**Introduction**

Paragraph 1 – sex differences

* Males tend to exhibit greater variability than females across behavioural and morphological traits
* Sex differences in variability have been described for traits like intelligence (Arden & Plomin 2006; Johnson *et al*. 2008) and creativity (Ju *et al.* 2015; Karwowski *et al*. 2016) in humans, and for a gamut of life-history traits by evolutionary and behavioural ecologists (references).
* Even Darwin (1871) thought that males might be the more variable sex for a suite of traits because they are often the sex under sexual selection, where such traits should have increased variance in order for sexual selection to operate.
* The ‘greater male variability’ hypothesis suggests that males are more variable than females across a range of behavioural and morphological traits.
* One hypothesis to explain greater male variation is the ‘sex chromosome’ hypothesis. Females generally have two X chromosomes, so the effects of any genes found on the X chromosome become averaged out (as some regions become epigenetically inactivated during development, and others might experience a form of mosaicism where the ratio of genes on either copy of the X chromosome are expressed). Males, however, only have one X chromosome, so all genes on that X chromosome are fully expressed, leading to more extreme phenotypes and consequently higher variances. If sex chromosomal arrangement is responsible for greater variability in one sex, we might then expect species where females are the heterogametic sex to express greater variability in traits than males. In a meta-analysis covering a broad range of taxonomic groups, Reinhold & Engqvist (2013) found that in species with heterogametic males, males had greater variability in body size than did females, and in species with heterogametic females, females had greater variability in body size than males.

Paragraph 2 – sexual selection and sex differences in variability

* Sexually-selected traits tend to be more variable in males than either the same trait in females, or other non-sexually selected traits
* Negative frequency-dependent selection might explain ‘greater male variability’
* Additionally, condition-dependent expression of traits under sexual selection, where environmental effects beyond heritable genetic effects, can increase trait variability
  + Such as SSD
  + sex chromosomal arrangement can also help to explain greater male variability where males are the heterogametic sex
  + as such, we would then expect species where females are heterogametic (i.e. birds) to become more variable for traits if the sex chromosome hypothesis explains variability
* there is evidence that morphological traits in particular show greater male variability, particularly within mammals
* When we look at the benefits of each trait in an evolutionary context, most seem to benefit males (i.e. more partners, better mating success, more attractive to females)
* So it might then be reasonable to assume that males are the more variable sex when it comes to personality…
* Can then talk about sex differences hypotheses (greater male variability hypothesis, sex chromosome hypothesis, or more broadly sexual selection i.e. the sex under sexual selection should be the more variable sex
* For mammals, females have varying degrees of X-chromosome inactivation, where genes on 1 X chromosome might be expressed 50% of the time up to 100% of the time (ratios vary from 50:50 - 100:0). This contributes to the averaging out of traits researchers report (hence males often being the more variable sex)

Paragraph 3 – personalities and sex differences

* *Trade-offs with personalities (costs and benefits to scoring high or low on each of the five factor traits) in a human context*
* behavioural traits, like personality, might benefit male mating success, are personality traits under sexual selection? Would we see one sex having greater variability in personality than the opposite sex?
* X chromosome inactivation in mammals – where gene doubles on both X chromosomes are silenced epigenetically early in development, making female X chromosome gene dosage similar to males. I think when phenotypic traits are influenced by multiple genes, the effects of each gene on each X chromosome are expressed at different ratios, averaging out the expression of the phenotype? Like a mosaic…
* Ecologists and psychologists alike have reasoned that personality traits, for males, might confer mating benefits depending on female preferences, frequency-dependence and environmental conditions. For example,

Paragraph 4 – what we did and why (aims and meta-analysis overview)