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Letter to the Editor

Reply to Drs. Almendra-Arao and Sotres-Ramos regarding Barnard's Concept of Convexity and Possible Extensions

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On p. 130 of his 1947's seminal paper, Barnard[1] wrote: "we propose that in our ordering, the two points which, respectively, have the same abscissa or the same ordinate as (a, b), and which lie further from the diagonal PR, shall be considered as indicating wider differences than (a, b) itself. Thus, [...] the points immediately above and immediately to the left of the point 'x' are reckoned to indicate wider differences than the point 'x' itself. This condition implies that the set of points indicating differences as wide or wider than (a, b) will have a shape property *vaguely related to convexity*, and we call it the 'C condition'.

It appears clear from this quotation how Barnard himself did not refer to a mathematical definition of a convex set *strictu sensu*, but, instead, was providing the reader with the intuition of convexity linked to his definition. In this spirit, since our paper[2] was a review paper for non-experts, our intent was to point out that there is no obvious connection with the usual notion of a convex set, which is usually a condition that ensures convergence of algorithms to a unique optimum.

We were not aware of the extended notions of convexity geometry or polyomino convexity that have appeared in the literature and we thank the Authors for pointing out that Barnard convex sets do satisfy these definitions. We would suggest that in future, when quoting Barnard convexity, it be noted that it is not related to closure under linear combination. In any case, we prefer to emphasise the monotonicity properties of the generating statistic and how this affects computation of the exact or quasi-exact p-value.

References

1. Barnard G. Significance tests for 2x2 tables. *Biometrika*. 1947;34(1/2):123-138.
2. Ripamonti E, Lloyd C. Tests for noninferiority trials with binomial endpoints: A guide to modern and quasi-exact methods for biomedical researchers. *Pharm Stat*. 2019;18(3):377-387.