

Confidence as a Predictor of Academic Success

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Abstract

This study aims to determine the impact of confidence on academic performance in a cohort of first year psychology students. Intelligence is well understood as a key predictor of academic performance, however there are other factors which can contribute to a student's success. Previous research highlights confidence as one of these potential factors. In order to distinguish confidence as a factor, participants completed a number of online measures and were asked to rank their confidence on each task. The tasks were the Mental-Rotation Task, a perceptual task, and the Raven's Advanced Progressive Matrices, an established measure of intelligence. It was found that confidence was positively correlated with academic performance, however the strength of the relationship was weak, this was due to suppression effects caused by gender differences. It was found that although males had lower academic performance than their female peers, they were more confident when rating their own performance. These results build upon previous research by exploring the potential impact that confidence can have on academic performance. It also highlights the differences and similarities in performance on cognitive and non-cognitive tasks. This research has potential impact in education research and the capacity for further exploration of gender differences.

Declaration

“This thesis contains no material which has been accepted for the award of any other degree of diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide’s digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the School to restrict access for a period of time.”

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Introduction

Student achievement is the primary indicator of how successful educational institutions are in training pupils in an area of expertise. It is no surprise that educational research is focused on ways that academic performance can be maximised. Many of these factors are outside the control of universities and even of students. There is a growing field of research around variables such as confidence that could be manipulated to increase academic performance. However, confidence needs to be more thoroughly understood to be used for this purpose.

The most well-known predictor for academic performance is intelligence and the cognitive abilities that relate to it (Heaven & Ciarrochi, 2012; Poropat, 2009; Rosander & Bäckström, 2012; Salanova, Schaufeli, Martinez, & Bresó, 2010). It has been reported that intelligence accounts for 49% to 81% of the variance in academic performance (Barton, Dielman, & Cattell, 1972; Deary, Strand, Smith, & Fernandes, 2007; Duckworth, 2006; Rosander & Bäckström, 2012; Salanova et al., 2010). It is clear that intelligence is the primary predictor in academic achievement, however, it is not the sole predictor.

This is where the research explores some of the non-cognitive abilities that may explain the variance that intelligence does not account for in academic ability. One of these variables is confidence. It has been shown that there is a strong relationship between confidence and academic success (Dinsmore & Parkinson, 2013; Kleitman & Stankov, 2001; Kukulcu, Korukcu, Ozdemir, Bezci, & Calik, 2013; Stankov, 2013; Stankov & Crawford, 1996, 1997; Stankov & Kleitman, 2008; Stankov, Kleitman, & Jackson, 2015; Stankov & Lee, 2008, 2014, 2017; Stankov, Lee, Luo, & Hogan, 2012; Stankov, Morony, & Lee, 2013). The current study aims to explore factors that can affect academic performance and to help build the literature towards a general measure of confidence. Intelligence and personality factors are known to affect how well students perform academically, and these variables will

also be explored within this study (Blanch & Aluja, 2013; Rosander & Bäckström, 2012; Rosander, Bäckström, & Stenberg, 2011).

The current study aims to expand on previous findings and strengthen the understanding of the role of confidence in academic settings. In employing a design looking at confidence on both non-cognitive and cognitive tasks, this study hopes to find that confidence is a predictor of academic success that is distinct from intelligence.

Defining Confidence

Confidence can be understood as a metacognitive ability to assess one's potential success when performing a task (Ehrlinger, Mitchum, & Dweck, 2016). This combines aspects of self efficacy and self belief as well as the cognitive ability to make accurate appraisals (Stankov & Lee, 2017). Levels of motivation and effort when completing a task, as well as interest in intellectual pursuits, may also affect confidence (Powell, Nettelbeck, & Burns, 2017). Confidence can be very complicated and multifaceted and there are a number of potential factors at play when we look at confidence in relation to academic performance. The importance of defining confidence is to distinguish it from other forms of confidence, such as confidence in social settings (Stankov & Kleitman, 2008). This allows for a more theoretical and structured approach to how confidence functions in student populations, which can then be applied more broadly.

Metacognition

Metacognitive processes are those that involve thinking about cognitions. This is the process of being aware of thought processes and being able to interpret them. These types of processes can be used for self monitoring in various situations (Kleitman & Stankov, 2001). For this reason, confidence has also been researched as a factor in decision making processes. In this area of psychology confidence is described as the phenomenon of 'knowing how

much you know' in order to judge how accurate a decision is, or how sufficient your knowledge is to make that decision (Stankov & Kleitman, 2008).

Using confidence as a process becomes important as we are made to make decisions in situations where we have limited information presented to us (Lee & Dry, 2006). By applying metacognitive processes such as confidence to learning, where the entire purpose is to gain knowledge that we do not currently have, we can assess whether having confidence in ability translates to actual academic outcomes (Jackson, Kleitman, Howie, & Stankov, 2016). This is especially promising as metacognitive processes are far more malleable than existing predictors of academic performance such as intelligence and personality (Burns, Burns, & Ward, 2016).

Self efficacy

Self efficacy can be thought of as beliefs that one has about themselves regarding their capability to produce desired outcomes (Stankov et al., 2013). Bandura and Adams (1977) found self efficacy to be a motivator of behaviour change to avoid negative outcomes, it was also found that levels of self efficacy could enhance or diminish cognitive performance (Bandura, 1989). Self efficacy is sometimes used in conjunction with or instead of confidence and has been found to account for 30% of the variance in academic performance (Stajkovic, Bandura, Locke, Lee, & Sergent, 2018). It is thought that self efficacy is a part of the non-cognitive factors that lead to academic success and that, along with confidence and other factors, adds to the perseverance of an individual when met with a difficult task (Stankov & Lee, 2017).

A similar concept is developing from ideas in sports psychology, it combines various factors (e.g. resilience, buoyancy, perseverance, self efficacy, confidence and motivation), to create a model of mental toughness (McGeown, St Clair-Thompson, & Clough, 2015). Although the current study is moving away from measuring self efficacy and related

phenomena such as self concept, it is important to consider the impact on the literature of confidence. Self efficacy is a factor that contributes to metacognitive abilities, as well as behaviours that lead to successful performance. When considering performance in academics and other areas, these ideas have shaped the way that confidence is measured in this study and in related research.

Intelligence and academic performance

It is no surprise that intelligence is the strongest predictor of academic performance, it is expected that intelligent students will achieve great results. In Cattell's (1971) theory of general and crystallised intelligence, it is thought that there are numerous cognitive abilities that make up overall intellect. It has been shown that these abilities can be increased through consistent training in high school populations (Stankov & Chen, 1988). Even in adolescent cohorts, there are factors such as self discipline which are considered when looking at which students are achieving regardless of their intelligence (Duckworth & Seligman, 2005). Cognitive ability is not seen to change once students are at the university level, this is where other factors are more indicative of academic performance (Rosander & Bäckström, 2012).

The correlation between intelligence and grades is observed at the university level, as students that perform well on tests of cognitive ability are suited to high education (Stajkovic et al., 2018). When looking at confidence of students there is a clear relationship between capability and self rating, in other words if a student is intelligent they are more confident in their ability to perform a task well (Stankov & Crawford, 1997). While it is important to consider cognitive abilities, at the university level non-cognitive factors are arguably more predictive of academic performance (Heaven & Ciarrochi, 2012). This study hopes to explore these factors to add to the literature that explores the impact that confidence has in academic settings, and its functions in relation to existing measures of cognitive ability.

Personality and academic performance

Personality can be seen as the combination of traits that make up our character. Our personality affects how we behave and think and impacts the way in which we learn. The most widely used personality theory is the Five Factor Model of personality, which includes the traits of Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Costa & McCrae, 1992). The traits of Conscientiousness and Agreeableness have been shown to increase through the stages of early adulthood, which is theorised to be due to their links to pro-social behaviours (Srivastava, John, Gosling, & Potter, 2003).

Conscientiousness may also be a key personality factor in high achieving students as it has been shown to positively correlate with high academic performance (Dumfart & Neubauer, 2016; Poropat, 2009; Rosander & Bäckström, 2012; Rosander et al., 2011; Zhou, 2015). Conscientiousness is associated with people who display behaviours that are associated with being hard working, disciplined, organised, and accomplished (Schulze & Roberts, 2006). This sets a precedent for the importance of personality traits in academic performance, these differences are pronounced in high school cohorts (Blanch & Aluja, 2013; Heaven & Ciarrochi, 2012; Rosander et al., 2011). A meta-analysis found that in tertiary level education, conscientiousness could have almost as much predictive power as intelligence on academic performance (Poropat, 2009). A similar affect was found between self efficacy and academic performance, with conscientiousness as the predictor (Stajkovic et al., 2018).

There is strong evidence that females show higher levels of conscientiousness than their male peers, which may suggest that females are more likely to have higher grades on average (Dumfart & Neubauer, 2016; Heaven & Ciarrochi, 2012; Leeson, Ciarrochi, & Heaven, 2008; Poropat, 2009; Singh, 2009; Srivastava et al., 2003; Vedel, Thomsen, & Larsen, 2015). This suggests that students who are high in traits such as discipline and

organisation are more capable of academic achievement, and their self efficacy is higher as a result.

Gender Differences in Confidence Relating to Academic Performance

There is very limited research on the differences in confidence brought about by gender differences. The research that has explored gender differences has found some interesting findings in the way males and females report confidence. It seems that males tend to be unrealistic in their confidence reporting, they tend to be overconfident but no more accurate in performance compared to females, who were far more realistic in their appraisals of their performance (Stankov & Kleitman, 2008). However, in another study it was found that males were fairly accurate in their confidence ratings when compared to their performance, and that females were underconfident (Jonsson & Allwood, 2003).

Kukulu et al. (2013) found that male nursing students exhibited much higher confidence than their female peers and suggested that confidence needed to be fostered for female students. The current study explores a number of key variables that may contribute to this effect of male students exhibiting higher levels of confidence compared to their female peers. Previous research has not looked for these differences in relation to confidence on tasks of cognitive and non-cognitive ability. Rosander and Bäckström (2012) found that high school students in Sweden had differences in learning style based on gender, which resulted in males and females performing better or worse in different subjects. There are differences in cognitive ability which may also carry over to academic performance in childhood and adolescence, males are generally more adept in tasks of visual-spatial ability and females tend to perform better on verbal tasks (Kukulu et al., 2013). Because this area has not been thoroughly explored there is no consensus on whether males and females show distinct

differences in confidence but there is evidence that there is a difference and that this may impact academic performance as well.

Previous Research on Confidence and Academic Performance

There is an existing area of research that has been exploring how confidence and self beliefs can affect academic performance. In a study of 598 high school students from Singapore, it was found that confidence accounted for 46.3% of the variance (Stankov et al., 2013). A similar study of over 3000 high school students found that domain specific confidence was predictive of performance in mathematics and English subjects (Stankov, Lee, et al., 2012). Stankov and Lee (2014) found a strong positive correlation ($r = .68$) between confidence and performance on mathematical tests. Similar results were found between tests of confidence on tests of cognitive ability and performance in mathematics, that were not found to correlate with English performance (Stankov & Crawford, 1997). The majority of these studies focused on academic abilities related to certain subjects rather than confidence as a general predictor of performance. These findings show that task or subject specific confidence are predictive of performance in English and mathematics. This study aims to show that tasks that are not subject specific and confidence ratings on them can also be predictive of academic performance.

A very similar design to the current study, with 114 first year students from the University of Sydney, found that participants tended to be overconfident on tests of cognitive ability and rated themselves as less confident on perceptual tasks (Stankov & Crawford, 1996). This suggests that there are differences in confidence on tasks that are specifically related to cognitive abilities compared to non-cognitive abilities. The current study aims to take these results and apply them to academic performance. These studies demonstrate a

strong relationship between confidence and academic performance and their methods and findings helped to shape the current study.

Measures used in previous research

As much of the previous research focuses on subject specific confidence, many of the measures used reflect this. Stankov et al. (2015) discuss the most commonly used measures in confidence research, their strengths and limitations. Much of the confusion over what type of confidence is being measured has resulted in multiple measures that are specifically designed for testing confidence in a particular domain. They are classified into four categories; cognitive confidence, physical confidence, measures of self efficacy, and online performance based measures. The first three categories involve questionnaires that ask specific questions relating to performance in specific domains and ask the participant to rate their own skill in a specific area. Many of these measures have been developed from earlier research looking at self concept and self belief, which were termed as self confidence, (Shrauger & Schohn, 1995) though more recent research has classified confidence as a distinct trait (Stankov & Lee, 2017).

Online measures of Confidence

One of the problems with measuring confidence is that because it is a metacognitive ability it is not able to be directly recorded. When self efficacy measures are used, they tend to capture more about self beliefs than about the metacognitive aspect of confidence. One type of measure developed to move away from self efficacy questionnaires are online measures. These were developed to obtain a metacognitive measure of confidence that was distinct from the self report measures of self efficacy (Stankov et al., 2013). These are typically completed after a task and ask the participant to indicate their level of confidence that they have successfully completed the task correctly or that their answer is correct. Online measures allow the participant to indicate their confidence on a specific task immediately

after completing it. They are designed in such a way that they can be applied to numerous research designs. These measures have been used to find differences in confidence among young and older adult populations, and it was found that the online confidence measure was measuring an independent effect when compared to existing self report measures (Burns et al., 2016). This suggests that there is an aspect of metacognition being captured by online measures that is not found in self report measures.

Potential Problem of Multicollinearity

By using measures of confidence that are directly related to cognitive ability there is a suspected problem of multicollinearity. Multicollinearity occurs when significant correlations are found between variables but are found to be false positives as the factors already share a commonality (Kalnins, 2018). In the case of confidence and academic performance this is due to many of the previous studies using confidence on tests of cognitive ability as a predictor of academic performance. As intelligence is already a known predictor of academic performance, there may be an issue with measuring confidence alongside measures of intelligence. It is expected that a relationship would exist between how students perform on cognitive tasks and their grades. It may be that much of the previous research has been measuring the predictive power of intelligence and confidence has been operationalised incorrectly. However, there is evidence that confidence is a general factor that can be measured on many tasks (Pulford & Sohal, 2006). This study will use online measures of confidence on tasks measuring cognitive and non-cognitive ability. If confidence on a non-cognitive task is predictive of academic performance then it can be concluded that confidence is distinct from intelligence and other cognitive abilities.

Current Study

We know that intelligence and academic performance are related and there is research that demonstrates the link between confidence and academic performance. However, there is a suspected problem of multicollinearity in the existing research. This study aims to implement a design that measures confidence in a way that avoids this problem and to build upon previous findings towards a general measure of confidence. By using a non-cognitive task as well as one that measures intelligence and using online measures of confidence it is expected that we can demonstrate a relationship between confidence on a non-cognitive task and academic performance. This will allow us to establish confidence as a factor that is independent from intelligence.

Research Question and Expected Results

Based on previous research and the dominating theories in this area, there are a number of research questions that this study aims to answer. By combining the areas of previous research that have led to the current study, such as measures of intelligence, personality factors and gender differences in academic settings, this study hopes to add to the understanding of confidence as a predictor of academic success. Particularly with the design being implemented it is hoped that this study can illuminate some of the complexities of confidence as it is related to academic performance.

Research Question: Is there a Relationship between Confidence on Cognitive and Non-Cognitive Tasks and Academic Performance?

Based on the precedent set by previous research it is anticipated that there will be strong correlations between confidence and performance on the exam (Stankov, 2013; Stankov & Crawford, 1996, 1997; Stankov & Kleitman, 2008; Stankov & Lee, 2008, 2017; Stankov, Lee, et al., 2012; Stankov et al., 2013). It is expected that there is a relationship between online measures of confidence on the cognitive task and academic performance. The

design of this study is also specifically looking at how confidence on a non-cognitive task is related to academic performance.

It is expected that confidence measures of the non-cognitive task will be correlated with academic performance, but that performance on the non-cognitive task will have no relation to academic outcomes. By looking at online measures of confidence on both cognitive and non-cognitive tasks there can be a direct comparison that may highlight any differences that exist. It is predicted that online measures of confidence will not differ between the non-cognitive and cognitive tasks. It is hypothesised that academic performance and confidence on the non-cognitive task will be significantly correlated. If this result is found it can be concluded that measures of confidence are an independent measure with predictive power of academic performance.

Method

Participants

This study was undertaken at the University of Adelaide, with first year psychology students as the sample population. All students that completed the course Psychology 1A were invited to participate. Participants were awarded course credit for completing the study.

Demographics

Ninety seven participants completed the study out of 570 students enrolled in the course. Thirty males and 67 females participated in the study. The age range of participants was 16-59 ($M = 19.77$, $SD = 5.07$).

Measures

Participants completed a cognitive and non-cognitive task which they were asked to give confidence ratings on. They also completed a personality measure and were asked to predict their own grades.

Cognitive task - Ravens Advanced Progressive Matrices

The Ravens Advanced Progressive Matrices short form (APM-SF) is 12 item task designed to measure analytic reasoning, or problem solving skills (Raven, 2000). It is commonly used as a measure of intelligence and has high correlations with established measures of intelligence such as the WAIS ($r = .74$) and Otis I.Q. ($r = .75$).

The task presents a matrix with a distinct pattern and eight possible panels that complete the matrix (see Figure 1). There were two sample items to familiarise participants with the task. Ravens APM has good reliability with a Cronbach's alpha of .73 (Bors & Stokes, 2016).

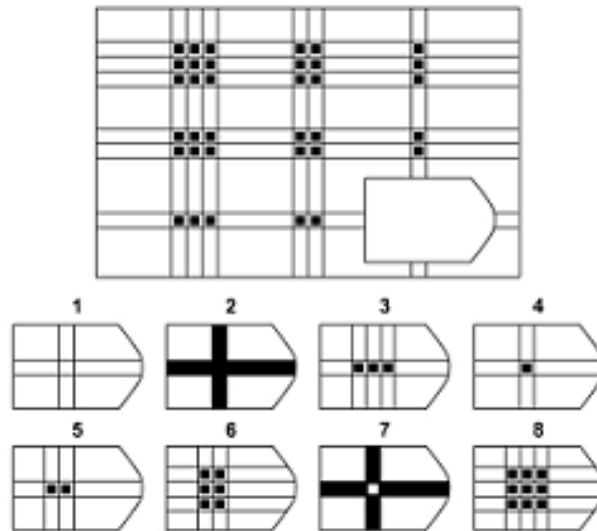


Figure 1. Example of the presentation of one item in the Ravens APM. The fourth option is the correct answer to complete the matrix.

Non-cognitive task – Mental Rotation Task

The Mental Rotation Task is a twelve item measure that assesses spatial visualisation. It is presented as 2D drawings of 3D objects, there are two matches to the original image, and two distractors, participants must select the two that are the rotated versions of the original image (see Figure 2). Answers are marked as correct only if participants select both of the images that are the rotated versions of the original image. There were 3 practice items to familiarise participants with the task. The Mental Rotation Task has good reliability of .88 (Vandenberg & Kuse, 1978).

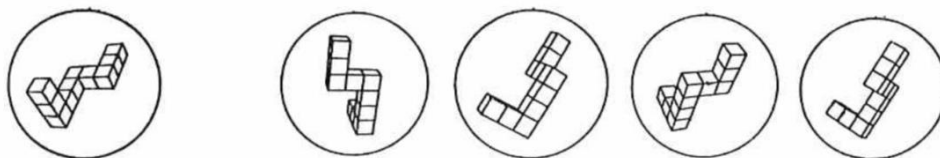


Figure 2. Example of the presentation of one item in the Mental Rotation Task. The first and fourth option are rotated versions of the original image on the left.

Measuring confidence

To gain an objective measure of confidence participants completed confidence ratings on a cognitive and non-cognitive task. The confidence ratings range from 0% to 100% and are in 10% increments. Participants completed these ratings after each individual question on the Raven's APM-SF and the Mental Rotation Task as well as after the entire set of questions on each of these measures. The confidence measure taken after the entire set of questions are termed as retrospective confidence, the confidence ratings taken concurrently with each question are the online confidence component. This method of measuring confidence is distinct from measures that may ask explicit questions of participants behaviour and cognition. The reliability of online self confidence ratings is good, with reported Cronbach's alphas ranging from .75 to .90 (Jonsson & Allwood, 2003; Kleitman & Stankov, 2007; Stankov & Crawford, 1996).

Measuring Personality - OCEANIC

Participants completed the 45 item Openness Conscientiousness Extraversion Agreeableness Neuroticism Index Condensed (OCEANIC). This short form personality assessment measures the constructs of the five factor model of personality. Each domain is assessed by 9 statements that are rated by the frequency in which they apply e.g. 'I am a shy person' (Extraversion). Participants responded to these statements using a 6 point Likert scale from 1=Never applies to me to 6=Always applies to me. The Cronbach's alpha for the personality domains range from .77 to .91, which indicates good reliability for the measure (Schulze & Roberts, 2006).

Academic Performance data

Academic performance data was measured using the participants semester one exam grade in Psychology 1A. All survey responses were collected before the exam. Participants had a six week window to complete the survey so that they could obtain their course credit. The average grade for the Psychology 1A course was not collected for the purposes for this study, as consent was not collected from all students in the course

Procedure

Participants completed an online survey using SurveyMonkey software (SurveyMonkey, 2019). Demographic information was collected at the start of the survey as well as informed consent. Participants then completed the measures in the following order: Raven's APM with confidence ratings, OCEANIC, Mental Rotation Task with confidence ratings, and then academic score predictions with confidence ratings.

Determination of statistical power

Power analysis was conducted using the statistics program RStudio ("R Core Team ", 2015). Based on a sample size of 97 and a power level of .80, an 0.2 effect size would be detected at alpha level .05. This analysis suggests that small but statistically significant effects will be detected through data analysis.

Ethics approval

The procedures and measures used in this study were approved by the University of Adelaide School of Psychology Human Research Ethics Subcommittee (Code number: 19/25).

Results

Screening and Cleaning Data

Data was collected over 6 weeks in Semester 1 and all responses were collected before the exam was undertaken. Twelve participants were removed from the data set due to failure to respond to a task, not completing the exam, or because they did not give consent for their data to be used. After these participants were removed the final sample size was 97.

Initial analysis suggested that many of the variables may not be normally distributed. Shapiro-Wilk tests indicated that exam scores, Advanced Progressive Matrices and the Mental Rotation Task scores may not normally distributed. Confidence scores on the Mental Rotation Task and Advanced Progressive Matrices were normally distributed. Exam grades were towards the higher end, which is not uncommon in university samples. The final data set was visually represented using histograms and QQ plots. These analyses demonstrated that the residuals were close to normally distributed, therefore parametric analyses were used.

As expected, the age of the participants was close to the 18-20 range, which is typically the ages of students in their first years of university ($M = 19.77$, $SD = 5.07$). There were also more than twice the number of female participants ($n = 67$) than male participants ($n = 30$). This disparity of participants between the genders meant that any statistical comparisons between males and females need to be done using non-parametric statistical analysis.

Table 1

Pearson Correlation Matrix Between All Variables

	1	2	3	4	5	6	7	8
1. Grade	-							
2. Grade prediction	.41**	-						
3. APM score	.36**	.21*	-					
4.APM online confidence	.10	.20	.57**	-				
5.APM retrospective confidence	.05	.11	.60**	.82**	-			
6.MRT score	.18	.09	.60**	.50**	.53**	-		
7.MRT online confidence	.11	.20*	.59**	.98**	.82**	.58**	-	
8.MRT retrospective confidence	.09	.15	.48**	.60**	.64**	.76**	.68**	-

Note: $p < .05$ * $p < .001$ **. $N = 97$

The Relationship between Exam Grades and Confidence

As shown in Table 1, there was a significant correlation between exam grades and grade predictions, this is not surprising as making a prediction on a particular task should correlate with performance on that task. This relationship was moderate which is expected as this was a prediction of future performance rather than reflecting on a task that was just completed. There was also a significant correlation between exam grades and Advanced Progressive Matrices scores, which was expected as it is a measure of intelligence. The Mental Rotation Task scores were not correlated with exam grades which was expected as the measure is non-cognitive and not found to be predictive of academic performance.

Scores on the Mental Rotation Task were moderately significantly correlated with scores on the Advanced Progressive Matrices, this was unexpected as these measures assess different abilities that are not considered to be related. Online and retrospective confidence on both the cognitive and non-cognitive task did not correlate with exam grades. The online measure of confidence on the both tasks were almost perfectly correlated which is a good indication that measuring confidence in this way is consistent on cognitive and non-cognitive tasks.

Interestingly, grade prediction was significantly correlated with Mental Rotation Task concurrent confidence but not with retrospective confidence. Both the tasks scores and online and retrospective confidence were significantly correlated, this shows that there is a relationship between the tasks and the participants confidence.

Differences in Performance and Confidence Between the Genders

When looking at the data set there were some interesting results between some variables and gender. These indicated that exam grade performance was higher among the female students but that males tended to report higher online and retrospective confidence on

both the Mental Rotation Task and the Advanced Progressive Matrices. This could indicate some correlations are being impacted by suppression effects brought about by gender differences.

Mann-Whitney U tests were used to determine whether there was a significant difference in results between the genders (Table 2). This test was used due to the unequal group size between male and female participants. It was confirmed that there were significant differences between males and females on exam grade performance, as well as online and retrospective confidence for both the Advanced Progressive Matrices and the Mental Rotation Task. Females scored higher on the exam and reported significantly less online and retrospective confidence on the Advanced Progressive Matrices and Mental Rotation Task, even though there was no difference between the genders on actual performance on either task.

Correlation matrices were then created for males and females separately to determine if there were significant correlations that were different from the correlation matrix of the entire sample.

Table 2
Mean scores for Males & Females, with Mann-Whitney U statistic, p and Cohen's D

	Males (N = 30)			Females (N = 67)			U	p	Cohen's D
	M	Mdn	SD	M	Mdn	SD			
Grade	67.39	66.67	13.11	74.04	75.00	12.75	733	.03	.51
Grade prediction	73.33	75.00	9.97	71.88	75.00	13.02	1046	.75	.12
APM scores	7.3	8.00	2.79	7.24	7.00	2.78	1032	.83	.02
APM online confidence	68.17	69.58	18.49	58.02	57.50	19.81	1303	.02	.52
APM retrospective confidence	7.4	7.00	2.33	5.99	6.00	2.42	1343	.01	.59
MRT scores	8.30	10.00	3.50	7.22	7.00	3.60	1173	.19	.30
MRT online confidence	65.17	65.00	20.04	54.13	54.17	20.22	1297	.02	.55
MRT retrospective confidence	7.23	8.00	3.53	5.10	5.00	3.35	1340	.01	.63

Male Participants Performance and Confidence

When looking at the correlation matrix of the male participants, there were findings that were distinct from the relationships seen within the entire sample. It was found that there were significant correlations between Advanced Progressive Matrices and Mental Rotation Task scores, as well as online and retrospective confidence with exam grades, which was not found when looking at the entire sample (Table 3). Their grade predictions significantly correlated to Advanced Progressive Matrices online and retrospective confidence and Mental Rotation Task online confidence, but not to Advanced Progressive Matrices scores. However, grade predictions were not found to be significantly correlated with exam grades Overall the relationships seen within the male participants are extremely different to the correlations seen within the entire sample.

Table 3

Male Correlation Matrix

	1	2	3	4	5	6	7	8
1. Grade	-							
2. Grade prediction	.19	-						
3. APM score	.54*	.27	-					
4. APM online confidence	.37*	.35*	.61**	-				
5. APM retrospective confidence	.43*	.36*	.66**	.81**	-			
6. MRT score	.50*	.19	.55*	.46*	.40*	-		
7. MRT online confidence	.44*	.37*	.63**	.98**	.80**	.56*	-	
8. MRT retrospective confidence	.53*	.27	.69**	.61**	.64**	.81**	.71**	-

Note: < .05 * < .001 **. N = 30

Female Participants Performance and Confidence

Female participants had results that were almost opposite to the relationships found with the male participants and were much more similar to the correlations seen in Table 1. The females in the sample only had grade predictions and Advanced Progressive Matrices performance correlate significantly with exam grades (Table 4). The female's grade predictions only had a significant relationship with exam grades and to no other variables. The correlations between Mental Rotation Task and Advanced Progressive Matrices scores, online and retrospective confidence with exam grades were very small. This may explain why the relationships seen within the male participants was not seen within the whole sample, as the relationships between these variables were suppressed by the results of the female participants.

Table 4

Female Correlation Matrix

	1	2	3	4	5	6	7	8
1. Grade	-							
2. Grade prediction	.53**	-						
3. APM score	.30*	.19	-					
4. APM online confidence	.08	.14	.58**	-				
5. APM retrospective confidence	-.02	.02	.60**	.81**	-			
6. MRT score	.09	.05	.62**	.50**	.56**	-		
7. MRT online confidence	.06	.14	.59**	.98**	.80**	.58**	-	
8. MRT retrospective confidence	-.01	.10	.41**	.56**	.59**	.74**	.64**	-

Note: < .05 * < .001**. *N* = 67

Effects of Personality

There is an established connection between academic performance and personality traits in the research. In our sample we found significant correlations between exam grade and conscientiousness ($r = .26, p < .01$), as well as between grade prediction and conscientiousness ($r = .25, p = .02$) and extraversion ($r = .20, p = .05$).

There were significant differences between the genders when it came to personality. A Mann-Whitney U test indicated that trait conscientiousness was significantly greater in the female group ($M = 4.10, Mdn = 4.11$) when compared to the males ($M = 3.76, Mdn = 3.72, U = 754, p = .05, d = .45$). There was also a significant difference between the genders in trait neuroticism, again with females ($M = 3.53, Mdn = 3.56$) reporting significantly higher than their male peers ($M = 3.06, Mdn = 3.17, U = 618, p < .01, d = .66$). There were no significant differences on the traits of Openness, Agreeableness or Extraversion between males and females.

For the males, personality traits did not correlate with exam performance, the tasks or either type of confidence on them. The females had some relationships present for conscientiousness. Particularly conscientious and exam grade had a significant moderate correlation ($r = .37, p < .01$), as did grade prediction ($r = .35, p < .01$). There were no significant relationships for neuroticism.

Discussion

This study aimed to add to the literature exploring the relationship between confidence and academic performance in university students. The design of this study is unique in this area and the subsequent findings are novel. This study aimed to demonstrate a relationship between confidence and academic performance that was independent of cognitive ability by using a non-cognitive task. The impact of factors related to academic success, such as personality and gender differences are explored. The findings and their implications are discussed below, as well as future directions of research based on the design and aims of this study.

Interpretation of Findings

When looking at the entire sample in this study, there were no significant correlations between the measures of confidence and performance on the exam. As opposed to the existing research, this study did not find a correlation between the measures of confidence on a cognitive task and performance on the exam as was hypothesised (Stankov, 2000, 2013; Stankov & Kleitman, 2008; Stankov & Lee, 2008, 2014). The differences in gender are believed to have suppressed the correlations that were expected to be present in the entire sample. The findings are discussed and interpreted below.

Confidence and Academic Performance

There was a significant moderate correlation between exam grade and grade prediction. This shows that in general this sample was well calibrated in their predictions of their performance, meaning that their confidence ratings were overall quite accurate of their actual performance. On this specific task of the exam the participants did not show overconfidence, which can be present when judging performance on cognitive tasks (Stankov, Pallier, Danthiir, & Morony, 2012). This type of prediction of performance has not

previously been explored in the literature on confidence. The grade prediction was a way to gauge the confidence that participants had before the exam on what they believed was an achievable outcome. This differs from the confidence measured on the cognitive and non-cognitive tasks as participants were not assessing their performance in real time but making an assessment of their future performance.

The female participants had a significant correlation between grade prediction and exam grades, this was the only confidence measure that had a relationship with performance outcomes. This may indicate that the female participants were more confident when they had not yet completed the task. The male participants had the opposite relationship to grade prediction, it was not significantly correlated with exam grade, whereas all other measures of confidence were. This could suggest that male participants are more confident on tasks they had completed immediately before giving a rating than they were on future tasks.

Interestingly, the median grade prediction given by males and females was exactly the same with the female participants scoring the same median result on the exam. This could suggest a difference in calibration occurred when predicting future performance (Dinsmore & Parkinson, 2013). Males and females predicted the same outcome, but the male students did not end up achieving based on their prediction. There are other factors that could contribute to the disparity in exam scores, but the result is interesting, nonetheless.

Online Measures of Confidence

Although the relationships were not significant, the correlations between online confidence on the Mental Rotation Task and Advanced Progressive Matrices and exam grade were of similar magnitude. This indicates that online measures are consistent on both cognitive and non-cognitive tasks. More studies that incorporate this design will help to illuminate the strengths and weaknesses of online measures of confidence. Online measures

of confidence have been thought to be measuring an ability that is a general factor (Burns et al., 2016).

The male participants had strong correlations between the online confidence and retrospective confidence of the Mental Rotation Task and Advanced Progressive Matrices with exam grade. This was the anticipated finding that demonstrates the value of confidence on tasks that are not directly related to cognitive ability or intelligence. As expected, based on previous findings confidence on the cognitive task was related to academic performance for the male participants (Gerry Pallier, 2003). This is theorised to be due to the shared factor of cognitive abilities in tasks such as the Advanced Progressive Matrices and academic performance (Stankov & Crawford, 1997). Finding this relationship between academic performance and confidence on a non-cognitive task, which for the male participants was of similar strength to the correlation of the cognitive task, substantiates the idea of confidence as a general factor that can be used as a predictor of academic success.

Personality and Academic Performance

There was a significant correlation between exam grade and conscientiousness. There were also gender differences in personality factors, with females reporting significantly higher trait conscientiousness and neuroticism. This is theorised to be due to the ways that females and males are socialised and the self concepts and beliefs that are developed from those experiences (Vianello, Schnabel, Sriram, & Nosek, 2013). When looking at the genders separately there were no personality traits for males that correlated with performance or confidence. Females had moderate relationships between conscientiousness and exam grade as well as grade prediction. Conscientiousness is associated with traits such as discipline, being hardworking, organisation, and the need for accomplishment (Dumfart & Neubauer, 2016). These traits lead to success in many areas, but especially in academic settings. It follows that a group which scores high in this trait are primed to achieve more than a group

that does not. It may be that the female participants put in more time and work to achieve high marks on the exam than their male peers.

The direct links between personality and confidence scores have not previously been explored in relation to academic performance. For the female participants in this study the most significant relationships to exam grade were with the Advanced Progressive Matrices, grade prediction and conscientiousness. Previous research demonstrated that students who were more conscientious, tended to display higher levels of self efficacy (Stajkovic et al., 2018). However it has since been found that existing measures of self efficacy were actually capturing data that is closer to personality traits than to metacognitive ability, which online measures of confidence measure (Burns et al., 2016).

Gender Differences in Confidence

Females outperformed the males on the exam, however there were no gender differences on the Mental Rotation Task or the Advanced Progressive Matrices. There were many gender differences when it came to confidence. The females had no significant relationships between exam grade and any form of confidence, the only correlated variables were Advanced Progressive Matrices scores and exam grade prediction. Both of the variables that had significant relationships for females have clear relationships with intelligence and academic performance specifically. Males had significant moderate correlations with scores on both tasks and with all confidence variables. The interesting difference was that grade prediction and performance had a non-significant weak correlation within the male participants, but that grade prediction had moderate significant correlations with both types of confidence on the Advanced Progressive Matrices and with online confidence on the Mental Rotation Task.

Findings in Relation to Previous Research

Due to the unique design of this study there are not many direct comparisons to the results found. Theoretically there is a lot to be unpacked within the findings, there are many trends that are seen in previous research. The hypothesised results were only found within the male participants and though this result has a precedent in the literature, it has not been explored using online measures of confidence (Gerry Pallier, 2003). There is evidence that demonstrates that females achieve more academically than compared to their male peers (Duckworth, 2006; Ehrlinger et al., 2016; G. Pallier et al., 2002; Shrauger & Schohn, 1995). This study explores how confidence is related to this pattern. There are aspects of self concept, personality, and gendered experiences that could produce the results seen in this study (Duckworth & Seligman, 2005, 2006; Kukulku et al., 2013).

Confidence and Academic Performance

Within the male participants it was found that confidence on a non-cognitive task was related to academic performance. This relationship demonstrates that measures of confidence can relate to academic performance independently of tests of cognitive ability. However, the non-cognitive task itself also correlated with exam grades for the males, this effect was unexpected. The Mental Rotation Task is not thought to be related to intelligence or academic performance but for the males in this study it was (Kleitman & Stankov, 2001). Previous research has shown task specific confidence to be related to performance, this was true of both the Mental Rotation Task and the Advanced Progressive Matrices (Stankov & Lee, 2008, 2017; Stankov et al., 2013). Confidence on the task was highly correlated with performance, which is consistent with previous findings that looks at mathematical confidence and performance (Stankov & Lee, 2014; Stankov et al., 2013). This study's findings demonstrate that the relationship between confidence and performance can be seen across many different tasks not just relating to intelligence or academic outcomes.

Gender Differences

The relationship expected to be found between confidence and academic performance seems to have been suppressed by the gender differences in this sample. When looking at the separate correlations for males and females it is very clear that the relationships are almost opposite. There have been differences found between the genders in confidence, academic performance and personality traits in previous research (Jonsson & Allwood, 2003; Kukulcu et al., 2013; Gerry Pallier, 2003; Rosander & Bäckström, 2012; Stankov & Kleitman, 2008). However, this type of effect has not been reported to this magnitude in previous studies, this may be because the participants in previous studies were older and their confidence scores were directly related to tests of cognitive ability (Gerry Pallier, 2003). There is evidence that males show overconfidence compared to their performance outcomes (Ehrlinger et al., 2016). In this study, males had confidence on both cognitive and non-cognitive tasks correlate with exam grades, whereas females did not. These differences could be due to personality factors, as females showed higher levels of trait conscientiousness which is linked to greater performance in academics due to the need for accomplishment and for having skills in organisation and discipline (Barton et al., 1972; Dumfart & Neubauer, 2016; Singh, 2009).

It may be that the female participants engaged in more behaviours that resulted in high marks on the exam due to their higher levels of trait conscientiousness. There was no measure of attendance of lectures, or any behaviours that may result in higher academic performance used in this study, so it is unclear what the relationship is between trait conscientiousness and positive outcomes in grades caused by study behaviours.

Implications of Findings

In many respects the results of this study raise more questions than they solve. Specifically, why the differences found between males and females in this study are so

pronounced. This particular sample may be an outlier but the differences in confidence and performance are certainly an interesting finding and could impact on how individual differences and non-cognitive predictors of academic performance are researched in the future. Specifically, in terms of the relationships that are explored, and the differences found between different groups, whether that be based on gender or other factors.

In terms of real world applications of this research, there is still a lot that needs to be explored in how confidence affects academic performance. There is an indication that confidence in grades does have a relationship with actual performance outcomes. With more research into this area and the specific functioning of confidence within academics there could be implementation of confidence building programs for students. It could also be useful for university staff to understand how confidence can affect their students' performance and how they can best promote confidence in the classroom to increase academic outcomes on assessments.

Confidence and related metacognitive abilities impact the way we experience our lives and these effects are interesting and have implications in different areas. In terms of academics there are inherent forms of self concept and personality that change the way students approach their work. Particularly in terms of trait conscientiousness and it's correlation with exam performance. Specific behaviours that students with higher trait conscientiousness engage in may be the difference between average and high academic outcomes. By understanding their functioning changes can be made in education to promote positive outcomes for individuals and for educational institutions.

Methodological Strengths

The design of this study is easily replicable which allows for reproduction of findings to build upon the research exploring confidence as a predictor of academic performance

(Makel, Plucker, & Hegarty, 2012). A survey format is also easily changed to include other variables that may be relevant. Online measures of confidence are able to be applied to many measures, allowing them to be utilised in various contexts. This will allow for the research to expand quickly and use various design formats and participant pools, due to the portability and ease of use of the survey format and online measures of confidence.

The variables collected in this design led to interesting findings that had not been extensively discussed in previous research. Opening new areas of interest is an aspect of research that leads to new discoveries and effects. By bringing the areas of confidence, performance, and personality factors together this study has illuminated some of the relationships that exist between these variables and the various ways they can present, even within a small and limited sample.

Within the entire sample, and the male and female participants separately, the strength of correlations were moderate to strong on most variables. Finding moderate sized effects within a small sample size indicates that the design and aims of this study are worth pursuing on a larger scale (Cizek, Bowen, & Church, 2010). This study has added to the understanding of how confidence functions in university students and how it is related to academic performance, which can be easily explored by further research.

Methodological Limitations

This study relied upon convenience sampling and the resulting sample size was limited. Psychology students are frequently used in studies for the ease of collecting data, which is an example of the sample bias present in much research in this area (Nielsen, Haun, Kärtner, & Legare, 2017). Due to the course requiring them to participate in studies to obtain credit, participants were incentivised to respond to this study. The results gathered from these participants may be different from those that would elect to participate in the study for no

course credit. The limited sample pool consisting of first year psychology students in Adelaide reduces the external validity of the results (Makel et al., 2012; Nielsen et al., 2017). These results are likely not representative of the wider university population.

Online measures of confidence have not been used in this specific context and are relatively new as a measure in this area of research. There is not a lot of literature on how they should be utilised in educational research. The lack of research on their reliability and validity makes it unclear how they impact the findings of this study (Cizek et al., 2010). Further research is required to understand the psychometric properties of online measures of confidence.

The survey used for this study was also lengthy and fatigue effects as well as random responses need to be considered. The average completion time was approximately thirty minutes and participants completed the survey within their own time and without researcher observation. This may have reduced the accuracy of the responses at the end of the survey (Meade & Craig, 2012). There were many sections of the survey to complete and, although there were no indications of this in the raw survey data, it is possible that participants submitted random responses to complete the survey and obtain course credit.

Considerations for Future Research

It would be interesting to see if these results would be replicated across different faculties and with university students of culturally diverse backgrounds. It may be that psychology students have certain traits that led to the results of this study (Nielsen et al., 2017). There were also some sampling biases due to all participants being psychology students and receiving course credit. The students that participate in research for their grades may be different from those that did not. Future research needs to consider the limitations

presented in this study as well as the evidence from previous research to improve upon the current study.

The small number of males in the study ($N = 30$) help to explain how the effects seen within the female participants ($N = 67$) suppressed those seen among the whole sample. If the groups were more even in number, the suppression of the relationships may not have been so extreme. Replication of this study with more equal group sizes would help to confirm the effects seen in this design. It may even be helpful to look at these effects within studies that only explore confidence and academic performance in males and females separately.

Exploring students' different experiences of confidence in relation to their gender, area of study, age, cultural background, and socio-economic status will help to build a more complete picture of the functioning of confidence. More measures of individual differences and demographics should be included to determine if there are certain factors that cause different experiences of confidence. These measures are typically collected by universities upon enrolment and with permission from participants could be collected by researchers.

Expanding the literature on online measures of confidence will help to clarify the strengths and limitations of using them as a predictor of academic performance. The validity and reliability of online measures of confidence are not currently known as the measure is relatively new. Future research should use these measures on various existing measures of cognitive and non-cognitive abilities. There is potential for online measures of confidence to be used in various areas of research, doing this will add to the understanding of confidence as a general factor.

Future directions based on findings

The purpose of this study was to demonstrate that confidence can be used as a measure of academic performance independently from cognitive abilities. Since this design is

unique it is expected that findings from this study will be replicated to build the literature that distinguishes confidence on cognitive and non-cognitive tasks. There are a number of existing areas of research as well as potential factors that could explain the relationships found in this study between confidence and academic performance (McGeown et al., 2015; Salanova et al., 2010; Stankov, Pallier, et al., 2012).

Mental toughness

This theory was briefly touched upon in the introduction, this theory posits that there are a number of metacognitive factors that combine to describe a student's mental toughness. This is their ability to cope and perform in various academic scenarios. Mental toughness could explain the gender differences in confidence as females are thought to exhibit more behaviours associated with models of mental toughness. There is evidence that female adolescents experience more negative mental health and still outperform their male peers (Duckworth, 2006; Heaven & Ciarrochi, 2012; Rosander & Bäckström, 2012). There may be other aspects of self concept and determination that contribute to both confidence and academic performance. It has been shown that levels of self discipline are predictive of academic performance, and that females exhibit more behaviours that show self discipline in academic settings (Duckworth & Seligman, 2005, 2006). These factors may contribute to metacognitive appraisals like confidence, but not enough is known about these relationships to make a conclusion.

Qualitative and Mixed Method Approaches

Although confidence is a metacognitive ability it may be illuminating to use qualitative methods with students to understand their experience of confidence in relation to their performance. Particularly linking students' comments about their confidence to ratings and academic outcomes could provide insight into types of thinking that affect this relationship. As confidence is related to thoughts about oneself there may be interesting

results gleaned from conducting thematic analysis or content analysis. A possible implementation could be asking students how they came to particular confidence ratings, the factors and ideas that lead them to pick a certain level of confidence. This could easily be added to online measures of confidence on various tasks.

Other Potential Impacts on Confidence

The gender differences found in this particular study indicate that the way confidence functions may be affected by external variables (Dinsmore & Parkinson, 2013; Ehrlinger et al., 2016; Stankov & Crawford, 1996). This particular study did not include any participants that identified as gender diverse, which may need to be considered for future research. Personality factors and other measures of individual differences should be explored for their relationship to confidence in student populations.

The age and experience of students in academic settings may add to their confidence as well as ability to achieve high results. This particular effect was not explored in the current study. There has been research looking at confidence and intelligence in younger adults compared to older adults, it was found that older adults tended to be overconfident, however this was not in relation to academic performance (Burns et al., 2016). In a university setting, older and more experienced adults may only be a few years older than the first year students that were participants in this study.

Students experiencing mental health issues may be experiencing low self esteem and other symptoms which could potentially lower their ratings of confidence (Salanova et al., 2010). These students may be achieving grades that are comparable with their peers. This affect has been seen within female high school students, where negative mental health did not affect academic performance (Duckworth & Seligman, 2005; Leeson et al., 2008; Rosander et al., 2011). However, it is unclear if there are any impacts of confidence ratings that could be caused by mental health. Including a measure of depression and anxiety, as well as asking

students of any mental health issues they are experiencing may allow for a more complete understanding of how this factor may impact confidence.

Traits such as self discipline and conscientiousness are shown to have a relationship with academic success. An added measure of behaviours related to these traits could help to distinguish their affects from confidence. This could include asking how many time students attend class, whether they complete readings and related tasks, how much and how often they study. This could help to gauge the relationship between motivation and actual behaviours that result in high grades. It is possible that high confidence in ability does not translate to behaviours that lead to academic success.

Conclusion

This study implemented a unique design and produced results with several points of interest. Specifically, the differences found between males and females, which may have several potential explanations. This is an area which further exploration may uncover functions of metacognition that are different between the genders or due to other factors. The findings within the male participants demonstrate the theoretical expectations of this study and it is hoped that further research will clearly distinguish confidence as a predictor of academic performance.

By moving away from measures of confidence that are related to cognitive ability research is able to focus and develop a general ability of confidence. There are many research areas that could incorporate ideas of metacognitive functioning to better understand human functioning and how these factors change behaviour and life outcomes beyond the academic setting.

The findings from this study are hoped to inspire further investigation into the relationship between confidence and academic performance. It is clear that there is a

relationship present, but more research is required for it to be more thoroughly understood. By increasing the understanding of how confidence operates in different settings it can be employed to increase performance in academics.

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