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Interactions among students' prior learning, aspiration, confidence and university entrance score as determinants of academic success

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Abstract

We studied the effect grade aspiration, confidence in achieving that grade, prior learning and university entrance ranking had on first year biology students' final grade. We hypothesised that (1) students with higher aspiration will achieve higher grades than those with lower aspiration; (2) students with prior biology learning will have a higher grade aspiration and a higher confidence of achieving that aspiration than those without such learning; (3) university entrance rank will impact students' final grade; and (4) students with prior biology learning will achieve a higher final grade than those without such study. We found that Hypotheses 3 and 4 were supported, Hypothesis 2 was partially supported, and that Hypothesis 1 was unsupported. If these results reflect broader patterns - that undergraduate student grade aspiration is not a predictor of their subsequent final grade - then targeted information and curricula scaffolding must be provided to better align student aspirations with their actual academic achievement.

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Introduction

The aspiration of commencing university students is a topical area of scholarly endeavour, with a broad range of researchers investigating links with gender (Arnold, 1993; Cundiff, Vescio, Loken, & Lo, 2013), ethnicity (Carter, 2001; Osler, 1999; Walpole, 2008), socio-economic status (Walpole, 2008), and emotional maturity (Jun, 2008), among other factors. Universities have also set targets for greater higher education participation for students from identified disadvantaged groups and have scaffolded this with appropriate aspirational frameworks (Nelson, Clarke & Kift, 2010). Quaglia and Cobb (1996) define an aspirational student as "one who is involved in various activities for both their inherent value, and enjoyment and their connection to future goals" (p. 127). In an educational context, academic aspiration can be defined as the level of quality of an assignment, unit or course that a student desires to attain (Patmalniece, 2011). A range of factors contribute to shaping students' aspirations for tertiary study, including their secondary school teachers (Buchmann & Dalton, 2002), and crucially, their peers and parents (Wentzel, 1998). Aspiration and achievement may be linked, in that students with high aspirations often achieve better grades (Abu-Hilal, 2000), accounting for individual and family factors. However, exceptions to this have been reported, including young people belonging to some minority ethnic groups (Gutman & Akerman, 2008) and incoming precollege business students (Smith & Wertleib, 2005). The discordance among these findings calls for more in-depth examinations of the relationship between aspiration and academic achievement.

Students' confidence in reaching their aspirational achievement may be a critical factor in their overall university experience and ultimate academic outcomes (Nicholson, Putwain, Connors, & Hornby-Atkinson, 2013). In broad terms, confidence can be regarded as

an individual's belief that they can accomplish a specific task (Simonson, 1999). Additionally, a student's level of confidence may result from a prior experience of meeting or not an educational aspiration, and/or an experience of academic failure (Nicholson et al., 2013). While a causal link between student confidence and academic success has yet to be demonstrated consistently, several factors have been identified as shaping academic achievement. These include the influence of family, friends and peers (James, 2012), students' engagement with and enthusiasm for learning (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008), their level of prior learning in a unit (Rayner, 2014; Sadler & Tai, 2007), socio-economic status (Gale, 2012; James, Baldwin, Coates, Krause, & McInnes, 2004) and university entrance score (Green, Brown, & Ward, 2009).

In an Australian context, the system used for ranking applicants for university entrance is the Australian Tertiary Admission Rank (ATAR). A positive correlation between a student's ATAR and their academic achievement has been widely reported (Anderton, Evans, & Chivers, 2016; Dobson & Skuja, 2005; Messinis & Sheehan, 2015). However, this does not hold true across all student cohorts, with ATARs below 80 not being a useful predictor of achievement (James, Bexley, & Shearer, 2009). Further, the ATAR may be a poor predictor of students' completion of their degree (Knipe, 2013), and there are mixed findings about how students' socioeconomic status and ATAR affect their university performance (Li & Dockery, 2014). Despite these inadequacies, the ATAR is likely to remain the primary criterion for entry into most Australian university courses. Consequently, the most popular university courses will continue to attract students with the highest ATARs (Chesters & Watson, 2013), notwithstanding the marketing that ties ATAR to the perceived quality of such courses (Devlin, 2016).

Despite the considerable body of published literature on undergraduate success, little has been reported on possible links among their grade aspiration, confidence of meeting that aspiration, university entrance score, prior learning in a discipline area, and actual achievement in a unit. Our study used a similar framework to that of Nicholson et al. (2013), grounded in the notion of academic behavioural confidence, which essentially describes students' judgements about their aspiration to achieve an academic outcome. In our investigation, academic behavioural confidence is contextually situated in a first year biology unit. First year biology was chosen due to its foundation for higher level science studies, the large student cohort, and the consequent disparities in prior biology learning among students. While Victorian Certificate of Education (VCE) Biology (Leather & Leather, 2011) is a popular secondary school subject (Katayama, Terada, & Wallis, 2001), it is often not a prerequisite for university biology (Burke da Silva, Young, Rayner, Blanksby, & Familiar, 2013). Thus, many students choose subjects other than VCE Biology as a strategy to maximise their ATAR (Rayner, 2014).

Aims

In this study, we investigated whether student aspiration for a particular grade impacted academic achievement in a large cohort, first year biology unit. We also sought to assess the possible role of factors such as ATAR and/or prior learning of biology in shaping undergraduates' grade aspiration, confidence in achieving that grade, and their actual grade achievement. For this study, we were primarily interested in prior knowledge as a possible determinant of grade aspiration, and thus did not include psychological, family or secondary schooling as factors in our investigation. Consequently, we tested the following four hypotheses:

H-1. Students with higher aspiration will achieve higher grades than students with lower aspiration, controlling for factors such as ATAR and prior learning in biology;

H-2. Students with prior learning in biology will both aspire to a greater final grade, and have a higher confidence of achieving that aspiration, than students without such prior study;

H-3. Students' ATAR will correlate positively with their final grade; and

H-4. Students with prior biology study will achieve a higher final grade than students lacking such study.

Methods

Sample

The study population consisted of the 1,062 undergraduate students undertaking the first year biology unit BIO1011 at the Clayton Campus of Monash University in Melbourne, Australia. They were requested to complete a survey in week 2 of semester 1, 2015 at which time they had not undertaken any assessments or assignments hence their perceptions were not influenced by assessment or any feedback.

Approximately 100 students chose not to participate, and along with those not enrolled in the Faculty of Science, those without an ATAR score or who did not complete BIO1011 were excluded from the cohort. The final volunteer sample was 801 students - 75.4% of the cohort - comprising 287 males and 514 females of roughly comparable age, with <1% categorised as mature-age.

Survey instrument

The survey comprised three volunteer-response questions designed to determine:

- students' final grade aspiration: Pass (P)=50-59%; Credit (C)=60-69%; Distinction (D)=70-79%; High Distinction, (HD)=80-100%), and
- their confidence of achieving this aspiration: Likert scale scores ranging from 1 - not at all confident, to 5 - very confident.

The survey was administered under Monash Human Ethics permit CF13/2305 - 2013001213.

Analysis

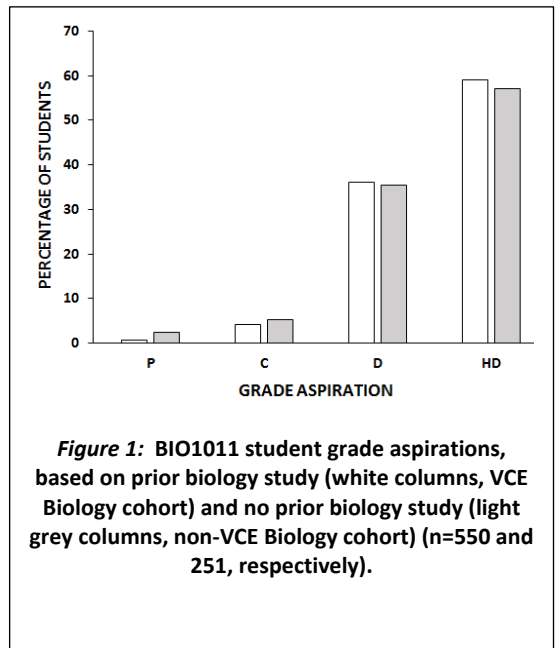
Mean Likert Scale (MLS) scores were calculated for students' confidence in achieving their aspirational grade, along with standard error using Microsoft Excel™. Student ATARs calculated by the Victorian Tertiary Admissions Centre were extracted from university records. At the end of the semester, students' final grades for BIO1011 were derived from a combination of a multi-choice question exam (50%), together with practical activities, and online quizzes (50%).

As indicated above, 801 complete and valid survey responses were obtained. Students' prior learning histories provided by university records were examined to determine if they had studied biology at secondary school (VCE Biology), or not (non-VCE Biology). In order to assess the effect of prior learning on students' aspirations, confidence and achievement (i.e. BIO1011 final grade), the overall cohort was segregated into students who had undertaken VCE Biology (68.6% of study participants), and those who had not (31.4%). All regression analyses were undertaken using Microsoft Excel™.

Results

Aspiration: What impact does prior biology learning have on final grade aspiration? (H-2, H-4)

Students' final grade aspiration was not affected by prior learning, with aspirations for each cohort being almost equivalent (Figure 1). Of students without a VCE Biology background, more than 92% aspired to either D or HD, which was very similar for students with such prior knowledge (95.2%). For students who had previously studied VCE Biology, only 0.6% aspired to a P and 4.2% aspired to a C, with comparable results for the non-VCE Biology cohort (Figure 1). This indicates that the majority of students aspired to a high grade, regardless of their level of prior learning.



Confidence: What impact does prior learning of biology have on students' confidence of achieving the final grade they aspire to? (H-2)

In general, neither group appeared overconfident of achieving their aspired-to grade. Whilst acknowledging the very small sample sizes for students aspiring to a P (Table 1), their mean confidence was consistently in the range 3-3.5 for both cohorts, and across all grade aspirations (Figure 2). Nonetheless, as a whole, VCE Biology cohort students were significantly more confident (MLS of 3.47 ± 0.03) than their non-VCE Biology counterparts (MLS of 3.28 ± 0.05) of achieving their final grade aspirations ($t = 1.6, p = 0.0007$). This indicates that prior learning *does* have a significant impact on students' confidence of achieving their aspired-to grade. Upon further investigation, regression of the association between students' confidence and their final grade showed that for the non-VCE Biology cohort, there was a significant causal relationship between these variables ($F = 11.0, r = 0.21, p = 0.001$), although there was no such relationship for the VCE Biology cohort. At the grade level, for students who aspired to a D, those with VCE Biology were significantly more

confident of achieving their aspiration than those without such prior knowledge ($t = 1.5, p = 0.0011$) (Figure 2). However, for students aspiring to a P, C or HD, there was no significant difference in confidence between students with and without prior study of biology (Figure 2).

Achievement: Do students with prior study of VCE Biology achieve a higher BIO1011 final grade than students without? (H-4)

As a group, VCE Biology cohort students attained a significantly higher final grade ($70.6 \pm 0.7\%$) than their non-VCE Biology counterparts ($66.8 \pm 1.3\%$) ($t = 2.2, p < 0.0001$). The overall pass rates were 97.3% and 96.8% for the VCE and non-VCE Biology cohorts respectively. For students who aspired to a D or HD, there was a significant difference between average final grades for these two cohorts ($t = 1.5$ and $p = 0.004$ for D aspirants, $t = 1.4$ and $p = 0.003$ for HD aspirants, respectively) (Figure 3). There was no significant difference between the two cohorts for students aspiring to either a P or a C (Figure 3).

An examination of within-cohort final marks (comparing final grades of P, C, D and HD aspirants for both groups of students) shows no apparent effect of aspiration on achievement. That is, there was no significant difference among *any* of the mean final grades of students aspiring to any of the grade levels, for both the VCE Biology ($F = 1.28, p = 0.27$) and non-VCE Biology ($F = 0.89, p = 0.44$) cohorts (compare four white columns and four light grey columns in Figure 3).

A more in-depth analysis revealed that all students who aspired to a P grade either met or exceeded their aspiration, for both the VCE Biology and the non-VCE Biology cohorts (Table 1). For students who aspired to a C, a higher percentage of them exceeded this aspiration for the VCE Biology cohort compared to the non-VCE Biology one, whereas

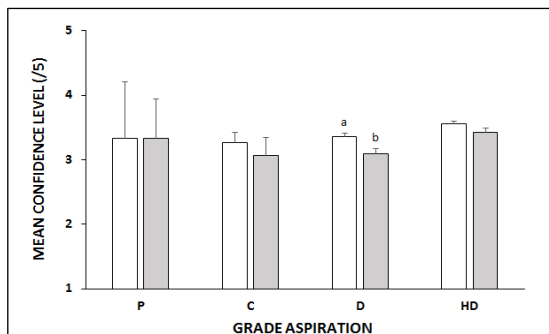


Figure 2: Mean student confidence levels based on grade aspiration, and grouped according to prior biology study (white columns) and no prior biology study (light grey columns). Error bars denote SEMs; non-shared alphabet letters denote a significant difference between mean scores for the aspired grade. See Table 1 for n values for each cohort/grade aspiration combination.

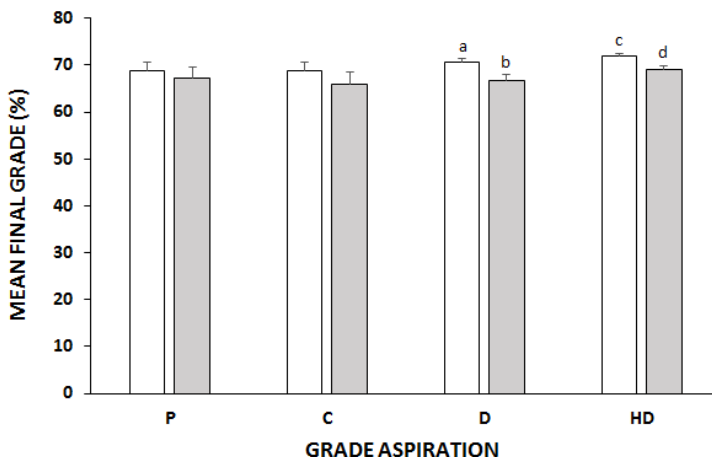


Figure 3: Mean student final grades based on grade aspiration and grouped according to prior biology study (n=550 and 251, respectively). All other indications are as per Figure 2.

a higher percentage of non-VCE Biology students either met or failed to achieve this aspiration (Table 1). For those who aspired to a D, a higher percentage of students met or exceeded this aspiration for the VCE Biology cohort, while a higher percentage of non-VCE Biology students failed to meet this aspiration (Table 1). For those students who aspired to achieve a HD, similar numbers for the two cohorts either did not meet their aspiration or

achieved it (Table 1).

Capability: Is ATAR a predictor of students' final grade? (H-3)

Overall, the average ATAR scores were not significantly different between the VCE Biology and non-VCE Biology cohorts (85.0 ± 0.7 versus 85.9 ± 0.3). Nonetheless, regression analyses indicate that for both groups of students, there

Table 1: Final grade outcomes of BIO1011 students based on prior biology and no prior biology study, as a function of final grade (P, C, D or HD) aspiration. N/A denotes Not Applicable

Non-VCE Biology (n=251)	P (n=6)	C (n=13)	D (n=89)	HD (n=143)
Did not meet aspiration (%)	0	23.08	60.67	80.42
Met aspiration (%)	16.67	46.15	31.46	19.58
Exceeded aspiration (%)	83.33	30.77	7.87	N/A
VCE Biology (n=550)	P (n=3)	C (n=23)	D (n=199)	HD (n=325)
Did not meet aspiration (%)	0	13.05	43.21	79.07
Met aspiration (%)	0	30.43	42.22	20.93
Exceeded aspiration (%)	100	56.52	14.57	N/A

was a statistically significant causal relationship between students' ATAR and their BIO1011 final grade ($F = 83.2$, $r = 0.36$, $p < 0.0001$ for the VCE Biology cohort; $F = 32.8$, $r = 0.34$, $p < 0.0001$ for the non-VCE Biology one). When the cohorts are segregated by ATAR extremes, the correlation holds true for students with ATARs above 80 ($F = 59.4$, $r = 0.34$, $p < 0.0001$ for the VCE Biology cohort; $F = 52.7$, $r = 0.46$, $p < 0.0001$ for the non-VCE Biology one), but not for students with ATARs below 80. Thus, ATAR *can* be a predictor for students' final grade, but this is dependent on the magnitude of the university entrance score.

Discussion

Is aspiration a predictor of achievement? (H-1)

That student grade aspiration in first year biology is *not* a predictor of their subsequent final grade highlights the complex nature of aspiration, and the factors that impact aspiration and final grade. Our results contrast with the perspective of Hart (2016), who contends that "aspirations are future-oriented, driven by conscious and unconscious motivations and they are indicative of an individual or group's commitments towards a particular trajectory or end point" (p. 326). Rather than reflecting some form of commitment on the part of the student, our findings suggest that aspiration may more accurately reflect students' hopes regarding their final grade. Such "hopes" may however be unrealistic (Brinkworth, McCann, Matthews, & Nordström, 2009) given that other factors, such as students' prior learning and their university entrance score, can be stronger predictors of academic achievement (Dobson & Skuja, 2005; Sadler & Tai, 2007).

Additionally, prior to attending university, many students have considerable difficulty visualising their higher education experience (Sander, Stevenson, King, & Coates, 2000; Smith & Hopkins, 2005). This creates a

potential mismatch between students' aspirations and what they *actually* experience during their first year (Tranter, 2003; Smith & Hopkins, 2005). Regardless of what commencing undergraduates actually aspire to, for many of them university life can be an imposing and unwelcoming experience. This may be due to a combination of factors including institution size, differences between secondary and tertiary teaching modes, and the larger numbers of students compared to high school (Welch, 2012). In order to address the disparity between students' aspiration and achievement, they need to be better prepared for university studies, and importantly, more aware of the requirements for academic success, particularly where they lack prior study in a discipline area.

What impact does prior learning of biology have on final grade aspiration? (H-2, H-4)

The lack of any apparent difference in final grade aspiration between students with and without a VCE Biology background appears somewhat paradoxical. This is because it could be expected that students with prior biology learning would have a higher final grade aspiration than those without it. Our results in regard to this may be due to a number of interacting variables. Firstly, if commencing students view biology as largely content-driven rather than concept-driven (Taylor, Peat, May, & Quinnell, 2007), they may, unrealistically, aspire to a high final grade. Their aim might therefore be to achieve their aspiration through memorisation of content, rather than developing a more thorough understanding of biology concepts. This approach to learning biology has been previously noted for first year university students by Quinnell, May, and Peat (2012). If true, it suggests that university educators need to more accurately inform commencing students about appropriate ways to study this subject, in order that they adopt deeper approaches to their learning, and maintain these over the course of their studies.

Secondly, students may not recognise their lack of prior biology learning as an obstacle to achievement in first year biology. Such students may incorrectly see biology as an easy unit (EMBO, 2006), and thus set themselves a high final grade aspiration. However, they may not apply suitable study strategies to increase the likelihood that they will meet their grade aspiration. This aligns with research suggesting that students who apply consistent and structured study strategies, including self-testing, rereading and allocation of study time, on average achieve higher grades than those who do not (Hartwig & Dunlosky, 2012; Renzulli, 2015).

What impact does prior learning of biology have on students' confidence of achieving the final grade they aspire to? (H-2)

The comparatively moderate level of confidence of students from both cohorts to achieve their aspirational grade for BIO1011 suggests, unexpectedly, that they may actually possess a nuanced understanding of their tertiary learning environment. This contrasts with Sander, Putwain and de la Fuente (2013), who contend that many students enter university with unrealistically high confidence of achieving their academic goals. An alternative explanation for our students' moderate levels of confidence is that they perceive university to be larger and more impersonal than their secondary schooling environment, and that they will be much less supported on their learning journey (Gawley & McGowan, 2006; Welch, 2012), which makes them more uncertain about achieving their aspired-to final grade.

Our finding that students' confidence of meeting their grade aspiration is dependent on their level of prior knowledge is consistent with the findings of Lodge and Kennedy (2015) and Watters, Loughlin, Brown, and Johnston (2014). In a study of first year chemistry students, Watters et al. (2014) found that those

with poorer mathematics background had lower levels of confidence in their mathematics skills than students with a strong mathematics background. However, little else appears to have been reported on this relationship, and it remains an area for future scholarly endeavour, particularly if other variables, such as student aspiration, are included.

The possible causal relationship between the confidence and achievement of non-VCE Biology students is consistent with Nicholson et al. (2013), who found that students reporting higher academic confidence achieved higher end-of-semester grades. The lack of a causal relationship between confidence and achievement for students with a VCE Biology background is however, paradoxical, given that such students, on average, achieved higher grades than students without such prior learning. At the secondary level, Boz, Yerdelen-Damar, Aydemir, and Aydemir (2016) reported a correlation between self-efficacy and achievement for senior secondary chemistry students, although the distinction between confidence and self-efficacy is noted. Our somewhat surprising results, together with the paucity of published literature on this topic, call for further investigation into the possible relationships between students' prior learning, their aspirational confidence and academic achievement, both within and across discipline areas.

Do students with prior learning of biology achieve a higher BIO1011 final grade than students without? (H-4)

Our finding that students with prior learning of biology achieved a higher mean final grade than those without is not unexpected, and is consistent with Sadler and Tai (2007), in their meta-analysis of the effect prior study on college science students' achievement in a range of subjects. Similar findings for biology have also been reported by Schwartz, Sadler, Sonnert and Tai (2009), Graham, Addy,

Huddleston and Stallard (2011), and McCoy and Pierce (2004). However, the very high pass rate for both cohorts (and a desire to avoid limiting student choice of subjects) negates any call for the integration of pre-requisite study (i.e. VCE biology) for commencing students. In order to better prepare students lacking prior biology study, a biology bridging course, conducted in the week prior to commencement of semester, has been designed and implemented for this unit. That significant differences in mean final grades were not found between the two cohorts (at the P and C aspirational grades) most likely reflects the small sample sizes in all of those aspirational groupings, rather than any fundamental link between aspiration and actual achievement.

Within each of the VCE Biology and non-VCE Biology cohorts, the lack of any difference in final grade (regardless of aspiration) is perplexing. This finding further suggests that for commencing students, aspiration should not be used as a reliable tool to predict achievement, at least in biology. The limitation of small sample sizes for the P and C aspiration groupings in each cohort is likely to be a contributing factor to this finding, although it is not easily resolved (i.e. few undergraduates will have such low aspirations). A more suitable approach would be to ask students to indicate their aspirational mark, rather than a grade.

Is ATAR a predictor of students' BIO1011 final grade? (H-3)

Our finding that ATAR is a good predictor of students' final grade in BIO1011 (at least for high university entrance scores) is consistent with that of Dobson and Skuja (2005). However, this does not appear to be a universal pattern across the higher education sector, particularly for students with ATARs below 80 (James et al., 2009). Other factors, including undergraduate students' age, gender, socioeconomic status and non-English speaking background have also been shown to

significantly affect their academic achievement (Messinis & Sheehan, 2015). One of the limitations of our study was that students' VCE Biology grades were not available; such data may have been valuable in terms of aligning ATAR more coherently with aspiration, confidence and BIO1011 final grade. More recently, researchers and politicians have called for supplementary processes, including use of pre-admission interviews and/or student portfolios, to determine students' suitability for a particular university course (Blyth, 2014). Our findings, while not inconsistent with this, call for further research incorporating metadata from student admissions, together with the relative success (in terms of student engagement and achievement) of these other forms of admission.

Conclusions

In this study, we found that: (i) H-1 was unsupported: students' final grade aspirations for BIO1011 were not affected by their ATAR or prior learning of biology; (ii) H-2 was partially supported: prior learning impacted students' confidence of achieving their final grade aspiration; (iii) H-3 was supported: there was a correlation between students' ATAR and their final grade; (iv) H-4 was supported: students with prior learning of biology achieved a higher final grade than students without such learning. Given these outcomes, it would be interesting to investigate how students in this study perform longer-term in their overall degree coursework, i.e. whether a lack of previous knowledge in biology has a longer-term impact on their academic achievement in a range of science-related units.

Importantly, our finding that student aspiration was *not* a predictor of their academic success in this unit calls for the development and inculcation of deeper learning approaches to better align students' aspirations with their final grade. To facilitate this, educators will require suitable

professional development, and to work more closely with educational designers and support services to better tailor orientation and transition programs, and provide more engaging and enriching curricula.

Limitations of our study included the survey design, incorporating a five-point Likert scale, which did not enable more sophisticated statistical modelling. We thus conclude that a continuous scale be used in future for measures of student aspiration and confidence, which would allow direct comparison with factors such as their ATAR and final grade. Additionally, it is possible that gender may have influenced our results, and a more thorough analysis of possible differences in the variables investigated in this paper, based on gender, will be the focus of a future manuscript.

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