Experiences and expectations: The real reason nobody likes stats

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Abstract:

Within undergraduate psychology courses, students often have significant levels of anxiety and negative attitudes toward the statistical element. This has been attributed to poor interaction with teachers, fears about mathematical abilities, and simply being unaware of that portion of the course or its relevance to psychology. To address this, 196 undergraduate psychology students completed a survey on statistics anxiety and attitudes. Additionally, 27 different students in similar situations took part in focus group to share their experiences of introductory statistics courses. Survey results showed that fewer than half were aware of the statistics portion of their course and that the expectation was a key factor in their experiences. Qualitative feedback from the focus groups revealed much about how the teaching may or may not improve attitudes nor decrease anxiety. Findings support various broad strategies (i.e. increase awareness of statistics in psychology and confidence in success in the course) as opposed to skill-specific (better ways of teaching probability or using games to increase participation, for example) classroom interventions to improve statistics education.

STATISTICS ARE an integral part of many academic programs (Nasser, 2004) and are a requirement of all United Kingdom psychology courses accredited by the British Psychological Society (BPS, 2002). However, an increasing amount of evidence suggests that undergraduate psychology students find statistics anxiety-provoking, which has subsequently been shown to affect performance negatively (Tremblay et al., 2000).

Statistics anxiety is a unique construct from mathematics anxiety, as it is heavily based on the interpretational aspect of statistics (Cruise et al., 1985) and is linked with negative outcomes such as poor classroom performance and avoidance of quantitative research (Baloğlu & Zelhart, 2003); similarly, attitudes toward statistics are also influential in how students learn and utilise analytical skills (Schau, 2003). Each has been linked with a variety of outcomes in statistics education in psychology (Tremblay et al., 2000; Schau, 2003).

Previous research has aimed to explain, quantitatively, the individual differences in attitudes towards statistics using variables such as gender (Baloğlu, 2001; Schram, 1996), previous experiences of mathematics and statistics (Sutarso, 1992), personality (Furnham & Chamorro-Premuzic, 2004), and personal/family background (Onwuegbuzie, 2000). These studies have used standard questionnaires, such as the Statistics Anxiety Rating Scale (STARS: Cruise et al., 1985) and the Survey of Attitudes Toward Statistics (SATS: Schau et al., 1995), to measure cognitions and emotions concerning statistics. Overall, these show that large numbers of students do experience statistics anxiety, have negative attitudes toward statistics, and that more work is needed to understand the problems in order to address them.

While work has been done to determine the aspects of the statistics curriculum which students experience in a negative way that creates such problems, rarely has an approach been used that began without questionnaires or preconceived agenda to support a theory. This is where a qualitative investigation may be useful and may indicate areas of the statistics curriculum where inter-

ventions designed to reduce statistics anxiety could be targeted. From the results of this, the best method of testing and reporting can then be selected, which better justifies an eventual intervention.

Minimal research has taken a qualitative approach (Schutz et al., 1998) to determining the experiences and practices of students in introductory statistics courses. However, these results should be interpreted with caution as the interviewer was also the statistics lecturer which may have induced a social desirability bias into responses (such as claiming to study equally on day one as on the last day before the exam, contemplating statistics while driving, and immediately placing studies into practical use). Additionally, this was conducted with non-psychology students, and differences in the perceptions of statistics between students from different disciplines may be so great as to prevent any extrapolations of the conclusions from this study.

Though some skill-specific interventions have been effective (i.e. Ryan, 2006), no broad efforts to improve attitudes or statistics anxiety have been demonstrated empirically (Henslee et al., 2006). Even first-day methods (Henslee et al., 2006) may do little to ease the overall burden of surprise created (Ruggeri et al., 2007) by learning that statistics is a major component of a course. Furthermore, those interventions presented at the beginning of a course have not been tested to show if they have any lasting, positive effect.

Expectations influence a variety of educational aspects (Pidgeon, 1970), so it is important to determine whether pre-emptive strategies to reduce statistics anxiety and improve attitudes would be beneficial. If students are unaware of a major element of their degree, their expectations of success may be low and their involvement in this portion minimal. This is critical to address, as expectations are linked with negative educational outcomes similar to those caused by high levels of anxiety (Holahan et al., 1982). It is also very likely that these are developed near the beginning of an academic course (Ross, 1997). These influences can come from a variety of sources and many influences are known to affect social aspects and academic performance (Wentzel & Wigfield, 1998).

The following method was thus two-fold: allow students to provide open-ended, undirected feedback about their experiences in introductory statistics and then note how those may have been affected by their expectations at the onset of the course. By doing this, it was possible to develop, from scratch, a method to look at the issues presented in undergraduate psychology statistics courses. This would allow for a long-term look into the area with measures completely determined by participant responses.

Method

Participants

To test the expectations of students in an introductory psychological statistics course, 196 psychology students in their first (158) or second (38) year were asked to complete the Composite Survey of Statistics Anxiety and Attitudes (COSSAA) during a laboratory class midway through the academic year. Of those students, 76.2 per cent were female. Ages ranged from 17 to 52 years ($M = 20.66$), though 83.3 per cent fell in the traditional 18–21 age range.

The target size for each group was between four and ten (Gibbs, 1997) students, though six was the preferred number. For this aspect, 27 psychology students (76.7 per cent female) from two universities in Northern Ireland volunteered to participate in focus groups. Students ranged in age from 18 to 49 ($M = 22.07$) years. Students from each of the three years of the psychology undergraduate programme participated. Via e-mails, personal contact and classroom announcements, students were recruited to meet in small (three to seven people per group) focus groups to discuss their experiences in statistics. They were informed that the sessions were meant as a chance to share their feelings about their specific course. The

group facilitator was a doctoral student from the same department, though was unfamiliar with the participants.

A minimal number of students may have participated in both aspects of the study but their results were never linked to create any type of specific relationships.

Instrument & procedure

The measure used for expectations was the Composite Survey of Statistics Anxiety and Attitudes (COSSAA). The COSSAA is a combination of the Statistical Anxiety Rating Scale (STARS; Cruise et al., 1985) and the Survey of Attitudes Toward Statistics (SATS; Schau et al., 1995). Additionally, it contains questions regarding the expectations, background and personal experience of students to explore these as possible roots of statistics anxiety and negative attitudes. No time limit was given for students to complete the form and no problems arose in testing.

Focus groups were used in the hope that an opportunity for discussion would create more useful feedback than one-on-one interviews, as participants might be encouraged to agree or disagree with their peers. It was expected that students would report highly similar, but more developed, feelings to those presented from work using questionnaires and surveys. Students were told that the purpose of the group was to determine what feelings, positive or negative, they had about the statistics portion of their psychology course. They were encouraged to speak as much as they like and not fear sharing strong opinions. Each participant was advised not to disclose the specific name of any person, specifically lecturers and other students. At the beginning of each group, students were asked an open-ended, cumulative question about the course ('What are your overall feelings and impressions of the statistics portion of your psychology degree?'). Though secondary questions were prepared, few were used as all groups provided ample responses covering a multitude of topics without additional provocation.

Method of analysis

A variety of tests were used to look at student expectations of the statistics element of their course. Subsequent ANOVA tests were used to determine if awareness affected their attitudes towards statistics and statistics anxiety. T-tests were also used to determine if differences in various categories between those who were aware and those who were not were significant.

For focus groups, each session was recorded and transcribed and the transcriptions were subjected to thematic analysis by the first author.

Results

Expectations (survey element)

Initially, it was found that only 46.7 per cent of students in the course were aware of the statistics element in a psychology course. However, awareness of statistics was not a good predictor of statistics anxiety or attitudes toward statistics, accounting at most for 8.9 per cent of the variance in one subscale (worth of statistics, see Table 1).

While not all subscales included in the COSSAA were affected by awareness, it does affect the level of worth and value students give to statistics. Additionally, it affected statistical confidence and gauges of utility and enjoyment, among other measures.

The importance of awareness was furthered by comparing first and second year results. On the whole, anxiety and attitudes did not improve significantly (see Table 2) which agrees with previous findings on attitudes (Verhoeven, 2008). As worth of statistics and interpretation anxiety are considered the most important factors of statistics anxiety (Onwuegbuzie, 1997), it is important to note that neither improved from first to second year.

Experiences (focus group element)

The following themes were identified to consolidate common topics or comments arising from the focus groups.

	R	R-square	Adjusted R-square
Statistics anxiety			
Worth of statistics	.304	.092	.089
Interpretation anxiety	.109	.012	.008
Test and class anxiety	.072	.005	.002
Computation self-concept	.217	.047	.044
Fear of asking for help	.039	.002	−.002
Fear of statistics teachers	.125	.016	.012
Attitudes toward statistics			
Affect	.108	.012	.008
Cognitive competence	.162	.026	.023
Value	.264	.070	.067
Difficulty	.066	.004	.001

Table 1: Regressions: Awareness of statistics

Lecturer impact

'When [teachers] walk around the lab, we act like we're doing work because we don't want to look stupid.'

'If there were less [students] you'd be way more willing to put up your hand.'

By all accounts in this study, one of the most difficult ways to overcome barriers in statistics courses is communicating problems. Within the groups, negative experiences with seeking help were immediately and unanimously agreed upon. Few even indicated a
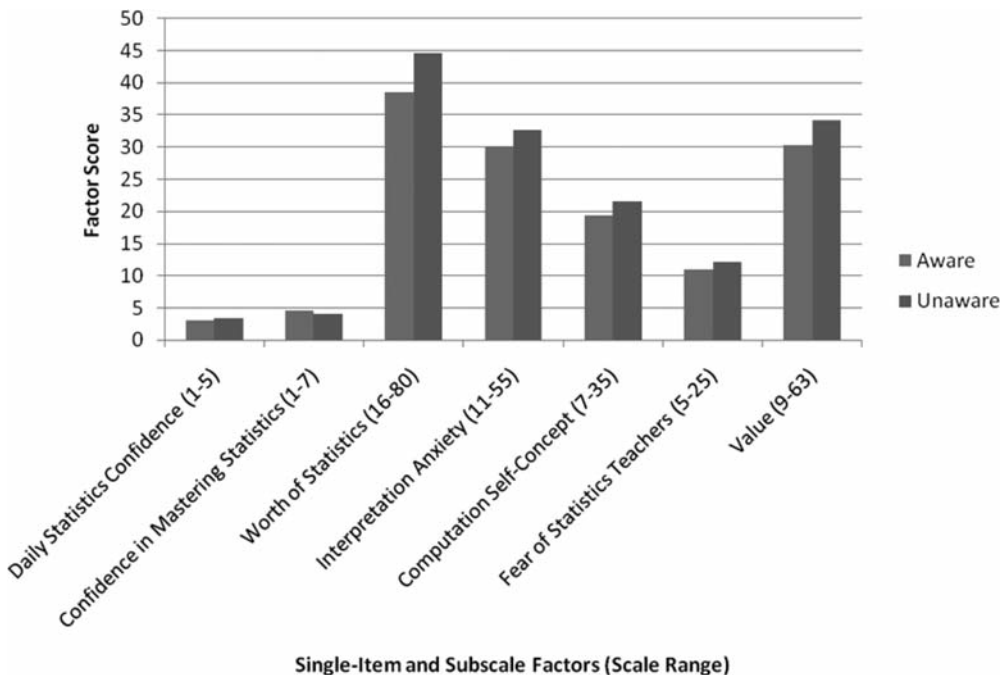

Figure 1: Factors affected by awareness of statistics in psychology

	Level	N	Mean	SD	t	p
Worth of statistics	1	158	41.759	10.949	0.012	0.991
	2	38	41.737	10.648		
Interpretation anxiety	1	158	31.475	7.63	−0.155	0.877
	2	38	31.684	6.815		
Test and class anxiety	1	158	27.082	6.098	−0.207	0.836
	2	38	27.316	6.799		
Computation self-concept	1	158	20.747	6.054	0.739	0.461
	2	38	19.947	5.685		
Fear of asking for help	1	158	8.797	3.753	−1.686	0.093
	2	38	9.947	3.862		
Fear of teacher	1	158	11.475	3.516	−0.125	0.901
	2	38	11.553	3.143		
Affect	1	158	27.924	6.76	1.879	0.062
	2	38	25.711	5.387		
Cognitive competence	1	158	23.684	6.61	2.123	0.035
	2	38	21.158	6.475		
Value	1	158	32.133	8.59	−0.611	0.542
	2	38	33.079	8.512		
Difficulty	1	158	32.924	6.252	−1.643	0.102
	2	38	34.711	4.898		

Table 2: Lack of improvement in anxiety and attitudes from first to second year

minimal level of comfort with any member of a teaching staff, be it a lab assistant or head lecturer. Furthermore, when asked specifically what the single greatest determining factor was for the overall experience of a course, many stated the professor was the undoubted cause.

Value of Statistics in Psychology
> *'We never see why it matters in psychology.'*
> *'I think the importance [of statistics] has decreased.'*
> *'I would prefer not to do [statistics]. I think it's useless and it's maths and we'll never really use it.'*

Participants consistently failed to see a connection between statistics and psychological studies. A limited few indicated minimal understanding as to why it was relevant, compulsory, or even offered. Most saw it as an unnecessary aspect meant only for the lim-

ited few who ever intended to do research.

Statistical literacy
> *'When I read a journal article, I skip the statistics section.'*
> *'It's like I need an interpreter. Whoa.'*
> *'Even now...I am running a t-test but what does that t-test actually tell you?'*

Most students claimed to be incapable of converting numbers from statistics into real-life meaning. Some explained moderate understanding of numbers but lacked the ability to put that understanding into words.

Course and teaching
> *'Last year it was like, "I really hate this."'*
> *'You can tell so much by attendance. Last year there was practically nobody there Monday morning, because there was no point.'*

Surprisingly, nothing said in any groups indicated negative feelings towards examinations. However, as they followed positive test comments with explanations that tests may have been less difficult that anticipated, this anxiety might have been eased by decreased fear of failure. As testing and classroom anxieties have been paired in their relationship to statistics anxiety, it is difficult to separate potentially unrelated statements. Some comments indicated a fear of the class environment was due to the size and, again, lack of familiarity with those around. This aspect of the factor was apparently eased in tutorial sessions where students were more familiar with the instructor and other class members.

Analysis

'You get a sheet of paper and you're supposed to work through it but then you get done and you have no idea what you just did [on SPSS].'

No single factor was more debated than instrument anxiety. Students equally fell on both positive and negative sides of utilising computer programmes such as SPSS in their courses. However, it can certainly be argued that those who reported anxiety did so less because of the actual programme than the way it was implemented. Positive feelings may have likewise been influenced by assessment, not instrumentation. In either way, levels of both sub-components of instrument anxiety – computational self-concept (anxiety during problem solving) and statistical computing anxiety (related to using computers for statistical calculations) – seem to be relevant.

Material

'I think I am studying psychology but then I have to do maths and that is not what I am good at.'

The strongest argument for statistics anxiety as being a state-influenced phenomenon is Content Anxiety. Without even discussing the specifics of the course or anything to do with analyses, students note this feeling. Others mentioned students who had dropped from psychology due to the statistics aspect, which promotes the idea of comparing attrition rates to statistics anxiety. Sub-components such as fearing statistical language, application, and recall were each mentioned to some extent as well.

Issues with success

"If we want to keep on going with psychology we have to do statistics but it seems like that is what keeps me from doing well in psychology."

Much like content anxiety, fearing failure strengthens an argument for speaking to students who have or are considering leaving psychology based on the statistics portion. Aside from surprising students by merely being part of the degree, the topic carries the burden of a high degree of difficulty which may exponentially increase this particular factor.

Implementation

'We learn some theory and then way later we're supposed to understand what it means, but it doesn't make any sense.'

Though highly similar to interpretation anxiety, many students were able to describe unique feelings about the idea of statistics as a language. One claimed to understand this idea, but never actually was able to utilise it as such. Others saw statistics as a maths class in a psychology course, having no explanation beyond numbers they could not understand.

Expectation

'I would say that definitely it counts to tell the first years coming in the first week that they're going to have stats in a psychology degree. It was like [expletive] I never even knew I would study it. Lots of people claim to never have known that stats was a part of psychology.'

The lack of awareness that statistics was a major aspect of the course dramatically influenced the feedback from students in every group. Indications were made that suggest further study is necessary to determine if informing incoming students might change their experiences.

Discussion

The results indicate clearly that awareness of statistics in a psychology degree programme is crucial in how students perceive it. Considering the ease at which students were able to share strong feelings about their experiences, it is apparent that they had either considered or discussed this previously. Furthermore, the few dissenting opinions suggest many students not tested may have had the same experiences.

Is a course handbook enough?

An incoming student is likely to be overwhelmed with paperwork regarding courses, social activities, and finances. Somewhere among that pile there may exist a line, paragraph, or page in a student handbook outlining the statistics element in psychology. Aside from the unlikelihood that this will even be read, it may potentially be too late. If students are already booked into a degree before they are told of possible negative aspects, it still doesn't satisfy knowing beforehand.

While it is the university's responsibility to accept only students that it believes can succeed in a course, many school counsellors play a critical role in helping students select a course. Thus, both parties must address the issue before a definite degree selection is made. An essential area for future research is based on this, and must address pre-emptive interventions to improve statistics anxiety and attitudes.

Though psychology students may be potentially worse than other degree programmes in terms of awareness of statistics and resulting problems, it is likely that similar issues will be found externally. This is likely due to many lacking an explicit mathematical component which would satisfy any concerns brought on by this particular aspect. However, as it is yet known, future work in the area is highly recommended.

Furthermore, focus groups and case studies have revealed even more negative responses, thus these results may even be more extreme in reality (Schau, 2003). If this is accurate, the level to which awareness affects anxiety and attitudes may be even greater.

For the qualitative portion of the study, it was important not to seek out patterns, codify statements, or in any way alter exact comments from recordings. In order to maintain this principle, responses were not put through any quantitative analyses. The interpretation of each statement is ultimately left to the individual. As the statement – not the cause – was the focus, the authors' interpretation was not a goal of this study.

A potential criticism of this study could be the selection method for participants. As the groups were not compulsory, it was possible that only students who had concerns to share would participate. When it appeared turnout might have been low, lecturers used personal and class time to encourage students to attend. Ultimately, these factors had no apparent impact on the participants or the responses. One purpose of the study was to determine if similar feelings to those which are assessed by questionnaires developed in North America existed in UK psychology students. Based on the findings of this piece, it appears that issues do overlap.

Some students indicated that their greatest problem was simply not being skilled in mathematics or lack of awareness that statistics was a major aspect of psychological degree. This raises the idea that any course considered irrelevant to a subject may produce similar anxiety (for instance, a law student studying foreign languages). Additionally, it may be that any topic that would be consistently difficult within a particular group of people would yield a unique anxiety toward that subject.

One drawback of the focus groups was the potential for socially desirable comments. A limited few students initially indicated positive feelings toward the overall experience, yet followed with mainly negative specific comments. Potentially, the initial statement was meant to avoid stigmatisation as one who may be anxious about a course. Conversely, if the opening statement was the more accurate sentiment, following thoughts may have

been induced by a feeling of not fitting with the general mindset of the group.

As mentioned, the attitudes and anxieties held by all students does not improve simply as more work is undertaken. Thus, they must be addressed before a class begins to ensure students have the best opportunity at learning statistics and developing as future psychologists, researchers, and the like.

With the large number of non-induced statements similar to ideas previously discussed, this study strengthens the argument for questionnaires, primarily *STARS*, as potentially standardised measures for future studies seeking to decrease statistics anxiety. As the results from these focus groups showed, there may be more factors or better definitions than currently exist. However, even if that is the case, the extent to which existing factors were repeatedly supported solidifies the argument for standardisation.

Undoubtedly there are similarities between students in Northern Ireland and those previously used for work on statistics anxiety (see Baloğlu, 2003; Schau, 2003). Subsequently, results suggest that similar responses may be found elsewhere, thus the issue is impacting more than the tested population. Based on comments made by students, it may be ideal to increase the familiarity of the educator to the students to decrease anxiety. As that was listed as the primary influence in overall feelings, it seems apparent to at least study this relationship. If anxiety towards an educator is decreased, the daily interaction would likely improve, thus affecting other factors. However, in universities where small class sizes are not common, unique methods must be developed to counter such a problem. If, as students indicated, teachers are the single greatest factor, then it demands immediate attention and understanding, as well as a proper definition.

Many comments did not fit solely into one category, thus it may serve to link some factors in future research. For instance, a student who fears a teacher will likely also be anxious about asking for help. By grouping these, there is a potential for intervening on two fronts simultaneously. Moreover, factors should be compared to similar experiences in other courses to see if the manifestation is unique. If parallels are found, then remedies will be effective beyond a single area of academia.

Previous work (Onwuegbuzie, 1999) has suggested a possible link between statistics anxiety and attrition rates. While this idea was not directly addressed in the current study, there is a definite need to determine of retention is another aspect affected by this phenomenon.

The qualitative aspect reinforces the factors relevant to statistics anxiety and attitudes used in the COSSAA. Furthermore, it adds validity to these measures for a British or Irish population. As all students in the focus group element reported some element of statistics anxiety, it strongly suggests that more work be undertaken to improve the experience of undergraduate psychology students in their statistics courses. Even if that step is as straightforward as notifying every student considering enrolling in a psychology course about statistics, it is necessary that students be given every opportunity to succeed.

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