The *N-Effect*: More Competitors, Less Competition

Stephen M. Garcia

University of Michigan

Avishalom Tor

University of Haifa

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Abstract

The present analysis introduces the *N-Effect* – the discovery that increasing the number of competitors (*N*) can decrease competitive motivation. Studies 1a-b found evidence that average test scores (e.g., SAT scores) fall as the average number of test-takers at test-taking venues increases. Study 2 found that individuals trying to finish an easy quiz among the top 20 percent in terms of speed finished significantly faster if they believed they were competing in a pool of 10 versus 100 other people. Using a social comparison orientation (SCO) scale, Study 3 showed the *N-Effect* occurs strongly among those high in SCO and weakly among those low in SCO. Study 4 directly linked the *N-Effect* to social comparison, ruling out the "ratio-bias" and finding that social comparison becomes less important as *N* increases. Finally, Study 5 found the *N-Effect* is mediated by social comparison. Limitations, future directions, and implications are discussed.

The *N-Effect*: More Competitors, Less Competition

Modern life often seems like a rat-race. But does one's motivation to run the maze, to compete, depend on how many other "rats" are in the race? When there is only one gold medal, for instance, increasing the number of contestants from 10 to 100 reduces each contestant's probability of winning and may therefore lead them to reduce their competitive efforts. We propose, however, that mere knowledge of the number of competitors can *independently* impact competitive motivation even where the chances of success remain constant. The present analysis thus introduces the *N-Effect* – the discovery that increasing the number of competitors ("*N*") decreases the motivation to compete.

While our primary objective is to introduce a new phenomenon and link it to the social comparison process, the *N-Effect* finding simultaneously makes two important theoretical contributions: First, it advances a new direction in social comparison research, which has traditionally examined how *subjective* factors amplify competition (Festinger, 1954; Tesser, 1988), but recently began exploring how *objective*, contextual, factors also impact the motivation to compete (e.g., Garcia, Tor, Bazerman, & Miller, 2005; Garcia, Tor, & Gonzalez, 2006; Garcia & Tor, 2007). The *N-Effect* continues in this direction, revealing the impact of a ubiquitous contextual factor – the number of competitors – on social comparison and, thus, on competitive motivation. Second, the present analysis reveals a boundary condition of social facilitation. While competitive motivation increases in the presence of a few others (Zajonc, 1965), we show it diminishes when the *few* become *many* competitors.

Social Comparison and the Competitive Landscape

Social comparison processes fuel the motivation to compete (Festinger, 1954; Garcia, et al., 2006; Johnson & Stapel, 2007). People ("Actors") comparing themselves to others ("Targets") on an important dimension begin to behave competitively toward them (e.g., Garcia & Tor, 2007; Hoffman, Festinger, & Lawrence, 1954; Poppe & Valkenberg, 2003). Traditionally, researchers emphasized three factors that impact social comparison-based competitive behavior: (i) importance of the performance dimension (Festinger, 1954; Tesser, 1988), (ii) commensurability of the Target (Goethal & Darley, 1977), and (iii) Target-Actor relationship closeness (Tesser, 1988). These factors are all *subjective*, varying among similarly situated Actors.

Recent studies, however, illuminate the important role of *objective,* contextual, features of the competitive landscape in shaping social comparison processes (Garcia, et al., 2005; Garcia, et al., 2006; Garcia & Tor, 2007), showing , for example, that competitive behavior only occurs when rivals are *near a standard*, an acknowledged measure of comparison. On the other hand, rivals not in the proximity of a standard exhibit fewer social comparison concerns and become less competitive (Garcia, et al., 2006; Garcia & Tor, 2007). In the same vein, the present analysis identifies the impact of *N* – another ubiquitous contextual factor – on social comparison and thus competitive motivation.

Among a few competitors, Actors can compare their performance to that of any given Target, a situation that fuels the motivation to compete (Festinger, 1954). We posit, however, that when *N* is large, social comparison concerns – which are, after all, an interpersonal, information-based process (Festinger, 1954) – become diffused by the sheer number of competitors. While Actors can experience or anticipate social comparisons between themselves

and a few others, it becomes less viable and informative to compare oneself, or anticipate comparisons, with a great multitude of Targets. For this reason, we hypothesize that in large *N* environments social comparison becomes less important and competitive motivation diminishes.

The Presence of Others and Motivation

The *N-Effect* contributes to the extant literature on the presence of others and motivation. For instance, "social loafing" findings (Latané, et al., 1979) reveal that individual effort generally decreases when an individual task is transformed into a *collective* group task. Nevertheless, individual performance feedback can increase motivation in collective tasks (e.g., Williams, Harkins & Latané, 1981), and heightened social comparison and competence concerns can reduce loafing as well (Kerr & MacCoun 1984).

The finding that the presence of others can increase motivation when raising social comparison concerns also appears in the social facilitation literature (Zajonc, 1965). In this case, motivation and effort increase through coaction effects (Zajonc, Heingartner, & Herman, 1969) when *individual* – rather than collective – tasks are performed in the presence of a few others.

We suggest that, like facilitation, the *N-Effect* is manifested in individual tasks. However, unlike facilitation, which compares an individual alone versus amongst a few others, this effect occurs in already competitive settings, when an environment with only *a few* competitors is compared or transformed to one with *many* competitors. We hypothesize that in these situations – where social facilitation and social comparison already are present – an increase in *N* would have the opposite effect of *reducing* social comparison concerns and thereby decreasing the motivation to compete and generating the *N-Effect*.

Studies 1a and 1b: Test-Taking Evidence

We first probed for the N-Effect in two datasets possessing a high degree of external validity, namely the Scholastic Aptitude Test (SAT) and the Cognitive Reflection Test (CRT). We examined SAT scores at the publicly available state-level,[1] and corroborated this evidence by examining an individual-level data set on CRT scores[2], which are highly correlated with SAT and intelligence measures (Frederick, 2005). We predicted that denser test-taking environments – where more test-takers are present in a testing venue – diminish competitive motivation and consequently reduce both SAT and CRT scores.

Data Sets

Study 1a: SAT State-Level Data

Key Variables. We constructed a dataset based on the publicly available state-level 2005 SAT results published by The College Board for all 50 states. In addition to the combined SAT score (SCORE), we created a test-taker density variable (DENSITY) for each state by dividing the total number of test-takers for 2005 in each state by the total number of test-taking venues in that state. Hence, DENSITY provides a state-level average of test-taker *N*.

Control Variables. In an attempt to minimize potential confounds, we controlled for relevant variables at the state level: the percent of high school students who take the SAT, the 10-year trend for performance on the SAT, the percent of test-takers who reported having parents with a college degree or higher, and the percent of test-takers who were self-identified as ethnic minority. We also controlled for important demographic variables by state: funding of state and local governments for elementary and secondary education (U.S. Department of Education, National Center for Education Statistics, 2005 table on 2002-03 data); per capita income (2004 Table of the Bureau of Economic Analysis); and population density (2000 U.S. Census). Finally,

we controlled for the percentage of high school students who take the ACT (the other main college entrance exam) and the average ACT score for each state.

Study 1b: Cognitive Reflection Test Data

Key Variables. We obtained a data set of CRT scores based on a sample of 1,383 University of Michigan undergraduates (711 female, 633 male, 39 n/a) collected over a three-year period that involved a total of 22 test-taking opportunities. Students took the CRT in a test-taking environment that was standardized across all 22 test-taking opportunities and was always part of a larger questionnaire day.

Results and Discussion

Study 1a: SAT Scores. As predicted, a significant inverse correlation emerged between DENSITY and SCORE (N=50, r=-.68, p<.05); the denser the test-taking environment, the lower the SAT score. We also conducted a partial correlation to control for the aforementioned control variables, and the inverse correlation between SCORE and DENSITY remained significant (N=50, df=39, r=-.35, p<.05). This result indicates that the more people showing up, on average, at the test-taking venue, the lower the SAT score.

Study 1b: CRT Scores. In a parallel analysis, we correlated the total number of participants that showed up for one of the 22 CRT test-taking opportunities with the corresponding average score of that particular session. As with the SAT analysis, we observed a strong inverse correlation between NUMBER and CRT scores (N=22, r= -.56, p<.01); this inverse correlation remained, controlling for gender (N=22, df=19, r=-.48, p<.05). Hence, the more participants that were present in a particular CRT test-taking session, the lower the CRT score for that particular session.

The SAT results, although striking, are subject to potential confounds, most notably distraction and self-selection. Denser test-taking environments may produce increased distraction that accounts for diminished performance. However, The College Board goes to great lengths to standardize the testing-taking environment within each venue, with high-volume centers typically trafficking students into one of many classrooms, making variable distraction during the test unlikely. Similarly, self-selection might have explained the data if better test-takers were to self-select to lower-density states, but there is little reason to believe this is the case. We nevertheless acknowledge the limitations of the SAT real-world data, which was available only at the state-level.

Importantly, however, the CRT scores were available at the individual level, in a comparatively homogenous University of Michigan sample, and thus afforded a better-controlled analysis which still provided clear evidence for the *N-Effect*. Here, moreover, the test-taking environment was standardized and self-selection irrelevant. Both SAT and CRT analyses thus support the *N-Effect*, which we next examined experimentally under controlled random assignment.

Study 2: Diminished Experimental Performance

Study 2 tested the *N-Effect* in a task where participants were given an easy but timed quiz, having been told their goal was to finish as fast as possible without compromising accuracy. We predicted the participants in the *10-person condition* would be more competitive, completing the quiz significantly faster than those in the *100-person condition*.

Participants

Seventy-four University of Michigan undergraduates (33 female, 41 male) were recruited while studying alone at university libraries. Because the quiz was timed, only native English speakers were recruited.

Procedure

Experimenters asked potential participants if they would be willing to take part in a short experiment. One experimenter then handed participants a two-page packet (a cover page followed by a short quiz page) and explained they would be taking a timed quiz and their goal was to finish the quiz as fast as possible without compromising accuracy. Participants were told they were competing against either 10 or 100 other participants and that those scoring in the top 20 percent in completion time would receive $5. The short quiz contained four general knowledge multiple-choice questions (e.g. "Who is the Secretary General of the UN?") and four true-false statements (e.g., "Michigan is shaped like a shoe").

Once the first experimenter gave participants the packets and instructions, the second experimenter, blind to the experimental condition, informed participants he would begin timing them with a stopwatch. Afterwards, each participant wrote their e-mail address, in case they scored in the top 20th percentile. Participants in the top 20 percent were later paid $5.

Results and Discussion

There were no significant accuracy or gender by condition interactions (F's<1). Importantly, participants in the *10-person condition* completed the quiz significantly faster (M=28.95, SD=7.69) than those in the *100-person condition* (M=33.15, SD=10.06; $F(1,73) = 4.09$, $p< .05$). Study 2 thus provides a between-subjects, direct, behavioral measure of the *N-Effect*, showing increased *N* to diminish competitive motivation on an individual task.

Moreover, because the effect was generated by mere knowledge of *N* it cannot be explained by mechanisms that require the actual presence of *N* (e.g., "arousal" or "coaction effects"). Notably, however, mere information is known to suffice for social comparison processes (Suls & Wheeler, 2000). Tentatively supporting a social comparison account of the *N-Effect*, moreover, a post-test suggested that social comparison concerns play a significantly greater role in the *10-person condition* than in the *100-person condition*.[3]

Study 3: Social Comparison Orientation and the *N-Effect*

Study 3 further probed social comparison's role in the *N-Effect*, using a social comparison orientation (SCO) scale (Gibbons & Buunk, 1999) to reveal interpersonal differences in the effect. The prediction was that high SCO individuals will be more likely to exhibit the *N-Effect* than low SCO ones.

Participants

Forty-seven undergraduate students (24 female, 23 male) from a Midwestern university participated in an online study. A total of 250 randomly selected e-mail addresses from the undergraduate student directory were e-mailed but a few e-mails "bounced-back." The response rate was approximately 20 percent.

Procedure

In a within-subjects design, participants read two randomly presented vignettes: "Suppose you are running in 5-K with 50 [500] people of similar running ability as yours. You have been told at the start of the race that all those who finish in the top 10% will get a $1,000 prize." Participants responded to the dependent variable, "To what extent would you run faster than normal?" (1=*Faster than normal*, 7=*Fastest in my life*). Participants also responded to the 11-items of social comparison scale (Gibbons & Buunk, 1999).

Results and Discussion

Participants indicated trying significantly harder in a 5-k race with 50 contestants (M=5.43, SD=1.63) than with 500 contestants (M=4.89, SD=1.71): The "NUMBER" within-subjects factor was significant ($F(1,46)=11.4$, $p<.01$). Moreover, when inputting the continuous SCO measure in the within-subjects ANOVA as a covariate, we observed a significant interaction between "NUMBER" and SCO ($F(1,45)=5.41$, $p<.05$). As predicted, individuals with increasingly higher SCO were more likely, while those increasingly lower in SCO were less likely, to exhibit the *N-Effect*. We also conducted a median split on SCO,[4] finding that among High SCO participants the *N-Effect* was pronounced (Few Competitors: M=5.87, SD=1.36; Many Competitors: M=5.22, SD=1.51; $t(22)=2.91$, p=.008), while among Low SCO participants it was insignificant (Few Competitors: M=4.95, SD=1.85; Many Competitors: M=4.70, SD=1.95; $t(19)=1.00$, p=.33). Study 3 thus shows social comparison is a necessary precondition for the *N-Effect*.

Study 4: Social Comparison or Ratio-Bias?

Study 4 began examining social comparison against alternative accounts, focusing on the potential role of the "ratio bias" (Denes-Raj & Epstein, 1994) alternative in generating the *N-Effect*. The ratio bias leads individuals to think it is easier, for instance, to draw one red jellybean from a jar containing 10 red out of 100 beans than to draw the only red bean out of a jar containing 10 beans, despite the equal probabilities of the two tasks. Competitors exhibiting this bias may reduce their efforts when facing a large N simply because they think their chances of success are *higher* than in small N settings, despite being told otherwise. Although the ratio-bias is primarily a within-subjects effect (e.g., Denes-Raj, et al., 1995) and thus an unlikely candidate

for explaining the between-subjects results of Studies 1-2, Study 4 sought directly to examine its explanatory power while further illustrating the social comparison roots of the *N-Effect*.

Participants

In the first sample, a total of 54 Midwestern undergraduates participated in an online survey and responded to questions about competitive feelings (approx. 29 percent response). In the second sample, a total of 48 Midwestern undergraduates participated in an online survey (appox. 25 percent response) and responded to questions about social comparison.

Procedure

Competitive Feelings Sample. In a within-subjects design, participants read: "Imagine going for a job interview with a company that is only extending offers to 20% of the equally qualified Michigan students who were invited to interview. Alone in the waiting room, you notice one other Michigan student exiting their interview..." Then participants responded to each of the four randomly presented levels of context: "If a total of 10 [30] [50] [100] Michigan students had been invited to interview, to what degree would you harbor competitive feelings toward the exiting interviewee?" (1=*Not At All*, 6=*Very Much*).

Social Comparison Sample. The second sample answered a different DV ("…to what degree would you feel inclined to compare yourself to the exiting interviewee?" 1=*Not at all*, 6=*Very Much*)

Ratio-Bias. On the next page, all participants responded to the ratio-bias scenario about "Ralph" (verbatim from Denes-Raj & Epstein, 1994).

Results and Discussion

As predicted, results showed *competitive feelings* decreased as the number of other interviewees increased from 10 (M=4.43, SD=1.77), to 30 (M=3.80, SD=1.72), to 50 (M=3.59,

SD=1.68), and finally to 100 interviewees (*M*=3.19, *SD*=1.76; $F(3,159)=25.07$, $p<.0001$; linear contrast: ($F(1,53)=29.6$, $p<.0001$). The *N-Effect* by ratio-bias interaction was insignificant ($F(6,147)=1.46$, $p=.20$). As for *social comparison*, participants similarly indicated decreasing desire to compare themselves to another interviewee as the number of total interviewees increased from 10 (*M*=5.00, *SD*=1.35), to 30 (*M*=4.37, *SD*=1.29), to 50 (*M*=3.90, *SD*=1.42), and finally to 100 (*M*=3.52, *SD*=1.53; $F(3,141)=35.3$, $p<.0001$; linear contrast: $F(1,47)=42.2$, $p<.0001$). Again, the *N-Effect* by ratio-bias interaction was insignificant ($F(6, 132)=1.59$, $p=.16$). Taken together, these results indicate the ratio-bias does not account for the *N-Effect*, while directly linking the latter to social comparison: The importance of social comparison decreases in *N*, leading the motivation to compete to subside as well.

Study 5: Social Comparison Mediates the *N-Effect*

Study 5 sought directly to show that social comparison mediates the *N-Effect*, while more generally controlling for the potential role of subjective perceptions of success. Thus, in addition to the ratio-bias examined in Study 4, some research suggests that competitors may reduce their competitive motivation to compensate for a perceived increase in the *easiness* of a task (e.g., Windschitl, Kruger, & Simms, 2003). At the same time, competitors may also reduce motivation and effort for large *N*s if they erroneously believe the task is more *difficult* and their success prospects and expected payoffs have diminished. Study 5 therefore controls for perceived easiness/difficulty of the task and predicts the relationship between *N* and the motivation to compete is mediated by social comparison processes, beyond the potential contribution of any biased likelihood-of-success perceptions.

Participants

Fifty undergraduates (25 female, 25 male) from a Midwestern university volunteered to participate in an online study. The response rate was approximately 20%.

Procedure

In a between-subjects design, participants read: "In a competition pool of 10 [10,000] students from around the country, imagine you were given one week to produce as many brand-spanking-new 'friends' to your Facebook account as possible. You would be competing in a pool of 10 [10,000], and those finishing in the top 20% would get a $100 cash prize." Participants then responded to three dependent variables: *competitive motivation* ("To what extent would you feel motivated to compete to win the cash prize?," 1=*Not At All*, 7=*Very Much*), *social comparison* ("To what extent would you be inclined to compare your own progress to your competitors' progress?," 1=*Not At All*, 7=*Very Much*), and *perceived ease* ("To what extent do you feel it would be easy to win the cash prize?," 1=*Not At All*, 7=*Very Much*). Participants were also asked to indicate their gender and answered manipulation checks about *N* and the percentage of competitors that would win.

Results and Discussion

Only 6 participants did not report or missed the question about the number of other competitors and only 4 missed the fact that the top 20% would receive the cash prize. We retained their data, as doing so did not affect direction or statistical significance. A multivariate ANOVA indicated that individuals reported feeling more motivated to compete in the *10 competitors condition* (M=4.07, SD=2.02) than in the *10,000 competitors condition* (M=2.00, SD=1.51, $F(1, 48)=16.1$, $p<.001$). They also indicated they would feel more inclined to compare their own progress to their competitors in the *10 competitors condition* (M=4.75, SD=2.10) than in the *10,000 competitors condition* (M=2.64, SD=2.01, $F(1, 48)=12.9$, $p<.01$). Interestingly,

however, participants felt it would actually be easier to win the cash prize in the *10 competitors condition* (M=3.89, SD=1.89) than in the *10,000 competitors condition* (M=2.50, SD=1.85, $F(1, 48)=6.82$, $p<.05$), although the effect size is somewhat smaller.

We tested our prediction that social comparison mediates the relationship between *N* and competitive motivation, controlling for the perceived easiness of the task and gender. As predicted, NUMBER (few/many competitors) was a significant predictor of the outcome variable COMPETITIVE MOTIVATION (*B-value*=-1.40, β=-.34, $p<.01$). NUMBER was also a significant predictor of the mediator SOCIAL COMPARISON (*B-value*=-1.38, β=-.30, $p<.05$). Finally, the mediator SOCIAL COMPARISON was a significant predictor of COMPETITIVE MOTIVATION (*B-value*=.67, β=.75, $p<.001$). Importantly, in this latter case, NUMBER was no longer a significant predictor of COMPETITIVE MOTIVATION (p=.16) – a significant drop (*Sobel* = -2.35, $p<.05$) that further indicates the motivation to compete is mediated by social comparison (MacKinnon et al., 2002).

Notably, we have also conducted a reciprocal parallel mediation analysis on the perceived easiness of the task (instead of social comparison) while controlling for gender and social comparison (instead of perceived easiness) at every step. In this case, neither Step 1 (N as a predictor of competitive motivation: p=.12), nor Step 2 (N as a predictor of perceived easiness: p=.36), nor Step 3 (perceived easiness as a predictor of competitive motivation: p=.17) were significant. Unlike social comparison, therefore, perceived easiness does not appear independently to mediate the N-Effect. However, a mediation analysis cannot fully substitute for a direct manipulation of social comparison, although it can help limit the inferential scope of possible mediators. The present social comparison analysis is thus preliminary, leaving its further refinement and development for future studies.

General Discussion

Among a few competitors, people can experience or anticipate social comparison concerns, which in turn fuels their motivation to compete. As *N* increases, the forces underlying social comparison processes typically diminish, making social comparison less important and dampening competitive motivation. The present analysis finds consistent, converging, evidence for the *N-Effect* across different contexts, methodologies, between- and within-subjects designs, in-person and online participants, and hypothetical and behavioral measures. Studies 1a-b showed that SAT and CRT scores fall as the number of test-takers in a given venue increases. Study 2 demonstrated the *N-Effect* in completion times using random assignment, showing that mere knowledge of *N* is sufficient to generate it. Study 3 further showed the *N-Effect* is moderated by individual differences manifested in the social comparison orientation (SCO) scale. Finally, Studies 4 and 5 rejected the alternative "ratio bias" and perceived easiness accounts, further linking the *N-Effect* to social comparison processes (Study 4) and showing these processes mediate it (Study 5).

Limitations and Future Directions

Despite the centrality of social comparison processes in generating it, other mechanisms that await further study might well contribute to the *N-Effect.* Indeed, decades of research on similar behavioral phenomena, like bystander apathy, have been found to be multiply determined (e.g., *diffusion of responsibility*: Darley & Latane, 1968; *social influence*: Darley et al., 1973; *confusion of responsibility*: Cacioppo et al., 1986; *pluralistic ignorance*: Prentice & Miller, 1996; *implicit bystander effect*: Garcia et al., 2002, etc.). Hence, we can confidently assert that social comparison is *one*, but not necessarily the *only*, mechanism of the *N-Effect*.

The present findings also do not clarify the limits of the *N-Effect*. Our studies, the psychophysics literature (Zipf, 1949), and what social impact theory calls "the psychosocial law" (Latané, 1981), all suggest that increasing N from 10,000 to 10,100 is unlikely significantly to change competitive motivation. The impact of *both* N *and* ΔN, moreover, may vary across competitive contexts; N poker-table competitors may well be perceived differently from N marathon runners.

Nevertheless, the present evidence of the *N-Effect* already has significant implications that go beyond social comparison, social facilitation, and related research. In the workplace, for instance, productivity on individual tasks (e.g., sales in a commission-based system) might be lower when the tasks are performed among many similar workers in a large warehouse than when they are performed among only a few workers in smaller branch offices. In educational settings, the *N-Effect* sheds new light on the class size debate (Mishel, & Rothstein, 2002). Some observers argue that class-size is rather insignificant (e.g., Hanushek, 2002), whereas others deem it important (e.g., Krueger, 2002). The *N-Effect*, however, indicates that as the number of students in the classroom increases, the motivation to compete and academic efforts are likely to decrease. In fact, perhaps the *N-Effect* could partly explain the mystery of the falling SAT scores in recent years (Finder, 2007), if the average number of test takers reporting to testing venues has been increasing.

Finally, we conclude by qualifying Zajonc's (1965) recommendation in his seminal article on facilitation: "If one were to draw one practical suggestion . . . [one] would advise [one's] student . . . to arrange to take his examinations in the company of many other students, on stage, and in the presence of a large audience. The results of his examination would be beyond his wildest expectations…" (p. 274, Zajonc, 1965). On the basis of our social comparison

account of the *N-Effect*, we recommend having only *a few* others on stage; adding too many competitors may dampen, rather than enhance, the motivation to compete.

Footnotes

1. The College Board denied our request for individual-level data.
2. We thank Shane Frederick for this helpful dataset.
3. An independent sample read the context of this quiz experiment and answered, "If there were 10 [100] competitors in the aggregated pool, to what extent would you be concerned about how your performance compared to the performance of any one particular competitor? (1=not at all, 7=very much)." Social comparison concerns were significantly greater in the 10 (M=4.93, SD=1.78) versus 100 (M=4.14, SD=1.68) conditions (paired-samples $t(58)=3.44$, $p<.01$).
4. Median-split statistics are supplemental; the reported covariate analysis is appropriate (MacCallum et al., 2002).

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