The *N*-Effect: Beyond Winning Probabilities

Avishalom Tor
University of Haifa

Stephen M. Garcia
University of Michigan

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Correspondence may be addressed to Avishalom Tor (ator@law.haifa.ac.il) or Stephen Garcia (smgarcia @umich.edu).

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The *N*-Effect reveals that the motivation to compete increases as the number of competitors decreases, controlling for overall expected payoffs (Garcia and Tor, 2009). In their thoughtful commentary, Mukherjee and Hogarth (in press) astutely reason that, given ability differences in the population, the greater sampling error (SE) in small-*N* settings increases weaker competitors' individual probability of winning, potentially causing a motivation gain on their part. Yet while SE may sometimes contribute to the *N*-effect, we explain why it is a theoretically unlikely account of Garcia and Tor's (2009) experiments,[1] then experimentally demonstrate the persistence of the *N*-Effect where an SE effect should not appear.

First, both the *absolute* and *relative* individual-level competitiveness SE implies sit uncomfortably with our individual-level data. To wit, Mukherjee and Hogarth's (in press) own formula reveals that where the proportion of winners is small (e.g. 10%), as in Garcia and Tor (2009), SE realistically only applies to a limited subset of competitors. For instance, their Figure 1 (p. _) illustration shows that even with the benefits of SE about half the population has no meaningful chance of winning even in the small-*N* competition.[2] Such competitors should therefore exhibit (a) no appreciable motivation and b) de-facto indifference between small and large-*N* competitions. Similarly, the diminished SE in large Ns suggests no motivation for the majority of all participating competitors (e.g. ~80% of 100, their Figure 1). Moreover, the SE account also suggests an upper bound on the *N*-effect: Individuals whose location in the population-wide distribution of ability is above the winning threshold (p*) benefit from the diminished SE in large-*N* competitions and should therefore exhibit a *reverse* *N*-effect. However, our extant individual-level data (Studies 3-5) reveals above-minimum competitiveness for most participants and virtually no individual-level motivation *gains* for large versus small-*N* settings in within-subjects designs.

Second, for SE to have caused the *N*-Effect in our studies, some unlikely prerequisites must obtain. For instance, individuals must both estimate their location on the relevant distribution and adapt their behavior to relatively small statistical effects even in between-subjects designs. The literature casts doubt these conditions will hold, however, from studies of people's difficulty to accurately estimate their relative ability (e.g., Burson et al., 2006; Kruger, 1999; Moore & Small, 2007; Svenson, 1981; Windschitl et al., 2008) to evidence that individuals either ignore or overweight small probabilities (e.g., Kahneman & Tversky, 1979). In fact, decision makers are commonly insensitive to sample size (e.g. Kahenman and Tversky, 1972). Thus, an integration of the subtle effects of SE on expected payoffs is implausible for most participants.

Beyond theoretical implausibility, however, a simple experiment clarifes the limits of SE's potential contribution to Garcia and Tor's (2009) experimental data.

Study: When Sampling Error Is Negligible

We tested for the *N*-effect where SE variations between large and even larger *N*s are so negligible they should have no appreciable effect on motivation. A within-subjects design was employed to create an informed setting that should facilitate a null effect for probability judgments. We, however, predicted a significant aggregate *N*-effect.

Participants

82 undergraduates (48 females) participated in an online survey.

Procedure

In a within-subjects design, participants read, "Imagine you were one of several students from across the country raising money for charity by selling candy bars. You have been told at the start of the fundraising drive that all those who finish in the top 10% in candy sales will get a $1,000 scholarship." At this point, participants responded to two randomly presented variants of the same question, " If 2,000 [20,000] students were participating in this fundraiser, to what extent would you be motivated to compete to place in the 10%? (1=not at all, 7=extremely)."

We also asked, "Where do you estimate you stand in terms of the ability to sell candy bars for charity among students from across the country?" (100%=top of distribution).

Results and Discussion

Participants indicated they would feel significantly more motivated amongst 2,000 (M=4.40, SD=1.90) than 20,000 students (M=3.09, SD=1.78; $F(1,81)=60.1$, $p<.001$). The emergence of the *N*-Effect when comparing two large samples, whose SEs differ only minimally, is not explained by the SE account. Moreover, because this scenario requires a top 10% placement to win, participants who believe themselves, for instance, below the 87^{th} ability percentile should exhibit little absolute motivation to compete even in the smaller N=2,000 condition given their exceedingly low winning likelihood of .0001 and less. Yet, this subset was significantly more competitive (M=4.26, SD=1.95; $t(67)=13.8$, $p<.001$) than the scale mark of 1 ("no motivation"); only 5 participants (7.5%) indicated "1" on the scale.

Furthermore, the SE account predicts that only participants believing they are between the 87^{th} and 92^{nd} ability percentile (if that) should show any appreciable difference in motivation between the two conditions: Even in the N=2,000 condition those below-range have a winning likelihood of .0001 or less, while those above it already have a winning likelihood of .9999. Unsurprisingly, however, both below- and above-range participants show the *N*-effect, trying harder among 2,000 (M_{below}=4.26, SD_{below}=1.95; M_{above}=5.00, SD_{above}=1.41) than 20,000 students (M_{below}=3.01, SD_{below}=1.71; F_{below} (1, 67)=42.2, p<.001; M_{above}=2.75, SD_{above}=2.22; F_{above} (1, 3)=6.9, p=.078) in contravention of the SE account.

In sum, SE cannot account for the *N*-effect in Garcia and Tor's (2009) results, although it may have contributed to it. Importantly, however, our studies have only begun identifying the *N*-effect, its causes and boundaries. Further research is also needed to identify conditions under which SE significantly contributes to the *N*-effect, a possibility suggested by Kareev and Avrahami's (2007) findings and Mukherjee and Hogarth's (in press) analysis.

Footnotes

1. These studies also arguably address SE: the mere presence of others lowers performance on the SAT and CRT (Studies 1a and 1b), where test-takers partake in a single competition; the *N*-effect is linked to social comparison (Study 3-4), controlling for perceptions of the easiness of winning (Study 5) and explicitly controlling for variations in individual ability (Studies 3 and 4).

2. For instance, the formula shows $P_a = .002$ and .0008 for $p = .50$ and .45 respectively.

References

Burson, K.A., Larrick, R.P., & Klayman, J. (2006). Skilled or unskilled but still unaware of it: How perceptions of difficulty drive miscalibration in relative comparisons. *Journal of Personality and Social Psychology*, *90*, 60-77.

Garcia, S.M., & Tor, A. (2009). The *N*-Effect: More competitors, less competition. *Psychological Science*, *20*, 871-877.

Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, *3*, 430-454.

Kahneman, Daniel, and Amos Tversky (1979). Prospect theory: An analysis of decision under risk, *Econometrica*, *47*, 263-291.

Kareev, Y., & Avrahami, J. (2007). Choosing between adaptive agents. *Psychological Science*, *18*, 636-641.

Kruger, J. (1999). Lake Wobegon be gone! The "Below-Average Effect" and the egocentric nature of comparative ability judgments. *Journal of Personality and Social Psychology*, *77*, 221-232.

Moore, D. A., & Small, D. A. (2007). Error and bias in comparative judgment: On being both better and worse than we think we are. *Journal of Personality and Social Psychology, 92*(6), 972-989.

Mukherjee, K., & Hogarth, R. (in press). The N-Effect: Possible effects of differential probabilities of success.

Svenson, O. (1981). Are we all less risky and more skillful than our fellow drivers?. *Acta Psychologica*, *47*, 143-148.

Windschitl, P.D., Conybeare, D., & Krizan, Z. (2008). Direct-comparison judgments: When and why above- and below-average effects reverse. *Journal of Experimental Psychology: General*, *137*, 182-200.