

Zoinks! Statistics and Maths Anxieties were the same all along!

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Background/Aim: Statistics anxiety is defined as being distinct from maths anxiety (Cruise et al. 1985, Chew & Dillon, 2014), yet very few empirical studies have tested this assumption. Existing findings suggest the ubiquitously used measure of statistics anxiety, the Statistics Anxiety Rating Scale (STARS; Cruise et al. 1985) measures something distinct from maths anxiety scales (e.g. Paechter et al., 2017), but reported differences are based primarily on correlations and could be due to various methodological limitations. We re-evaluated the STARS's discriminant validity in three novel ways. No predictions were made.

Participants: $N = 465$ undergraduate psychology students in the UK (age: $M = 20.5$, $SD = 2.8$; gender identity: 79% female, 19% male, 0.65% non-binary)

Measures: Statistics anxiety - STARS (Cruise et al., 1985); Maths anxiety - R-MARS (Baloğlu & Zelhart, 2007); A statistics version of the R-MARS and a maths version of the STARS; State/trait anxiety - STICSA (Ree et al., 2008).

Procedure: Participants completed online self-report questionnaires (STARS, R-MARS, the modified versions, trait anxiety, and pre-manipulation state anxiety), followed by a between-participants experimental manipulation (multiple-choice test: statistics or mathematics), and a post-manipulation state anxiety questionnaire.

Results/Conclusion: Results from each of three pre-registered analyses (summarised below) support the conclusion that statistics and maths anxieties are not separate constructs and we may have unearthed another *jungle fallacy* (i.e. two measures treated as unique that are actually the same; Kelley, 1927). This pattern of results has been replicated in a second sample.

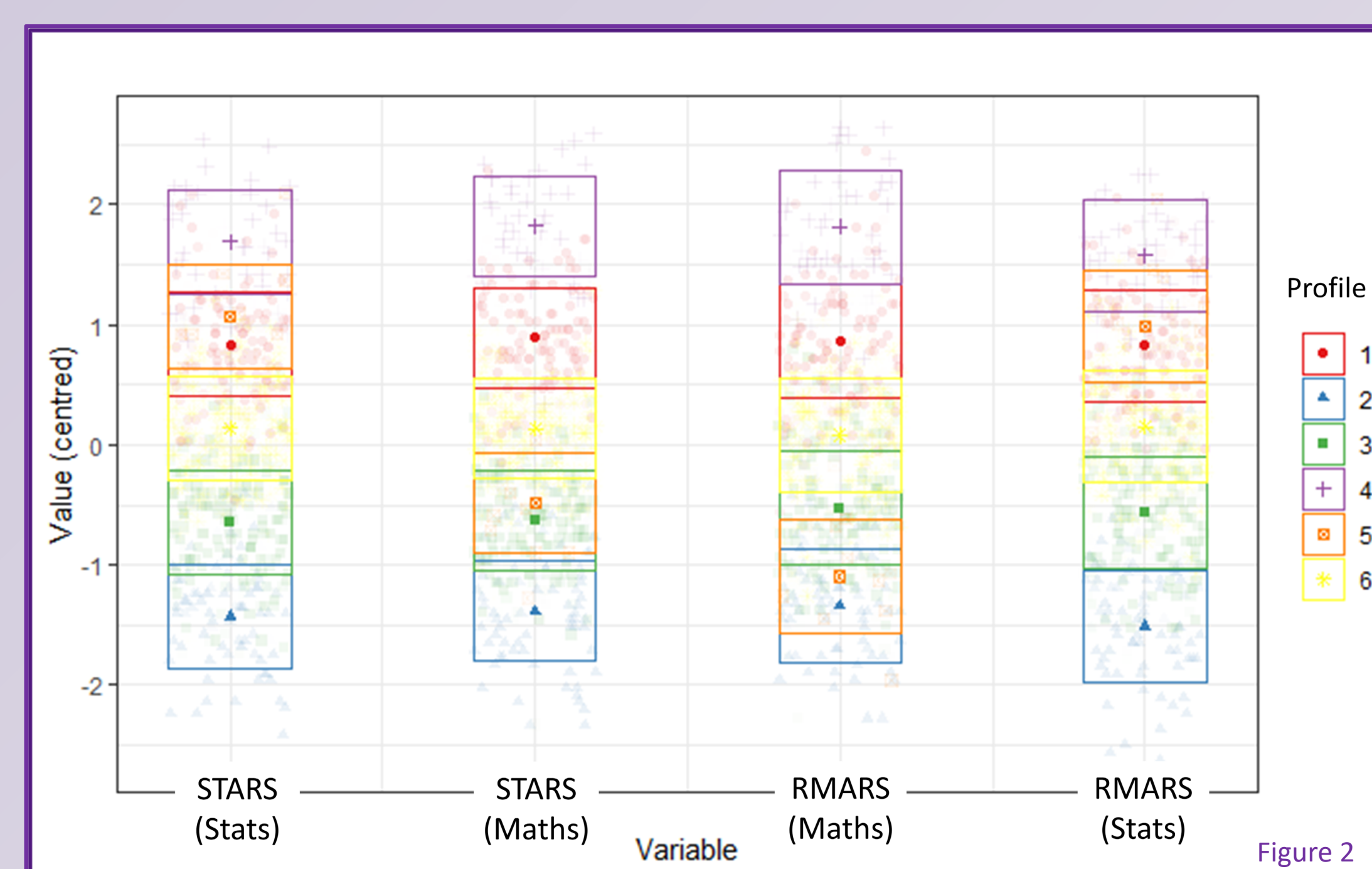


Analysis #1: Exploratory factor analysis of all four statistics and maths anxiety measures

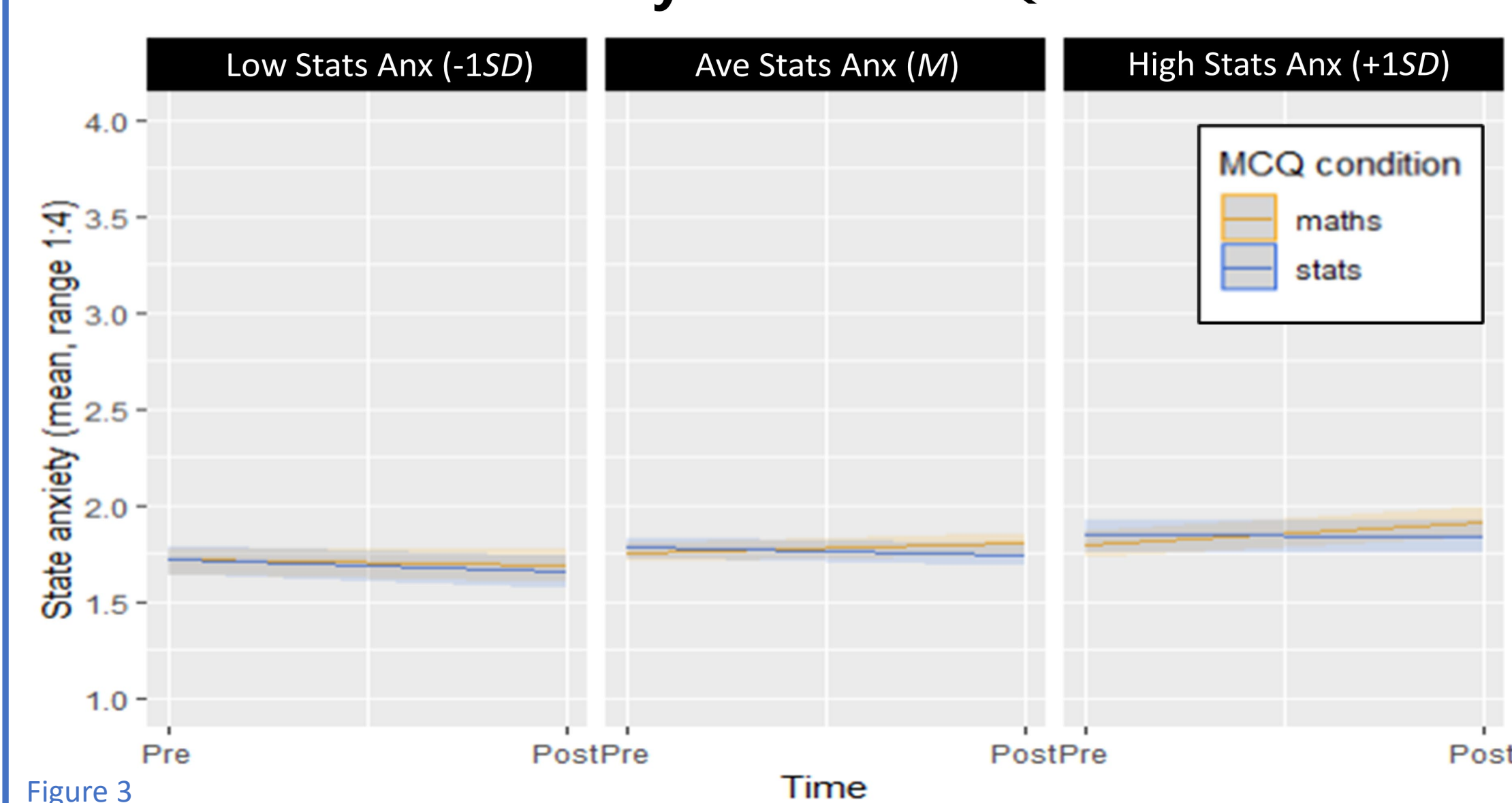
Exploratory factor analysis resulted in factors seemingly driven by a shared underlying construct. For example, Figure 1 shows that items from the test anxiety subscales of all four statistics and maths anxiety measures loaded onto a single test anxiety factor (loadings $> .4$ shown), not distinguishing between statistics and maths. This pattern was repeated for other items and subscales, revealing additional factors apparently driven by anxiety about academic activities (e.g. tests, studying, feedback) and not specific to the subject being studied (i.e. statistics or maths), nor always corresponding to the subscales in the original measures. This suggests that the measures are not tapping something unique to the other.

Analysis #2: Latent profile analysis of all four statistics and maths anxiety measures

Latent profile analysis indicated 98% ($n = 458$) of participants had similar ratings on each of the maths and statistics anxiety scales (Figure 2). Only profile 5 (orange) deviated, whereby individuals had higher statistics anxiety than maths anxiety. No profiles contained individuals meaningfully higher in maths anxiety. This pattern suggests it is very unusual for an individual to report having statistics anxiety without also having maths anxiety and vice-versa, indicating they rarely develop independently and could be the same construct.



Predicted mean values of state anxiety change at -1 SD, M , & $+1$ SD of **statistics anxiety** for each MCQ condition



Analysis #3: Mixed effects analysis of state anxiety change after a maths or statistics MCQ test at different levels of maths and statistics anxieties

The two models showed state anxiety changes did not vary by MCQ type for either statistics-anxious, $\gamma = -0.04$, $p = 0.29$, 95% CI $[-0.11, 0.034]$ (Figure 3), or maths-anxious individuals, $\gamma = -0.02$, $p = 0.51$, 95% CI $[-0.10, 0.05]$ (not shown). Furthermore, state anxiety change was similar for statistics-anxious and maths-anxious individuals, regardless of whether they did a statistics or a maths test. The STARS and R-MARS therefore showed no specificity in their predictive validity, indicative of a shared underlying construct.

