LETTER

REPLY TO GINER-SOROLLA:

Relationships between inequality and air rage are robust to additional specifications

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We appreciate Giner-Sorolla's thoughtful comments (1) on our paper (2).

We first provide "effects of the variables of interest… controlling only for seats, flight length, and their interaction" (1). Odds ratios (ORs) for the presence of first class on incidents in economy [2.5001(0.2570), $P < 0.0001$], boarding from the front on economy incidents [1.4246(0.1572), $P = 0.001$], and boarding from the front on first-class incidents [1.9345(0.6336), $P < 0.05$] all remain statistically significant. [We report ORs to four significant digits because covariates are intentionally in original units for ease of interpretation; for example, the OR for flight distance in model 1 in table 2 of ref. 2 (1.0004) indicates that the odds of air rage increased by 1.0004 per mile, such that the odds of air rage roughly double for every 1,750 miles: $1.0004^{1,750} = 2.01$]. The interaction terms are significant (*P*s < 0.0001), with plots across the models suggesting that the effect of number of seats on air rage is larger for longer flights; including these interactions does not alter our hypothesized inequality-based effects.

We next include the interaction in the analyses in table 2 of ref. 2. ORs for the presence of first class on incidents in economy [2.6930(0.3501), $P < 0.0001$], boarding from the front on economy incidents [1.6601(0.4551), $P = 0.064$], and boarding from the front on first-class incidents [11.8766(11.3231), $P < 0.01$] are statistically or marginally significant. All results are significant when we recreate table S3 of ref. 2, following the suggestion to repeat "robust logistic regression models" [2.7564(0.3502), $P < 0.0001$; 1.7345(0.4385), $P < 0.03$; and 13.3177(12.9320), $P < 0.01$, respectively]. The interaction is significant in all models (*P*s < 0.05) but, again, does not substantively alter the pattern of results.

Including seats^2 × flight_length and seats × flight_length^2 interactions is more complicated. Inclusion would require a priori theorized moderated quadratic effects, complex interactions that are difficult to interpret. Moreover, these variables introduce serious multicollinearity. We subjected all current and proposed covariates to collinearity diagnostics. All suggested additions to our model, as well as the lower order squared terms (seats^2 and distance^2), have very high variance inflation factors (VIFs; range: 75.25–2729.12; refs. 3 and 4). We removed the lower order squared terms [because they were not requested (1)] and mean-centered the variables before creating interactions (5), but VIFs remained quite high (range: 20.46–125.27). This issue makes the resulting estimates potentially unreliable (3, 4), and suggests that these interaction terms are likely not explaining unique variance. Multicollinearity is comparatively not problematic in our original analyses despite some naturally high correlations: VIFs are all <12, except for cabin area in model 2 (17.12); the model remains robust to its exclusion.

We nonetheless conducted the proposed analyses. Recreating table 2 of ref. 2, ORs for the presence of first class on incidents in economy class [2.0753(0.3077), $P < 0.0001$] and for boarding from the front on first-class incidents [11.5249(12.5675), $P < 0.03$] remain statistically significant; boarding from the front on economy incidents is not significant [1.4122(0.3887), $P = 0.21$]. Results recreating table S3 of ref. 2 are similar [2.1174 (0.3214), $P < 0.0001$; 10.8560(12.0602), $P < 0.04$; and 1.4575(0.3825), $P = 0.15$, respectively). The proposed moderated quadratic interactions vary in significance between models and follow no clear pattern.

We believe that these analyses, taken together, offer further support for the robustness of our results.

1 Giner-Sorolla R (2016) Linear controls are not enough to account for multiplicative confound effects on air rage. *Proc Natl Acad Sci USA*, 10.1073/pnas.1607914113.
2 DeCelles KA, Norton MI (2016) Physical and situational inequality on airplanes predicts air rage. *Proc Natl Acad Sci USA* 113(20):5588–5591.
3 Freund RJ, Littell RC, Creighton L (2003) *Regression Using JMP* (SAS Institute, Inc., Cary, NC).
4 Aiken LS, West SG (1991) *Multiple Regression: Testing and Interpreting Interactions* (Sage Publications, Thousand Oaks, CA).
5 Robinson C, Schumacker RE (2009) Interaction effects: Centering, variance inflation factor, and interpretation issues. *Multiple Linear Regression Viewpoints* 35(1):6–11.

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The authors declare no conflict of interest.

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