ROYAL SOCIETY OPEN SCIENCE

rsos.royalsocietypublishing.org

Invited reply

CrossMark click for updates

Cite this article: Norscia I, Demuru E, Palagi E. 2016 Difference in contagious yawning between *susceptible* men and women: why not? *R. Soc. open sci.* **3**: 160477.
http://dx.doi.org/10.1098/rsos.160477

Received: 6 July 2016
Accepted: 7 August 2016

Subject Category:
Psychology and cognitive neuroscience

Subject Areas:
behaviour

Keywords:
yawn contagion, gender bias, *Homo sapiens*

Author for correspondence:
Elisabetta Palagi
e-mail: elisabetta.palagi@unipi.it

The accompanying comment can be viewed at http://dx.doi.org/10.1098/rsos.160174.

THE ROYAL SOCIETY PUBLISHING

Difference in contagious yawning between *susceptible* men and women: why not?

Ivan Norscia[1], Elisa Demuru[1] and Elisabetta Palagi[1,2]

[1]Museo di Storia Naturale, Università di Pisa, Via Roma 79, Calci, Pisa 56011, Italy
[2]Unità di Primatologia Cognitiva, ISTC-CNR, via Aldrovandi 16b, 00197 Roma, Italy

EP, 0000-0002-2038-4596

1. Comparing the incomparable

In their commentary, Gallup & Massen [1] criticize the fact that we did not consider 'more than a dozen' previous publications which did not report gender differences in human contagious yawning. We thank the authors for pointing out this issue and for giving us the possibility to provide a brief explanation on some aspects that are not as obvious as we thought.

Our investigation was ethological and our framework was centred on behavioural studies also on non-human primates and other mammals. We therefore selected the articles that were relevant to our comparative and evolutionary approach. Gallup & Massen [1] state that the gender difference in yawn contagion detected in our study is a false positive and that the null effect is real. Unfortunately, the sample that they used to make this assumption (17 negative cases and one positive case) is incorrect and, consequently, so is their conclusion. The possibility to find a phenomenon relies on whether the sample and the methodology used are suitable to detect it. To retain the metaphor used by Gallup & Massen [1], you can flip a coin as many times as you want and never find what you expect if what you expect is to get a six. You should change the approach and roll a dice, instead.

The results presented in the article by Palagi *et al.* [2] were based on naturalistic observations (and not on videos as it is said in table 1 of the commentary [1]) and the database also included bonobos, in which the sex of the trigger and not the sex of the responder tended to influence yawn contagion rates [3]. Therefore, it could not be used to evaluate which variables affect yawn contagion rates in humans only. Four of the articles mentioned in their commentary must be excluded from the sample, because they were focused on sexually immature subjects and on the difference between autistic versus non-autistic children [4–7], whereas our study was focused on non-pathological adults. Children are not suitable to test for gender differences because the power of empathy and yawn contagion is strongly influenced by age [8]. One further article cannot be included because the gender of the potential responder was not considered at all [9], and another one has to be excluded because it investigated yawn contagion and psychopathy [10]. In seven articles, the experimental subjects were either aware of the purpose of the study and/or a control condition was missing (the rate of spontaneous yawning) [11–17]. Adopting a blind procedure—with the experimental subjects not knowing the purpose of the study—is crucial when dealing with yawn contagion because simply thinking about yawning can elicit yawns [18]. Knowing the baseline level of spontaneous yawns is also pivotal to properly measure the real differences between the rate of spontaneous and infected yawns.

Four of the articles mentioned in Gallup & Massen's commentary [1] used static images as stimulus to elicit a motor pattern [12,14–16], and six were based on self-reports and not on objective observations (as the authors specify in table 1 of their commentary) [12–17]. The commentary's authors state that there is no *a priori* reason to believe that different methods and measurements would alter the expression of yawns in men versus women consistently in one direction. The literature, however, does not support this statement. Static images of facial expressions lack the dynamic complexity of naturalistic social–emotional interactions and, therefore, have limited external validity [19,20]. There is evidence that static and dynamic images have a different effect on men and women, with the latter showing an increase of the perception of the emotional intensity when exposed to both happy and angry dynamic facial stimuli [21]. As for the validity of self-reporting methods, a significant gender bias has been demonstrated in a wide variety of studies focusing on many different contexts [22–24]. Petrides & Furnham [25], for example, demonstrated gender differences in measured and self-estimated emotional intelligence with men showing higher correlations between measured and self-estimated scores, whereas women underestimated their emotional reactions and skills. Hence, there are solid reasons to believe that different methods and measurements can alter the expression of yawns in men versus women because the existence of methodology-related gender biases has already been highlighted in previous studies focusing on the expression of emotional states. If we exclude the articles that cannot be used for comparisons for the above-mentioned reasons (self-reported scores, static images, no proper control and non-blind procedures), only two articles of the initial pseudo-sample remain. These two studies considered humans in their natural conditions: one [26] was carried out on all individuals to find out what factors influenced the presence and frequency of yawn contagion and the other [27] considered only the susceptible population to detect if other factors could affect the rate of yawn contagion when yawn contagion occurs. Based on the real available sample, and the related probability, it cannot be stated that our result is a false positive.

2. Comparative versus comparable studies

As regards non-human animals, the commentary's authors criticize the fact that we did not cite all the literature taking into account possible sex effects in yawn contagion. This is not correct. We cited the literature that was relevant to support and understand our results. Very briefly, we excluded articles dealing with (i) birds [28] because the framework of our study connects yawn contagion with the mirror neuron system and the mammalian brain, (ii) stressed dogs showing no yawn contagion [29], (iii) animals exposed to videos of humans or avatars [30,31] and (iv) sexually immature subjects [32].

The work by Massen *et al*. [33] deserves a specific comment as it supports our general idea that yawn contagion is also influenced by the role that individuals play in their society. Chimpanzees form male-bonded societies. Hence, it is not surprising that yawn contagion may be higher in response to males, because the relationship with males can be the most meaningful to the group members. As we summarize in Norscia & Palagi [34], there is growing evidence that the social status affects the degree of emotional involvement of individuals and their interest in what others may feel [35,36]. However, we believe that this study should be replicated without using slow motion videos because, as said above, mimicry responses are influenced by the quality of motor patterns. Moreover, the authors failed to demonstrate that the yawning response of chimpanzees was elicited by the video stimulus and not by other group mates yawning nearby. This bias raises serious concerns on how to interpret the final results.

The other works mentioned by Gallup & Massen [1] were considered when and if appropriate. As we specify in our article, Campbell & de Waal [37] found that only the social bond influenced yawn contagion rates in chimpanzees, which is similar to what we found in humans in our previous article [26]. The same applies to the study on dogs by Romero *et al*. [38], which is cited in our article. The importance of social bond in influencing yawn contagion can be so strong as to dampen the effect of any other factor if we consider the whole population (both susceptible and non-susceptible subjects).

The commentary's authors also state that 'the findings supporting a female bias in non-humans do not actually describe a female bias that is comparable to what Norscia and co-authors [27] report for humans'. However, we did not state that the other works of non-human animals described the exact same bias that we found. We stated that several other works had found a female skew (not the *same* skew) in yawn contagion and then we interpreted the different skews in the light of the role that females have in their groups 'according to species-specific social dynamics' ([27], p. 6). Finding exactly the same bias would go against our own framework, which links possible biases in yawn contagion to social dynamics. If the social dynamics are different, so should be the biases.

3. When the sample is not simple

The commentary's authors confirm that at least within our restricted sample women are more likely to yawn contagiously. And we still claim this. Within the susceptible subjects included in our study, women contagiously yawned more than men. In some of the studies cited in the commentary, some concerns could be raised about the possibility to generalize the results when the analyses are restricted to a certain cohort of individuals (e.g. undergraduate students), uprooted from their context (e.g. laboratory condition) and exposed to unreal stimuli (static images or slow motion videos; e.g. [11,16]).

In our case, Gallup & Massen [1] question how we selected the sample for the analysis, only leaving 34.5% of the original dataset. We indicated the size of the original dataset to precisely show that contrary to laboratory-controlled conditions, in natural settings it is necessary to gather an enormous quantity of behavioural bouts to obtain a sufficient amount of data suitable for analyses. This is a common situation in observational studies, not only in humans, but also in non-human animals.

It is true that in our 2016 study, we 'did not assess whether there was a difference in contagious yawning frequency in the total sample of men and women'. Indeed, as Gallup & Massen [1] also note, we had already demonstrated in 2011 that in the susceptible and non-susceptible population there is no difference between men and women in the yawn contagion frequency [26]. As a further step, we wanted to verify whether within the population in which the phenomenon of yawn contagion is present, different factors other than social bonding would affect the rates of the yawning response. We confirmed that the social bond is a key factor but also that gender can make the difference in how much a subject responds to another one within the 'yawning dyad'. Gallup & Massen [1] also criticize our choice of considering only the subjects exposed to at least three stimuli (yawns) but we strenuously defend this approach. In a natural setting, with confounding auditory and visual stimuli, we must be reasonably sure that the study stimulus is detected. This approach mirrors laboratory experimental procedures in which the yawning pattern is repeated several times in a single video to make sure that the stimulus is perceived by the observer.

In sum, the sample of articles on human contagious yawning that Gallup & Massen used to conclude that our result is a false positive is incorrect, because the cited articles cannot be reliably compared with our study. The comparative studies considering non-human animals were used to discuss why it is reasonable to interpret the different types of biases in contagious yawning in the light of the role that the individuals play in their social groups. Finally, not to replicate previously published results, we focused on the subjects that showed yawn contagion and we made sure that the eliciting stimulus was perceived. In our study, we found that women produce slightly more yawns than men (moderate effect size) and that gender plays a statistically significant role in susceptible people, with women showing a higher level of yawn contagion than men. We are confident that future studies will confirm our results.

Authors' contributions. All the authors contributed equally to this work.
Competing interest. We declare we have no competing interests.
Funding. No funding has been received for this article.
Acknowledgements. We thank two anonymous referees for the accurate and critical revision of our reply.

References

1. Gallup A, Massen JM. 2016 There is no difference in contagious yawning between men and women. Commentary. *R. Soc. open sci.* **3**, 160174. (doi:10.1098/rsos.160174)
2. Palagi E, Norscia I, Demuru E. 2014 Yawn contagion in humans and bonobos: emotional affinity matters more than species. *PeerJ* **2**, e519. (doi:10.7717/peerj.519)
3. Demuru E, Palagi E. 2012 In bonobos yawn contagion is higher among kin and friends. *PLoS ONE* **7**, e49613. (doi:10.1371/journal.pone.0049613)
4. Senju A, Maeda M, Kikuchi Y, Hasegawa T, Tojo Y, Osanai H. 2007 Absence of contagious yawning in children with autism spectrum disorder. *Biol. Lett.* **3**, 706–708. (doi:10.1098/rsbl.2007.0337)
5. Senju A, Kikuchi Y, Akechi H, Hasegawa T, Tojo Y, Osanai H. 2009 Brief report: does eye contact induce

contagious yawning in children with autism spectrum disorder? *J. Autism Dev. Disord.* **39**, 1598–1602. (doi:10.1007/s10803-009-0785-5)

6. Helt MS, Eigsti IM, Snyder PJ, Fein DA. 2010 Contagious yawning in autistic and typical development. *Child Dev.* **81**, 1620–1631. (doi:10.1111/j.1467-8624.2010.01495.x)
7. Usui S, Senju A, Kikuchi Y, Akechi H, Tojo Y, Osanai H, Hasegawa T. 2013 Presence of contagious yawning in children with autism spectrum disorder. *Autism Res. Treat*. **2013**, Article ID 971686. (doi:10.1155/2013/971686)
8. Anderson JR, Meno P. 2003 Psychological influences on yawning in children. *Curr. Psychol. Lett. Behav. Brain Cogn.* (11, Vol. 2, 2003).
9. Platek SM, Critton SR, Myers TE, Gallup GG. 2003 Contagious yawning: the role of self-awareness and mental state attribution. *Cogn. Brain Res.* **17**, 223–227. (doi:10.1016/S0926-6410(03)00109-5)
10. Rundle BK, Vaughn VR, Stanford MS. 2015 Contagious yawning and psychopathy. *Pers. Indiv. Diff.* **86**, 33–37. (doi:10.1016/j.paid.2015.05.025)
11. Gallup AC, Gallup GG. 2007 Yawning as a brain cooling mechanism: nasal breathing and forehead cooling diminish the incidence of contagious yawning. *Evol. Psychol.* **5**, 92–102. (doi:10.1177/147470490700500109)
12. Gallup AC, Eldakar OT. 2011 Contagious yawning and seasonal climate variation. *Front. Evol. Neurosci.* **3**, 3. (doi:10.3389/fnevo.2011.00003)
13. Bartholomew AJ, Cirulli ET. 2014 Individual variation in contagious yawning susceptibility is highly stable and largely unexplained by empathy or other known factors. *PLoS ONE* **9**, e91773. (doi:10.1371/journal.pone.0091773)
14. Massen JJ, Dusch K, Eldakar OT, Gallup AC. 2014 A thermal window for yawning in humans: yawning as a brain cooling mechanism. *Physiol. Behav.* **130**, 145–148. (doi:10.1016/j.physbeh.2014.03.032)
15. Eldakar OT, Dauzonne M, Prilutzkaya Y, Garcia D, Thadal C, Gallup AC. 2015 Temperature dependent variation in self-reported contagious yawning. *Adapt. Hum. Behav. Physiol.* **1**, 460–466. (doi:10.1007/s40750-015-0024-6)
16. Massen JJ, Church AM, Gallup AC. 2015 Auditory contagious yawning in humans: an investigation into affiliation and status effects. *Front. Psychol.* **6**, 1735. (doi:10.1339/fpsyg.2015.01735)
17. Gallup AC, Church AM, Miller H, Risko E, Kingstone A. 2016 Social presence diminishes contagious yawning in the laboratory. *Sci. Rep.* **6**, 25045. (doi:10.1038/srep25045)
18. Provine RR. 2005 Yawning: the yawn is primal, unstoppable and contagious, revealing the evolutionary and neural basis of empathy and unconscious behavior. *Am. Sci.* **93**, 532–539. (doi:10.1511/2005.56.980)
19. Kret ME, De Gelder B. 2012 A review on sex differences in processing emotional signals. *Neuropsychologia* **50**, 1211–1221. (doi:10.1016/j.neuropsychologia.2011.12.022)
20. Wiggert N, Wilhelm FH, Derntl B, Blechert J. 2015 Gender differences in experiential and facial reactivity to approval and disapproval during emotional social interactions. *Front. Psychol.* **6**, 1372. (doi:10.3389/fpsyg.2015.01372)
21. Biele C, Grabowska A. 2006 Sex differences in perception of emotion intensity in dynamic and static facial expressions. *Exp. Brain Res.* **171**, 1–6. (doi:10.1007/s00221-005-0254-0)
22. Pennebaker JW, Roberts TA. 1992 Toward a his and hers theory of emotion: Gender differences in visceral perception. *J. Soc. Clin. Psychol.* **11**, 199. (doi:10.1521/jscp.1992.11.3.199)
23. Kling KC, Hyde JS, Showers CJ, Buswell BN. 1999 Gender differences in self-esteem: a meta-analysis. *Psychol. Bull.* **125**, 470. (doi:10.1037/0033-2909.125.4.470)
24. Pallier G. 2003 Gender differences in the self-assessment of accuracy on cognitive tasks. *Sex Roles* **48**, 265–276. (doi:10.1023/A:1022877405718)
25. Petrides KV, Furnham A. 2000 Gender differences in measured and self-estimated trait emotional intelligence. *Sex Roles* **42**, 449–461. (doi:10.1023/A:1007006523133)
26. Norscia I, Palagi E. 2011 Yawn contagion and empathy in *Homo sapiens*. *PLoS ONE* **6**, e28472. (doi:10.1371/journal.pone.0028472)
27. Norscia I, Demuru E, Palagi E. 2016 She more than he: gender bias supports the empathic nature of yawn contagion in *Homo sapiens*. *R. Soc. open sci.* **3**, 150459. (doi:10.1098/rsos.150459)
28. Gallup AC, Swartwood L, Militello J, Sackett S. 2015 Experimental evidence of contagious yawning in budgerigars (*Melopsittacus undulatus*). *Anim. Cogn.* **18**, 1051–1058. (doi:10.1007/s10071-015-0873-1)
29. Buttner PA, Strasser R. 2014 Contagious yawning, social cognition, and arousal: an investigation of the process underlying shelter dogs' responses to human yawns. *Anim. Cogn.* **17**, 95–104. (doi:10.1007/s10071-013-0641-z)
30. Campbell MW, Carter JD, Proctor D, Eisenberg ML, de Waal FB. 2009 Computer animations stimulate contagious yawning in chimpanzees. *Proc. R. Soc. B* **276**, 4255–4259. (doi:10.1098/rspb.2009.1087)
31. Madsen EA, Persson T, Sayehli S, Lenninger S, Sonesson G. 2013 Chimpanzees show a developmental increase in susceptibility to contagious yawning: a test of the effect of ontogeny and emotional closeness on yawn contagion. *PLoS ONE* **8**, e76266. (doi:10.1371/journal.pone.0076266)
32. Madsen EA, Persson T. 2013 Contagious yawning in domestic dog puppies (*Canis lupus familiaris*): the effect of ontogeny and emotional closeness on low-level imitation in dogs. *Anim. Cogn.* **16**, 233–240. (doi:10.1007/s10071-012-0568-9)
33. Massen JJ, Vermunt DA, Sterck EH. 2012 Male yawning is more contagious than female yawning among chimpanzees (*Pan troglodytes*). *PLoS ONE* **7**, e40697. (doi:10.1371/journal.pone.0040697)
34. Norscia I, Palagi E. 2016 *The missing lemur link: an ancestral step in the evolution of human behaviour*. Cambridge, UK: Cambridge University Press.
35. Zink CF, Tong Y, Chen Q, Bassett DS, Stein JL, Meyer-Lindenberg A. 2008 Know your place: neural processing of social hierarchy in humans. *Neuron* **58**, 273–283. (doi:10.1016/j.neuron.2008.01.025)
36. Muscatell KA, Morelli SA, Falk EB, Way BM, Pfeifer JH, Galinsky AD, Lieberman MD, Dapretto M, Eisenberger NI. 2012 Social status modulates neural activity in the mentalizing network. *NeuroImage* **60**, 1771–1777. (doi:10.1016/j.neuroimage.2012.01.080)
37. Campbell MW, de Waal FB. 2011 Ingroup-outgroup bias in contagious yawning by chimpanzees supports link to empathy. *PLoS ONE* **6**, e18283. (doi:10.1371/journal.pone.0018283)
38. Romero T, Konno A, Hasegawa T. 2013 Familiarity bias and physiological responses in contagious yawning by dogs support link to empathy. *PLoS ONE* **8**, e71365. (doi:10.1371/journal.pone.0071365)