LETTER

The individual and the team in collaborative science

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The analysis of collaborative science by Herz et al. (1) raises additional points worth consideration.

The "deeply rooted biases in perceived self-contribution" that Herz et al. (1) describe are also well known outside of science. Most (all?) of us have lived with roommates, and worked alongside labmates, whom we have had to clean up after. From personal experience, I know I am fully cognizant of this time and effort. In contrast, when (inevitably) my roommate or labmate cleans up after me, I am less aware of their time and effort—indeed, I might not even realize that I left a mess! I use this analogy to initiate authorship discussions with students and postdocs, as recognizing up front this natural tendency to overemphasize your own contributions raises self-awareness and aids these discussions.

It should be no surprise to scientists—who spend years of immense, unseen effort to uncover what was previously unknown—that there may be elements of collaboration not readily apparent or measurable. In addition, Herz et al. (1) implicitly assume an additive mathematical model, such that author contributions independently sum to 100%. However, many phenomena are not additive. Consider a collaborative paper between a technical laboratory and a biological laboratory where a new technique is used to answer an important biological question. Without both laboratories the novel findings would not have been obtained. Our 100% completed study goes to 0%!

There is an additional intrinsic bias: People tend to most value what they do—otherwise, they would do something else! So, if you asked the technical and the biological groups whether the technique or the question was more important, you would expect different answers. There are, of course, additional questions to ask in authorship discussions. Was a preexisting technique used with minimal adaptation, or was it extensively developed for this study? Did the biological group mainly contribute reagents for the technical group, or did they frame a novel question? Still, in the final analysis, researchers will value more what they do; that is human nature and it is also good for science. We need people with different values, perspectives, and passions to synergistically answer questions beyond what each could answer alone, or would even think to ask.

A basketball analogy helps. Top scorers are often considered to be the best players, but when put together, they do not make the best team. Rather, an individual scorer's value is enhanced by a great passer who can find her the open shot. Even sports, won or lost by a seemingly simple sum of points, use high-level, nonadditive analytics to assess impact (2, 3).

The best team integrates individuals with complementary skills, in basketball and in science. As the cliché goes, a team is more than the sum of its parts: The additive model does not hold. In science, we need to seek out opportunities to practice teamwork, and we need to stop penalizing scientists, especially young scientists, for teamwork. We should feel good about—and celebrate—integrating scientists from diverse backgrounds and diverse perspectives toward a common goal. This perspective might even enhance appreciation of diversity in other ways, something sorely needed in science and our broader world.

Note Added in Proof. Since this was written, the need for systemic societal change has risen in the public conscience. Embracing collaboration, in science and beyond, is one of the small but many needed agents of change.

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1 N. Herz, O. Dan, N. Censor, Y. Bar-Haim, Opinion: Authors overestimate their contribution to scientific work, demonstrating a strong bias. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 6282–6285 (2020).

2 S. Kalman, J. Bosch, NBA lineup analysis on clustered player tendencies: A new approach to the positions of basketball & modeling lineup efficiency of soft lineup aggregates. *42 Analytics* (2020). http://www.sloansportsconference.com/wp-content/uploads/2020/02/Kalman_NBA_Line_up_Analysis.pdf. Accessed 3 April 2020.

3 B. Taylor, Nylon calculus: What's the best advanced stat? *FanSided* (2019). https://fansided.com/2019/01/08/nylon-calculus-best-advanced-stat/. Accessed 3 April 2020.

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