"I FEEL LIKE I AM WASTING MY TIME . . ." -

ADDRESSING STATISTICS ANXIETY IN STUDENTS REQUIRED TO LEARN STATISTICS AS PART OF ANOTHER COURSE

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Introduction and Literature Review

Statistics and research methods are embedded in the university curricula for Psychology and more widely in the curricula for university courses in education and the social sciences (QAA, 2010; BPS 2013), yet many students underestimate the extent of statistics covered in these subjects (Ruggeri, Dempster, Hanna & Cleary, 2008). Although statistics is an important part of many courses, it is also one of the subjects that is most disliked by students (Sciutto, 2002), and indeed causes anxiety in students (Schacht & Stewart, 1990).

Statistics anxiety is defined as the experience of fear or dread regarding statistically-related tasks or concepts in any form or at any level (Cruise, Cash & Bolton 1985; Payne & Israel, 2010). A major challenge facing the teaching and learning of statistics in HE is the high levels of statistics anxiety reported in psychology and social science subjects students (Baloglu & Zelhart, 2003; Papousek, Ruggeri, Macher, Paechter, Heene, Weiss et al., 2012), i.e. those required to learn statistics as part of another course. Statistics anxiety has been shown to be positively associated with state and trait anxiety (Macher, Paechter, Papousek, Ruggeri & Freudenthaler et al., 2013; Papousek et al., 2012), perfectionism and procrastination (Onweugbuzie, 2004;. Onweugbuzie & Daley, 1999). Aside from the emotional impact, the experience of statistics anxiety has been found to be negatively associated with self-efficacy (Finney & Schraw, 2003), motivation to learn (Linnenbrink & Pintrich, 2003) and has been shown to negatively impact academic attainment outcomes (Hembree, 1990; Macher et al., 2013; Zeidner, 1991). Antecedents of statistics anxiety include gender, with females experiencing higher levels of statistics anxiety than males (Baloglu, Deniz & Kesici, 2011), and international students reporting higher levels of statistics anxiety than domestic students (Bell, 2008). This suggests that statistics anxiety may be particularly prevalent in subjects with a high proportion of female students, like psychology (Willyard, 2011), and may become more of a problem in HE in general in future with increasing student mobility (Knight, 2006).

Although awareness of statistics anxiety is increasing, practical interventions targeted at reducing statistics anxiety are less well researched. Use of an open book exam format (Onwuegbuzie, 2000) and inclusion of problem solving activities in the teaching and learning of statistics (D'Andrea & Waters, 2002) have previously been shown to be effective in alleviating statistics anxiety (Onwuegbuzie & Wilson, 2003). A recent review of the statistics anxiety literature (Chew & Dillon, 2014) has made a number of recommendations on how to address statistics anxiety, including a reduction in the emphasis on mathematical formulae in the teaching of statistics, use of teaching methods aimed at reducing student procrastination when studying for statistics (Onwuegbuzie, 2004), online forums to address the issue of fear of asking for help, use of humour in teaching (Schacht & Stewart, 1990) and application of statistics to real world settings (Dilevko, 2000; Pan & Tang, 2004; Wilson, 1999). When considering how these recommendations can be taken forward, issues such as varying levels of student numeracy and mathematical experience (Mulhern & Wylie, 2004), the increase in large class sizes (e.g., Level 2 Psychology 2014-15 class has 400 + students) and the impact of massification on student learning (Cuseo, 2007; Hornsby & Osman, 2014)) also have to be taken into account. In short, what is the most feasible approach in tackling statistics anxiety when faced with large class sizes and a diverse group of students?

Description of Issues and Aims

In the School of Psychology, considerable staff time and attention has been directed towards improving our teaching provision and support for research methods and statistics (RM&S) at all levels of the UG course, including the introduction of a lecture module and an extensive, complementary practical course at Level 2. Despite positive reports from L2 students regarding the new RM&S provision, attendance at lectures has been notably low compared to other psychology lectures (sometimes as little as 30 out of 220 students). In addition, cursory feedback from students indicated that considerable levels of anxiety exist in relation to their engagement with statistics.

The purpose of the current research was initially to identify the levels of statistics anxiety in UG and PGT psychology students; identify perceived causes of this; and establish any practical interventions that could be introduced in an attempt to alleviate anxiety and increase student engagement. The second stage of the research was to introduce and evaluate a number of practical interventions targeted at alleviating statistics anxiety in psychology students at the University of Glasgow.

Methods and results

Stage 1

Participants were 44 undergraduate and 12 PGT psychology students at the University of Glasgow. Quantitative data was collected using the Statistics Anxiety Rating Scale (STARS, Cruise, Cash & Bolton, 1985) with UK revisions (Hanna, Shevlin & Dempster, 2008) and a measure of self-efficacy in statistics (Finney & Schraw, 2003). For the purposes of comparison, adapted versions of the STARS and self-efficacy measures were also included to measure anxiety towards psychology (the participants' main subject of study) and their self-efficacy in a number of psychology related tasks. Qualitative data was also collected using focus group discussions (n=12).

Results: Analysis of results based on the overall medians of the STARS subscales, suggest that over 50% of students reported moderate/considerable statistics anxiety. In order to compare the students in the current study with the established norms, median percentile rank equivalent scores (MPRES) were calculated by comparing the median anxiety scores in the present study to the percentile rank norms reported by the developers of the STARS (i.e. Cruise *et al*., 1985 Onwuegbuzie, 2004). For example, an MPRES of 61 for worth of statistics indicates that at least 50% of the present sample scored higher than did 61% of the norm group on this dimension. Because the MPRES range from 42 to 72, it is clear that the participants in this study represented a moderate to high statistics-anxious group.

UG and PGT students reported higher levels of anxiety towards statistics than psychology in the interpretation, worth, and fear of teachers subscales. All students reported lower levels of self-efficacy in their ability to complete statistics related tasks compared with psychology related tasks, and statistics self-efficacy was positively correlated with students' statistics course grades. Thematic analysis of the qualitative data indicated that students felt that assessment, use of mathematical concepts, choosing statistical tests, and using statistical software increased levels of anxiety, and this anxiety prevented students from revising for exams and attending statistics lectures. Students identified more opportunities for practical experience with statistical concepts and support from fellow students as factors that might alleviate their anxiety.

Stage 2

As a result of these findings and the recommendations in the literature, a number of practical interventions were introduced aimed at increasing student engagement and alleviating anxiety: 1) an open book format for the UG statistics exam (Onwuegbuzie, 2000); 2) a customised movie aimed at enhancing the perceived worth of statistics in psychology and as a graduate attribute by use of humour, and application of statistics to real world settings and news stories (Dilevko, 2000; Pan & Tang, 2004; Schacht & Stewart, 1990; Wilson, 1999). The movie was developed and evaluated by undergraduate students; 3) a VLE resource designed to complement the existing statistics and research methods course by hosting weekly interactive problem solving activities to address issues of procrastination and statistics anxiety (Onwuegbuzie, 2004), and the fear of asking for help in statistics through use of forums (Chew & Dillon, 2014). The course that was developed was very practical in nature and students were therefore required to actively engage with the course content. This included video clips, datasets, forums and quiz based activities.

Results: 1) Evaluation of the open book exam format showed that 90% of UG students (N=40) indicated that this format reduced their anxiety and increased their self-efficacy compared with the traditional exam format.
2) The movie reduced UG students' (*N* = 20) negative views of the "worth" component of statistics anxiety compared to a control group (*N = 20*). However, the level of interpretation anxiety was significantly higher for the experimental group compared to the control group, suggesting that in persuading students that statistics is worthwhile increased their anxiety about being able to work with statistics.
3) The VLE resource to support the existing statistics and research methods course was introduced in September 2014 and activities were added weekly throughout the course of the academic year. Four students (3 undergraduates and 1 postgraduate) of varying statistics ability evaluated the resource and provided extensive feedback throughout the year to allow real time feedback and any changes in focus of the VLE resource. In order to measure the short term impact of the VLE resource, levels of statistics anxiety and self-efficacy in UG and PGT students were measured before (September 2014) and after (May 2015) the intervention using the UK version of the STARS measure (Cruise et al., 1985; Hanna et al., 2008), and self-efficacy by use of a questionnaire developed to assess confidence in different aspects of the statistics and research methods course (Finney and Schraw, 2003). UG and PGT psychology students were also invited to fill out an evaluation questionnaire about the utility and ease of use of the resource, and student focus groups were run in order to gain in-depth feedback on the resource. .

Preliminary analysis of the number of student visits to the VLE resource suggest that student engagement was highest in the first semester, that the datasets and quiz based activities were most popular, and the number of forum posts was relatively low. Data from the focus groups suggest that the VLE resource was received positively by students. Evaluation of the VLE resource is on-going, and the STARs, self-efficacy and evaluation data will be presented at the IMA conference in June.

Conclusions

The results gathered so far suggest that statistics anxiety is a significant issue for psychology students at the University of Glasgow, and that the introduction of relatively small scale practical interventions addressing the test and worth components of statistics anxiety have reduced students' levels of anxiety and increased self-efficacy in statistics. The intention is to maintain and further develop the VLE resource to benefit students studying non-mathematical subjects which include statistics as part of the curricula.

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