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The Academic Performance Stages of Change Inventory (APSCI): An application of the Transtheoretical Model to academic performance

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Abstract

The Transtheoretical Model (TTM) conceptualizes change as a process with five identifiable stages. Each stage has psychological characteristics that are manifestations of an underlying continuum of change. Surprisingly few studies have applied the TTM to understand the process involved with academic development. The objective of this study was to assess a new instrument designed to measure the stages of change in the development of academic performance: the Academic Performance Stages of Change Inventory (APSCI). High-school students (N = 564) were sampled from the 10th, 11th, and 12th grades of a secondary school in Portugal. Results showed that a correlated five-factor structure, corresponding to the five stages of change, had good empirical fit. The latent factors of this model (stages) were shown to have the same meaning across school grade and gender. We concluded that the five APSCI subscales had reasonable internal consistency considering the small number of items per factor. Students in the later stages of change tended to have better academic performances and to be more engaged in school than those in the earlier stages, particularly the precontemplation stage. This study provides good preliminary evidence that the APSCI is a suitable tool for assessing stages of change of academic performance.

Keywords: Transtheoretical Model; stages of change; academic performance; psychometrics; Academic Performance; Stages of Change Inventory

Introduction

Academic performance has been shown to be predictive of several long-term outcomes, including health outcomes (Adler & Rehkopf, 2008; Cohen, Rai, Rehnkopf, & Abrams, 2014; Fiscella & Kitzman, 2009) and level of income (Chia & Miller, 2008), and can therefore be considered to be of individual and societal importance (Deryakulu, Büyüköztürk, & Özçınar, 2010; O'Connor & Paunonen, 2007). Given the benefits of good academic performance, students are likely to experience a multitude of intrinsic and/or extrinsic sources of encouragement to adopt attitudes and behaviors that will change their academic performances for the better. One approach that may prove useful for understanding the process of improving academic performance is to examine the applicability of theories that describe of the components and processes of behavioral change (Darnton, 2008). The focus of this study will be on one particular theory that adopts Stages of Change (SOC) as its conceptual framework.

The Transtheoretical Model (TTM) of Change

The TTM, which was originally developed to describe the process of intentional behavior change from a transtheoretical perspective (Prochaska & Di Clemente, 1982), conceptualizes change as movement across a series of discrete stages over time. These stages capture the temporal and motivational aspects of the process of change (DiClemente, 1999), and at each stage individuals are characterized by a particular pattern of psychological processes, emotions, and behaviors (Prochaska, Wright, & Velicer, 2008; Velicer & Prochaska, 2008). In the precontemplation stage, individuals are unmotivated to change in the near future because they are either unaware of the need to change or because they are demoralized. Individuals in the contemplation stage recognize the need to improve their academic performances, but do not intend to act in the near future. In the next stage, the preparation stage, individuals are motivated and willing to change and have begun to explore how they might achieve this. Individuals in the action stage are committed to changing their behavior and are now actively making behavioral

efforts to this end. Finally, at the maintenance stage individuals have made changes to their behaviors, have been consistent with this over time, and are involved in the consolidation of changes (Prochaska, 2013; Prochaska & DiClemente, 1983; Prochaska, DiClemente, Velicer, & Rossi, 1993; Prochaska et al., 2008). The TTM incorporates the concepts of self-efficacy (Bandura, 1993), an individual's confidence about not relapsing to former maladaptive behaviors, as a measure of progress of change over time, and decisional balance as a deliberative processes of remaining engaged with change. Progression through stages, which is dependent on change to one's organizations of psychological processes, is frequently non-linear, with movement back-and-forth between stages (Prochaska & DiClemente, 1983; Prochaska, Redding, & Evers, 2008). This non-linearity of progression means that individuals can experiences advances toward their desired outcome, but also relapses in behavior (DeBarr, 2004; Prochaska, 2013). Permanent behavioral change is achieved when an individual obtains an organization of psychological processes associated with full maintenance of a new behavior (Moreira, Cunha, Inman, & Oliveira, 2019; Moreira & Garcia, 2019).

The TTM has been studied extensively. This is nicely illustrated in a study by Prochaska et al. (1994), which examines the prediction made by the TTM regarding changes in decisional balance across the five stages. Across 12 examined studies, the TTM was at least partially supported. Slightly more recently, a literature review and meta-analysis of studies applying the TTM in the context of just one behavior, physical exercise, identified 61 published research articles (Marshall & Biddle, 2001). This study concluded that changes in self-efficacy and processes of change were consistent with TTM. Finally, the TTM continues to be a topic of scientific interest. A cursory search for articles in Web of Science [v.5.30], from the year 1900 to September 2018, using the search terms "transtheoretical model" AND "stage of change" resulted in 1,394 articles, 45 published in 2018. From these 45, it was evident the TTM continues to be applied to a range of issues, such as fruit and vegetable consumption (Menezes,

De, Mendonça, Ferreira, Guimarães, & Lopes, 2018) and the cessation of drug use (Lee, Wu, Chen, & Chang, 2018). Operationalizations of the TTM to academic performance A current trend in TTM research is the development and testing of instruments applied to specific behaviors, most often health-related. Examples of these include the Anorexia Nervosa Stages of Change Questionnaire (ANSOCQ; Rieger, Touyz, & Beumont, 2002), the Bulimia Nervosa Stages of Change Questionnaire (BNSOCQ; Martinez et al., 2007), the University of Rhode Island Change Assessment–Domestic
Violence (URICA-DV; Levesque, Gelles, & Velicer, 2000), and the Stages of Change–Continuous Measure (URICA-E2; Lerdal et al., 2009). Research on the psychometric properties of these instruments has generally supported the five-factor structure, although some versions, such as the URICA-Adapted for Gambling, have only identified four components consistent with Precontemplation, Contemplation, Action, and Maintenance (Petry, 2005).

Generally, the instruments that assess behaviors from the perspective of the TTM (e.g., URICA, DiClemente & Hughes, 1990) provide a continuous measure of attitudes reflecting each stage of change. Individuals generally do not score high for one stage and low on all others. Instead, they tend to present interrelated patterns of responding across the factors that reflects the dynamic associations between stages or, alternatively, the fact that the factors may not tap discrete and qualitatively distinct stages (e.g. Sutton, 2001; Weinstein, Rothman, & Sutton, 1998). Indeed, some researchers have argued that the stages of change are, in fact, constructs superimposed on a continuum of change (Kraft, Sutton, & Reynolds, 1999); nonetheless, this remains a useful heuristic for understanding the change process (Grant & Franklin, 2007).

Considering the large number of validated applications of the TTM to various health-related behaviors, it is surprising that there are few studies testing TTM in the context of academic performance. It is surprising because the constructs and processes on which the TTM is founded

map well onto the development of academic performance. For example, personal agency mechanisms, including self-efficacy, and their effects on cognitive processes and behavior are crucial for academic development (Bandura, 1993; Moreira, Oliveira, Dias, Vaz, & Torres-Oliveira, 2014). Student engagement with school, which shares a close conceptual relationship with the construct of motivation (Appleton, Christenson, & Furlong, 2008), is also predictive of academic performance (e.g. Lee, 2014; Moreira, Dias, Vaz, & Vaz, 2013). Moreover, having supportive relationships, a process of change associated with the later stages, is also predictive of positive academic outcomes such as engagement and academic performance (Lee, Dedrick, & Smith, 1991; Moreira et al., 2018; Moreira, Bilimória, Pedrosa, Pires, Cepa, Mestre, et al., 2015; Roorda, Koomen, Spilt, & Oort, 2011; Thoits, 2011; Wang & Eccles, 2013). We therefore considered that the stages of change applied to academic development might be conceptualized as follows. In the pre-contemplation stage students do not perceive a need, and are unmotivated, to improve their academic performances. In the contemplation stage, students recognize the need to improve their academic performances, but do not intend to change soon. In the preparation stage, individuals are motivated and willing to try to improve their academic performances, and have begun to explore how they might achieve this. In the action stage, students have begun to make active efforts to improve their academic performance. Finally, in the maintenance stage, students are being consistent with their behavioral efforts to improve academic performance. It is important to note that for the action stage we were interested in the existence of any behavioral effort, and not a specific type of behavioral effort.

Of the few studies that have applied the TTM to academic performance, three studies, presented in dissertations, have considered the specific behaviors of academic probation (Rojas, 2003; Topitzhofer, 1996) and academic procrastination (O'Brien, 2002). None used TTM assessment instruments with tested psychometric properties. One peer-reviewed study has applied the TTM to study skills (Grant & Franklin, 2007), although the authors classified

participants into stages by asking them to indicate which of five statements was most applicable (e.g. “I have been actively and deliberately improving the way I go about my studies for at least the past month” for action). They did not develop a bespoke instrument for the assessment of stages of change. Nonetheless, using this operationalization of the TTM Grant and Franklin (2007) showed that university students in the earlier stages of change were more likely to use a surface strategy to learning (e.g. rote learning), while students in the later stages were more likely to use a deep strategy to learning (e.g. seeking to understand meaning). Moreover, they found a general trend for higher self-efficacy in the later stages.

One validated measure of the TTM, the Stages of Learning Motivation Inventory, has been published (Cole, Harris, & Feild, 2004). This instrument includes items that assess motivation to learn in undergraduate students and has been shown to have an acceptable structural validity and good internal consistency ($.92 < \alpha > .77$). However, the SOLMI was designed to assess only four of the five postulated stages of change, excluding Maintenance, due to the contextual specificities of academic courses at university. It is thus possible that this instrument would not be suitable for use in other contexts, such as for assessing motivation to improve exam grades at school.

The Academic Performance Stages of Change Inventory

The TTM offers a robust framework with which to examine the developmental and processual nature of change. It is surprising that the TTM has not been applied to academic performance considering academic development is dependent on conceptually similar processes (e.g. personal agency mechanisms) to those described by the TTM as being relevant for health behaviors (Moreira et al., 2012). An important step for understanding the process of change involved in improving academic performance is, therefore the development of reliable and valid measures of the stages of change in academic performance.

Toward this goal, we developed the Academic Performance Stages of Change Inventory (APSCI). We designed the items for this instrument to measure how students perceive, contemplate, and respond to their academic performances, and to represent the five stages of change proposed by the TTM. The primary objective of this study was to assess the suitability of the APSCI for assessing stages of change in academic performance in terms of factorial validity and other psychometric properties. We anticipated that factorial analyses would extract and confirm a five-factor structure consistent with the stages described by the TTM.

A valid instrument is one that accurately measures its proposed construct. We developed the APSCI to assess the stages of change related to the improvement of academic performance. Consequently, if the APSCI is valid, students in the later stages of change should be more motivated to improve their academic performances, and to have been making efforts to do so for a longer period. Given this assumption, our hypothesis was that stage of change would be associated with better academic performance. Another common way to assess the validity of an instrument is to assess its nomological network with other theoretically related variables. Because the stages of change capture motivational aspects of the process of change, we chose to examine the relation between stage of change and another construct related to motivation. The construct of motivation is widely incorporated as part of the meta-construct of student engagement with school, particularly as part of cognitive engagement (which incorporates investment with learning and self-regulation: Fredricks, Blumenfeld, & Paris, 2004), and authors generally consider motivation to be a necessary, although not sufficient, aspect of engagement (Appleton et al., 2008). We therefore proposed that a measure of student engagement, the Student Engagement Instrument (Appleton, Christenson, Kim, & Reschly, 2006), and particularly its subscales related to cognitive engagement, would share a positive association with stage of change.

Method

Participants and Procedure

The data presented in the present article represent analyses from a sample of Portuguese highschool students from a single secondary school (10th to 12th grades) in the north of Portugal. This school agreed to participate in the study after being contacted directly by the research team. Prior to data collection, teachers administered consent forms to all students. Data were then collected (participants completed paper format questionnaires independently in a classroom setting supervised by a teacher and member of the research team) from students who consented to participate and whom had also acquired parental consent. Students were not incentivized to participate with any type of reward. In total 564 students (327 females, 236 males) from the 10th (37.8%; mean age 15.6 years), 11th (27.7%; mean age 16.6 years), and 12th (34.4%; mean age 17.6 years) grades completed the study. The overall average age for the participants was 16.6 years (SD = 1.31).

Measures

Developing the academic performance stages of change inventory. Our initial step was to develop items based on our overall understanding of the TTM and stages of change (described in detail above; Prochaska, Wrigth, et al., 2008; Velicer & Prochaska, 2008), as well as specific descriptions of core constructs (e.g. Prochaska, Wrigth, et al., 2008). Items were not adapted from any existing instrument. All the items were written in Portuguese, and designed to capture students' thoughts, feelings, and behavioral responses concerning the need to improve academic performance at school. English translations of these items are given throughout the manuscript for ease of interpretation. Items were written to refer to academic performance in general, as opposed to performance within specific learning contexts (such as specific classes). The result was a pool of 36 items designed to capture five stages of change. When all items had been written, a small panel of academics—including a university professor who is an expert in Educational Psychology, and several researchers—reviewed all components of the scale

including the conceptualization and definition of each stage, the individual items, the response format, and instructions to be followed by participants. As part of this review process, the members of the panel individually classified the items into five subscales based on their conceptual fit with the stages of change. These categorizations were then discussed. Items were revised when they failed to be classified consistently by all members of the panel. The pre-contemplation subscale comprised seven items to assess whether students consider their academic performance to be problematic (e.g. “Having bad grades is not a problem”). The contemplation subscale included eight items to assess whether students have made a decision to try to improve their grades once they consider their current performance could be improved (e.g., “I really need to improve my grades”). The preparation subscale included seven items to assess whether students are attempting to plan behavioral changes toward improving their grades (“I would like some help going beyond the intention of improving my grades and actions”). The action subscale comprised seven items to assess whether students are actively involved in attempts to improve their grades (e.g., “I’m trying to accomplish my plans to improve my grades”). Finally, the maintenance subscale had seven items to assess whether students are involved in maintaining the changes already attained (e.g. “I’ve tried to improve my grades, but sometimes I still have trouble doing what I planned to improve my grades”).

Given the growing demand in research for short measures (Sandy, Gosling, Schwartz, & Koelkebeck, 2017), the panel then came to a consensus, via discussion, on the three most relevant items for each of the stages. The result of this process was a 15-item instrument. Responses to all items are made via a Likert-type scale with 5 points (1 = strongly disagree; 2 = disagree; 3 = do not agree or disagree; 4 = agree; 5 = strongly agree). High scores on a subscale indicate that the individual has an organization of psychological processes associated with that stage of change.

Student engagement inventory. We measured engagement using a well-validated instrument, the Student Engagement Instrument (SEI; Appleton et al., 2006). Although multiple different factorial structures for the SEI have be championed (Moreira & Dias, 2018; Virtaten et al., 2017), for the purpose of this study we used the structure outlined by Moreira, Vaz, Dias, and Petracchi (2009). This version of the SEI, which has 27 items, includes five subscales. Two subscales are considered indicators of cognitive engagement. The first, the perceptions of control and relevance of schoolwork subscale (CRSW), comprised six items, such as "Most of what is important to know you learn in school." The second subscale, future aspirations and goals (FG), comprised three items, including "School is important for achieving my future goals." Three further subscales are indicators of psychological engagement, and reflect students' perceptions of support and connection with others at school. The teacher–student relationship (TSR) subscale includes eight items such as "My teachers are there for me when I need them." The peer support for learning (PSL) subscale has six items, including "Other students here like me the way I am." Finally, the family support for learning (FSL) subscale comprises four items, such as "When I have problems at school, my family/guardian(s) are willing to help me." Items are scored on a 4-point Likert scale from 1 (totally disagree) to 4 (totally agree). Within the present sample, these five subscales had good reliability (omega total = .73 to .82).

Exam performance. We obtained students' exam grades from the previous academic year from school records. At this age in Portugal, exam grades are scored on a scale of 0 (lowest) to 20 (highest). We collected grades for a range of subjects and calculated a mean grade.

Statistical analysis

Before analysis, we conducted a missing value analysis for all study variables. Little's MCAR test, conducted in SPSS, indicated that data were not missing completely at random ($\chi^2(6186) = 6903.4$, $p < .001$) and we therefore imputed missing data using the "mice" package in R

(Buuren & GroothuisOudshoorn, 2011). All other analyses were conducted using R (R Core Team, 2017).

Because the TTM has a well-established theoretical framework, we tested the factorial validity of two five-factor models using confirmatory factor analysis (CFA). Because the data was ordinal, we used a WLSMV estimation that is specifically designed for this purpose (Li, 2016). We assessed measurement invariance across gender and grade using a multigroup CFA procedure (Cheung & Rensvold, 2002). This stepwise procedure involves comparing a series of increasingly restricted nested models to assess invariance at a number of levels: configural (baseline model; freely estimated factor loadings across group), weak (metric; factor loadings constrained to be equal across groups), strong (scalar; factor loadings and intercepts constrained to be equal across groups), and strict (factor loadings, intercepts, and residual variances constrained to be equal across groups). We considered a number of model fit statistics and heuristics to assess model fit for all CFA procedures: the Chi-square test (χ^2); the root-mean square error approximation (RMSEA); the Comparative Fit Index (CFI); and the standardized root-mean square residual (SRMR). The Chi-square test is sensitive to large samples and so we also calculated χ^2/df ratios. A common heuristic for these ratios is that values < 5 reflect good model fit (Marsh & Hocevar, 1985). CFI can take values from 0 to 1, and values ≥ .95 are considered to represent good model fit (Cangur & Ercan, 2015; Hu & Bentler, 1999). RMSEA reflects lack of fit per degree of freedom; values between .05 and .08 represent reasonable errors and RMSEA < .05 is considered a good fit (Byrne, 2001). Values of SRMR < .10 are an indication of acceptable fit (Cangur & Ercan, 2015). For measurement invariance, differences in CFI (ΔCFI) of ≤ .01, and differences in RMSEA of ≥ .015 between nested models are taken as general indicator that fit is not significantly reduced by the addition of constraints (Chen, 2007). We also considered BIC, for which the model with the lowest value is considered the best trade-off between model fit and model complexity. To assess reliability we calculated omega total and

95% confidence intervals for each of the subscales. Similar to the much more commonly applied alpha, values closer to 1 indicate better internal consistency. Consistent with psychometric literature, we considered .70 as a heuristic for acceptable reliability (Lance, Butts, & Michels, 2006).

Finally, we assessed construct validity by classifying our sample into the five stages following a validated classification method that has shown to be robust across a range of behaviors and samples (Cole et al., 2004; Di Clemente et al., 1991; Prochaska et al., 1994). Specifically, for each participant we calculated a mean score for each subscale and participants were classified into the stage corresponding to the subscale with the highest score. To be consistent with the TTM (Prochaska & Di Clemente, 1982), in instances of tied scores this was considered as upward movement between stages, and participants were classified in the later stage. Subsequently we conducted a series of oneway ANOVAs, with planned polynomial contrasts, to examine the effects of student mean exam grade and student engagement across groups. Because psychometric studies have supported a correlated factors structure for this instrument (Appleton et al., 2006), we conducted separate analyses for each of the five subscales. These were complemented by correlational analyses, using Spearman's rho, where stage of change was classified from 1 (pre-contemplation) to 5 (maintenance).

Results

Means, standard deviations, skew, and kurtosis for the 15 APSCI items selected in the development of the measure are reported in Table 1. Items scores from the pre-contemplation subscale were generally low and positively skewed. For all other items, scores were around the middle of the response scale. The standard deviation for all items was around 1.

TABLE 1 ABOUT HERE

The top row of Table 2 depicts the outcome of the CFA for the 15-item APSCI. Overall, the model fit was not adequate, χ^2/df (5.86), CFI (.92), RMSEA (.09), and SRMR (.07). Correlated

residuals (shown in Table 3) indicated that one item (Item 4) shared an unexpected relationship with the three items from the pre-contemplation stage, with values ranging from .20 to .30. We therefore conducted a second CFA with Item 4 removed. This model had satisfactory fit based on the χ^2/df (3.18), CFI (.97), RMSEA (.06), and SRMR (.05) indices. Figure 1 shows the factor loadings, covariances, and item error variances for this model.

TABLES 2 AND 3 ABOUT HERE

FIGURE 1 ABOUT HERE

The baseline models for both gender and grade showed acceptable fit (gender: CFI = .945, RMSEA = .055; grade: CFI = .944, RMSEA = .056), representing configural invariance (See Table 4). There was evidence of strong invariance across gender and grade, as indicated by a ΔCFI < .010 and ΔRMSEA < .015. For both variables, changes in χ^2 between the weak and strong invariance models were significant. For both variables, values for BIC were lowest for the model assessing strict invariance. These findings were taken as evidence of strong invariance across grade and gender.

TABLE 4 ABOUT HERE

Given the small number of items per subscale, internal consistency was considered to be acceptable: Pre-contemplation (omega total = .71, 95% CI [.64, .77]), Contemplation (omega total = .63, 95% CI [.55, .69]), Preparation (omega total = .82, 95% CI [.78, .85]), Action (omega total = .69, 95% CI [.64, .75]), and Maintenance (omega total = .59, 95% CI [.51, .67]). Figure 2 shows that the five groups corresponded well to the predictions of the hierarchical TTM model in that each group showed a peaked profile. Most participants were clustered in the Action group (N = 241) followed by the Maintenance (N = 157), Contemplation (N = 125), Preparation (N = 32), and Pre-contemplation (N = 8) groups.

FIGURE 2 ABOUT HERE

The descriptive statistics for academic performance, cognitive engagement, and support for learning are displayed in Table 5. A one-way ANOVA based on these group means showed that there was a significant linear trend in academic performance, $F(1,559) = 28.60$, $p < .001$, indicating that performance was superior in the later stages.

TABLE 5 ABOUT HERE

There were also a significant linear trend for TSR, $F(1,559) = 4.53$, $p = .034$, indicating that the later stages were characterized by better TSRs, with the highest score reported by students in the action stage. This peaked effect was also evident for FSL for which there was a significant quadratic trend, $F(1,559) = 4.99$, $p = .026$. There was a significant effect of stage for CRSW, $F(1,559) = 9.83$, $p < .001$, and PSL, $F(1,559) = 4.34$, $p = .002$, although no significant trends for these variables. In both instances, however, the lowest score was for the Pre-contemplation group. Finally, there was no significant effect of stage for FG, $F(1,559) = 2.24$, $p = .064$. Consistent with the observed linear trends, there were significant positive correlations between stage and academic performance ($r = .16$, 95% CI [.06, .26], $p = .001$), and with TSR ($r = .11$, 95% CI [.02, .20], $p = .021$). No significant correlations were found for CRSW ($r = .07$), FG ($r = .02$), PSL ($r = .06$) or FSL ($r = .09$).

Discussion

The TTM is debatably one of the most important theoretical models for describing processes of behavioral change, particularly in the field of health promotion (Samuelson, 1997). Although the model was initially applied to smoking cessation (Prochaska. Redding, et al., 2008), it has since been used to describe readiness to change among individuals with other health problems including alcohol and substance abuse, anxiety and panic disorders, diet, and physical activity (Hall & Rossi, 2008; Helitzer, Peterson, Sanders, & Thompson, 2007; Lowther, Mutrie, & Scott, 2007; Prochaska & Velicer, 1997). We applied the TTM to the development of academic

performance and present the psychometric properties of an instrument developed for the assessment of academic performance stages (the APSCI).

Our analyses suggest that the TTM of change is a suitable framework for organizing and assessing students in terms of the psychological characteristics and processes related to academic development. A confirmatory analysis suggested that a five-stage model had good fit to our data. Items loading on Pre-contemplation reflected an apathy concerning poor performance and lack of intention to engage in change behaviors. Items loading on Contemplation reflected an acknowledgment of a problem and realization that changes are required. Preparation items reflected a desire to seek help and thus indicate an increase commitment to change. Items loading on the Action stage refer to a current effort to improve academic performance (although do not refer to specific behavioral actions). Finally, items loading on the Maintenance stage reflected perceptions of the difficulties in continued efforts to improve grades. These conceptualizations are consistent with other operationalizations of stages of change in academic performance (Grant & Franklin, 2007) and, despite not being delineated in terms of a specific timeframe as has often been the case with the TTM when applied to health behaviors (e.g. pre-contemplators have no intention to change in the next six months), are also consistent with stages applied to other contexts (Di Clemente et al., 1991). This pattern of theoretically consistent results combined with the evidence of reasonable internal consistency within our sample and measurement invariance across gender and grades suggests that the APSCI is a suitable instrument for assessing the TTM in the context of academic performance in adolescents.

We also found that mean exam grades and indicators of cognitive engagement and perceived social support differed across the five measured stages in a theoretically consistent manner, thus further validating the suitability of the APSCI as a measure of stages of academic change. As hypothesized, a linear trend was found for the change in student grades across stages

confirming that the TTM of change is applicable to academic development. Students in the later stages were more likely to have better grades than those in earlier stages. Also consistent with our hypotheses, a linear trend was identified for teacher-support for learning, and a quadratic trend was found for FSL. For other subscales (with the exception of FG) the planned contrasts were not significant but the significant ANOVA indicated significant effects of stage, with the most evident difference being lower scores for students in the Pre-contemplation group. These results imply that low engagement and perceived social support was associated with students not considering poor academic performance as a problem. Overall, this finding is largely in keeping with the predictions of the TTM, which posits that stages and their psychological characteristics correspond to manifestations of continuums representing increasingly adaptive psychological processes such as self-efficacy, goals and selfliberation (Grant & Franklin, 2007; Zimmerman & Cleary, 2006). These processes, which correspond to personal agency, are an intrinsic component of engagement (Moreira, Crusellas, Sá, Gomes, & Matias, 2010; Moreira et al., 2014; Reeve & Tseng, 2011). These findings together offer a reasonable first validation that the APSCI is an appropriate application of the TTM.

A final finding worth considering is the low values for reliability, particularly for the maintenance and contemplation stages. Typically, and often erroneously, a reliability of .70 has been cited as a cut-off point for acceptable reliability, although it is now better understood that this should not be considered as a truism in all instances (Lance et al., 2006). As such, we argue that the results should be interpreted against this value with caution. Indeed, because short measures have a limited number of items, in cases when constructs are broad and items are selected to increase content validity, such as with the APSCI, the result can be low internal consistency (Ziegler, Kemper, & Kruyen, 2014). It is also crucial to acknowledge that the confidence intervals offer a degree of certainty to these estimates of reliability and improves the interpretation of single point estimates (Dunn, Baguley, & Brunsden, 2014). Nonetheless, future

studies could consider adapting or adding items to the APSCI as a means to improving its reliability.

Study limitations

As with any study, the present investigation has some limitations. One major limitation is that after classifying participants into groups it became apparent that two of the derived groups (Pre-contemplation and Preparation) had small sample sizes. This finding shows that the overwhelming majority of our sample at least acknowledged that they could improve their grades, and, further, that they tended to move quickly from acknowledging the need to improve to taking action. That said, although we overcame this limitation by reporting weighted trend analyses, these small sample sizes mean that some caution should be taken when interpreting the influence of stage on academic performance, particularly the finding that students in the preparation group had the numerically highest average exam grades. It is therefore necessary that our findings, both in terms of distribution of students across stages and group differences in academic performance, are replicated with larger samples.

Another limitation with our study concerns the choice to recruit students from high school. Although we recruited participants from three school grades and demonstrated measurement invariance, it is possible that our sample reflects a specific learning environment where the pressures of national exams and acceptance into university are highly salient. It is therefore unclear whether the APSCI, which focuses on exam grades, would apply equally well to younger students (for whom exams are less consequential), or to university students. Furthermore, it is important to acknowledge that we recruited our sample from a single school in the north of Portugal, and did not consider variables such as student ethnicity. This also questions the generalizability of the findings to students from other cultures, or students from

other regions in Portugal (or indeed students from different schools). Future research is therefore required to validate the APSCI in more diverse samples.

This study is also limited in the types of validity offered of the APSCI. According to the TTM individuals move nonlinearly through the stages across time. A suitable test of scale reliability, therefore, is that test-retest reliability of the APSCI should decrease if students are measured at several time points. This type of test has been used previously to validate different applications of the TTM (e.g. Cole et al., 2004), and as it stands, without such as test it is unclear whether the APSCI suitably captures the dynamic nature of change. Similarly, because we applied the APSCI at only one time point the present study provides no indication of whether movement up through stages leads to better exam grades compared to remaining static. Further studies are required to understand whether the APSCI can be used to confirm these predictions of the TTM of change.

Some other limitations of the study concerns the manner in which the APSCI was developed. We developed items to assess student motivation toward improving overall exam grades. While our intention was to capture the global motivation to do better at school, this approach was potentially limited as it ignores the nuances in motivation that might occur between subjects. For example, while a student may not be concerned about his or her performance in mathematics, he or she may be concerned about biology, and would thus be experiencing different experiential and behavioral processes for academic performance in these areas and would be in different stages of change for those subjects. One, therefore, cannot be sure what achievement area the student was considering when responding to the items. Consequently, educators and assessors may wish to adapt and use the APSCI in the context of specific subjects rather than for a global measure of motivation to improve school performance. Finally, it has been argued that the presence of intercorrelations between adjacent stages is supportive of the TTM (McConnaughy, Di Clemente, Prochaska, & Velicer, 1989). Based on

the output of the CFA analysis, the pre-contemplation latent factor was found to be negatively correlated with the other latent factors, suggesting that it is qualitatively distinct. This finding is consistent with other past studies (Greenstein, Franklin, & McGuffin, 1999; McConnaughy et al., 1989). However, large positive correlations were observed between other non-adjacent stages such as contemplation and maintenance, and preparation and maintenance, and this is difficult to reconcile with the TTM as it suggests that these stages are not qualitatively distinct, despite representing different factors. After examining the items that load onto the maintenance factor, it became apparent that they appear to reflect doubts and concerns about changes made, and it is possible that this is more consistent with processes associated with earlier stages of change (e.g., consciousness-raising), than those with the later stages. Alternatively, these strong correlations could reflect a social bias: students responded positively to all items with a positive connotation, such as "I really need to improve my grades" from the Contemplation group and "There are days when I do what I can to improve my grades. . ." from Maintenance. Researchers using the APSCI in the future may wish to adapt these items in order to ensure that accurately represent the processes and psychological organizations associated with maintaining a changed behavior.

Implications

Although more research is needed to determine if the TTM has broader applicability in the academic domain, the evaluation of the psychometric characteristics of this instrument is an important stepping-stone for further investigations into the applicability of the TTM and to academic performance. Because our analyses found that the 14-item APSCI had good construct validity, reliable items, and to be associated with students' grades, and aspects of student engagement in theoretically consistent ways, our results suggest that this instrument may be useful for studying the process of change toward improving academic performance in students. Moreover, with the new insights that might be gained from such research, it may be possible to

develop targeted and stage-specific interventions to help students develop their academic performances further. Toward this goal, future studies may wish to consider developing the APSCI and its items further, and then to use this instrument to advance our understanding of whether certain student characteristics (such as personality, well-being, and intelligence) (Moreira et al., 2015) predispose them to being in a particular stage.

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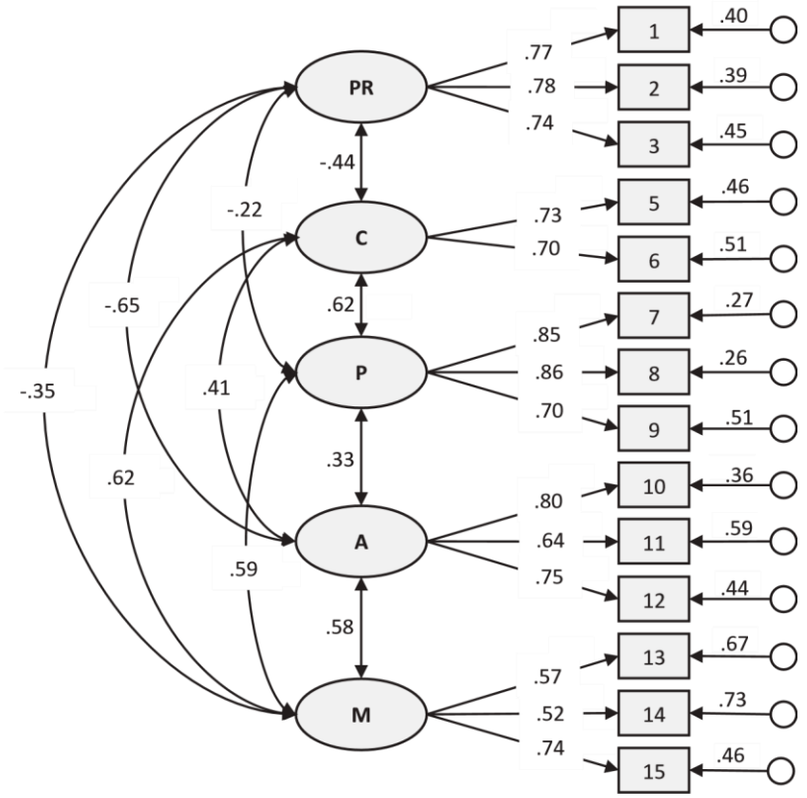

Figure 1. Factorial structure of the APSCI based on a confirmatory factor analysis of sample 1a. Double ended arrows between factors (ellipses) and values correspond to covariance. Singleended arrows and values correspond to standardized loadings of items (rectangles) on factors. Circles and corresponding values over arrows correspond to item error variance.

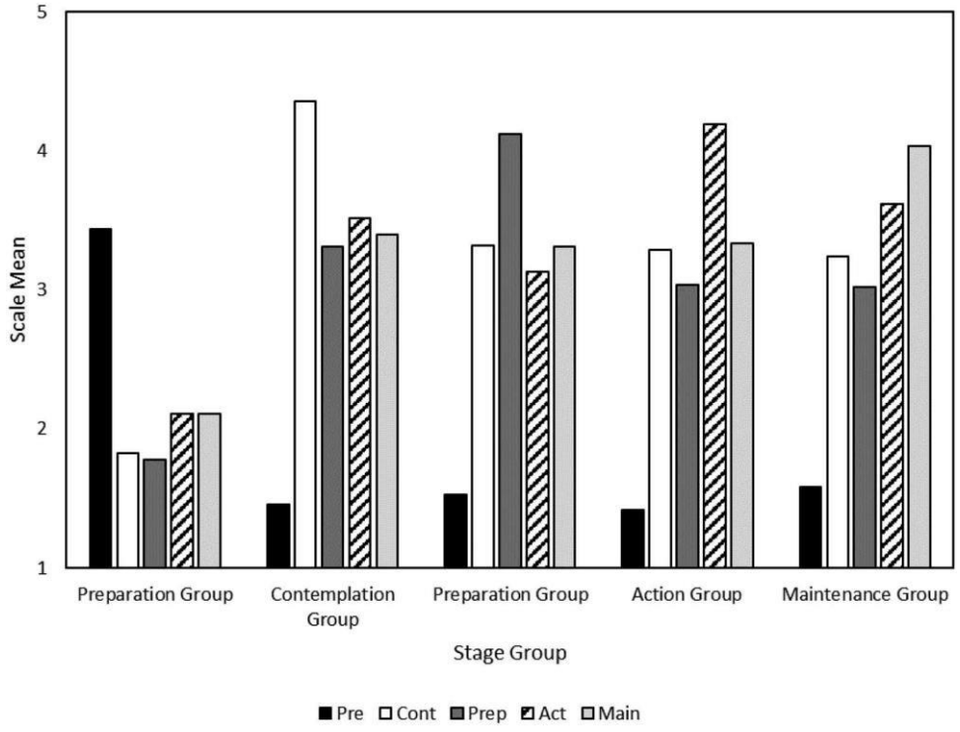

Figure 2. Mean score profiles for the five stage groups: Pre = pre-contemplation; Cont = contemplation; Prep = preparation; Act = action; Main = maintenance.

Table 1.

Item descriptive statistics. All items are scored from 1–5.

Item Text (English Translation)	M	SD	Skew	Kurtosis
The fact that my grades aren't good doesn't worry me	1.63	0.84	1.39	1.83
Having bad grades isn't a problem	1.76	0.86	1.10	1.01
Although they tell me that I should improve my grades, I have no intention of doing anything to change	1.46	0.78	1.95	4.06
I really need to improve my grades	2.32	1.05	0.38	−0.74
I have had problems and concerns because of my grades	3.57	1.07	−0.54	−0.36
I am beginning to realize that my performance at school is a problem	3.21	1.11	−0.35	−0.67
I would like to have help to keep the changes that I have already achieved in my study habits	3.09	0.96	−0.40	−0.35
I would like to have help to fulfill what I have planned in order to improve my grades.	3.06	0.97	−0.35	−0.42
I would like some help to go beyond the intentions of improving my grades	3.21	1.00	−0.35	−0.33
I am trying hard to improve my grades	3.98	0.77	−0.96	2.02
I know I can't always get good grades, but at least I'm trying	3.61	1.00	−0.75	0.21
I am trying to keep my plans to improve my grades	3.69	0.71	−0.94	1.63
There are days when I do what I can to improve my grades, but there are other days when I can't	3.68	0.84	−0.62	0.50
I managed to improve my grades, but sometimes I still have trouble doing what I planned to improve my grades	3.48	0.82	−0.45	0.08
I've done concrete things to improve my grades, but I'm afraid I can't maintain these changes	3.26	0.94	−0.27	−0.40

Table 2.

Goodness-of-fit indices following CFA. Model estimated using robust WLSMV.

Model	Scaling correction factor	χ^2	df	χ^2/df	CFI	SRMR	RMSEA, [90% CI]
1. 5-stage, 15-items	.79	468.79*	80	5.86	.92	.07	.09, [.09, .10]
2. 5-stage, 14-items	.74	213.39*	67	3.18	.97	.05	.06, [.05, .07]

*p < .05

Table 3.

Correlated residuals between the 15 APSCI items following CFA (Model 1).

	PR				C			P			A			M	
Item No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.000	.004	.033	.296	.092	.120	.042	.009	.018	.026	.104	.023	.096	.006	-.039
2		.000	-.031	.204	-.053	-.060	-.008	-.049	.022	-.053	.076	-.055	.048	.034	-.045
3			.000	.245	-.040	-.098	-.031	.002	.036	-.041	.086	.008	-.015	-.014	-.033
4				.000	.095	.032	.013	.041	.153	-.265	.030	-.199	.032	-.044	-.012
5					.000	-.057	-.071	-.023	.062	-.009	.094	-.022	-.007	-.031	-.005
6						.000	-.078	.014	-.017	.048	.056	.095	.020	-.093	.074
7							.000	.008	-.005	-.036	.065	.063	.057	-.016	.005
8								.000	-.013	-.057	.076	.011	.013	-.031	-.045
9									.000	-.098	.046	-.070	.043	-.009	-.006
10										.000	.028	.028	-.195	-.002	.040
11											.000	-.103	.017	.061	.075
12												.000	-.059	.060	.035
13													.000	.126	-.045
14														.000	-.055
15															.000

PR = Pre-contemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance

Table 4.

Measurement invariance across gender (males vs. females) and school year (10th, 11th and 12th grades) based on Model 2: 5-stage, 14-items. (N = 564).

	χ2	df	BIC	CFI	ΔCFI	RMSEA	ΔRMSEA
Gender							
Configural invariance	246.11	134	19079	.945	NA	.055	NA
Weak invariance	252.76	143	19029	.947	.001	.052	.002
Strong invariance	265.82	152	18985	.945	.002	.052	.001
Strict invariance	336.66*	166	18967	.917	.028	.060	.009
School grade							
Configural invariance	321.07	201	19409	.944	NA	.056	NA
Weak invariance	338.61	219	19313	.944	.000	.054	.002
Strong invariance	376.65*	237	19237	.935	.009	.056	.002
Strict invariance	427.21*	265	19110	.925	.010	.057	.001

*p < .05

Table 5.

Descriptive statistics and ANOVAs with planned polynomial contrasts for academic performance and subtypes of student engagement with school.

	Stage					Weighted Trend		
	PC (n = 8)	C (n = 125)	P (n = 32)	A (n = 241)	M (n = 157)	ANOVA	Linear	Quadratic
	M (SD)					F value		
Academic performance	13.71 (3.00)	12.91 (2.01)	14.14 (1.78)	13.96 (1.80)	13.88 (1.92)	7.32*	28.60*	0.38
Student engagement								
Cognitive engagement								
CRSW	1.98 (0.69)	2.93 (0.51)	2.95 (0.45)	3.05 (0.48)	2.95 (0.52)	9.83*	1.22	0.22
FG	2.67 (0.53)	3.33 (0.54)	3.31 (0.68)	3.31 (0.63)	3.27 (0.66)	2.24	0.43	0.07
Psychological engagement								
TSR	2.31 (0.62)	2.80 (0.38)	2.79 (0.46)	2.95 (0.44)	2.85 (0.47)	6.28*	4.53*	1.82
PSL	2.22 (0.88)	3.28 (0.51)	3.04 (0.76)	3.37 (0.59)	3.29 (0.64)	4.34*	0.85	1.16
FSL	2.48 (0.84)	3.03 (0.43)	2.99 (0.54)	3.11 (0.43)	3.06 (0.48)	8.73*	0.06	6.19*

PC = Pre-contemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance; CRSW = Control and Relevance of School Work; FG = Future Aspirations and Goals; TSR = Teacher–Student Relationship; PSL = Peer Support for Learning; FSL = Family Support for Learning. *p < .05