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Predicting gainful learning in Higher Education; a goal-orientation approach

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ABSTRACT

We present data that may not only provide direction to those who are interested in developing a measure of learning gain, but also provide a route for those wishing to directly enhance student performance through gainful learning. Richardson found that student performance showed moderate correlations with only three self-regulatory variables academic self-efficacy, grade goal and effort regulation. We examine how student self-regulatory behaviours and predict these predict feedback engagement and behavioural change. Data provide converging evidence suggesting that mastery approach goal orientations, challenging interventions from feedback, and motivational intentions are essential personal constructs linked to behavioural change. These tentative findings support the suggestion that measures of gainful learning could be operationalised as ‘self-reported behaviours that suggest the productive acquisition of beneficial skills, knowledge and attitudes through study and experience’. Evidence is also offered indicating that more research is necessary to understand the measurement of mindset.

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In Psychology, we typically observe human behaviour as a way of assessing unobservable psychological attributes such as intelligence, depression, ability or knowledge. In most cases, we identify patterns of observable behaviour that may represent the unobservable psychological attribute, state or processes. We strive to develop measurement tools purporting to tap into the unobservable psychological characteristics that we think maybe reflected in measurable behaviour. This means that the first step in developing any new measurement tool is that the domain of interest needs to be thoroughly understood, as well as any measurement issues in sampling that the construct may engender. It is from this approach that we examine the utility in the measurement of learning gains. The HEFCE (2017) operationalisation of Learning Gain as ‘the *improvement in knowledge, skills, work-readiness and personal development made by students during their time spent in higher education*’ is broad in concept but a useful starting point for debate and discussion. This is what we call in psychology ‘scale dimensionality’, and this dimensionality will ultimately reflect the number

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and nature of the variables that any measure of learning gain will assess, but also the extent to which it is a useful measure by which to predict learning gain in future cohorts.

Measure what you value

One place to start with learning gains would be to examine what students value from their learning. Asking students and academics what their self-identified values are related to learning gain perhaps encourages breadth, authenticity and a critical personal construct facet to the process (Kelly, 1955). However, some values are more generally accepted in the main stream as normal or important, and will therefore obtain higher evaluations: some things are just easier to say yes to. For example, when asking students to identify dimensions of their degree that were of value to them, an item such as 'critical evaluation' would likely emerge as highly important because students receive regular feedback on this dimension and therefore it is deemed to be of value. The terminology is very available to the student lexicon and because grades are associated with the term it has significant positive valence. This bias in psychology is known as the availability heuristic and explains how humans have a propensity to rely on examples that come immediately to mind when evaluating topics, constructs or making decisions. Asking students and academics what they value perhaps adds some authenticity to the measurement process, but because people rely on mental shortcuts (Ajzen, 1996; Fishbein & Ajzen, 1975; Kahneman & Tversky, 1979, 1984; Tversky & Kahneman, 1974), such information is not necessary a good place to start with measurement development. Even if those insights are critical and insightful, some items are clearly more powerful and valuable than others (thus ipsative or most preferred) and a measurement tool constructed on those principles could drown out the variance of other important factors.

Grade point average (GPA) is often considered to be the clearest indicator of student success and is valued by students, academics and employers. The extent to which GPA is a useful barometer for students advancing learning is however, debatable. Recent systematic reviews show the range of effects of GPA as indicators of performance vary from small (Richardson, Abraham, & Bond, 2012) to moderate (Schneider & Preckel, 2017). However, derived prior performance is suggested to aid future performance in a reciprocal way because it draws on knowledge (prior achievement and intelligence) and strategies (self-efficacy and goal-directed use of learning strategies) (Schneider & Preckel, 2017). For example, in England and Wales A-level grades operationalise prior performance and are considered a proxy for cognitive ability, however, Richardson and colleagues found small weighted average correlations from a limited number of studies examining the association between A level grades ($r = 0.25$), measures of general intelligence ($r = 0.20$), and GPA (Richardson et al., 2012). This low-level association appears to be attributed to range restriction which attenuates the predictive utility of measures of cognitive ability (Jensen, 1980; Poropat, 2009). These meta-analytic findings suggest that traditional measures indicating students' cognitive ability account for 25% of performance variation, however, up to three-quarters of the variation in performance remains unexplained.

Despite the wealth of empirical testing that has been devoted to understanding graduate performance, only a few variables seem to be reasonable predictors of academic performance. Demographic and psychosocial variables are at best small predictors of student performance and scores on secondary education standardised tests or A-levels are at best moderate predictors of tertiary academic performance (Richardson et al., 2012). The non-intellective constructs that Richardson et al., found that predicted GPA (modestly), were self-efficacy (one's belief in one's ability to succeed in specific situations or accomplish a task), effort regulation and grade goal.

Self-regulation: goal orientations, mindset and academic performance

Using GPA to set distal performance goals may present too many self-regulatory challenges to be efficacious in the long term (Bandura, 2013). However, goal orientation in the right combination may tap individual and situational mechanisms of motivation and self-regulation leading to achievement. Goal orientation is characterised by two fundamental approaches. Mastery orientation, focuses on demonstrating competence, and is traditionally associated with adaptive approaches. Alternatively, a less adaptive performance orientation focuses on demonstrating ability or attempting to surpass normative performance standards, in order to exceed others' performances (Elliot & Harackiewicz, 1996; Hsieh, 2011; Nicholls, 1984).

Experimental studies (Komarraju & Nadler, 2013; Morisano, Hirsh, Peterson, Pihl, & Shore, 2010) and meta-analyses over the past seven years, provide compelling evidence that specific goal orientations are related to academic performance (Ames & Archer, 1988; Garn, Ware, & Solmon, 2011; Huang, 2012). In some cases, these indicate that goal orientations extend even beyond that of personality and intelligence (Steinmayr, Bipp, & Spinath, 2011). Richardson et al. (2012) report relatively low-level associations between mastery and performance orientations and GPA. However, the theoretical underpinning and subsequent measurement of goal orientations may not have reached a point of stability (Payne, Youngcourt, & Beaubien, 2007). This may in turn impact the performance of the construct overtime.

The ambiguous predictive validity of performance orientation led to revisions based on valence (Elliot & Harackiewicz, 1996). The revision speaks either to the motivation to approach a desired level of performance, described as a performance approach orientation, or avoid performing poorly, resulting in a performance avoidance orientation. Mastery orientation has been subsequently revised to mirror this approach, with the 2×2 goal-orientation framework, with mastery and performance orientations associated with both approach and avoidance valences, is proposed (Elliot & McGregor, 2001). Although evidence supporting the four possible goal orientations is equivocal, for mastery avoidance and performance approach, endorsing a combination of high mastery approach and low performance avoidance is postulated to predict higher levels of performance (Payne et al., 2007).

Supporting this, mindset theory is suggested to precede goal orientation. Mindset theory is underpinned by two conceptually related but distinct factors, growth and fixed mindset. Researchers propose these are related to adaptive or maladaptive motivations, strategy use and subsequent behavioural trajectories (Dweck, 2017). Growth perspectives are typically associated with adaptive self-regulatory behaviours (Robins & Pals, 2002). These include intrinsic motivations towards learning and mastery of task, possessing higher levels of

self-efficacy and setting achievement goals (Dinger & Dickhäuser, 2013; Furnham, 2014; Zhao, Zhang, & Vance, 2013). Conversely, it is suggested that those endorsing fixed perspectives regulate behaviours less well, select strategies associated with avoidance, helplessness and self-handicapping. Those with fixed mindsets are less likely to take appropriate remedial action when faced with feedback following failure (Forsythe & Johnson, 2016; Rickert, Meras, & Witkow, 2014; Zhao et al., 2013).

Longitudinal research in middle school children supports the idea that adaptive growth mindsets are related to performance improvements (Blackwell, Trzesniewski, & Dweck, 2007). However, recent meta-analytic evidence suggests low-level associations with performance and higher, but still moderate, relations with self-regulatory processes including goal setting, operating and monitoring (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013). Despite the expected behavioural patterns, research findings also indicate that growth perspectives may not contribute to performance where competence beliefs are high (Bodill & Roberts, 2013). This suggests that in groups of highly able students, such as in Higher Education, that growth mindsets maybe of limited use. A recent large cohort study in HE indicates that incremental beliefs are less strongly related to achievement than was reported by Bahník and Vranka (2017), however, mindset measured in this study used a two-item dichotomous scale, which maybe a limitation.

Simple conceptualisation and measurement of mindset theory suggests the two belief factors as antipoles, however more nuanced perspectives and measurement approaches appear to be emerging in the literature. This appears to mirror discussions in personality and attitude research suggesting that a simple conceptualisation of mindset theory maybe the subject of debate, (for example, see Arnau, Green, Rosen, Gleaves, & Melancon, 2003; Mercer & Ryan, 2009; Widiger, 1993). In specific HE domains, it is postulated that individuals can endorse both mindsets concurrently and that neither remain stable overtime (Dai & Cromley, 2014; Zuckerman, Gagne, & Nafshi, 2001). Although there is some support for more nuanced perspective within HE samples this is rarely examined (Chen & Wong, 2015; Tempelaar, Rienties, Giesbers, & Gijsselaers, 2015). As discussed previously, complex behavioural patterns are also seen in relation to effort attributions and goal orientations which are proposed as close associates of mindsets (Dupeyrat & Marine, 2001; Tempelaar et al., 2015). Taken together the evidence reviewed suggests that measurement of mindset may not, to this point, have captured the complexity of interacting beliefs, behaviours and strategies and their joint contribution to outcomes. This may go some way to explaining the low level of utility seen in the literature for mindset. That said, whilst modest effects are reported, even modest effects maybe meaningful to individual gains in learning.

A measure that can be acted upon

Focusing on the measurement of the various non-intellective factors thought to be important to performance is academically interesting but to what extent can the data be acted upon? Constructs such as mindset and self-efficacy for example, are slowly wired from early childhood (Bandura, 1977, 1982) so one could argue that developing a high impact pedagogical framework to increase gains in learning based on increasing efficacy, growth mindset or other psychosocial skills would not necessarily provide much utility in a typical three-year degree programme. Psychometrically then, clarifying the purpose of learning gain measurement is essential because poorly considered measurement systems come with

unintended consequences (Gray, Micheli, & Pavlov, 2015) and people will work to the measure for better or worse.

We approach the examination of gainful learning with the priority of identifying what we can as academics proactively act upon. As such, we offer an extension of the HEFCE (2017) operational definition for the measurement of a 'gainful learning' as: 'reported behaviours that suggest the productive acquisition of beneficial skills, knowledge and attitudes through study and experience'. The development of a gainful learning evaluation tool which tracks student perceptions of changes in their behaviour could be supported academically through a theoretically driven toolkit which aims to encourage the setting and attainment of achievable goals and the self-management of feedback behaviours in students. Together with effective pedagogies, encouraging receptive feedback behaviours should result in more positive behavioural change in students, however such methodologies have not been rigorously and systematically researched to provide effective support for this approach (Winstone, Nash, Parker, & Rowntree, 2017).

Such an approach would drive the development of pedagogical frameworks based on performance management theories, such as the high-performance cycle, that have stood the test of time (Locke & Latham, 2013). It is suggested here that measuring student self-reported behavioural change could then become not only a tool for the evaluation of gainful learning across programmes of study, but also a teaching philosophy that can be acted upon. Such an approach makes prediction possible and prediction is an imperative criterion for a psychological approach to learning gain. Prediction is valued over measurement description because it leads to a greater understanding of human behaviour. In this case, the encouragement of adaptive student approaches should result in more self-reported positive behavioural changes and development. Then learning gain scales developed on one cohort, should be able to predict the performance of other students in subsequent cohorts.

In pursuit of this, Forsythe and Johnson (2016) applied the Boudrias, Bernaud, and Plunier (2014) feedback model in the analysis of students' personal dispositions and self-reports of their post feedback behaviours. Generally, students fostered self-defensive and self-deceptive behaviours that fail to nurture remediation following feedback, and there was some evidence to support the arguments by Dweck and her colleagues that students who see their intelligence as a fixed entity are more likely to adopt these types of behaviours. This study reported offers preliminary data on a revision of the Boudrias et al. (2014) feedback measure for use in student populations. The Bourdrais et al. measure was originally designed for use in industrial settings to evaluate the effectiveness of feedback procedures related to psychometric developmental review meetings, however there is some evidence that it could be usefully adopted in the student population to encourage and measure behavioural change in students (Forsythe & Johnson, 2016).

The Boudrias et al. (2014) measure taps nine dimensions of attitudes towards feedback. Four of these are 'process' characteristics associated with delivery of the message. These include message valence, face validity, credibility of the source delivering the message, in addition to whether the message provides an intervention that is appropriately challenging. These lead in turn to cognitive appraisals in terms of feedback acceptance and greater awareness gained from feedback. Integrating these effectively leads to greater motivational intention and two active performance outcomes, behavioural changes and developmental activities. Integrating feedback through these mechanisms is suggested to support higher levels of task performance.

The objective of this study was to further test the validity of the Boudrais et al. measure for use in student evaluations and to determine the extent to which mindset and goal orientation predict positive changes in student self-reports of their behaviours. Such data could then lend support to our argument that learning gains could be measured through student self-reported changes in their behaviour in the spirit of what are described in psychology as Behaviourally Anchored Rating Scales (BARS). Such scales were developed in response to dissatisfaction with traditional self-report measures which are subjective and less able to directly measure target performance or behaviour dimensions. BARS have a particular advantage in determining and targeting what is needed to perform, rather than looking for example at more general student characteristics such as self-efficacy or satisfaction. As in industry, academics could potentially use such measures to evaluate progress at modular and programme level and adapt their pedagogical approaches to support students in adapting behaviours that will challenge maladaptive behaviours and support greater leaps in personal performance.

A secondary aim in this study was to examine the measurement approach, particularly in relation to the predictive utility of mindset, which has been the subject of much recent criticism (Visser, 2017 and others).

Methodology

Participants and procedure

One-hundred and sixty-three students were recruited from the second-year psychology undergraduate cohort from the University of Liverpool. Ages were commensurate with those expected at this academic stage ($M = 20.20, \pm 3.52$). There was an unbalanced gender split with 88% of the participants being female. This study had the relevant University ethical approvals. Data were collected and collated through the online survey platform provider Qualtrics and to meet regulations regarding the storage of data, retained on European Union Servers.

Materials

The psychological assessment feedback questionnaire

A nine-factor measure of feedback integration proposed by Boudrias et al. (2014) was utilised in this study. Four 'process' characteristics associated with feedback were measured.

Of these, message valence, is the extent to which the feedback message is positive or negative, with students responding more positively to the former; face validity, or perceived legitimacy of the feedback message; source credibility, this speaks to the extent to which the deliverer of the message can be trusted; and challenge interventions, which maybe targeted feedback that confronts students, in a constructive manner, prompting them to consider how to remedy their blind spots. Five 'action oriented' factors that relate to integration of feedback were also assessed. These relate to feedback acceptance, fundamentally whether the student agrees with the feedback after considering process characteristics; awareness from feedback, or the extent to which feedback enhances ones understanding of the performance and knowledge demonstrated; these lead in turn to motivational intentions, which is the extent to which one is prepared to act based on that information. Finally, two outcome

measures indicate the extent to which students are likely to make behavioural changes and undertake developmental activities. A Likert scale using six anchor points strongly disagree (1) to strongly agree (6) was used by respondents. Internal consistency was assessed for each factor using Cronbach's α and Guttman's λ^6 , all factors met exceeded the cut off threshold (0.70) for reliability using at least one of these coefficients, in most cases both. Exploratory factor analysis was performed using a varimax rotation, eigenvalues above 1 and factor loadings above 0.4. This suggested the omission of awareness from feedback and combining two outcome variables, behavioural and developmental changes into a single factor.

2 × 2 Goal setting framework

The 2 × 2 framework (Elliot & McGregor, 2001) was designed specifically to assess achievement goals. The measure operates through independent competence dimensions; mastery-approach, performance-approach, mastery-avoidance and performance-avoidance. Individuals who are mastery-approach orientated focus on attaining task based or intrapersonal competence. Performance-approach orientations focus on attaining normative competence; mastery-avoidants focus on avoiding task-based or intrapersonal competence, and those who are performance-avoidant focus on avoiding normative incompetence. The measure was revised and modified by Elliot and Murayama (2008) to improve the precision of the instrument and reports reliabilities (Cronbach's α) from 0.84 to 0.98 on each of the factors. A five-point Likert scale is used here with responses ranging from strongly disagree (1) to strongly agree (5). 'My aim is to completely master the material presented in this class' is an example of a mastery approach goal. With the exception of the mastery approach, which demonstrates internal consistency slightly below the expected threshold (Cronbach's $\alpha = 0.65$; Guttman's $\lambda^6 = 0.56$), all factors demonstrate reliabilities above 0.70 using Cronbach's α and Guttman's λ^6 .

Mindset

The eight-item measure proposed by Levy and Dweck (1998) was employed in the current study. This measure has been used widely and Hong, Chiu, Dweck, Lin, and Wan (1999) report this measure as having solid internal consistency in undergraduate students, this is mirrored in the current study (Cronbach's $\alpha = 0.91$; Guttman's $\lambda^6 = 0.93$). In this measure, four items speak to a fixed mindset with the remainder addressing growth mindset. Reversing of scores ensures that all items load on to a single factor. Mean score from this ipsative measure indicates endorsement of one of the two mindsets. A Likert scale with six anchor points strongly disagree (1) to strongly agree (6) are used in this measure. A high score on this scale indicates endorsement of a fixed mindset.

In addition, the Implicit Theories of Intelligence Scale (ITIS) measure of mindset was employed to examine differences between the two measurement approaches (Abd-El-Fattah & Yates, 2006). Two factors, each formed of seven items, measure fixed and malleable (growth) mindsets. High scores in each record endorsement of both types of mindset. To illustrate an item endorsing a fixed mindset suggests 'If I fail in a task, I question my intelligence'. A seven-point Likert response format 'strongly disagree' (1) to 'strongly agree' (7) is employed despite the original scale references four anchoring points. Reliabilities were recorded for Egyptian and Australian samples respectively, all demonstrating good

levels of internal consistency (Fixed: Cronbach's $\alpha = 0.83$ and 0.78 ; and Growth: Cronbach's $\alpha = 0.75$ and 0.76). In the original study, a significant low negative correlation ($r = -0.33$) is mirrored in the current study $r = -0.31$, $p < 0.001$. Internal consistency in the current study is broadly acceptable (Fixed: Cronbach's $\alpha = 0.71$; Guttman's $\lambda^6 = 0.70$; Growth: Cronbach's $\alpha = 0.55$; Guttman's $\lambda^6 = 0.66$).

Results

In this set of preliminary results, feedback characteristics, motivational intentions including mindset and achievement goal orientations were regressed on one feedback outcome: behavioural and developmental change. Within the model proposed by Boudrias and colleagues, these are postulated as two separate outcomes. However, preliminary data analysis indicated that these outcomes were highly correlated, this was supported by exploratory factor analysis which suggested collapsing these into one superordinate outcome. As a result, the outcome was collapsed in to one item after removal of one question, however, the remaining predictors were retained in the regression model.

Table 1 presents descriptive statistics for, and correlations between, each of the factors examined. In addition, assumptions of multi-collinearity were met.

When regressed on the collapsed variable 'behavioural change and developmental activity', the combination of message characteristics, motivational intentions and achievement goal orientations explained 36% of the variance in the model, $\Delta R^2 = 0.36$, $F(11,130) = 6.82$, $p < 0.001$. Students' willingness to make active changes resulting from feedback were positively predicted by motivational intentions ($\beta = 0.30$, $p < 0.001$), mastery approach goal orientations ($\beta = 0.29$, $p < 0.001$) and challenge interventions ($\beta = 0.20$, $p = 0.048$) with higher endorsement of each predicting a greater likelihood of taking positive incremental steps because of feedback.

Behavioural change and developmental activity were not associated with other feedback characteristics including valence of the message ($\beta = 0.06$, $p = 0.456$), face validity ($\beta = -0.04$, $p = 0.630$), acceptance of feedback ($\beta = -0.06$, $p = 0.423$) or source credibility ($\beta = -0.12$, $p = 0.246$). Nor was it associated with the endorsement of mindsets ($\beta = -0.15$, $p = 0.053$), with mastery avoidance ($\beta = -0.06$, $p = 0.490$), performance avoidance ($\beta = -0.03$, $p = 0.741$) or performance approach ($\beta = 0.03$, $p = 0.742$) goal orientations.

Measuring mindset

Two mindset scales were employed, the first betraying the greater nuance that appears to have emerged in the literature where both types of mindset can be held concurrently and endorsed at different levels. The second mindset measure aligns to the simple, ipsative, conceptualisation of mindset which forces a choice, proposing endorsement of one or other of the mindset beliefs along a continuum.

An interesting pattern of findings emerged within these preliminary results. The ipsative measure of mindset held a highly significant yet moderate relationship with outcomes, see Table 1. However, this relationship attenuated somewhat when entered in to the regression model with a borderline significant association reported. Interestingly concurrent measures held lower, albeit significant associations, with making adaptive changes (Fixed $r = -0.17$, $p = 0.031$; Growth $r = 0.22$, $p = 0.006$). Neither of these concurrent approaches approached

Table 1. Correlation matrix feedback message characteristics, goal orientations and mindset.

	Mean (\pm)	2	3	4	5	6	7	8	9	10	11	12	13
1. Message valence	2.81 (± 0.83)	0.16*	0.33***	0.1	0.27**	0.08	0.18*	0.08	0.03	0.04	0.03	-0.05	-0.22**
2. Face validity	3.59 (± 0.87)		0.32***	0.28***	0.32***	0.14	0.16*	0.11	0.19*	0.17*	0.04	-0.01	-0.17*
3. Source credibility	4.07 (± 0.62)			0.61***	0.36***	0.28***	0.42***	0.22**	0.18*	0.24**	0.04	-0.02	-0.22**
4. Challenge interventions	3.91 (± 0.79)				0.14	0.45***	0.48***	0.35***	0.21**	0.28***	0.1	0.02	-0.04
5. Feedback acceptance	3.72 (± 0.90)					0.05	0.14	0.05	0.12	-0.02	-0.01	0.03	-0.13
6. Awareness	4.52 (± 0.69)						0.41***	0.35***	0.16*	0.04	0.05	-0.08	-0.08
7. Motivational intentions	4.65 (± 0.74)							0.51***	0.42***	0.24**	0.20*	0.02	-0.27**
8. Beh. change & dev act	3.75 (± 0.84)								0.43***	0.13	0.15	-0.03	-0.29***
9. Mastery approach	4.04 (± 0.70)									0.34***	0.21**	-0.01**	-0.16
10. Mastery avoidance	3.45 (± 0.86)										0.19	0.30***	-0.07
11. Performance approach	3.91 (± 0.81)											0.65***	-0.03
12. Performance avoidance	3.92 (± 0.83)												0.09
13. Mindset	2.81 (± 0.91)												

* $p < .05$; ** $p < .01$; *** $p < .001$.

a significant association in the regression model. Endorsement of the two types of mindset measurement approach by the same participants was further explored in Figure 1.

The scatterplot at Figure 1 identifies on the x and y axes observations reported for concurrent measures of fixed and growth mindset. In addition, participant's observations on the ipsative measure are then colour-mapped on to observed responses. For this measure, a single cut point was made at the midpoint of participant scores, with scores attributed to respective fixed and growth mindsets. Within the two sets of measures clear patterns emerge. Smaller clusters of participants clearly endorse one of two mindsets. However, this also indicates a large central cluster with more nuanced endorsement of the two approaches. This may counter the commonly received simple conceptualisation of mindset theory. In turn, this may go some way towards explaining its low level of predictive utility.

Discussion

These preliminary results support the hypothesis that a crucible of adaptive, action oriented strategies are associated with making behavioural and developmental changes resulting from feedback. Specifically, mastery approach goal orientations and 'action focused' feedback characteristics, including motivational intentions and challenge interventions, were all associated with this adaptive approach. The remaining 'process focused' feedback characteristics including valence, face validity, acceptance and source credibility were not associated with making change following feedback, nor were any of the other goal orientations. Despite being a diagnostic hallmark of mindset theory, none of these process-focused theoretical approaches were associated with making beneficial changes.

As suggested by the literature, approach goal orientations focused on mastery of task, rather than on a specific performance outcome per se, are positively associated with

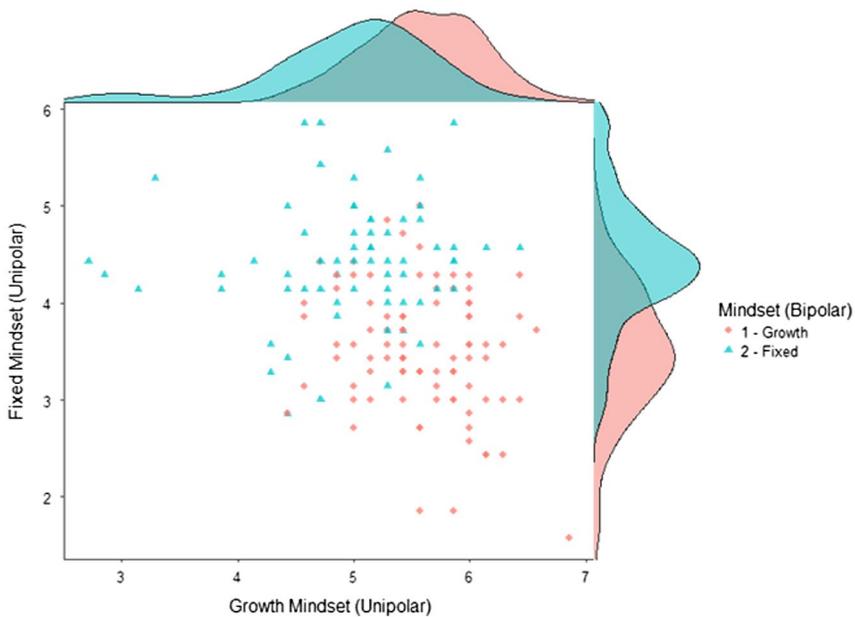


Figure 1. Scatterplot indicating within participant endorsement of concurrent and ipsative mindsets.

making changes that persist (Martin & Elliot, 2016). In this way, these adaptive strategies are endorsed by those who relish the challenge that mastering a learning outcome offers. Mastery experiences are reciprocally related to future mastery approaches and are thought to underpin self-regulatory models of learning (Zimmerman, 1998). Therefore, it is unsurprising that those who relish mastery and make behavioural and developmental changes also possess higher levels of motivational intention. Mastery experiences are fundamental to efficacious behaviours and as suggested by Richardson and colleagues (2012), interventions that promote goal setting maybe the route to increasing these most crucial behaviours. These results support the spirit of a recent systematic review of feedback recipience (Winstone et al., 2017) and diverge in that only actionable strategies around goals, mindset and motivational intentions are systematically supported in making behavioural change where process-related feedback characteristics are not.

These results also partially replicate Forsythe and Johnson's (2016) finding that motivational intentions were significantly and positively associated with the making of behavioural and developmental changes after receiving feedback. Interestingly, sample characteristics meant that this finding related only to those participants endorsing a fixed mindset. In contrast, for the study reported here, those that positively embraced challenging interventions were also more likely to change behaviour and seek out approaches that foster development. Further, those embracing this challenge maybe more willing to manage the incongruence that may result from feedback to make a constructive realignment on the route to future performances. This is therefore aligned with the two previous complementary approaches, mastery approach goals and motivational intentions. However, within the current sample, unexpectedly this is not related with endorsement of fixed or growth mindsets.

Two measures of mindset were taken in the current study. The preliminary findings indicate that neither approach to measuring mindset has utility as a predictor of action following feedback. This is despite research suggesting those endorsing a growth perspective embrace challenge and take heed of useful feedback (Dweck, 2017). This perspective has not emerged in these preliminary results. It may also be that moderating factors, for example competence beliefs as suggested by Bodill and Roberts (2013) attenuate the direct effect of mindset. Although not directly measured here, participants of the current study have successfully managed their way through four semesters of an undergraduate programme in a selective tertiary setting and competence beliefs may as a result be high. The mixed results for mindset here maybe particular to the sample and in other samples or with a larger pool of participants, different results may emerge reinforcing the need for further replication studies in the area. However, these tentative findings may support the suggestion of greater nuance in measurement of mindset than the approaches that appear to prevail allow for (Tempelaar et al., 2015). This greater nuance appears to be betrayed in the contemporary narrative on mindset (Dweck, 2017).

As with any study, the research here is limited. It is based on preliminary results and may benefit from greater statistical power that a larger sample would afford structural equation modelling. As is tentatively indicated above, mindset measurement may not have reached a point of stability, or utility, that allows mindset to predict behavioural outcomes with the simplicity that appears to be inherent in the narrative on mindset, as has previously been indicated (Tempelaar et al., 2015). Finally, whilst there has been some attempt made here to validate Boudrias and colleagues (2014) model of feedback integration in undergraduates, only one other study has examined this in these populations that we are aware of (Forsythe &

Johnson, 2016). As a result, longitudinal research examining these factors and psychometric evaluation of measurement approaches piloted here is strongly recommended.

To conclude, this study found a combination of actionable strategies to be tentatively associated with positive remediation following feedback. These include mastery approach orientation, and action focused feedback characteristics comprising challenge interventions and motivational intentions. Whilst these results are not surprising, the mixed results in relation to mindset were unexpected, given what is suggested about mindset elsewhere (Dweck, 2017; Tempelaar et al., 2015), indicating that more research is necessary to understand measurement and prediction issues in relation to mindset. Nevertheless, the results do suggest other factors that maybe utilised either by practitioners in interventions or by students in their approach to receiving feedback that encourages incremental learning gain.

General conclusions

A goal-orientation approach has a sound pedigree for improving human performance and we should build on such knowledge to develop pedagogical frameworks that support students to develop a mastery approach to their learning. We argue that the key to measuring learning gains is to evaluate student progress through the measurement of self-reported positive changes in student behaviour, rather than incremental changes in their grades. This strategy is likely to have greater effect in producing incremental gainful learning behaviours than focusing on the influence of non-intellective factors such as mindset and self-efficacy which appear to be difficult to operationalise and suffer from poor predictive validity. However, it is recognised that this strategy may reciprocally influence these non-intellective factors.

To meet this objective, scales that tap into student behaviour in the spirit of what are described as BARS should be further developed and evaluated. Such scales were developed some time ago in industry in response to dissatisfaction with subjective measures which are less able to directly measure or target performance. Measurement based on behaviour dimensions has the advantage in determining and targeting what is needed to perform, rather than looking for example, at more general student characteristics such as self-efficacy or satisfaction. The strength of the Boudrias et al. measure is the breadth of dimensions it seeks to evaluate with the goal of predicting behavioural change and the seeking of developmental activities, however, simply measuring changes in behaviours needs to be supported through a pedagogical framework which supports productive change. Staff would require support to developing such a framework through, for example, a toolkit which provides specific training in the cognitive functions associated with being able to meet these goals. By applying a revised definition of learning gains as 'behaviours that suggest the productive acquisition of beneficial skills, knowledge and attitudes through study and experience', academic programmes can be evaluated by the extent to which they are able to afford the desired behaviour change in their students. Such a measure has more utility because it becomes possible to use data from one cohort to predict the future behaviour of other students, and shifting focus in this way drives pedagogical advances by engaging academics to design frameworks to better help support positive behavioural change in students driven by a sound theoretical framework.

Developing a measurement system which targets behaviour has stronger theoretical and practical application to students and academics. Traditional predictors may diagnose

what a student may achieve and non-intellective strategies may even have greater utility in predicting what a student will go on to achieve (Richardson et al., 2012; Schneider & Preckel, 2017), however, both may be very difficult for academics to effectively measure and influence. Positive changes in student behaviours brought about through a goal mastery pedagogy could present opportunity for learning gain measurement because we know that such behaviours are linked with the productive acquisition of skills, knowledge and attitudes. However, measuring changes in feedback-triggered behaviours needs to be supported through a pedagogical framework which supports productive change.

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