Do newborn boys really tend to prefer a 'mechanical object' to a human face?

Failure to assess the confounding effect of an exceptionally high caesarean section rate

Authors

Losse K ^a, Redmond A ^b

a. Independent research

b. Professor Emeritus of International Emergency Medicine, University of Manchester

Abstract

We review a twenty year old paper on sex differences in human neonatal social perception, and identify a serious issue: a failure to assess whether the results were distorted by an exceptionally high caesarean section rate. This is in addition to a number of other methodological weaknesses, which together mean that there is too much 'noise' in the data to draw clear conclusions from the results. The paper's stark conclusion to have 'demonstrated' biological sex differences is unsubstantiated and misleading, and it should no longer be considered a reliable reference point.

About the original study on sex differences in human neonatal social perception

1. In this study¹, published in 2000, 102 'newborn'² boys and girls, were shown a "mobile" and a person's face, in a randomised order, each for around a minute. The mobile was a ball, about the same size as a face, with a 3cm string at its centre, to which was attached a smaller ball. Facial features were pasted on to the mobile, arranged in a "scrambled but symmetrical pattern". The researchers videoed the infants, and assessed the amount of time each infant spent looking at the stimulus.
2. The researchers then:
 - calculated a 'difference score' for each infant, by subtracting the percentage of time they spent looking at the mobile, from the time they spent looking at a face; and
 - classified the infants into three categories, as having a 'preference' for (a) the face (b) the mobile or (c) 'no preference', with a difference score of +/-20 chosen as the cutoff for showing a preference.
3. They reported the following results:
 - of the 58 girls, nearly half (27) showed 'no preference', 22 a 'face preference' and 10 a 'mobile preference'
 - of the 44 boys, nearly one third (14) showed no preference, 11 had a 'face preference', while 19 had a 'mobile' preference

¹ Connellan et al (2000)

² The mean age of the infants studied was a day and a half (36.7 hrs), with a standard deviation of just over a day (26.03 hrs). *ibid*, p 11

4. Using these results, they reported a statistically significant association between sex and stimulus preference (on the basis of an χ^2 test, with $\chi^2 = 8.3$, $df = 2$, $p = 0.016$). From this they concluded that male infants show a stronger interest in a “mechanical” object, while female infants show a stronger interest in a “social” object, and summarised that their findings “clearly demonstrate that sex differences are in part biological in origin.”

Why review the methodological rigour of this study?

5. This twenty year old study has an ongoing and practical influence on how people treat each other and consider their potential, as it continues to be cited in public conversations about sex differences. It was referred to by one of the authors as recently as March 2019 in an article in *The Times* as ‘striking at the heart’ of the issue of whether there are innate differences between men’s and women’s brains³. Google scholar shows 34 citations for the paper in 2020.
6. We therefore considered it was worth checking its analytical rigour. This is particularly important in light of the so-called “replication crisis” in psychology, whereby researchers have highlighted a real risk of false conclusions in the literature. A 2015 project, for example, attempted to replicate 100 studies published in top psychology journals, but found similar findings in less than half of cases⁴.

Failure to analyse the effect of a potentially critical confounding factor

7. We identified a previously unreported serious weakness in the study’s analysis: a failure to analyse the potential confounding effect of an exceptionally high Caesarean Section rate.
8. The Caesarean Section rate in the cohort studied was 40%, double the national average at the time⁵. It is likely that many of these were carried out under general anaesthetic: at the time, around 23% of emergency caesarean sections in England and Wales were carried out under general anaesthesia, and 10% of elective caesarean sections.⁶
9. This unusual feature of the study group could well have skewed the results, because infants born by Caesarean Section, particularly if performed under general anaesthesia would have had very different experiences in the lead-up to the experiment, with implications for their ability and inclination to focus on a stranger’s face or distinguish a real face from an object with scrambled facial features. In particular these infants would have had less opportunity for:

³ Baron-Cohen S, (2019)

⁴ Open Science Collaboration (2015)

⁵ Average caesarean section rates in the UK in 2000 were 197 per 1000 live births in 2000: World Health Organisation Information Gateway available here:

https://gateway.euro.who.int/en/indicators/hfa_596-7060-caesarean-sections-per-1000-live-births/visualizations/#id=19691

⁶ Royal College of Obstetricians and Gynaecologists (2001)

- immediate skin-to-skin contact between mother and baby, a factor that has since been shown to affect newborn stress levels⁷; and
 - mother-baby bonding, a factor that may affect an infants' preference for its mother's face.⁸
10. Moreover, Cesarean Sections are most often performed, and particularly at that time in the UK, because of concerns for the welfare of the infant if labour continued. We do not know the medical reasons for the Caesarean Section and therefore cannot exclude the reasons for the Caesarean Section influencing the infants' behaviour in the neonatal period. We similarly cannot rule out pain-relieving drugs administered for Caesarean Section having an ongoing effect on the behaviour of the infants at the time of the experiment, either directly or through the impact on the mother's engagement with her child in the neonatal period.
11. Yet the paper does not analyse or discuss the Caesarean Section rate as a potential confounding factor, and we do not know from the publication whether caesarean section rates were comparable between the group of boys studied and the girls.
12. These issues cannot be clarified now as the research team has not kept the original datasets, nor the Masters thesis that it is drawn from, nor the more detailed paper referred to in the paper as 'available on request'.⁹

Other methodological weaknesses

13. Moreover, previous critiques have highlighted other weaknesses¹⁰ in the study's design, which introduce additional 'noise' into the data. In particular:
- *the stimuli were presented one after the other rather than at the same time*. This means the results are not a good measure of 'preference', and although the order was randomised this could be another confounding factor. This means the results could have been affected by one group of infants having been shown the face first more often than the other.
 - *it would not have been possible to keep the face stimulus exactly the same for each infant*. The "face" in this experiment was the lead author, and although the paper reports

⁷ Phillips R (2013)

⁸ Bushnell (2001) concluded "the opportunity to view the mother's face is correlated with expressed visual preference for that face, and greater levels of exposure lead to a stronger preference" Bushnell (2001)

⁹ FOI request to Cambridge University and Professor Baron Cohen, 12th March 2019

¹⁰ See Nash A & Grossi G (2007), Rippon (2019) p175-176, and Saini (2017) p70-1 & 87-90

that she aimed to keep her expression “neutral”, there would have been some natural facial movement, In many cases the lead author knew the sex of the infants, and her expectations could have unconsciously influenced her interactions with the infants before the experiment and her facial expressions during it. This means the results could have been affected by the ‘face’ in the experiment inadvertently engaging a bit more with one group of infants than with the other.

14. We would also highlight two other potential confounding factors that the paper fails to analyse:

- gestational age of the infants
- proximity of the mother during the experiment (the paper reports that some babies were held on a parent’s lap while others were on their back in a crib)

Analytical weaknesses

15. On top of these methodological weaknesses, there are serious flaws in the way the paper draws and reports its conclusions:

- *Failure to take account of a null result.* The authors report that they found no statistically significant difference between the boys and the girls on the straightforward comparative measure of percentage looking times for the face and the mobile¹¹, yet they do not accord this any weight in their conclusion. The authors also do not report whether they originally planned to test the data using the more complicated comparison of “difference scores”, which also raises the risk that the authors tried it out in search of statistically significant results. This approach (known as ‘p-hacking’ or ‘data-dredging’) was fairly commonplace at the time, but it is a serious problem, because of how easy it is to find a significant effect if you explore the data after collecting results: statistically significant associations can occur in any data set by chance.¹²
- *Misleading and overstated claims...*
 - *...about having shown “sexual dimorphism”* While in one part of the paper the authors acknowledge that its conclusions relate to average differences between groups of males and females, this important caveat does not feature in the abstract, and the paper claims to have demonstrated sexual “dimorphism”, a phrase that usually means two distinct groups. Yet as Rippon (2019) highlights, the researchers’ results give 40 percent of the infants having no preference for either the mobile or the face, and many of the boys looked longer at the face than at the mobile, and vice versa.
 - *...about having tested mechanical vs social interest.* As Nash & Grossi (2007) highlight, it is not clear that looking at the mobile in this experiment necessarily

¹¹ The paper states that “A repeated measures ANOVA, comparing percentage looking times for males and females for the face and mobile, found that neither the main effect of sex [$F(1, 100) = 1.03, p > 0.3$] or of stimulus type [$F(1, 100) = 0.10, p > 0.7$] were significant.”

¹² Bishop (2019)

signified 'mechanical' interest, rather than, for example, interest in a 'face-like' pattern.

- ... *about having demonstrated a biological issue "beyond reasonable doubt"* The paper claims to have 'demonstrated beyond reasonable doubt' that sex differences are "in part biological in origin". Yet even if its methodology were sound, this could not be proved by a statistical association in a single experiment. Statistics helps us understand probabilities but it does not prove biology. As a recent comment piece in Nature, with 850 signatories including the president of the Royal Statistical Society, emphasised: we should not believe a result is definitely 'real' just because it crosses a threshold of statistical significance.¹³

Conclusion

Individually each of these weaknesses is a serious flaw. Together they fundamentally undermine the study's conclusions. There is too much noise in the data to be able to tell whether the results are actually likely to be due to average sex differences, or whether they are more likely to be the result of other influences on the infants studied. The paper draws misleading and overstated claims from its results. It should no longer be considered a reliable reference point.

¹³ Amrhein, Greenland, McShane et al. (2019)

References

- Amrhein, Greenland, McShane et al (2019) *Scientists rise up against statistical significance*, Nature, March 2019, Available here <https://www.nature.com/articles/d41586-019-00857-9>
- Baron-Cohen S, (2019) *The Gendered Brain by Gina Rippon review — do men and women have different brains?*, *The Times*, March 8th 2019, Available here: <https://www.thetimes.co.uk/article/the-gendered-brain-by-gina-rippon-review-do-men-and-women-have-different-brains-vq757qnph>
- Bishop D (2019), *“Rein in the four horsemen of irreproducibility”*, Nature, April 2019, Available here <https://www.nature.com/articles/d41586-019-01307-2>
- Bushnell (2001), Mother's face recognition in newborn infants: Learning and memory, *Infant and Child Development*, 67- 74
- Nash A, Giordana G (2007) *Picking Barbie's brain: inherent sex differences in scientific ability?*, *Journal of Interdisciplinary Feminist Thought*, Volume 2, Article 5, June 2007
- Connellan J, Baron-Cohen S, Wheelwright S, Batki A, Ahluwalia J, (2000) *Sex differences in human neonatal perception*, *Infant Behavior and Development*, Volume 23, Issue 1, Pages 113-118, Available here: <https://www.sciencedirect.com/science/article/pii/S0163638300000321>
- Open Science Collaboration (2015). *Estimating the reproducibility of psychological science*. *Science*, 2015 Aug 28 Volume 349 Issue 6251
- Phillips R. (2013). *The sacred hour: Uninterrupted skin-to-skin contact immediately after birth*. *Newborn & Infant Nursing Reviews*, 13, 67–72.
- Rippon G. (2019) *The Gendered Brain: The new neuroscience that shatters the myth of the female brain*, London, Penguin Random House
- Royal College of Obstetricians and Gynaecologists (2001) *The National Caesarean Section Audit Report*, RCOG clinical effectiveness support unit, October 2001 Available here: http://orca.cf.ac.uk/93112/1/nscs_audit.pdf
- Saini A.(2017), *Inferior: The true power of women and the science that shows it*, London, 4th Estate