‘Sociologists shouldn’t have to study statistics’:

Epistemology and anxiety of statistics in sociology students

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Abstract

Worry about learning maths and statistics has been widely researched internationally but very little of this work has focussed on sociology. It is well documented that sociology students can be reluctant to engage with statistical methods. This article provides an exploration of the relationship between anxiety of statistics and its antecedents in sociology students. The analyses presented are based upon data collected from over thirty universities in the UK and is the most comprehensive sample of its type. The primary aim of this article is to analyse whether the perceived epistemological legitimacy of statistics, among sociology students, is associated with reported statistics anxiety. The results show that epistemological legitimacy is highly associated with reported statistics anxiety. Confidence in maths is also strongly associated with statistics anxiety. The implications of acknowledging these and other pedagogical issues in teaching quantitative research methods are complex and layered. Measures capturing whether students accept the epistemological legitimacy of statistical methods should be routinely incorporated in research examining statistics anxiety.

**Introduction**

This article provides an exploration of the relationship between anxiety of statistics and its antecedents in sociology students. It is well documented that sociology students can be reluctant to engage with statistical methods (Jones, 2018; Carter et al., 2017; Paxton, 2006; Bridges et al., 1998; Schacht and Stewart, 1990). Indeed, sociology students in the UK, and elsewhere, may have explicitly chosen the subject in order to avoid contact with maths (Blaikie, 2003).

A range of antecedents of statistics anxiety have been identified within the literature. These cover sociodemographic, experiential and perceptual underpinnings of statistics anxiety (Onwuegbuzie and Wilson, 2003). Epistemological anxiety has also been identified as potentially associated with statistics anxiety (Wilensky, 1997, 1993). This includes the idea that students do not engage with statistics because they are not seen as either appropriate or legitimate methods for researching social life (Wilensky, 1997). Worry about learning in maths and statistics has been well researched in an international context (e.g. Suárez-Pellicioni et al., 2016; Chew and Dillon, 2014; Onwuegbuzie and Wilson, 2003), but very little work has focussed on sociology. In addition to a lack of research into the statistics anxiety experienced by sociology students, there is also a lack of research that considers the relationship between epistemological legitimacy and reported anxiety of statistics. These types of concern are likely to be relevant in sociology, in the UK, and elsewhere, where the philosophical bases of research, and qualitative methods, are often taught and applied more widely than statistical practices (Williams et al., 2017; Payne et al., 2004). Whitley and Deitz (2017) recently wrote of graduate students in the US who do not see statistics as ‘salient to their interests’ and there are general concerns internationally over levels of maths skills (e.g. Nortvedt and Siqveland, 2019).

The analyses presented are based upon data that is the most comprehensive of its type, collected from over thirty universities in the UK. The relationship between self-reported anxiety of statistics and measures of antecedents is examined. Indictors that capture aspects of epistemological legitimacy are also incorporated into the analyses presented. The article begins by summarising variation in definition of statistics anxiety and literature on its antecedents. Aims and results are then introduced followed by discussion and conclusions.

***The problem of statistics anxiety***

Onwuegbuzie *et al.* (1997) defined statistics anxiety (SA) as *‘an anxiety that comes to the fore when a student encounters statistics in any form and at any level’*. Subsequent definitions have applied more focussed specificity than this simple, all encompassing, definition. Chew and Dillon (2014) argue that the meaning of statistics anxiety should include both prior attitudes and that it is an unambiguously separate concept from maths anxiety. Macher *et al.* (2015) offer a definition that varies again, in, for instance, incorporating an explicit temporal dimension, describing the anxiety as an ‘enduring, habitual’ type of anxiety.The definitions share basic commonalities, however. That the anxiety experienced has negative effects and that students experience anxiety when there is an expectation they will engage with statistics.

The issue of anxiety in learning contexts is pervasive. Anxiety is seen as a problem within more numerate subjects than sociology, including maths (Henrich and Lee, 2011) and in other learning environments, such as the teaching of language (Liao and Wang, 2015). It has also been argued that being anxious about performing well in a new or difficult task is not necessarily a bad thing. For example Savage and Torgler (2011) suggest that elite sport is an arena where nerves, when controlled, can enhance performance. Macher et al. (2013, 2015) propose a similar relationship between anxiety and performance in the context of statistics anxiety. They put forward a model where statistics anxiety positively influences learning behaviours. There have been three reviews published summarising the statistics anxiety literature (Chew and Dillon, 2014; Baloğlu and Zelhart, 2003; Onwuegbuzie and Wilson, 2003). The review by Chew and Dillon (2014) concentrates particularly on psychology literature. The older review, by Onwuegbuzieand Wilson(2003), draws upon a literature primarily published in education journals, particularly work by Onwuegbuzie himself. Baloğlu and Zelhart (2003) surveyed both the psychology and education literature. The belief that statistics courses induce anxiety in students and that this leads to negative outcomes underpins these reviews. For example, Chew and Dillon (2014) report that: *‘A consistent negative relationship has been found between statistics anxiety and achievement in a variety of studies’*. Similar views are expressed generally within the SA literature (e.g Macher et al., 2015; Paxton, 2006; Baloğlu and Zelhart, 2003; Bridges et al., 1998; Schacht and Stewart, 1990).

DeCesare (2007) suggests that the issue of anxiety of statistics has been overstated. As evidence supporting this he presents research on an institution in the USA where 43% of sociology students, who responded to a survey on a social statistics unit, reported no anxiety, 25% reported being very anxious and 32% reported being anxious (n=196). There was also some evidence of gendering in anxiety as 57% of men in the sample reported being relaxed or indifferent to the thought of taking the course. Comparable gendered patterning of anxiety is widely reported both in respect of statistics and anxiety more generally (Baloğlu et al., 2011; Erdoğan et al., 2011; Remes et al., 2016). Williams *et al.* (2008) similarly found only a slight majority to report being anxious of statistics in a sample of sociology and political science students in England and Wales (n=738)[[1]](#endnote-1). Statistics anxiety is often stated as a problem within the literature and there is some work to suggest that higher anxiety leads to poorer course performance (see, Macher et al., 2015). Yet the lack of research within the context of sociology means there is no strong base on which to draw firm conclusions.

***Antecedents of statistics anxiety***

The focus of the analysis presented in this article is the relationship between self-reported anxiety of statistics and antecedent predictors of anxiety. Wilensky (1993, 1997) put forward the concept of epistemological anxiety as underlying difficulty in learning statistics. This includes the idea that learners do not engage with the legitimacy of mathematically based methods for understanding the social world. Wilensky (1993) coined the term as representing a feeling that a student *‘does not comprehend the meanings, purposes, sources of legitimacy of the mathematical’*. This notion is applied here also using the term *epistemological legitimacy*. For the purposes of the current research the concept of epistemological legitimacy/anxiety is used to denote reticence expressed by sociology students towards the legitimacy of statistical methods (Brown, 2017). This may be of particular relevance in sociology, a discipline where there has been a degree of historical animosity towards statistical methods (Daddow, 2010; Williams et al., 2008).

Previous studies examining statistics anxiety in social scientists have tended not to included indicators that capture epistemological opposition to statistical methods (e.g. Zeidner, 1991). Measures intended to capture levels of statistics anxiety, such as the Statistics Anxiety Ratings Scale (STARS) (Cruise et al., 1985; Hanna et al., 2008) include epistemological elements. STARS is a 51-item measure covering six dimensions, the first three of which are suggested as measuring statistics anxiety and the rest, attitudes to statistics (Chew and Dillon, 2014). These are, test and class anxiety, interpretation anxiety, ask for help anxiety, worth of statistics, teacher anxiety and self-concept. The items are scored using Likert style indicators and summed to generate a scale. Yet the idea that epistemological legitimacy is part of the anxiety itself could use further reflection. The STARS measure does not directly include indicators of other antecedents of statistics anxiety such as maths performance or confidence in maths. STARS includes only one indicator that might partly measure confidence in maths[[2]](#endnote-2). There are no indicators of STARS that directly capture maths performance. This is quite correct because performance and confidence are considered antecedents. Yet there are four STARS indicators that are likely to directly relate to epistemological legitimacy[[3]](#endnote-3). Drawing on the argument put forward by Wilensky (1997) epistemological legitimacy is here treated as an antecedent of statistics anxiety and the relationship between this and self-reported anxiety of statistics is examined.

Additional antecedents of statistics anxiety have been summarised as encompassing *situational, dispositional* and *environmental* factors (Onwuegbuzie and Wilson 2003). Situational antecedentsrelate to experience. It is suggested this includes measures of statistics course grade, whether the student has undertaken a course that is required or selected or whether the main degree subject has a more statistical emphasis. The issue of choice is to the fore, because where a student has chosen a course involving maths or statistics this is likely to represent self-belief, previous strong performance in maths and/or greater confidence (Nasser, 2004; Paxton, 2006). Variables measuring aspects of maths experience which have been found to relate to statistics anxiety include basic mathematics skills, number of prior mathematics courses completed and levels of prior achievement in mathematics (Fitzgerald et al., 1996; Hamid and Sulaiman, 2014).

Dispositional antecedents of statistics anxiety cover issues such as self-concept, level of self-esteem and ‘mindset’ (Smith and Capuzzi, 2019; Macher et al., 2013, 2011; Onwuegbuzie, 2003; Onwuegbuzie and Wilson, 2003). This includes levels of self-perception, such as perceived academic competence, intellectual ability or creativeness (Zare et al., 2011). Perfectionism, in terms of worry about how you are viewed by others and whether it is possible to achieve a socially acceptable level of competence, is suggested as an antecedent (Onwuegbuzie and Daley, 1999). Differences in preferred modes of learning are also put forward as dispositional antecedents (Macher et al., 2011, 2015). For instance, it is suggested that learners who are less oriented towards linguistic and logical mathematical style based knowledge, compared to those more oriented towards spatial and interpersonal based intelligence may tend to have higher levels of statistics anxiety (Daley and Onwuegbuzie, 1997). Other dispositional factors include academic procrastination and levels of hope (whether a learner has a positive outlook) (Macher et al., 2011, 2015).

The list of factors put forward as comprising environmental antecedents is somewhat less substantial than the other antecedent categories. The label, environmental antecedent, given by Onwuegbuzie and Wilson (2003), is arguably misleading as it primarily contains demographic characteristics rather than environmental ones. These include gender, with women often reported as more likely to experience anxiety (Davis, 2003; Onwuegbuzie, 1995; Papanastasiou and Zembylas, 2008; Zeidner, 1991). Age is also considered a factor as older students have been found to report higher anxiety and also to prefer different styles of learning statistics (Fitzgerald et al., 1996; Maltby, 2001). A study of international students found they were likely to report higher levels of statistics anxiety (in Onwuegbuzie and Wilson 2003). Although Onwuegbuzie and Wilson (2003) highlight that the sample in this was small including only 10 international students. This small sample is not much smaller than research samples used elsewhere in the field. For example, Onwuegbuzie and Seaman (1995) where n=26, with an experimental group and control group each of thirteen. Research from the USA also highlights that “race” could relate to differentially reported anxiety (Onwuegbuzie, 1999).

Stereotype threat is a related issue which links with anxiety and is especially applicable to the socio-demographic characteristics outlined as environmental antecedents (Danley-Scott, 2019; Kapitanoff and Pandey, 2017). This occurs where negative stereotypes exist of how certain groups perform within specific fields of study. Where there is a perception that a group does poorly this has been shown to increase the anxiety of those from the group who are aware of the stereotype and to negatively impact learning outcomes. This is particularly relevant to courses in statistics where there are a number of myths around maths and statistics (e.g. Chestnut et al., 2018; Clements and Sarama, 2018). In summary, the literature has limitations but highlights a wide variety of potential antecedents of statistics anxiety. Variables comprising measures of environmental/socio-demographic, dispositional and situational, along with epistemological antecedents have been incorporated in the analysis presented below.

**Aims**

Although there is an international literature researching statistics anxiety the evidence base is inadequate in several areas. There are large gaps in our understanding of statistics anxiety in sociology students. The relationship between epistemological legitimacy and statistics anxiety also needs clarification. This article comprehensively tests the relationship between measures of antecedents of statistics anxiety and the likelihood that sociology students report being anxious of statistics. The aim is to assess whether measures of the supposed antecedents of statistics anxiety are associated with reported experience of statistics anxiety. This is undertaken by applying a multivariate modelling approach in the context of UK sociology students. This is the first research to examine empirically a relationship between epistemological anxiety and statistics anxiety in sociology students. Acknowledging these pedagogical issues and their complex interrelations has implications for both teaching practice and future research. The quality of the sample of sociology students and the relative sophistication of the modelling approach are factors enhancing the contribution these analyses make to the field.

Guiding research questions:

* Is the perceived epistemological legitimacy of statistical methods associated with reported statistics anxiety in the context of controlling more established antecedent factors?
* Which other antecedent factors (environmental/socio-demographic, situational or dispositional) are associated with reported statistics anxiety in sociology students?

**Data and Methods**

***Measuring antecedents of statistics anxiety***

The data analysed are available on the UK data archive (Payne et al., 2009). The data were gathered to describe attitudes to quantitative methods in general (Williams et al., 2008) but provide substantial scope to explore the relationship between statistics anxiety and its antecedents. These data were gathered on a random sample of (34) sociology units in universities in England and Wales, this resulted in a sample of 738 cases. The sample includes both old and new universities. Questionnaires were issued online. Where student response was low physical questionnaires were also used, in testing data quality Williams (2007) reported no significant institutional or gender differences were found on the main items. Although these data are amongst the most comprehensive ever collected on the attitudes of sociologists to quantitative methods, they have never been used to model statistics anxiety.

Table 1 provides descriptive statistics of the variables used in the analyses. An item included in the survey asked individuals to respond to the statement: *the idea of learning statistics makes me feel anxious.* Categories of possible response were *agree*, *disagree*, *not sure*. This is a measure of self-reported anxiety in the context of quantitative methods and used as the indicator of statistics anxiety. This outcome was modelled as a multinominal outcome and a dichotomous outcome. Only the dichotomous results are reported. This merges the *Disagree* and *Not sure* categories, contrasting those who agree they are anxious with those who do not agree they are anxious. The Not Sure category is small at only 9% (n=66) of the sample. On checking the outcome as multinomial the direction of the effect for responses of interest on the *Disagree* and *Not Sure* categories were identical whilst the magnitudes were similar. On this basis it was decided to collapse these categories together as it leads to a simpler interpretation of a dichotomous outcome. This approach has several benefits. It simplifies the interpretation of the results, improves statistical power but does not alter the substantive interpretation. There are a small number of item missing cases on the variables analysed (n=34) the final analytic sample is n=704. The analyses use logistic regression. The category of the outcome variable in which people reported being anxious is coded one. Results are given as log-odds. Independent variable indicators therefore express a coefficient that is the logged odds of agreeing that they are anxious. Categorical variables are included as dummy categories. There are a number of variables in the dataset which are considered antecedents of statistics anxiety. The socio-demographic antecedents, sex and age are included in this analysis. Respondents were asked whether they identify as male or female. Sex is recorded as dichotomous and included in the model with men as the reference category. Any differences are likely to represent gendering in anxiety around maths and statistics rather than biology (Chipman, 2005). Age was tested as linear and quadratic, as the quadratic term was non-significant it was dropped from the model and is not reported.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 1 Descriptive statistics** | | | | | |
| *Variable type* | *Variable label* | *Categories* | | *Frequency* | *Percent* |
| Outcome variable | Learning statistics  makes me feel anxious | don't agree | | 329 | 47 |
| agree | | 375 | 53 |
|  |  | |  |  |
| Environmental antecedent | Sex | male | | 113 | 16 |
|  | female | | 591 | 84 |
|  |  |  | |  |  |
| Situational antecedents | Has a maths qualification | no | | 598 | 85 |
| yes | | 106 | 15 |
|  |  | |  |  |
| Previously studied quantitative methods | no | | 41 | 6 |
| yes | | 663 | 94 |
|  | |  |  |
|  |  | |  |  |
| Overall average mark (self-reported) | 0-49% | | 32 | 5 |
| 50-59% | | 260 | 37 |
| 60+% | | 412 | 58 |
|  |  |  | |  |  |
| Dispositional antecedents | On the whole I'm good at maths | agree | | 306 | 43 |
| disagree | | 295 | 42 |
|  | not sure | | 103 | 15 |
|  |  | |  |  |
| My degree will  help me get a good job | agree | | 395 | 56 |
| disagree | | 50 | 7 |
| not sure | | 259 | 37 |
|  |  |  | |  |  |
| General control variables | Type of course  being studied | sociology | | 594 | 84 |
| politics | | 34 | 5 |
| other | | 76 | 11 |
|  |  | |  |  |
| Current year of study | one | | 65 | 9 |
| two | | 457 | 65 |
| three, or more | | 182 | 26 |
|  |  |  | |  |  |
|  | Parent who undertook higher education | yes | | 315 | 45 |
|  |  | no | | 389 | 55 |
|  |  |  | |  |  |
| Epistemological antecedents | I don't think sociology  students should have to study statistics | agree | | 127 | 18 |
| disagree | | 483 | 69 |
| not sure | | 94 | 13 |
|  |  | |  |  |
| Using statistics  detaches you from your research topic | agree | | 154 | 22 |
| disagree | | 414 | 59 |
| not sure | | 136 | 19 |
|  |  |  | |  |  |
|  |  |  | | *Mean* | *Standard deviation* |
|  | Art or science scale | 1 = closer to an art  10 = closer to a science | | 2.8 | 1.5 |
|  |  |  | |  |  |
| Environmental  Antecedent | Age | Age in years | | 22 | 5.3 |
| Data source: Williams et al. (2009) | | |

The data include measures that are likely to relate to the perceived epistemological legitimacy (Wilensky 1997) of statistically based methods. This includes the variable ‘using statistics detaches you from your research topic’ to which students’ could respond ‘agree’, ‘disagree’ or ‘not sure’. In addition, a question asking whether the respondents consider sociology to be closer to an art or a science was asked on a scale of 1 to 10. This is included as a metric variable. More direct antipathy to statistical methods is measured by the variable ‘I don’t think sociology students should have to study statistics’. Responses are grouped ‘agree’, ‘disagree’ and ‘not sure’.

Subject of study is controlled. Most of the sample are sociologists (84%) but there are a smaller number of politics students and ‘other’ students. The inclusion of the categories in a model controls for whether there are differences between these groups. Whether respondents were in year one, two or three+ of their degree was included as categories. Parental educational attainment has been associated with outcomes for children (Dickson et al., 2016) and a measure of parental educational attainment is included. This is a simple dichotomous ‘yes’, ‘no’ measure of whether one or both parents studied in higher education.

Prior maths experience has been characterised as a situational antecedent of statistics anxiety. The design of the survey required an individual to confirm the level of their most recent qualification. Individuals’ were then asked whether this included maths. The maths qualification variable is therefore sub-optimal, only controlling for whether the most recent qualification obtained included maths. Nevertheless, it might be expected that a recent math qualification would be associated with lower anxiety of statistics. Whether students reported having previously studied quantitative methods is dichotomised as a ‘yes’, ‘no’ response.

A variable measuring a student’s overall average grade has been applied as a proxy of general academic performance. This is also a sub-optimal measure that asked the student to confirm their average grade in the previous year. It is therefore an indirect and indicative, rather than an objective, measure. In this respect the indicator is likely to capture a socially desirable response (Van de Mortel, 2008) rather than reflecting the full variation of academic performance. The variable has been coded into three groups 0 to 49%, 50 to 59% and 60+%. This collapsed the original variable which also included the categories 0-39%, 60-69% and 70+. The 0-39% category contained <2% of cases, the 70+ category <5%.

Self-perception of maths performance is considered a ‘dispositional’ antecedent of anxiety and is also incorporated in modelling. Those who ‘agree’ they are good at maths are contrasted with two groups, one that ‘disagrees’ they are good at maths and a group which are ‘not sure’. The indicator ‘my degree will help me get a good job’ relates to antecedents of anxiety such as the wider motivations students may have in relation to hope/optimism (Papanastasiou and Zembylas, 2008). Responses are grouped ‘agree’, ‘disagree’ and ‘not sure’.

**Results**

***Modelling the likelihood of reporting anxiety of statistics by antecedents***

**Table 2, Logistic regression:** The outcome variable measures whether sociology students agree that learning statistics makes them feel anxious. The model controls for several antecedent factors of statistics anxiety. The results are given as log-odds coefficients.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable label | Variable categories | | | Log-odds | | SE | p-value | 95% Confidence interval |
| Age | Age | | | 0.05\*\* | | 0.02 | 0.01 | 0.01, 0.09 |
|  |  | | |  | |  |  |  |
| Sex | Men | | | . | | . | . | . |
| Women | | | 0.65\*\* | | 0.25 | 0.01 | 0.15, 1.14 |
|  |  | | |  | |  |  |  |
| Has a maths qualification | No | | | . | | . | . | . |
| Yes | | | -0.52 | | 0.28 | 0.06 | -1.06, 0.02 |
|  |  | | |  | |  |  |  |
| On the whole I'm good at maths | Agree | | | . | | . | . | . |
| Disagree | | | 1.77\*\*\* | | 0.20 | 0.00 | 1.38, 2.17 |
| Not sure | | | 1.14\*\*\* | | 0.26 | 0.00 | 0.63, 1.65 |
|  |  | | |  | |  |  |  |
| Overall average mark (self-reported) | 0-49% | | | . | | . | . | . |
| 50-59% | | | -0.58 | | 0.47 | 0.22 | -1.49, 0.34 |
| 60+% | | | -0.19 | | 0.46 | 0.75 | -1.08, 0.70 |
|  |  | | |  | |  |  |  |
| Using statistics  detaches you from your research topic | Agree | | | . | | . | . | . |
| Disagree | | | -0.87\*\*\* | | 0.27 | 0.00 | -1.40, -0.35 |
| Not sure | | | -0.81\*\* | | 0.31 | 0.01 | -1.42, -0.2 |
|  |  | | |  | |  |  |  |
| Art or science scale | 1 = closer to an art  10 = closer to a science | | | -0.06 | | 0.06 | 0.35 | -0.18, 0.06 |
|  |  | | |  | |  |  |  |
| Previously studied quantitative methods | No | | | . | | . | . | . |
| Yes | | | 0.09 | | 0.43 | 0.84 | -0.76, 0.93 |
|  |  | | |  | |  |  |  |
| Type of course  being studied | Sociology | | | . | | . | . | . |
| Politics | | | -0.13 | | 0.45 | 0.68 | -1.01, 0.75 |
| Other | | | -0.18 | | 0.29 | 0.60 | -0.76, 0.39 |
|  |  | | |  | |  |  |  |
| Current year of study | 1 | | | . | | . | . | . |
| 2 | | | -0.11 | | 0.33 | 0.74 | -0.76, 0.54 |
| 3+ | | | 0.11 | | 0.36 | 0.76 | -0.59, 0.82 |
|  |  | | |  | |  |  |  |
| Parent who undertook higher education | Yes | | | . | | . | . | . |
| No | | | -0.17 | | 0.18 | 0.39 | -0.53, 0.18 |
|  |  | | |  | |  |  |  |
| I don't think sociology  students should have to study statistics | Shouldn’t study stats | | | . | | . | . | . |
| Should study stats | | | -1.59\*\*\* | | 0.31 | 0.00 | -2.21, -0.98 |
| Not sure study stats | | | -1.22\*\*\* | | 0.37 | 0.00 | -1.96, -0.49 |
|  |  | | |  | |  |  |  |
| My degree will  help me get a good job | Degree will help get good job | | | . | | . | . | . |
| Degree won’t help get good job | | | -0.29 | | 0.36 | 0.42 | -0.98, 0.41 |
| Not sure degree will help get good job | | | 0.06 | | 0.19 | 0.77 | -0.32, 0.44 |
|  |  | | |  | |  |  |  |
|  | Constant | | | 0.25 | | 0.82 | 0.76 | -1.36, 1.86 |
| Mean dependent var | |  | 0.53 | | SD dependent var | | | 0.5 |
|  | |  |  | |  | | |  |
| Pseudo r-squared | |  | 0.22 | | Number of obs | | | 704 |
| Chi-square | |  | 210.77 | | Prob > chi2 | | | 0.00 |
| Akaike crit. (AIC) | |  | 804.17 | | Bayesian crit. (BIC) | | | 899.86 |
| Data source: Williams et al. (2009) *\*\*\* p<=0.001, \*\* p<=0.01, \* p<=0.05*  SE – Standard Error | | | | | | | | |

Table 2 reports the results of a model estimating the likelihood someone reports statistics anxiety. Several measures of antecedents are significant while several others are not. Three variables were included as potential indicators of perceived epistemological legitimacy of statistical approaches to research. Of these, the variable measuring whether respondents believe sociology to be closer to an art or a science was non-significant. The other potential indicators of epistemological legitimacy were significant. Those who agree that statistics detach researchers from their project are significantly more likely to report being anxious of statistics than those who disagree to the proposition. The measure of whether respondents believe sociologists should study statistics also shows substantial significant associations. Those who think that sociology students should study statistics and those who are not sure are significantly less likely to report anxiety than the those who think sociologists shouldn’t study statistics. Overall, these results suggest that epistemological legitimacy is significantly associated with statistics anxiety in sociology students.

In addition to epistemological legitimacy, self-efficacy has a relatively strong association with reported statistics anxiety. Those who disagree they are good at maths are around six times (exp1.77=5.9) more likely to agree they are anxious about learning statistics than those who say they are good at maths. Those who are ‘not sure’ how to rate their maths performance are around three times (exp1.18=3.1) more likely to agree they are anxious than those who agree they are good at maths. None of the measures of situational antecedents were significantly associated with reported statistics anxiety in the context of the other control variables. Those with a maths qualification were less likely to report that they are anxious although the result was non-significant. Self-reported grade level was not significantly associated with reported anxiety. There is no significant difference in likelihood of reporting anxiety between those who have never studied any quantitative methods and those who have previously done some statistics.

Several other indicator controls were also non-significant. Most of the sample studied sociology, five percent of the sample studied politics, ten percent studied another subject and there were no significant differences between these groups in terms of reported anxiety. There were no significant differences by year of degree or by whether a student has a parent who undertook higher education. The variable indicating whether students believe their degree will lead to a good job is non-significant, suggesting that wider motivations associated with perceived relevance of the degree is not related to statistics anxiety. The results show that age is associated with an increase in the odds of reporting being anxious of statistics. Finally, men have lower odds than women of reporting being anxious.

**Discussion**

The findings here indicate that epistemological legitimacy is an important antecedent of the anxiety of statistics of sociology students. Sociology in the UK is a discipline that is dominated by non-statistical approaches to research (Payne et al., 2004), where students have previously been found to be antipathetic to these approaches (Williams et al., 2008) and are considered anxious of statistics (DeCesare, 2007; Murtonen and Lehtinen, 2003; Bridges et al., 1998; Schacht and Stewart, 1990). A distinction between qualitative and quantitative methods is maintained in publication and statistical approaches are applied in only a minority of published sociological research (Williams et al., 2008). This environmental context is likely to play a part in anxiety and engagement with statistics, where statistical approaches are not given the same legitimacy as non-statistical methods as tools to help sociologists understand the social world. The limited engagement by the discipline with statistical methods is mirrored in the class room in a lack of student interest, or competency, in working with numbers (Byrne, 2012). It is probable that the wider lack of engagement of sociology with statistical methods helps to re-enforce any reticence students have for statistical methods (Byrne, 2012; Gorard, 2015; Williams et al., 2008).

The results here also have methodological implications for the measurement of statistics anxiety. It is the case that measures intended to capture levels of statistics anxiety, such as the Statistics Anxiety Ratings Scale (Cruise et al., 1985; Hanna et al., 2008) include epistemological elements. Yet, whether epistemological legitimacy is part of the statistics anxiety itself, or whether it is an antecedent needs further consideration in respect of these measures. The results here show that this issue is especially relevant for sociology students.

Along with the importance of epistemological legitimacy the results confirm self-efficacy as a factor in the likelihood a sociology student experiences anxiety of statistics. The variable measuring confidence in maths records a large influence on likelihood of reporting anxiety. This indicator is also likely to proxy actual maths performance, along with confidence and self-efficacy in general. In this respect the measure also represents levels of previous success in maths. Those with high levels of self-confidence but lower math achievement might still have self-belief in their ability in maths (DeCesare, 2007). These possibilities underscore why those who perceive themselves to be good at maths are also more likely to report lower levels of statistics anxiety. Both, confidence based on performance and confidence based on self-belief would reasonably be expected to be associated with less anxiety of statistics.

The measure of confidence in maths was a more effective indicator of statistics anxiety than the objective measure of maths performance available. This measure was sub-optimal, recording only if the *most recent* qualification included maths, and was non-significant. A better formulated measure of performance in maths/statistics would be expected to perform better at predicting statistics anxiety (e.g. Fitzgerald et al., 1996; Hamid and Sulaiman, 2014). Self-rated academic performance was included in the model, but this was also non-significant. Under these circumstances perceived maths ability is an important dispositional indicator of statistics anxiety in sociology students and should be incorporated in analyses. To improve understanding of the influence of confidence and performance, future research should include alternative controls for objective performance.

The associations between demographics age/sex and statistics anxiety confirm what is generally reported in the literature. It has previously been found that women students are more likely to report being anxious of statistics (Baloğlu et al., 2011; Erdoğan et al., 2011; Remes et al., 2016) while older learners are also more likely report being anxious of statistics (Fitzgerald et al., 1996; Maltby, 2001). Perhaps more surprising is that the variables denoting previous experience of quantitative methods and having parent who went to university are both non-significant. There is literature to suggest that previous experience of statistics is associated with lower anxiety of statistics (Fitzgerald et al., 1996; Hamid and Sulaiman, 2014). It may be that sociology undergraduates are excessively reluctant to engage with statistics (Blaikie, 2003), so it could be that experience does not improve the disposition of sociology students in the same way as it does for other students. A binary indicator of whether the student had a parent with a degree was included. Although parental educational attainment is associated with educationally related outcomes for children (Dickson et al., 2016), here it is not associated with reported statistics anxiety. This type of simple binary is a blunt instrument with which to control for associations such as parental background. Future research into the statistics anxiety of sociology students should build on this work to incorporate more sophisticated measures of background socio-economic status and parental and student educational attainment levels.

There have been calls to embed work involving quantitative methodologies more widely in sociology curricula (Adriaensen et al., 2014; Atkinson et al., 2006; Bridges et al., 1998; Lindner, 2012; Onwuegbuzie et al., 2010; Wilder, 2009, 2010). Henshaw and Meinke (2018) provide an advanced example of this, where data analysis and assignments are introduced on a substantive courses in political science. The relationship between epistemological legitimacy and statistics anxiety reported above suggests an approach could be beneficial whereby all methods are treated as equally appropriate tools to be chosen, depending on the aims of the research (Gorard, 2015). This would de-emphasise any philosophical distinction while endorsing the legitimacy of statistical methods as appropriate in understanding sociological questions (Byrne, 2012). The results here indicate that this could lead to benefits, both in terms of student anxiety and general willingness of sociology students to engage with statistical methods. If published research, applying statistical approaches to relevant questions, is introduced and highlighted on substantive courses, it becomes harder to maintain a position that these approaches are something ‘other’ than sociology.

Beyond embedding, the results exemplify the need for sophisticated pedagogical approaches to teaching quantitative methods. A proportion of UK sociology students do not accept that statistics are legitimate (Jones, 2018) in researching the social world and this group are more likely to report experiencing statistics anxiety. This indicates a need for approaches to teaching that acknowledge epistemological and statistics anxiety in the learning-teaching environment, alongside approaches for teaching the methods themselves. There are additional issues identified in the research literature that are also likely to negatively affect students learning of research methods, such as belief in myths around the learning of maths (Barlow and Reddish, 2006; Mendick, 2005), or levels of self-efficacy (Zare et al., 2011). To acknowledge these issues a pedagogical approach that situates strategies for teaching methods within strategies designed to demonstrate the legitimacy of statistical approaches, along with additional devices that recognise statistics anxiety alongside other learning-teaching issues is required. In principle pedagogical strategies that acknowledge the issues outlined can be layered across a course within an overall approach to teaching methods. This is a complex and context specific undertaking that indicates a level of difficulty involved in teaching quantitative methods within disciplines such as sociology. The deep understanding and levels of skill required to do this are underappreciated and often left unrecognised in higher education.

**Conclusions**

This article draws upon data collected at over thirty universities in the UK on the attitudes of sociology students to quantitative methods. The article is the first to examine an association between epistemological anxiety (Wilensky, 1997, 1993) and statistics anxiety within this context, contributing to the international literatures on statistics anxiety and teaching sociology. The relationship between anxiety of statistics in sociology students and wider antecedents was modelled. The analyses show association between students who question the legitimacy of statistical methods and statistics anxiety. Those who think that statistics detach them from their research project and those who do not think sociology students should study statistics are more likely to report being anxious of statistics. Confidence in maths is also found to be a key predictor of statistics anxiety in this context. These findings highlight that research into statistics anxiety in sociology students should explicitly account for whether the student believes these methods are legitimate in studying the social. Overall the results indicate a complex array of issues in the learning-teaching of social statistics. Pedagogical approaches need to account for the perceived legitimacy of statistics, student confidence, statistics anxiety and gendering of statistics anxiety, amongst other issues. This suggests the need for a pedagogical approach that situates strategies for teaching methods within strategies designed to demonstrate the legitimacy of statistical approaches, along with additional devices that acknowledge statistics anxiety and other learning-teaching issues.

**Limitations and future research**

There are limits to these analyses. The outcome variable is a dichotomous measure of self-reported anxiety, rather than a statistics anxiety scale. A multiple item measure was unavailable in the data. On this issue, Gogol et al. (2014) writes that single item alternatives are appropriate in educational research where multi-item scales are not available. As noted above, some of the independent variables are sub-optimal.For instance, the maths qualification variable only measures whether the most recent qualification obtained included maths. Parental education only indicates whether either parent had a degree level qualification. These limits have been explicitly discussed. In addition, it may be the case that students do not actually believe the epistemological defences they apply in opposition to statistical methods. These could be convenient arguments deployed in order to justify a disengagement from, or general dislike of maths. Examination of this is beyond the scope of this research and could be a focus of future work. It would also be useful for the field if future research were able to validate, in a sociological context, teaching approaches that are successful in acknowledging complex issues including epistemological anxiety and statistics anxiety.

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1. These are the data also analysed here. Although these data are freely available they have only been used to report base line attitudes of sociology students to quantitative methods. In this respect they represent an untapped resource. [↑](#endnote-ref-1)
2. Indicator: I cannot even understand secondary school maths; how can I possibly do statistics. This does not directly measure confidence in maths in the manner that the indicator in this research does, that asks respondents directly whether they feel they are good at maths. [↑](#endnote-ref-2)
3. Indicator: I am a subjective person, so the objectivity of statistics is inappropriate for me; Statistics is worthless to me since it is empirical, and my area of specialization is abstract; I wish the statistics requirement would be removed from my academic program; I do not understand why someone in my field needs statistics. [↑](#endnote-ref-3)