

Do attitudes towards statistics influence the decision to study psychology at degree level? A pilot investigation

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Statistics anxiety has often been linked to performance in statistics modules for psychology students, despite this no research to date has examined whether attitudes towards statistics can predict whether or not a student chooses to carry on psychology from pre-tertiary to higher education. In this pilot study 41 second year A-level psychology students completed an online measure of statistics anxiety (Statistics Anxiety Rating Scale, STARS) and answered questions about their current A-levels and whether or not they were applying to study psychology at university. The findings showed that worth of statistics, but no other STARS measures significantly predicted whether or not an individual was planning on studying psychology at university. Findings are discussed primarily in relation to teacher variables that may impact subject choice and statistics anxiety in A-level students.

Keywords: transitions, statistics anxiety, worth of statistics, A-level psychology.

Introduction

IT IS NOW well established that up to 80 per cent of psychology undergraduate students report experiencing statistics anxiety (Onwuegbuzie & Wilson, 2003), and this means that teaching research methods and statistics can be very challenging. This may be exacerbated by the finding that many new entrants to a psychology degree are not aware of the statistical and methodological components of their course (Ruggeri et al., 2008), or viewing it as the hardest part of the psychology curriculum (Barry, 2012). High levels of anxiety about studying statistics, along with negative attitudes towards the relevance of statistics, are associated with a range of negative academic outcomes for psychology students. For example, high levels of statistics anxiety are associated with higher levels of procrastination (Onwuegbuzie, 2004) and poorer academic achievement on statistics assessments (e.g. Hanna & Dempster, 2009; Macher et al., 2012). Whilst we have some understanding of the relationship between anxiety about and attitudes towards statistics within the undergraduate psychology population, to date, no research

has explored whether these anxieties and attitudes influence who applies to study psychology at degree level. Whilst there are likely to be a wide range of factors that determines a student's educational choices, having an understanding of the possible role of statistics anxiety would be beneficial in supporting pre-tertiary students in making informed choices about studying psychology, and during students transitions from pre-tertiary to higher education.

The Statistics Anxiety Rating Scale (STARS; Cruise, Cash & Bolton, 1985) is an often used measure, which contains two sections: statistics anxiety and attitudes towards statistics. Three scales relate to statistics anxiety: test and class anxiety, interpretation anxiety, fear of asking for help, and three separate scales related to attitudes towards statistics: worth of statistics, fear of statistics teachers, computational self-concept or confidence in mathematical ability. In addition to the emotional consequences of experiencing high levels of anxiety, students who report experiencing statistics anxiety tend to have poorer performance in statistical

assessments (e.g. Hanna & Dempster, 2009; Macher et al., 2012).

A fair amount of research has explored students' abilities and attitudes towards statistics at the very beginning of their undergraduate studies, and Field (2014) suggests that research on the transitions into the statistical components of a psychology degree fall into four categories: how well the pre-tertiary study of psychology prepares students for degree level study, students' mathematical and statistical competency, diagnostic assessment of numeracy and statistical skills, and student expectations. For example, the A-level psychology syllabus may ensure that all students start their psychology degree with strong basic knowledge and confidence in their statistical ability, but not all psychology undergraduates have previously studied psychology. Further, the mathematical abilities of psychology students appear to be declining over time (Mulhern & Wylie, 2005). Few psychology degree programmes include an early assessment of mathematical and statistical ability (around 13 per cent; Field, 2014). Perhaps more importantly, students often have unrealistic expectations about the content of their psychology degree with many not knowing about the statistical content of the degree upon entry to the programme. Ruggeri et al. (2008) found that just over half of students feel that the statistical elements of their degree are emphasised too much, even at the end of their first year of study (Rowley et al. 2008).

Whilst the previous literature does provide some insights that may help us to develop interventions to alleviate statistics anxiety, support the learning of statistics, and encourage engagement, the research to date focuses on undergraduate psychology students. When trying to understand the factors that may support transition into the statistical components of a degree, it is likely to be of great benefit to consider these issues in students in pre-tertiary education, who are currently deciding whether to study psychology at degree level. The present study fills this gap with a study of

A-level psychology students, currently in their final year of pre-tertiary education, who are applying to study at university. In this study students were asked whether they were applying to study psychology at university, or another subject. They were also asked to complete the STARS and comparisons were made between the two groups to consider whether students who experience higher levels of statistics anxiety are less likely to apply to study psychology at degree level.

Methods

Participants

There were 41 participants in this study, all were in the final year of studying for their A-levels, one of which was in psychology, and all were applying to study at university. There were four males and 37 females. The participants were recruited through advertising the study on Twitter and through advertisements sent to schools that our department has existing links with for either outreach or research purposes. Participants were recruited from 26 different schools, 19 (46.3 per cent) of the participants were studying at a state school, 12 (29.2 per cent) at a grammar school and 10 (24.4 per cent) at a private school. Fifteen (36.6 per cent) of the students had a parent who had studied at university. Nineteen (46.3 per cent) were applying to study psychology at degree level and 22 (53.6 per cent) were applying to study a different subject. This study was granted approval by the Royal Holloway College Ethics Committee.

Materials

The survey was run through Qualtrics, allowing participants to complete the survey online. It was divided into two parts, the first asking participants about their educational background and the second was the STARS. Participants were asked about the type of school they attended for their GCSE examinations (state, grammar or private school) and their grades in maths, English language, English literature and science examinations. They were also asked about the type

of school they were currently attending for their A-level examinations (state, grammar or private school) and which subjects they were studying.

The STARS comprises of 51 questions divided into two parts. The first 23 questions are regarding statistics anxiety, where students have to rate how anxious different situations would make them feel, and contains three separate scales: test and class anxiety (e.g. walking into the room to take a statistics test), interpretation anxiety (e.g. determining whether to reject or retain the null hypothesis) and fear of asking for help (e.g. asking one of your lecturers for help in understanding a printout). The following 28 questions are for the attitudinal scales, asking students the extent to which they agree with statement, and including scales regarding worth of statistics (e.g. I feel statistics is a waste), fear of statistics teachers (e.g. most statistics teachers are not human) and computational self-concept or confidence in mathematical ability (e.g. I do not have enough brains to get through statistics). For all scales responses are given on a Likert scale of 1–5, with higher scores indicating higher levels of anxiety or poorer attitudes towards statistics.

For the anxiety scales, students are asked to indicate to what extent a particular scenario makes them feel anxious, from 'not at all' to 'extremely.' The test and class anxiety scale has eight items, giving scores that range from 8–40. Cronbach's alpha was .923, indicating an excellent level of internal consistency. Interpretation anxiety has eleven items within the scale, giving scores from 11–55, and Cronbach' alpha was good at .850. Fear of asking for help comprises just four items, resulting in scores from 5–20, with a good level of internal consistency as Cronbach's alpha was .813.

In the measurement of the attitudinal scales, students are asked how much they agree with statements, from 'strongly disagree' through to 'strongly agree'. Unfortunately, data were not recorded for four items due to a computer error. However, the

Cronbach's alpha for all three attitudinal scales suggests that the data collected are reliable, and therefore the data have still been included in the analysis. The worth of statistics scale should comprise sixteen items, but data were recorded for fourteen items, giving scores ranging from 14–70. Cronbach's alpha was .921, indicating an excellent level of internal consistency. Fear of statistics teachers typically has five items, but data were recorded for three, resulting in scores ranging from 3–15. This scale is deemed to be reliable as Cronbach's alpha was .731, indicating an acceptable level of internal consistency. Finally, computational self-concept included all seven items, giving scores running from 7–35. Internal consistency was deemed to be good as Cronbach's alpha was .898.

Design and analysis

The main analysis was a logistic hierarchical regression, with the binary outcome being whether the participant was applying to study psychology at university, or another subject. The first block of predictors included the control variables of the student's maths GCSE grade and the type of school they were attending for their A-levels. There were three school types (state, grammar or private), and these were coded with being at state school as the comparator group, therefore providing two separate predictor statistics to show whether attending a grammar school or a private school is predictive of choosing to study psychology at university, or not. The second block of predictors contained the six STARS variables to explore whether statistics anxiety and/or attitudes towards statistics are predictive of whether students choose to study psychology or not.

Results

Descriptive statistics for all six STARS scales, for the overall sample and separately for those applying to study for psychology or not are shown in Table 1. The only significant difference between the two groups was for understanding the worth of statistics, with

those who were applying to study psychology at degree level having more positive attitudes (lower scores, see Table 1). There were no significant differences in the STARS scales between students whose parents did or did not study at university (all p 's $\geq .095$). Overall, in comparison to previously published data from undergraduate students (e.g. Bourne, 2018; Hanna et al., 2008), scores on all scales are relatively low, indicating that the students tended not to have excessively high levels of anxiety or poor attitudes towards studying statistics.

In the logistic regression, the first block, containing the control variables, was significant ($\chi^2(3) = 9.9, p = .020$), with the variance explained being 28.6 per cent, as indicated by the Nagelkerke R^2 . The control variables are able to correctly predict whether students apply to study psychology or not at university in 68.3 per cent of cases, with higher accuracy for predicting students who do choose to study psychology (73.7 per cent) than those who chose not to (63.6 per cent). Maths GCSE grade was not a significant predictor, but type of school was

approaching significance. The percentage of students applying to study psychology at university was 57.9 per cent for state schools, 58.3 per cent for grammar schools and 10 per cent for private schools. In comparison to participants attending state schools, the subject choice for those at grammar schools was not significantly different. However, for participants attending a private school, there were significantly fewer students applying to study psychology than for students in state schools.

Including the statistics anxiety predictors significantly improved the model ($\chi^2(6) = 13.0, p = .043$), with the final model being significant ($\chi^2(9) = 22.9, p = .006$) and the total variance explained was 57.2 per cent using the Nagelkerke R^2 . In this final model, whether a student applied to study psychology or not was successfully predicted in 80.5 per cent of cases, with similar accuracy for those who chose to study psychology (78.9 per cent) as for those who did not (81.8 per cent). Five of the six STARS predictors were not significant: test and class anxiety, interpretation anxiety, anxiety around asking for

Table 1: Descriptive statistics for all six STARS scales, for all participants and separately for those applying or not applying to study psychology at university

	Scale scores		All participants (N = 41)		Not applying to study psychology (N = 22)		Applying to study psychology (N = 19)	
	Min	Max	Mean	SD	Mean	SD	Mean	SD
Test and class anxiety	8	40	22.4	8.0	23.5	7.5	21.1	8.6
Interpretation anxiety	11	55	22.9	7.5	24.5	7.5	21.0	7.2
Anxiety around asking for help	5	20	7.2	2.9	7.7	2.9	6.7	2.8
Worth of statistics	14	70	37.3	11.4	41.3	10.0	32.7	11.4
Fear of statistics teacher	3	15	6.6	2.7	7.0	2.6	6.1	2.8
Computational self-concept	7	35	19.3	6.8	20.5	6.5	17.9	7.1

Table 2: Summary of the regression analysis

		β	p
Block 1: Control variables	Maths GCSE grade	-.565	.189
	Type of school	-	.055
	Grammar school	-.308	.703
	Private school	-2.953	.018
Block 2: STARS variables	Test and class anxiety	.097	.275
	Interpretation anxiety	.052	.543
	Anxiety around asking for help	.122	.567
	Worth of statistics	-.252	.024
	Fear of statistics teacher	.200	.387
	Computational self-concept	-.093	.395

help, fear of statistics teachers and computational self-concept. Only the understanding of the worth of statistics was a significant predictor, with lower mean scores, indicating a better attitude towards the worth of statistics within psychology, for students who were applying to study psychology at university.

Discussion

This study is the first to examine whether A-level psychology students who experience higher levels of statistics anxiety are less likely to apply to study psychology at degree level. In the final model, worth of statistics was a significant predictor of group membership, with individuals who were applying to study psychology at university having a better attitude towards the worth of statistics than those who were applying to study another subject. None of the other STARS measures (test and class anxiety, interpretation anxiety, anxiety asking for help, fear of statistics teachers, and computational self-concept) were significant predictors of whether an individual was applying to study psychology at university or not. In the first block it was found that school type was approaching significance, with individuals attending a private school less likely to be applying to study psychology at university. Despite this, only 10 students in

our sample were from a private school and therefore the relationship between school type and whether or not someone applies to study psychology warrants further investigation. Indeed, statistics reveal that individuals in independent schools are less likely than those in state schools to choose to study Psychology at A-level to begin with (Rodeiro, 2007).

This research highlights the importance of worth of statistics when exploring the factors that predict whether or not students choose to study psychology at university. This finding may be explained by evidence that worth of statistics has been related to student procrastination (Onwuebuze, 2004), as well as to fear of failure and task aversiveness (Azure, 2011). Consequently, students who fail to engage with the area of study, either through avoidance or fear, may be less likely to then pursue studying psychology. Furthermore, an individual's interest in statistics has been found to be related to performance in statistics exams (Macher et al., 2012). It is therefore possible that a student's understanding of the worth of statistics might impact not only on their choice of degree subject, but also on their approaches to their studies (e.g. increased procrastination and

fear of failure) and their academic performance during their undergraduate studies.

Whilst students may anecdotally blame their statistics anxiety on their mathematical ability, these findings suggest that mathematical ability might not be the only contributing factor to statistics anxiety. The findings of this research suggest that computational self-concept, or confidence in mathematical ability, does not significantly predict whether or not students continue studying psychology in Higher Education. This provides further grounding that statistics anxiety is a separate phenomenon to maths anxiety, this has recently been supported in research demonstrating both shared and independent variance in maths and statistics anxiety (Paechter et al., 2017).

It is also noteworthy that the extent of statistics taught at A-levels differs depending on exam board taken. Although similar in content, exam boards differ in their emphasis of practical work and examination of research methods. Whilst some courses introduce statistics and research methods in Year 1, other courses do not introduce statistics and research methods in Year 2 (Rowley & Dalgarno, 2010). As such, how much emphasis is placed on statistics early on in the study of psychology may influence attitudes towards statistics. In fact, researchers have emphasised that many students do not realise the centrality of research methods and statistics in psychology courses in higher education institutes (Hulme & Kitching, 2013; Ruggeri et al., 2008). This may be particularly important as university application deadlines often fall early in the second term of the second year of A-level, some students may not have had as much experience of the statistics and research methods requirement of psychology at this stage, on the other hand some students' attitudes regarding statistics and research methods may already have formed influencing degree choice.

Teacher variables are also likely to play an important role in whether a student decides whether or not to study psychology

at university. In fact, previous research has suggested that subject teachers influence a student's subject choice (Moogan & Baron, 2003) and in a large sample of UK students planning to enter higher education in the next year, teachers were found to be the strongest factor influencing a student's decisions about degree choice (Maringe, 2006).

It is noteworthy that a student's subject-specific anxiety has been found to be influenced by teachers, whom may shape attitudes towards subject specific content (Brady & Bowd, 2005). In fact, in mathematics, a teacher's level of maths anxiety has been linked to student's maths achievement (Beilock et al., 2010). In examinations of psychology teachers' attitudes towards teaching psychology A-level, it was demonstrated that 28 per cent of teachers reported lack of confidence in statistics and research methods and 48 per cent of teachers expressed that they required further training on research methods and statistics content (Rowley & Dalgarno, 2010). It is therefore possible that A-level teachers' lack of confidence may be passed on to their students. In turn, this may have an impact on understanding the relationship between statistics anxiety and the choice to study psychology at university. Future research should examine how A-level psychology teachers statistics understanding, competency and anxiety may influence their students' attitudes towards statistics. Given that teachers are a strong factor in student's choices about higher education, understanding how teacher variables may impact student's attitudes towards statistics warrants further investigation.

Teaching style may also play a role in student's level of statistics anxiety, in particular, immediacy, the perceived physical and psychological closeness students feel to teachers, has been found to influence all six subscales of the STARS measure (Williams, 2010). Further, Williams (2010) compared immediacy instruction (treatment) with a low immediacy condition (control), within a statistics course. They found that teachers who were more approachable and available

had students who reported significantly lower levels of statistics anxiety post-treatment compared to students in the control condition. This research further emphasises the need to examine how teacher variables may account for student variability in statistics anxiety, which may consequently impact the decision to study psychology in Higher Education.

There are likely to be a large number of factors that determine a student's university choices, and as such the present study only reflects a narrow examination of the possible predictors. For example, in future studies we could include factors such as career choice (Kaye & Bates 2016), being the first in their family to apply to university, or previously studied subjects. Why, then, might anxiety about statistics, and specifically understanding the worth of statistics for psychology, influence a student's university choices? It may be that students who are less interested in psychology (perhaps taking psychology as a fourth subject) are less likely to engage with the curriculum, making the worth of statistics less clear. Or it might be that students who have struggled with the statistical elements of the curriculum are less likely to want to pursue the subject further. Alternatively, it might be that students who have weaker mathematical abilities or are more anxious are less likely to want to study psychology at degree level. It is also possible that some students decide to still study psychology at degree level, even though they are highly anxious about statistics, and it would be interesting to further consider their coping strategies if they are successful in gaining a place at university. The role that statistics anxiety, or more specific aspects of attitudes towards studying statistics within psychology, plays in A level student's university choices certainly deserves greater attention in future studies.

It is also relevant to consider whether the link between experiencing statistics anxiety and negative attitudes towards studying statistics is a direct relationship, or whether there may be other mediator factors. For example, a student's own mathematical ability or their

confidence in their mathematical ability, may be an important variable to consider when exploring the relationship between statistics anxiety and their choices regarding entering higher education. Within the undergraduate psychology student population there is evidence that students with poorer mathematical abilities have greater anxiety about and negative attitudes towards statistics (Chiesi & Primi, 2010), and there is some evidence of slightly poorer performance in statistics assessments for students who have weaker mathematical skills ability (Bourne, 2014; Harvey, 2009). Consequently, in future research it would be important to consider more variables that might impact on a student's choices around entering higher education.

This research highlights the importance of understanding the worth of statistics as a predictor of whether A-level students choose to study psychology at degree level. Previous research has suggested at undergraduate level, worth of statistics increases over time as students gain more experience in statistics (Chew & Dillon, 2012), however this research has highlighted that an individual's understanding of the worth of statistics may play a role in whether or not they decide to choose to study psychology at degree level to begin with. Research has suggested that it may be possible to reduce statistics anxiety through changing student's perceptions of the worth of statistics (Dilevko, 2000). Future research would benefit from longitudinal work to examine whether individuals actually went on to study psychology at university and how statistics anxiety changes and influences academic performance over time.

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