones, Carbonneau, & Mueller, 2016; for a meta-analysis, see Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013).

Despite its long tradition of research and important contributions, some researchers argue that the current framework of entity- versus-incremental beliefs might not capture the whole picture of change beliefs, thereby limiting its applications (e.g., Berg & Sternberg, 1992; Ziegler & Stoeger, 2010). Berg and Sternberg (1992) argued that "Dweck and colleagues assessed plasticity or modifiability of intelligence in only one direction, namely, that of increase, and did not assess beliefs regarding decreases in intelligence" (p. 228). This suggests that previous work on implicit theories may express change beliefs in a unidirectional manner by focusing on beliefs about growing (i.e., positive change) but not beliefs about declining (i.e., negative change). This research aims to address this concern. To this end, we proposed a theoretical extension of implicit theories by adding a new dimension, decremental beliefs (i.e., beliefs that intelligence can be reduced), and examined whether this construct is independent from the two implicit theories (i.e., entity and incremental beliefs) advocated in Dweck's model in an achievement context.

1.1. What do changes mean? Not only ups, but also downs

To understand the complexity of mindsets, we drew from the

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research on lay theories of change, which concerns people's beliefs, interpretation, and prediction about how events, people, and things change and develop in general (Ji, 2008; O'Brien & Kardas, 2016). Although conceptualized differently from mindsets, lay theories of change inform the theorizing of mindsets regarding beliefs about how specific human attributes (e.g., intelligence, will power, and personality) can be changed. That is, a person's interpretation and prediction about how thing changes in general may give rise to their more specific beliefs about what directions their own and other's characteristics can be changed.

In general, literature on lay theory of change suggests that lay people's views regarding changes in intelligence are more complex than a continuum from entity theories to incremental theories would indicate; most people hold beliefs about not only whether human attributes will change, but also about how they change (i.e., ups and downs; Berg & Sternberg, 1992; Ross, 1989; Sternberg, 1985; Ji, 2008). For example, many people believe that intelligence changes across the lifespan following an inverted U-shape: children and younger adults' intelligence grows while that of older adults declines. Similarly, many people can hold two seemingly contradictory beliefs about growth (in crystallized intelligence) and decline (in fluid intelligence; Berg & Sternberg, 1992; Bluck & Gluck, 2005). Such beliefs about multidirectional changes are in line with people's personal and vicarious experience with ability increase and decrease (Berg & Sternberg, 1985; Plaks & Stecher, 2007). In summary, people have access not only to incremental and entity beliefs, but also to decremental beliefs.

Although beliefs about negative change are commonly held among lay people, this concept is under-researched in the achievement motivation literature. One possible reason that the discourse about change beliefs has emphasized the positive direction is North Americans' cultural emphasis on self-enhancement and positive self-regard (Heine, Lehman, Markus, & Kitayama, 1999; Henrich, Heine, & Norenzayan, 2010). Research shows that North Americans are less self-critical and prevention-focused compared to East Asians (Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997; Lockwood, Marshall, & Sadler, 2005). Although North Americans show stronger self-serving biases, they also posit a belief that positive characteristics can easily deteriorate, as well as a tendency to detect negative changes and loses (Norenzayan, Choi, & Nisbett, 2002; O'Brien & Klein, 2017). Therefore, we should not limit our understanding of the beliefs about negative changes to the cultural level; decremental beliefs, while they may vary across cultures, may be a universal tendency.

Another possible reason is that researchers may assume that beliefs about positive change and negative change are already covered by an overarching belief about change. Contrary to this view, we argue that beliefs about change assessed by the existing mindsets research capture primarily positive changes. Research shows that people tend to subjectively interpret their changes in a positive light when asked about their own changes (O'Brien & Kardas, 2016). For example, people recall more positive changes (e.g., I improved my foreign language ability this year) than negative changes (e.g., my foreign language ability is getting worse because I haven't practiced for a long time) when asked about how they have changed in the past, but not when asked about other people's changes. This tendency to see more positive changes in themselves reflects people's self-esteem and self-enhancement motives (Leary & Baumeister, 2000). From this perspective of lay theory of change, O'Brien and Kardas (2016) argued that the traditional method of measuring mindsets that asks participants about whether ability can be changed (e.g., "you can change your basic intelligence level considerably"), although the direction of change is not specified, may activate mainly their beliefs about positive change but not beliefs about negative change. This is not limited to lay people; many researchers also assume and interpret the original implicit theories items as beliefs about positive change.

Despite people's motivation to maintain a positive view about how they have changed, they are also more sensitive about negative changes

than positive changes (O'Brien & Klein, 2017). As such, people diagnose declines more quickly and view declines as more common than increases in their own and others' qualities, including academic ability. This asymmetry of tracking negative changes versus positive changes occur possibly because people assume that it is more plausible for positive qualities to become worse than for negative qualities to become better (O'Brien & Klein, 2017). These lay beliefs about decline reflect people's tendency to be alert to negative changes (i.e., loss aversion) and motivation to avoid negative consequences that dampen self-esteem (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001).

In summary, although people have self-serving biases towards positive change when asked about how their ability has changed in the past, they are also afraid of loss, sensitive about negative changes, and perceive decrease as more plausible than increase (see O'Brien & Klein, 2017 for a discussion). Previous literature suggests that beliefs about positive or negative changes may be based on different motivational drives and lead to different psychological processes. However, it is not clear how they these different beliefs are linked to motivation in the achievement context.

1.2. Decremental beliefs and achievement motivation

Implicit theories are important in the achievement context because they are considered to be the core beliefs in the "meaning system" that shapes individuals' meaning-making of their learning experience and in turn their learning motivation, emotion, and behaviours (Molden & Dweck, 2006; Plaks, Levy, & Dweck, 2009). In particular, Dweck and her colleagues argue that implicit theories influence students' achievement through their effort beliefs and goal orientations (Blackwell, Trzesniewski, & Dweck, 2007; Molden & Dweck, 2006). Given that negative change is also a common perception about human attributes, and linked to some fundamental motives of loss aversion and self-esteem protection, it is possible that decremental beliefs are part of the meaning system that guides students' motivation. People's beliefs about negative change may be elicited by the detection of their declining ability, and thus are related to negative-defensive motivation (e.g., use it or lose it). This prevention-focused motivation can potentially enrich our understanding of students' effort beliefs and goal orientations.

1.2.1. Decremental beliefs and effort beliefs

One underlying factor that links implicit theories and achievement outcomes is students' beliefs about effort (Blackwell et al., 2007). For example, Heine and his colleagues used a scenario to examine participants' effort beliefs about ability and found that incremental (vs. entity) participants expected a greater improvement when the target person in the scenario put more effort into studying, and, in turn, participants who expected a greater improvement persisted longer in challenging tasks (Heine et al., 2001). Incremental theorists are more persistent because they believe that working hard is an important and effective means of improving ability, whereas entity theorists expect that effort is ineffective in terms of improving ability and that working hard on a subject implies a lack of intelligence (Blackwell et al., 2007; Lou & Noels, 2016).

How are decremental beliefs linked to effort beliefs? We argue that decremental beliefs may link to effort beliefs about ability loss (e.g., if you don't practice enough, you will lose your ability). In other words, people who think their ability can decrease believe that lack of effort can aggravate the process. Although people tend to attribute the cause of decrease in their own and other's ability to lack of motivation and effort (Hertzog, McGuire, Horhota, & Jopp, 2010; Maurer, Barbeite, Weiss, & Lippstreu, 2008), we argue that students with stronger decremental beliefs will more strongly endorse effort beliefs about ability loss.

1.2.2. Decremental beliefs and goal orientations

Goal orientations are another important mechanism through which implicit theories guide achievement behaviours (Dweck & Leggett, 1988). Incremental beliefs guide students to be primarily concerned with developing and improving their ability and thus, to set learning goals that focus on the learning process. On the other hand, entity beliefs guide students to be primarily concerned with their fixed intelligence, and therefore, lead students to set performance goals, such as pursuing tasks that they know they can perform well in to win social validation (Dweck, 1999).

Given that decremental beliefs are linked to concerns about ability loss, it is conceivable that decremental beliefs may guide students to set goals to prevent ability loss. To understand students' prevention motivation in goal settings, we draw from Regulatory Focus Theory (Higgins, 1998). Molden and Miele (2008) suggested that prevention- and promotion-focused goals are fundamental motivations in the achievement context and are important to understanding students' learning processes and achievement. Students who set strong promotion-focused goals are primarily concerned with growths and gains. For example, they will approach opportunities for attaining high performance and avoid missing out on opportunities for improving, and thus are likely to exert effort to pursue such improvement goals. In contrast, students who set prevention-focused goals are concerned with security and losses. For example, they strive to maintain their ability and performance and avoid losses, and thus are likely to allocate their time and effort to pursue such secure goals. Research shows that promotion-focused goals are more adaptive in achievement contexts that requires flexible thinking (e.g., creative problem solving skills, and learning new materials), whereas prevention-focused predict better performance at tasks that emphasize conservative tactics with few time constraints (e.g., error detection, proof-reading, loosely-timed exams; Rosenzweig & Miele, 2016). Simply put, promotion- and prevention-goals are linked to different learning and performance strategies, and both of them can be adaptive under different learning conditions (see Molden & Rosenzweig, 2016, for a discussion).

Related but distinct from approach–avoidance goal theory (Elliot, 1999), the promotion–prevention goal theory focuses on the motivation to pursue gain or growth and the motivation to prevent losses or maintain status quo, regardless of the orientations of approaching positive outcomes or avoiding negative outcomes (e.g., failure; see Molden & Rosenzweig, 2016 for an overview). For instance, one can set a promotion goal to approach gain (e.g., approach opportunities to improve) or to avoid non-gain (e.g., avoid missing the opportunity to learn). Similarly, one can set a prevention goal to approach non-loss (e.g., approach learning opportunities in order to maintain high performance) or to avoid loss (e.g., avoid ability loss). That is, promotion and prevention goals are independent from approach and avoidance orientations.

Using this conceptualization of prevention–promotion goal orientations, we examined the relationship between implicit theories and goal orientation. Previous research suggests that incremental beliefs are positively linked to promotion-focused goal orientations and that entity beliefs are negatively linked to promotion-focused goal orientations (e.g., Mathur, Jain, Hsieh, Lindsey, & Maheswaran, 2013; Timpone & Hostutler, 2012). However, neither incremental beliefs nor entity beliefs predict prevention-focused goal orientations, possibly because neither of these beliefs emphasize losses (e.g., Mathur et al., 2013; Timpone & Hostutler, 2012). Thus, we predict that decremental beliefs will have a unique contribution in predicting prevention-focused goal orientation. Students who believe their ability can be reduced may also set goals to maintain ability or buffer against ability loss in order to protect themselves against negative consequences from ability loss.

1.3. Overview of the present research

This research aims to explore a new dimension of implicit theories

— decremental beliefs, which are characterized as beliefs that intelligence can decrease. Accordingly, our two main goals in the research are (a) to examine whether decremental beliefs are commonly held among university students and can be seen as an independent construct that differs from entity and incremental beliefs, and (b) to examine whether decremental beliefs play a unique role in achievement motivation regarding students' beliefs about effort and goal orientations. To accomplish the first goal, we modified the items regarding beliefs about change from the original Implicit Theories Scale (Dweck, 1999) into beliefs about positive change (i.e., incremental beliefs) and beliefs about negative change (i.e., decremental beliefs), and tested the factorial structures and correlations among different beliefs. Furthermore, in Study 2, we examined the hypothesis that beliefs about change assessed by the traditional mindsets scale are strongly linked to the beliefs about positive change but are not (or weakly) associated with beliefs about negative change (O'Brien & Kardas, 2016). To accomplish the second goal, we tested the relationships of the three implicit theories with effort beliefs (Study 1) and promotion–prevention goal orientations (Study 2). We predicted that decremental beliefs were linked to a use-it-or-lose-it expectation about effort and the setting of prevention-focused goals.

This research included self-esteem for two purposes. First, to rule out an alternative explanation that the effects of implicit theories on motivation are simply due to self-esteem. Second, to explore the association between decremental beliefs and self-esteem. Previous research shows that people with high self-esteem tend to endorse incremental beliefs (vs. entity beliefs) and achieve better learning outcomes (Diseth, Meland, & Breidablik, 2014; King, 2012; Robins & Pals, 2002). This may be because incremental beliefs are linked to positive self-regard about one's ability. Conversely, people who believe their ability is fixed and set performance goals have a more vulnerable self-esteem because their self-esteem is contingent on social validation (Molden & Dweck, 2006). However, it is not known if people's beliefs about decrease in intelligence are associated with an external validation or a negative self-regard. Thus, two studies will explore the relationship between decremental beliefs and self-esteem.

2. Study 1

2.1. Participants and procedure

A total of 174 undergraduates (1st year = 106; 2nd year = 37, 3rd year = 13, 4th year = 15, 5th year = 3) from a large Canadian university participated in this study in exchange for partial credit for their introductory psychology course (87 females, M_{age} = 19.16, SD_{age} = 1.84).[1] Upon arrival, participants were provided with a consent form and informed that they were participating in a survey about university students' learning and motivation. They then completed a brief questionnaire as described below. Ethical approval for the procedure and materials were received from the University of Alberta.

2.2. Measures

2.2.1. The Trichotomous Implicit Theories Scale

This measure of three-dimensional implicit theories consists of four items for each dimension (entity, incremental, and decremental beliefs; see Appendix A). The entity theory items (e.g., "To be honest, you can't really change how intelligent you are;" α = 0.92) were directly derived from the original measure of implicit theories (Dweck, 1999). The

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[1] We found that age and year of university was not correlated with implicit theories. Specifically, age was not significantly correlated with entity beliefs ($r = -0.08$), incremental beliefs ($r = 0.04$), and decremental beliefs ($r = 0.07$); year of university was not significantly correlated with entity beliefs ($r = 0.01$), incremental beliefs ($r = 0.04$), and decremental beliefs ($r = 0.02$). Thus these two variables were not examined in the further analyses.

Table 1
Model fit statistics results for the confirmatory factor analysis (CFA) for the Trichotomous Implicit Theories Scale in Study 1 ($N = 174$), Study 2 ($N = 233$).

Model	χ^2	Df	CFI	RMSEA	SRMR	$\Delta \chi^2$(df)
Study 1 ($N = 174$)						
Hypothesized three-factor model[a]	98.28	51	0.98	0.07	0.05	
Alternative one-factor model[b]	1130.59	54	0.49	0.34	0.23	1032.31(3), $p < 0.001$
Alternative two-factor model 1[c]	953.12	53	0.58	0.31	0.22	854.84(2), $p < 0.001$
Alternative two-factor model 2[d]	277.79	53	0.89	0.16	0.07	179.51(2), $p < 0.001$
Alternative two-factor model 3[e]	954.15	53	0.58	0.31	0.22	855.87(2), $p < 0.001$
Study 2 ($N = 233$)						
Hypothesized three-factor model[a]	147.21	51	0.97	0.08	0.04	
Alternative one-factor model[b]	1549.46	54	0.50	0.34	0.20	1402.25(3), $p < 0.001$
Alternative two-factor model 1[c]	1212.51	53	0.61	0.30	0.19	1065.30(2), $p < 0.001$
Alternative two-factor model 2[d]	471.04	53	0.86	0.18	0.07	353.83(2), $p < 0.001$
Alternative two-factor model 3[e]	1274.74	53	0.59	0.31	0.21	1127.53(2), $p < 0.001$

Notes. CFI = Comparative Fit Index; RMSEA = Root-Mean-Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.
[a] Hypothesized three-factor model: Items of entity beliefs, items of incremental beliefs, and items of decremental beliefs load onto three separated factors.
[b] Alternative one-factor model: All items loaded onto a single factor.
[c] Alternative two-factor model 1: Items of entity beliefs load onto one factor and items of incremental beliefs and decremental beliefs loaded onto the same factor.
[d] Alternative two-factor model 2: Items of entity and incremental beliefs load onto the same factor, and items of decremental beliefs load onto the other factor.
[e] Alternative two-factor model 3: Items of entity and decremental beliefs load onto the same factor, and items of incremental beliefs load onto the other factor.

incremental theory items (e.g., "Your intelligence can always be substantially increased;" $\alpha = 0.93$) and decremental theory items (e.g., "Even your basic intelligence level can be reduced considerably;" $\alpha = 0.96$) were modified based on the original change theory items (e.g., "You can change even your basic intelligence level considerably;" Dweck, 1999). Participants responded on a six-point Likert scale from "1 = strongly disagree" to "6 = strongly agree". All three dimensions were normally distributed: the values of Skewness were 0.65, − 0.33, and 0.00, and the values of Kurtosis were − 0.12, − 0.49, and − 0.80 for entity, incremental, and decremental beliefs, respectively.

2.2.2. Effort beliefs about ability gain and ability loss

We adapted a scenario-based scale (Heine et al., 2001) to measure participants' effort beliefs about ability gain and ability loss. Specifically, participants read a scenario concerning a student who took a standardized test and received an average score (i.e., a score of 100, where the range was from 50 to 150), and then evaluated what score that student would get the next time if the student put (a) same amount of effort, (b) more effort, and (c) less effort into studying (see Appendix B). Participants responded to all the three effort conditions. *The effort belief about ability gain* was computed by subtracting the expected score for putting in more effort by the expected score for putting in the same amount of effort (i.e., b – a), such that a higher score represented a stronger belief that effort would lead to greater improvement. *The effort belief about ability loss* was computed by subtracting the expected score for putting in the same amount of effort by the expected score for putting in less effort (i.e., a – c), such that a higher score represented a stronger belief that lack of effort would lead to a greater reduction in ability.

2.2.3. Self-esteem

To control for the effect of self-esteem, participants completed the 10-item Rosenberg self-esteem scale (Rosenberg, 1965). Participants responded on a six-point Likert scale, ranging from "1 = strongly disagree" to "6 = strongly agree" ($\alpha = 0.89$). Scores for negative items were reversed, such that a higher mean score represents a higher self-esteem.

2.3. Results

2.3.1. Differences among entity, incremental, and decremental beliefs

We conducted two analyses to test whether decremental beliefs are independent from entity and incremental beliefs. First, we used confirmatory factor analysis (CFA) to test the hypothesized three-factor structure of mindsets (i.e., entity, incremental, and decremental

beliefs), and to test and compare with different alternative models (see Table 1).[2] Second, we examined the correlation among entity, incremental, and decremental beliefs. If decremental beliefs are a distinct factor, the results would show a weak correlation with incremental and entity beliefs.

2.3.1.1. Factorial Structure of Implicit Theories. We first tested the hypothesized three-factor model, in which items of entity beliefs, incremental beliefs, and decremental beliefs were loaded onto three different factors. As expected, the three-factor model fit the data well. Moreover, its model fit indices were significantly better than those in the alternative one-factor model that loaded all items onto a single factor, the alternative two-factor model that combined the items of incremental and decremental beliefs, the alternative two-factor model that combined the items of entity and incremental beliefs, and the alternative two-factor model that combined the items of entity and decremental beliefs. These findings suggest that entity beliefs, incremental beliefs, and decremental beliefs are three distinct mindsets.

2.3.1.2. Correlation. The correlations among the three factors (see Table 2) further demonstrated that decremental beliefs are a distinct construct. Decremental beliefs were positively and weakly correlated with incremental beliefs (latent factor correlation: $r = 0.14$, $p = 0.07$; bivariate correlation: $r = 0.18$, $p = 0.02$) and were negatively but not significantly correlated with entity beliefs (latent factor correlation: $r = -0.12$, $p = 0.12$; bivariate correlation: $r = -0.13$, $p = 0.10$). That decremental beliefs were more strongly correlated with incremental beliefs is possibly due to the fact that both of them involve the beliefs of change.

2.3.1.3. Mean comparison and group classification. We conducted repeated measures ANOVA to test the degree of endorsement of decremental beliefs compared to the endorsement of incremental and entity beliefs. Results showed that people believe in decremental beliefs ($M = 3.39$) more weakly than incremental beliefs ($M = 3.92$),

Table 2
Study 1 ($N = 174$): descriptive results and correlation between variables.

	1	2	3	4	5	6	7	8
1. Entity beliefs	–	− 0.72***	− 0.13	− 0.22**	− 0.21**	− 0.17*	− 0.08	0.01
2. Incremental beliefs	− 0.78***	–	0.18*	0.29**	0.20**	0.08	0.04	0.04
3. Decremental beliefs	− 0.12	0.14	–	− 0.11	0.23**	0.02	0.07	0.02
4. Effort beliefs about ability gain				–	0.31**	− 0.04	− 0.07	− 0.09
5. Effort beliefs about ability loss					–	− 0.02	− 0.22**	− 0.24**
6. Self-esteem						–	− 0.02	0.08
7. Age							–	0.78***
8. Year of university								–
Mean	2.84	3.92	3.39	15.30	16.02	4.20	19.16	1.67
SD	1.12	1.10	1.28	9.59	10.33	0.92	1.85	1.02
Skewness	0.65	− 0.33	0.00					
Kurtosis	− 0.12	− 0.49	− 0.80					

Values above the diagonal represent the zero-order correlation, and values below the diagonal represent the correlations among the latent variables in the final CFA model.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

$F = 24.15$, $p < 0.001$, $\eta_p^2 = 0.11$, but more strongly than entity beliefs ($M = 2.84$, $F = 16.25$, $p < 0.001$, $\eta_p^2 = 0.09$.

In addition, we roughly classified students' mindsets to be strong or weak in different mindsets using the mid-point (i.e., 3.5 in a 6 point-scale; see Chiu, Dweck, Tong, & Fu, 1997). We found that about half of the participants scored above mid-point on decremental beliefs ($n = 82$; 47.1%). > Slightly more than 60% of the participants rated above mid-point on incremental beliefs ($n = 111$, 63.8%) but only about a quarter rated above mid-point on entity beliefs ($n = 41$, 23.6%). These results are consistent with the mean level comparison, such that holding decremental beliefs is fairly common among university students, at least more so than entity beliefs.

2.3.2. Relationships between implicit theories and effort beliefs

In addition to the bivariate correlations (see Table 2),[3] we conducted two regression analyses to examine the relationship between implicit theories and beliefs about effort utility (Table 3). Given that self-esteem was negatively correlated to entity beliefs, to rule out an alternative explanation, we included the self-esteem score as a covariate.

In the first regression analysis (Table 3), we entered entity, incremental, and decremental beliefs into the equation predicting effort beliefs about ability gain ($R^2 = 0.11$, $p < 0.001$). As expected, incremental beliefs were positively associated with effort beliefs about ability gain ($\beta = 0.29$, $t = 2.74$, $p = 0.007$), even after controlling for self-esteem ($\beta = 0.28$, $t = 2.64$, $p = 0.009$). Students who strongly endorsed incremental theories believed that effort could lead to more improvement on standardized test scores. Although decremental beliefs and effort beliefs about ability gain were not significantly correlated ($r = − 0.11$, *ns*), they were negatively associated in regression when entity and incremental beliefs were controlled ($\beta = − 0.17$, $t = − 2.27$, $p = 0.02$). This association was significant even when self-esteem was controlled ($\beta = − 0.17$, $t = − 2.29$, $p = 0.02$). That is, the more strongly students endorsed decremental theories, the less likely they believed that exerting effort could result in improvement on standardized test scores. Although entity and effort beliefs about ability gain were negatively correlated in the bivariate correlation, they were not significantly associated in the regression analyses ($\beta = − 0.04$, $t = − 0.33$, $p = 0.74$). That is, students who believed that intelligence

was fixed did not believe that effort would lead to greater improvement. But this association did not hold after controlling for incremental and decremental beliefs.

In the second regression analysis (Table 3), we used the effort belief about ability loss as a criterion variable ($R^2 = 0.09$, $p = 0.002$). As predicted, decremental beliefs were positively associated with effort beliefs about ability loss ($\beta = 0.20$, $t = 2.61$, $p = 0.01$), even after controlling for self-esteem ($\beta = 0.20$, $t = 2.61$, $p = 0.01$). Students who strongly believed that intelligence could be reduced believed that standardized test scores would drop more if people put in less effort. However, both entity beliefs ($\beta = − 0.14$, $t = − 1.34$, $p = 0.18$) and incremental beliefs ($\beta = 0.06$, $t = 0.57$, $p = 0.57$) were not significantly associated with effort beliefs about ability loss. In summary, these findings suggest that decremental beliefs uniquely predict students' beliefs about effort utility on ability gain and preventing ability loss.

3. Study 2

Study 1 found that decremental beliefs have unique features that are distinct from entity and incremental beliefs. However, we also found that decremental beliefs and incremental beliefs are positively correlated. It is possible that beliefs about change in Dweck's original measure already explain the variations for both beliefs about positive change (incremental beliefs) and negative change (i.e., decremental beliefs); thus, one may argue that adding the decremental dimension is not necessary. Therefore, in Study 2, we included the items of beliefs about change in Dweck's original measure to further examine whether they simply capture incremental beliefs but not decremental beliefs (O'Brien & Kardas, 2016). Furthermore, to examine whether decremental beliefs can explain prevention–promotion goal settings differently from entity and incremental beliefs, we asked participants to set two different goals and evaluate each in terms of prevention and promotion orientations.

3.1. Participants and procedure

A total of 233 university students (1st year = 140; 2nd year = 58, 3rd year = 24, 4th year = 8, 5th year = 3) who were enrolled in introductory psychology courses participated in this study (138 females; $M_{age} = 19.19$, $SD_{age} = 2.03$).[4] They received partial credit for

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[3] The zero-order correlation showed that effort beliefs about ability gain were positively related to incremental beliefs ($r = 0.29$, $p < 0.001$) and negatively associated with entity beliefs ($r = − 0.22$, $p = 0.003$), but were not related to decremental beliefs ($r = − 0.11$, $p = 0.14$). On the other hand, effort beliefs about ability loss were positively correlated to decremental beliefs ($r = 0.23$, $p = 0.003$) and incremental beliefs ($r = 0.20$, $p = 0.009$), and were negatively correlated to entity beliefs ($r = − 0.21$, $p = 0.005$).

[4] Consistent with Study 1, Study 2 showed that age was not significantly associated with entity beliefs ($r = 0.10$), incremental beliefs ($r = − 0.07$), decremental beliefs ($r = − 0.06$), and change beliefs ($r = − 0.04$). Similarly, year of university was not significantly associated with entity beliefs ($r = 0.04$), incremental beliefs ($r = − 0.03$), decremental beliefs ($r = − 0.12$), and change beliefs ($r = − 0.07$). Thus these demographic variables were not considered in further analyses.

Table 3
Study 1: standardized estimates for regression analyses.

Outcome variable	Predictor	VIF	Tolerance	β	t	R^2
Effort beliefs about ability gain						0.11***
	Entity beliefs	2.09	0.48	− 0.04	− 0.33	
	Incremental beliefs	2.12	0.47	0.28	2.74**	
	Decremental beliefs	1.03	0.97	− 0.17	− 2.27*	
Effort beliefs about ability gain						0.11***
	Self-esteem	1.03	0.97	− 0.07	− 0.87	
	Entity beliefs	2.11	0.47	− 0.05	− 0.46	
	Incremental beliefs	2.10	0.48	0.28	2.64**	
	Decremental beliefs	1.03	0.97	− 0.17	− 2.29*	
Effort beliefs about ability loss						0.09**
	Entity beliefs	2.09	0.48	− 0.14	− 1.34	
	Incremental beliefs	2.12	0.47	0.06	0.57	
	Decremental beliefs	1.03	0.97	0.20	2.61**	
Effort beliefs about ability loss						0.08**
	Self-esteem	1.03	0.97	− 0.01	− 0.13	
	Entity beliefs	2.11	0.47	− 0.14	− 1.26	
	Incremental beliefs	2.10	0.48	0.06	0.53	
	Decremental beliefs	1.03	0.97	0.20	2.61**	

Note. The multicollinearity statistics (i.e., Tolerance and VIF) were within accepted limits, thus the data assumption of multicollinearity was met.
β = *S*tandardized path coefficient.
*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

3.2. Materials

3.2.1. Implicit Theories Scale

To understand whether beliefs about change are related to incremental and decremental beliefs, we added four items regarding beliefs about change from Dweck's (1999) original measure (e.g., "Even your basic intelligence level can be changed considerably.") in addition to the Trichotomous Implicit Theories Scale described in Study 1. The Cronbach alpha indices showed that internal consistencies were good (α = 0.93 for entity beliefs, α = 0.93 for incremental beliefs, α = 0.96 for decremental beliefs, and α = 0.94 for beliefs about change). All four measures were normally distributed: the values of Skewness were 0.23, 0.03, 0.28, and 0.04, and the values of Kurtosis were − 0.57, − 0.53, − 0.52, and − 0.61 for entity, incremental, decremental beliefs, and beliefs about change (i.e., items from the original mindsets scale that did not indicate change) respectively.

3.2.2. Promotion- and prevention-focused goal orientations

Following Ebner, Freund, and Baltes' (2006) study, participants first read the definition of a goal (i.e., "goals are what you would like, and what you would not like at present and in the following weeks, months, and years"), and then wrote down their two most important goals related to their studying at the university. Next, participants assessed the promotion and prevention orientations for each of the goals they generated.[5] Specifically, they rated two goals separately on the orientation towards growth and gains (i.e., "with the first/second goal, I want to improve something or achieve something new") and on orientation towards maintenance (i.e., "with the first/second goal, I want to maintain something") on a seven-point scale from "1 = strongly disagree" to "7 = strongly agree." We calculated the mean scores for promotion-focused orientation (r = 0.45, p < 0.001; M = 6.05, SD = 0.97) and prevention-focused orientation (r = 0.38, p < 0.001;

$M = 5.03$, $SD = 1.37$).[6]

3.2.3. Self-esteem

Participants rated the 10-item Rosenberg self-esteem scale (Rosenberg, 1965; described in Study 1) on a four-point Likert scale, ranging from "1 = strongly disagree" to "4 = strongly agree" (α = 0.88).

3.3. Results

3.3.1. Confirmatory Factor Analysis

Similar to Study 1, the three-factor model that treated incremental, entity, and decremental beliefs as separate dimensions provided a better fit than other alternative models (Table 1), suggesting that decremental beliefs, entity beliefs, and incremental beliefs were three distinct constructs.

3.3.2. What are the implicit meanings of change?

The zero-order correlations (see Table 3) showed that beliefs about change (i.e., original implicit theories items that did not indicate the direction of change) were strongly correlated to incremental beliefs (r = 0.82, p < 0.001) and entity beliefs (r = − 0.77, p < 0.001). However, beliefs about change were only moderately associated with decremental beliefs (r = 0.38, p < 0.001). A further hierarchical regression analysis showed that decremental beliefs explained only 1% of the variance of beliefs about change in addition to incremental beliefs.[7] On the other hand, incremental beliefs explained 54% of the variance of the beliefs about change in addition to decremental beliefs.[8] As

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[5] Some typical responses were as follows: increase my GPA, getting into medicine/law school, maintain GPA, not fail second semester, be able to stay in university.

[6] The value of Cronbach's α is dependent on both the number of test items and inter-correlations among items. The promotion-focused goal scale (α = 0.61) and prevention-focused goal scale (α = 0.55) consist of only two items respectively, and the Cronbach's α tends to yield a low value even when the inter-correlations are acceptable. Thus, we reported the inter-item correlations, which showed that the items were significantly correlated and were within an acceptable level of consistency (Clark & Watson, 1995).

[7] In the first step we entered incremental beliefs onto beliefs about change ($R^2 = 0.67$, $p < 0.001$), and in the second step we entered both incremental beliefs and decremental beliefs onto beliefs about change ($R^2 = 0.68$, $p < 0.001$).

[8] In the first step we entered decremental beliefs onto beliefs about change ($R^2 = 0.14$, $p < 0.001$), and in the second step we entered both decremental beliefs and incremental beliefs onto beliefs about change ($R^2 = 0.68$, $p < 0.001$).

completing a short questionnaire. Ethical approval for this study was received from the University of Alberta.

Table 4
Study 2 ($N = 233$): descriptive results and correlation coefficients between variables.

	1	2	3	4	5	6	7	8	9
1. Entity beliefs	–	− 0.70**	− 0.22**	− 0.77**	− 0.14*	− 0.01	− 0.20**	0.10	0.04
2. Incremental beliefs	− 0.73**	–	0.35**	0.82**	0.22**	0.12	0.17**	− 0.07	− 0.03
3. Decremental beliefs	− 0.23**	0.35**	–	0.38**	0.09	0.24**	0.02	− 0.06	− 0.12
4. Beliefs about change				–	0.16*	0.05	0.21**	− 0.04	− 0.07
5. Promotion goal					–	0.11	0.10	0.20	0.06
6. Prevention goal						–	0.02	0.01	− 0.07
7. Self-esteem							–	0.11	0.04
8. Age								–	0.54**
9. Year of university									–
Mean	2.96	3.98	3.64	4.00	6.05	5.03	2.89	19.02	1.59
SD	1.17	1.02	1.14	1.06	0.97	1.37	0.49	1.92	0.87

Notes. Values above the diagonal represent the zero-order correlation, and values below the diagonal represent the correlations among the latent variables in the final CFA model.

 ** $p < 0.01$.

 * $p < 0.05$.

expected, these findings support the notion that beliefs about change are closely linked to positive change (i.e., incremental beliefs) but not to negative change (i.e., decremental beliefs).

3.3.3. Mean comparison and group classification

In terms of the mean levels (see means and standard deviations in Table 3), beliefs about change showed no difference with incremental beliefs, $F (1, 232) = 19.68$, $p = 0.69$, $\eta_p^2 = 0.01$, suggesting that people may perceive beliefs about change to be equivalent to incremental beliefs. Decremental beliefs were scored lower than beliefs about change, $F (1, 232) = 19.68$, $p < 0.001$, $\eta_p^2 = 0.08$, and incremental beliefs, $F (1, 232) = 17.56$, $p < 0.001$, $\eta_p^2 = 0.07$. Moreover, decremental beliefs were scored higher than entity beliefs, $F (1, 232) = 33.46$, $p < 0.001$, $\eta_p^2 = 0.13$. Consistent with Study 1, students endorsed decremental beliefs more weakly than incremental beliefs but more strongly than entity beliefs.

We then used the mid-point (i.e., 3.5) to categorize students according to their mindsets. Consistent with Study 1, we found that about half of the participants scored above mid-point on decremental beliefs ($n = 116$; 49.8%) and only about a quarter rated above mid-point on entity beliefs ($n = 65$, 27.9%). We also found that slightly more than 60% of the participants rated above mid-point on incremental beliefs ($n = 147$, 63.1%) and beliefs about change ($n = 146$, 62.7%).

3.3.4. Implicit theories and prevention–promotion focused goal orientations

Correlational analyses showed that self-esteem was positively correlated with incremental beliefs, and negatively correlated with entity beliefs, but not correlated with decremental beliefs (see Table 4).[9] To rule out alternative explanations, we controlled for self-esteem in analyses.

We conducted regression analyses to test the relations between implicit theories and goal orientations (Table 5). We first regressed incremental, entity, and decremental beliefs on promotion-focused goal orientation ($R^2 = 0.05$, $p = 0.013$). We found that only incremental beliefs ($\beta = 0.23$, $p = 0.02$) were a significant predictor; entity beliefs ($\beta = 0.02$, $p = 0.79$) and decremental beliefs ($\beta = 0.02$, $p = 0.83$) did not significantly predict promotion-focused goal orientation. As predicted, students who strongly endorsed incremental beliefs were more likely to set goals that focused on ability growth. Moreover, the effect of incremental beliefs on promotion-focused goal orientation remained significant ($\beta = 0.23$, $p = 0.017$) even after controlling for self-esteem.

We then used prevention-focused goal orientation as a criterion variable ($R^2 = 0.07$, $p < 0.001$). We found that only decremental beliefs ($\beta = 0.23$, $p = 0.001$) were a significant predictor; incremental beliefs ($\beta = 0.13$, $p = 0.16$) and entity beliefs ($\beta = 0.13$, $p = 0.14$) did not significantly predict prevention-focused goal orientation. As predicted, students who strongly endorsed decremental beliefs were more likely to set goals focused on maintaining their current ability. Moreover, the effect of decremental beliefs on prevention-focused goal orientation remained significant ($\beta = 0.22$, $p = 0.002$) after controlling for self-esteem.

In summary, although the three mindsets explained a small variance in promotion- and prevention-focused goals in general, these findings supported our hypothesis that incremental beliefs were associated with promotion-focused goal orientation whereas decremental beliefs were associated with prevention-focused goal orientation.

4. Discussion

"Loss is nothing else but change, and change is nature's delight."
–Marcus Aurelius, 16th Emperor of the Roman Empire

"Change must be constantly renewed and fortified. Otherwise, the world will soon return to its previous state."
–Lao Tzu, *Tao Te Ching*

People's fundamental beliefs about change in human attributes comprise not only growth and stasis, but also decline. Proverbs from different cultures tell us that decrease is part of the nature of change and constant effort has to be exerted in order to prevent negative change. In line with these cultural lay beliefs, our findings show that decremental beliefs are linked to prevention motivation. This research demonstrates that mindsets are inherently more complex than the current fixed-versus-growth model, and thus provides important theoretical implications for extending the framework of mindsets.

4.1. Theoretical implications

4.1.1. Clarifying the construct of decremental beliefs

Two studies showed that almost half of the university students in our samples held decremental beliefs. In general, students endorsed decremental beliefs at a moderate level (3.39 and 3.64 on a six-point scale) and more strongly than entity beliefs. Moreover, students' decremental mindsets are distinct from their entity and incremental mindsets, as indicated by the three-factor model. Similarly, as indicated by the weak to moderate positive correlation between incremental and decremental beliefs, students' beliefs about negative change and beliefs about positive change are not the opposite ends of a continuum or the same construct; they are independent from each other. Furthermore, beliefs about change in the original implicit theories measure mainly

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 [9] The zero-order correlation also showed that promotion-focused orientation was positively related to incremental beliefs ($r = 0.22$, $p < 0.001$) and negatively associated with entity beliefs ($r = − 0.14$, $p = 0.04$), but was not related to decremental beliefs ($r = 0.09$, $p = 0.17$). On the other hand, prevention-focused orientation was positively related to decremental beliefs ($r = 0.24$, $p < 0.001$), but was not related to entity beliefs ($r = − 0.01$, $p = 0.92$) and incremental beliefs ($r = 0.12$, $p = 0.07$).

Table 5
Study 2: standardized estimates for regression analyses.

Outcome variable	Predictor	VIF	Tolerance	β	t	R^2
Promotion-focused goal						0.05*
	Entity beliefs	1.89	0.53	0.02	0.27	
	Incremental beliefs	2.07	0.48	0.23	2.42*	
	Decremental beliefs	1.15	0.87	0.02	0.21	
Promotion-focused goal						0.06*
	Self-esteem	1.04	0.97	0.07	1.05	
	Entity beliefs	1.98	0.50	0.04	0.47	
	Incremental beliefs	2.13	0.47	0.23	2.41*	
	Decremental beliefs	1.14	0.87	0.02	0.32	
Prevention-focused goal						0.07***
	Entity beliefs	1.89	0.53	0.13	1.49	
	Incremental beliefs	2.07	0.48	0.13	1.39	
	Decremental beliefs	1.15	0.87	0.23	3.23**	
Prevention -focused goal						0.07***
	Self-esteem	1.04	0.97	0.02	0.32	
	Entity beliefs	1.98	0.50	0.13	1.44	
	Incremental beliefs	2.13	0.47	0.13	1.31	
	Decremental beliefs	1.14	0.87	0.22	3.16**	

Note. The multicollinearity statistics (i.e., Tolerance and VIF) were within accepted limits, thus the data assumption of multicollinearity was met.

$\beta = S$tandardized path coefficient.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

tap incremental beliefs, but not decremental beliefs. These findings suggested that previous methodology in the implicit theories framework indeed primarily captured beliefs about positive change.

The distinctions among these three mindsets were further supported by their associations with effort beliefs, prevention–promotion goal orientations, and self-esteem. Decremental beliefs had a unique role in predicting effect beliefs about loss and prevention-focused motivation (discussed in Section 4.1.2). Regarding self-esteem, we found that it was negatively linked to entity beliefs across two studies, possibly because entity theorists tend to seek for social validation and view challenges and failures as a reflection of lack of intelligence (Molden & Dweck, 2006). However, self-esteem was not related to decremental beliefs, suggesting that students with decremental beliefs did not necessarily had vulnerable self-esteem. This is possibly because students who think their intelligence can be reduced do not necessarily believe that their ability will decrease; they may believe that they can maintain their ability with enough effort. Therefore, we argue that decremental beliefs, unlike entity beliefs, are not tied to social validation motives. Although incremental beliefs were positively correlated with self-esteem in Study 2 ($r = 0.17$), there was only a non-significant trend in Study 1 ($r = 0.08$). Hence, this research offers only partial support that incremental theory is related to positive self-regard (Robins & Pals, 2002).

In summary, decremental beliefs are a unique dimension of implicit theories. The findings of the three-dimensional framework suggest that students can hold mixed beliefs about intelligence. Indeed, recent research shows that even incremental and entity beliefs are two independent factors (e.g., Bråten & Strømsø, 2004; De Castella & Byrne, 2015; Diseth et al., 2014; Dupeyrat & Mariné, 2005; King, 2012; Lou & Noels, 2017; Lüftenegger & Chen, 2017). In our view, understanding these theoretical constructs is a necessary prerequisite for further empirical investigation into how and why implicit theories influence other related psychological and motivational processes in learning. To further validate the three-factor construct, experimental paradigms (e.g., Hong, Chiu, Dweck, Lin, & Wan, 1999) are needed to compare and contrast the role of decremental beliefs with entity and incremental beliefs in predicting learners' motivation.

4.1.2. Decremental beliefs and motivation

The extension of implicit theories offers a broader perspective for

understanding the underlying beliefs in different achievement motivations. Consistent with previous research, this research showed that students who strongly endorsed incremental theories were more promotion-oriented and more likely to set goals to grow and learn, whereas students who strongly endorsed entity beliefs were less likely to set promotion-oriented goals and did not believe effort or lack thereof influenced ability (Mathur et al., 2013; Timpone & Hostutler, 2012). Importantly, this research showed that decremental beliefs were the only mindsets that were associated with prevention-related motivation. Students who strongly endorsed decremental theories expected that a lack of effort would lead to the reduction of ability and were more likely to set goals that focused on maintaining ability. These students also believed that exerting more effort could result in little improvement on standardized test scores, possibly because decremental theorists think that effort is less useful in making learning progress. This motivation of decremental theorists is consistent with their prevention goals to prioritize their effort in maintaining ability or preventing loss rather than in increasing competence (or learning new things; Molden & Rosenzweig, 2016).

In summary, these findings suggest that decremental beliefs may link to a "meaning system" that guides students to make sense of and to respond to their learning experiences differently from entity and incremental beliefs. However, more research is needed to examine whether and how decremental beliefs lead to different learning strategies, engagement, learning behaviour, and achievement outcomes, perhaps through the mediation of effort beliefs and prevention-focused goal orientation. In particular, it is important to understand whether and when decremental beliefs are adaptive in learning, compared to entity and incremental beliefs. Given that prevention-focused motivation has pros and cons depending on the learning situation (see Molden & Rosenzweig, 2016 for discussion), it is possible that students will be more engaged when the learning environment matches their beliefs and goals (Higgins, 1998). For example, students who hold decremental beliefs may persist and perform better in tasks that promote maintenance of current endowments or prevent falling behind, whereas students who hold incremental beliefs may be more motivated in tasks that emphasize growth and gain.

4.1.3. Lay theory of change

This research provides insights for understanding lay beliefs about

multidirectional changes in an achievement context. Supporting O'Brien and Kardas' (2016) findings that people tend to perceive and interpret change in a positive light (i.e., growing and improving) rather than a negative light (i.e., losing and declining), we demonstrated that students who held strong beliefs about change (in Dweck's original items) also strongly believed in incremental beliefs, but not necessarily in decremental beliefs. Similarly, we found that students held stronger incremental beliefs than decremental beliefs and entity beliefs, reflecting people's self-enhancement motives to view their ability positively (De Castella & Byrne, 2015). Many students are also motivated to avoid negative consequences of decline in ability, and such motivation may not be contradictory to their self-enhancement motives, as this research showed that decremental beliefs were independent from incremental and entity beliefs (see O'Brien & Klein, 2017 for a discussion). One reason decremental beliefs were rated lower than incremental beliefs might be that positive changes are more socially desirable and that presenting incremental items may suppress respondents' agreement on entity and decremental beliefs (Chiu et al., 1997; Lüftenegger & Chen, 2017).

Self-enhancement motives may also lead people to rate decremental beliefs more strongly when items are about others' ability compared to when items are about their own ability (De Castella & Byrne, 2015; O'Brien & Klein, 2017). However, this research did not examine beliefs about change in one's own ability (e.g., "My intelligence can be reduced") versus general others (e.g., "people's intelligence can be reduced"). This differentiation is important to understand people's own learning motivation and their interpretation of others' ability, as the former has implications for students' engagement and performance and the latter is more likely to influence people's attitudes towards and feedback given to others.

4.2. Limitations and future directions

4.2.1. The causal effect of decremental beliefs

Findings in this cross-sectional research should be interpreted with caution; this research cannot be used to infer a causal relationship between decremental beliefs and prevention-focused motivation. Therefore, it is important to examine the causal effect of decrements beliefs. Although people have seemingly contradictory knowledge and mixed experience about how human ability increases, decreases, and remains stable, all these theories, like common knowledge, are readily accessible to most people (Poon & Koehler, 2006). Implicit theories can be conceptualized as knowledge systems that help people construct perceptions of their social world; people can activate particular knowledge depending on the situation (Leith et al., 2014; Plaks & Stecher, 2007). Much research has shown that experimental procedures (e.g., reading a mock article) can prime participants to endorse entity and incremental beliefs, which in turn influence their motivation and behaviours (e.g., Hong et al., 1999; Lou & Noels, 2016). Therefore, given that most people also have experience with ability decline and knowledge regarding decremental beliefs, we argue that decremental beliefs can be activated when information about decremental theory is presented, explicitly or implicitly. According to this current study, activating decremental beliefs may lead students to endorse prevention-focused goal orientations and effort beliefs.

4.2.2. How do people develop decremental mindsets?

It is important to understand not only the consequences, but also the antecedents of decremental beliefs. Previous research shows that people can change their mindsets in response to situational goals (Leith et al., 2014). For example, students may be more likely to hold incremental (vs. entity) beliefs in failure situations because seeing failures as changeable is less self-threatening than seeing them as fixed. Thus, holding incremental beliefs may help one to protect their self-regard. However, according to this research, activation of decremental beliefs may not be associated with self-regard. Students may activate their decremental beliefs in response to contexts where prevention-focused goals are salient; for instance, when students are asked to set goals not to maintain their status quo. It is also conceivable that students may adopt decremental beliefs if they make self-comparisons on a declining ability (Suls, Marco, & Tobin, 1991). For example, when students are asked to recall an ability that they were better in the past, people may adopt decremental beliefs to justify their decline in ability. To test these bidirectional relationships between decremental mindsets and prevention-focused goals, more experimental research is needed.

Age may be an important precursor of decremental mindsets because people may have more experience with and show more concern for ability loss as they age (e.g., Baltes, 1987). However, our studies did not capture the variability that reveals any age effects; the sample consisted of mostly first-year university students around age nineteen. It is possible that first-year university students may experience more declines in their ability during the transition from high school, which results in greater endorsement of decremental beliefs (Haynes, Daniels, Stupnisky, Perry, & Hladkyj, 2008; Shim, Ryan, & Cassady, 2012). Although research shows that older children are more pessimistic than younger children about their changes in ability (Freedman-Doan et al., 2000), little is known about whether and when people start to realize that their ability can decrease, and what leads them to develop decremental beliefs about their ability. Thus, it would be interesting to examine whether and how people develop stronger decremental beliefs as they age. However, the scale should be adapted cautiously (or phrased differently) when applying it to examine older adults' decremental beliefs because the items may be perceived as describing dementia in older adults.[10]

Another important antecedent is learners' skill level. For example, compared to beginners in domains like language and sports, higher-level learners who have spent many years learning may be more likely to observe plateaus and declines in progress and that lack of effort can result in decrease in ability (Ciani & Sheldon, 2010). It is also possible that students are more likely to adopt decremental beliefs in their non-specialized areas. For example, a math student may believe his/her foreign language aptitude is declining because he/she has not spent much time on language learning. To understand how people develop decremental beliefs in intelligence and in specific academic domains, future research should examine different populations and age groups, as well as their learning experiences.

4.2.3. Are decremental mindsets meaningful in different domains?

Given the domain-specific nature of mindsets (i.e., one can hold different beliefs across domains), students may develop and change their mindsets based on their experience in a particular domain (Dweck, Chiu, & Hong, 1995; Freedman-Doan et al., 2000). As an influential social-cognitive framework across different areas of research, such as personality (Plaks et al., 2009), second language acquisition (Lou & Noels, 2017), and social relationships (Lou & Li, 2017), re-conceptualizing implicit theories to include decremental beliefs may inform a more comprehensive understanding of mindsets in learning and behaviour. For example, in the domain of interpersonal relationships, people who expect that relationship quality can drop easily over time may be more alert to signs of negative relationships. They may be more likely to prevent a relationship from becoming negative, or more likely to accept and stay in a relationship when quality is declining.[11] To understand this theoretical applications for other areas, it is important to examine the constructs of decremental beliefs and whether they are distinguishable from entity and incremental beliefs across different domains.

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[10] We appreciate an anonymous reviewer for pointing out that items of decremental beliefs may perceived differently among older adults.

[11] We are grateful to an anonymous reviewer for suggesting the role of decremental beliefs in relationship mindsets.

4.2.4. Cultural variations of decremental mindsets

Another route for future research includes the investigation of how socio-cultural learning influences the formation of decremental beliefs. Dweck maintains that socialization practices are the keys that influence mindsets (Dweck, 2017). As such, the environment (e.g., teachers, parents, or even the media) can guide people to create meanings of their learning experiences, and thus influences their mindsets and beliefs about change (Ji, 2008; Jose & Bellamy, 2012). Moreover, previous research shows cultural variation in implicit theories: incremental beliefs are more prevalent in collectivistic countries compared to individualistic countries (Heine et al., 2001; Rattan, Savani, Naidu, & Dweck, 2012). Regarding decremental beliefs, previous research showed that learning environments in East Asian countries (vs. North American countries) are generally more prevention-focused, and East Asian students also express a stronger prevention orientation (Lockwood et al., 2005). It is possible that such societal values on prevention-focused beliefs in East Asian countries may strengthen learners' adoption of decremental beliefs, which may explain East Asians students' high academic performance (Eaton & Dembo, 1997). Examining the role of culture can inform understanding of the nature and scope of the influence of decremental beliefs.

5. Conclusions

This research represents an initial step towards extending Dweck's entity-vs.-incremental model (1999) by proposing an alternative trichotomous framework of implicit theories (i.e., entity, incremental, and decremental beliefs). We argue that decremental beliefs are also a core belief in the "meaning system" that influences achievement motivation; decremental beliefs explain why some students are prevention-oriented in their learning and set goals that are primarily focused on maintaining ability. To further understand the utility of decremental beliefs in students' learning, motivation, and achievement, more research is needed to examine whether and how decremental beliefs are linked to learners' motivational processes in different domains and across different populations. We hope this new framework can inspire further investigations to create a broader picture of implicit theories and achievement motivation.

Acknowledgements

Appendix A. The Trichotomous Implicit Theories Scale

Entity

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

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

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

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

Incremental

Even your basic intelligence level can be **increased** considerably.

Your intelligence can always be substantially **increased**.

No matter how much intelligence you have, it can always be **increased** quite a bit.

No matter who you are, your intelligence can be significantly **increased**.

Decremental

Even your basic intelligence level can be **reduced** considerably.

Your intelligence can always be substantially **reduced**.

No matter how much intelligence you have, it can always be **reduced** quite a bit.

No matter who you are, your intelligence can be significantly **reduced**.

Note. Items are randomized in the questionnaire. Incremental and decremental items are adapted from the items of beliefs about change in the original measure (Dweck, 1999).

Appendix B. Scenario about effort beliefs about ability gain and ability loss

The Academic Aptitude Test (AAT) is a standardized test that measures students' intelligence including numerical ability, language usage, mechanical reasoning, and abstract reasoning. Test experts and educators consider the test to a fair and objective method of predicting a student's ability to succeed in an intellectual endeavor, mainly because the standardized format, coupled with computerized scoring, removes the potential for favouritism, bias, and subjective evaluations. Some universities in the United States use this test to measure students' ability as one evaluation of their application. The score of AAT is ranged from 50 to 150.

Jessie took the AAT test last year and Jessie got a score of 100, which is the average score in the population. After that, Jessie _____ (put the same amount effort, didn't put as much effort, or put a lot more effort) into studying compared to last year. What score do you expect Jessie would get in this standardized AAT one year later?

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