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Testing social impact and self-attention predictions with live audiences and co-actors

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Abstract: This experiment examined the influences of the number of co-actors and audience size on manual dexterity task performance and subjective reactions such as perceived effort and arousal. Predictions derived from social impact theory and the self-attention perspective's other-total ratio indicated that both the number of co-actors and audience size should influence responses. Undergraduate students ($N = 128$) responded as 1, 2, 4, or 8 group members who were observed in a counterbalanced fashion by 1, 2, 4, or 8 audience members for four performance trials. The predictions of increased task performance with larger audience sizes and decreased performance as the number of co-actors increased were not supported. Participants rated arousal as somewhat consistent with the predictions from the self-attention perspective and social impact theory. Self-reported effort was consistent with the predicted patterns, but not always significantly so. The influence of the number of others is moderated by the objective-subjective nature of the responses of real co-actors performing in front of live audiences.

Keywords: social impact; self-attention; co-actors; audience; other-total ratio; objective and subjective reactions

1. Introduction

Social psychology rests upon the belief that the presence of others influences individuals' thoughts, feelings, and actions (Allport, 1954). A distinction important for this research is drawn between those who observe the individual (audience members) and those who perform with the individual (co-actors). Research related to audience effects has been related to social facilitation (Geen, 1980) and topics such as choking under pressure (Baumeister and Showers, 1986), but can also be seen in how groups interact with groups (Klonek et al., 2023). The performance of tasks with co-actors is central to small group performance and group dynamics (Davis, 1969; Forsyth, 2019) and Triplett's (1898) original experimental research in social psychology. Yet, due to their complexity, the combined influences of audiences and co-actors have rarely been experimentally investigated. This research tests predictions of two theoretical approaches to the impact of variations in the number of co-actors and audience members on assessments of objective task performance and subjective reactions to the setting, such as effort and arousal.

The influences of co-actors and audiences are demonstrated in a number of social situations, such as team athletic events, social performances (e.g., plays, recitals), team games, and workgroup performances. Research in a number of domains, such as sports and organizational psychology, finds that co-actors and audience size impact performance (Chung et al., 2018), as well as subjective reactions about the performance, e.g., effort, arousal, and quality (Forsyth, 2019). Given the prevalence

of these social situations and the impact of audiences and co-actors on the outcomes of the interaction, our understanding can be guided by theoretical frameworks that predict the effects of the number of co-actors and audience size. The self-attention perspective (Mullen, 1983) and the theory of social impact (Latané, 1981) are investigated as two frameworks that describe the combined influences of the number of co-actors and audience size on outcomes such as objective performance, perceived effort, and subjective reactions.

1.1. Self-Attention and the other-total ratio

The self-attention perspective (Carver and Scheier, 1981; Mullen, 1987; Wicklund, 1980) examined the effects of the group on an individual (Mullen, 1983). Mullen proposed that the presence of others, such as co-actors, makes an individual more self-attentive so that the person focuses on the self as an object of evaluation. When people, such as co-actors, are made more self-attentive, they become more concerned with matching their responses to the standards of appropriate behavior. Mullen contends that easily perceived differences can separate people into homogeneous subgroups (e.g., co-actors and audiences). The smaller subgroup receives the focus of attention, and the larger subgroup does not. As a result of this attentional focus, the smaller subgroup would emit more matching-to-standard behavior (e.g., conformity), while the larger subgroup, having a relative absence of self-attention, would be less likely to match-to-standard (Mullen, 1983).

In group settings, a member or subgroup might become the focus of attention of others. When larger audiences are present, an actor or co-actors will be the focus of attention. Importantly, an actor is predicted to have more self-focus as the number of co-actors being observed or evaluated decreases (as the size of the sub-group decreases) (Mullen, 1983). For co-actors performing a task in front of an audience, the co-actors' self-attention should increase as audience size increases, while self-attention decreases as the number of co-actors increases because of the reduced focus of the evaluation on a single actor.

Formally, Mullen (1983) proposes an Other-Total Ratio for the composition of the group that specifies how the context a co-actor faces impacts self-attention. The other (O) in the ratio reflects the number of observers or evaluators, such as the audience. The number of people who can serve as the stimuli (S) under observation or evaluation needs to be considered as well (e.g., co-actors). The total (T) of others evaluating (O) and the persons being evaluated (S) provides the total in this representation ($T = O + S$). The Other-Total ratio (O/T) indicates that self-attention decreases as the ratio diminishes. The self-attention model makes specific predictions regarding the impact of the number of co-actors and audience size on self-attention, as depicted in **Figure 1** (Mullen, 1983). Specifically, it is hypothesized that the effects of self-attention decrease as audience size increases and that the effects of self-attention increase as the number of co-actors increases.
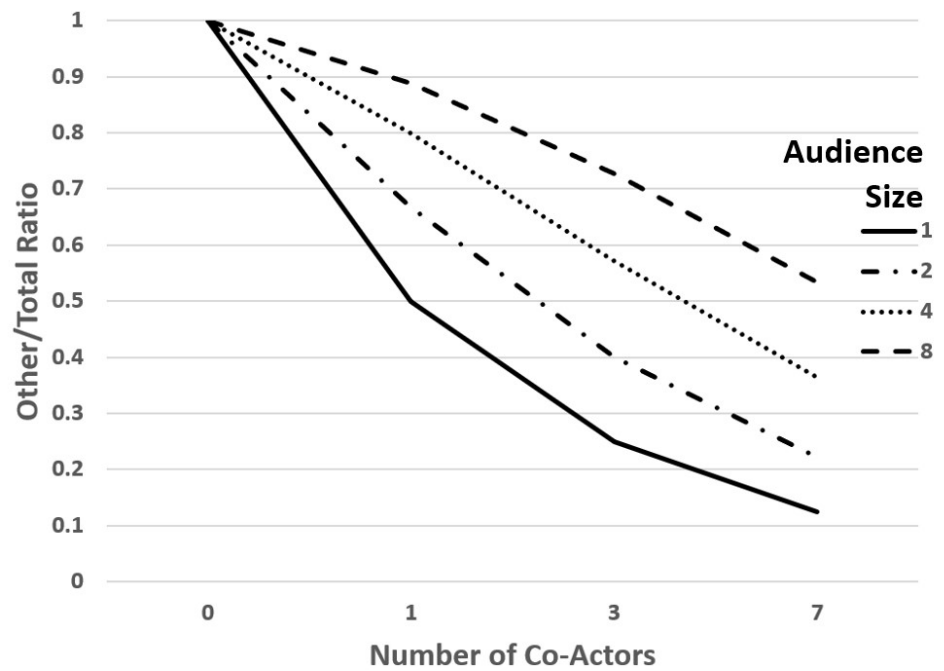
Figure 1. Other/Total Ratio values for the number of co-actors and audience size.

Mullen (1983) also briefly discusses other factors that can moderate this self-attention. In particular, the dimensions of salience and proximity help determine the attentional focus on individuals in social settings. Self-attention should be stronger if the others are more salient to the individual (e.g., being known versus unknown) or the others' are closer in proximity versus being more distant. Consequently, self-attention processes will be activated as a function of the relative size of the subgroup the person inhabits (i.e., Other-Total Ratio), the salience of the others for the person, and the proximity of co-actors and audience members to the person.

Mullen (1983) reported a number of tests of the prediction of the Other-Total Ratio, primarily involving re-analysis of previously collected data to show how the data fit the ratio (e.g., self-attention, tension, conformity, social loafing). Using correlational and regression techniques, Mullen reported that the Other-Total Ratio provided an exceptionally good fit to the mean values in the data. Mullen noted that self-attention is conceptualized as an individual-level phenomenon, yet these tests of the predictions were limited to mean values. Moreover, the use of correlations and regression analyses as means of testing formal models has substantial limitations (Birnbaum, 1973), which is particularly unfortunate given the precision provided by predictions from the Other-Total Ratio. The experiment reported here investigates the predictions of the Other-Total Ratio as illustrated in **Figure 1** in a complex social setting in which the number of co-actors and audience size vary to determine the impact of self-attention on task performance, self-reported effort, and co-actor subjective reactions.

1.2. The theory of social impact

Another perspective on the influence of co-actors and audiences on task performance and subjective reactions is provided by social impact theory (Latané, 1981). Building on research investigating the impact of observers as well as the social

loafing phenomenon (Latané et al., 1979), the theory of social impact prescribes the influence of the number of targets (actors) and the number of sources (evaluators, observers, and the audience) on individual actions, performances, and reactions. Social impact reflects "changes in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, values, and behavior, that occur in an individual, human or animal, as a result of the real, implied, or imagined presence or actions of other individuals" (Latané, 1981, p. 343). The impact of real others on an individual's behavior, beliefs, and subjective feelings is particularly relevant for this experiment.

Latané (1981) proposes that this social impact follows a psycho-social law. That is, the amount of social impact is a multiplicative function of the strength (S, salience or importance), the immediacy (I, closeness), and the number of other persons present (N). Formally, this is denoted as $I = f(S, I, N)$. Given our focus on the number of audience members and the number of co-actors, the critical equation is $I = sN^t$, in which the amount of social impact, I, a person will experience is equal to the number of sources (N) raised to some power (t; expected to be less than one) multiplied by a scaling constant, s. Consequently, social impact has diminishing returns (as reflected by the power function) as the number of sources or targets of influence increases. Each additional audience member (source) and each additional co-actor (target) produces relatively less impact. Consequently, when one refers to the impact of audiences (number of sources), the power function (t) is positive. However, as the number of co-actors (targets) increases, the impact diminishes for each target, such that the power function (t) is negative. Social loafing would be an indicator that as the number of co-actors increases, the relative impact of each additional member on the total impact is a negative diminishing (power) function.

In sum, hypotheses based on the psycho-social law for social impact are that, as the number of others (observers, audience) increases for a given set of co-actors of constant size, social impact on the co-actors should increase as a power function. Also, as the number of co-actors increases in the presence of observers of a constant number, the social impact should decrease for each co-actor as a power function (reflecting social loafing). It is important to note that the impact of the function of the number of co-actors and audience members assumes that the factors of strength and immediacy are held constant. Thus, the scaling constant, s, in the equation reflects the relative impact of strength and immediacy.

In the situation of interest for this experiment in which both the number of co-actors and the audience size are manipulated, social impact theory states that the impact on an individual will be a ratio of the social impact of the audience size with a positive power function, t, divided by the social impact of the number of co-actors reflecting a negative power function, t, i.e., $I = sN^{+t}/sN^{-t}$ (Jackson and Latané, 1981). Because the individual receiving the impact is in a situation in which strength and immediacy are held constant, resulting in one scaling constant such that $I = s(N^{+t}/N^{-t})$, specific predictions of the pattern of social impact can be made for the conditions of this experiment (see **Figure 2**). Moreover, recognizing that power functions can be made linear by taking the logarithm of the function, we can see that $I = sN^{+t}$ becomes $\log I = \log s + t(\log N_1)$ for audience size and $I = sN^{-t}$ becomes $\log I = \log s - t(\log N_2)$ for number of co-actors. Thus, precise relative predictions can be made for the relationships and functions of the number of co-actors and audience size, as depicted

in **Figure 3**. In particular, under log transformation, the effects of the number of co-actors and audience size on variables reflecting social impact should be linear in nature, as shown in **Figure 3**.
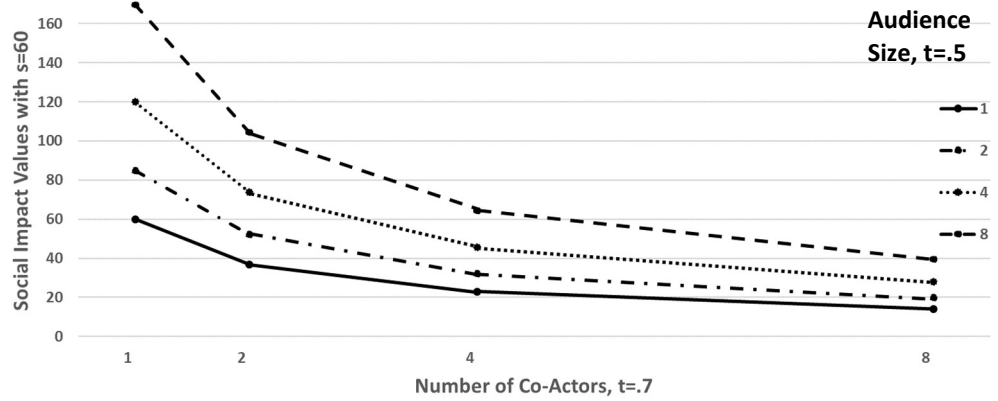

Figure 2. Social impact values for the number of co-actors ($t = 0.7$) and audience size ($t = 0.5$).
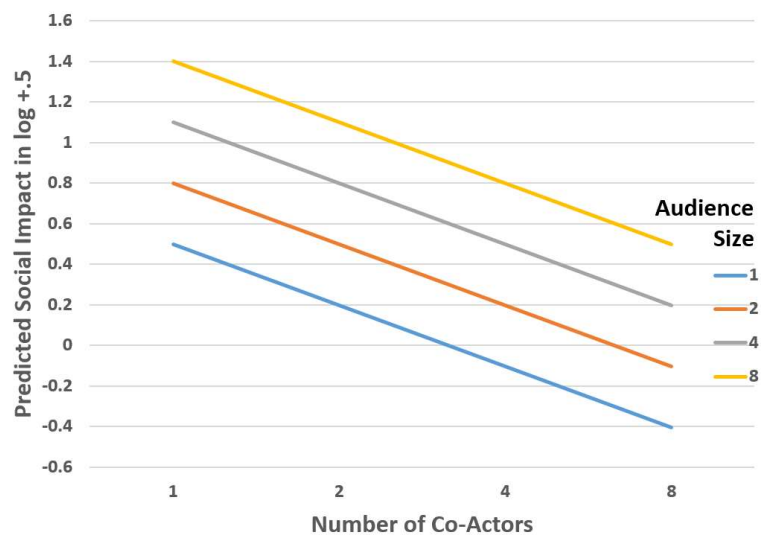

Figure 3. Predicted social impact for the number of co-actors and audience size.

Social impact theory (Latané, 1981) describes how individuals behave differently as the number of co-actors and audience size vary. Specifically, the theory predicts that as the number of co-actors increases, task performance, self-reported effort, and rated apprehension or arousal will decrease, while as audience size increases these variables will increase. For example, Jackson and Latané (1981) demonstrate that the apprehension (speech anxiety) felt by individuals increased as the perceived size of the audience increased. Although people are influenced by the real, implied, or imagined presence of others, most previous social impact research focuses on the implied presence of others (see Jackson and Latané, 1981, Study 1 as an example and Study 2 as a counter-example). This current experiment examines how a live audience affects the responses of real co-actors in groups of various sizes.

Jackson and Latané (1981) examined self-reports of arousal (nervousness and tension) as a result of anticipating singing a known song along with a specific number of others (co-singers) in front of an audience composed of various sizes. The co-actors

and the audience members were displayed with slide images of sets of individuals. As predicted by social impact theory, the participants' nervousness and tension increased as a function of audience size and decreased as a function of the perceived number of co-actors. It is important to recognize that the reactions observed were for implied or imagined others (audiences and co-actors), not for real individuals for whom social impact makes its predictions. However, in Study 2 of Jackson and Latané (1981), the number of co-acting performers varied in front of a fixed audience, which was a live audience and known co-actors.

Accumulated literature examines the predictions of the number of co-actors and audience size on social impact (Latané and Nida, 1981; Mullen, 1986), but rarely have both the sources and targets of the impact been manipulated simultaneously (Jackson and Latané, 1981; Latané and Harkins, 1976). This is an unfortunate, missed opportunity because the psych-social law, like the Other-Total Ratio, makes precise predictions in situations in which the number of co-actors and audience size vary systematically. Such research can provide a more robust basis for understanding how individual actions, performances, and subjective reactions are influenced by the presence of real co-actors and audiences.

1.3. Overview of the experiment and predictions

This experiment tests the predictions of the theory of social impact and the self-attention perspective using real co-actors in the presence of live audiences. The participants' task performance, rated effort, and subjective reactions (e.g., arousal) were assessed in conditions in which the number of co-actors (targets) and audience size (sources) were manipulated. In the performance of a manual dexterity task, each co-actor contributes to the collective effort and task performance. Participants reported their effort and contributions to the task, as well as their subjective reactions to other aspects of the experimental setting. It is predicted by the self-attention perspective and social impact theory, that as the size of the audience increases, individual performance, effort, and arousal will increase. Moreover, the number of co-actors increases, individual performance, effort, and arousal will decrease. These predictions are displayed in **Figures 1** and **2**, in which the predictions are demonstrated for the conditions of this experiment. Given the precision of the predictions generated by the Other-Total Ratio and the psycho-social law, it is important to recognize the differences in the conceptual predictions as illustrated by **Figures 1** and **2**.

2. Methods

2.1. Participants

A sample of undergraduate students (*N* = 128) enrolled in introductory psychology courses at a university on the U.S. northern prairie volunteered to participate in this experiment and received extra credit in their courses. These students had ancestry predominately from Northern and Central Europe (>90%). Because gender was not going to be tested for specific hypotheses in this experiment, the gender identity of the students was not requested, however, participant samples in the research were generally 55% female and 45% male.

2.2. Design

Students were randomly assigned to a condition of the number of co-actors of 1, 2, 4, or 8 as a between-subjects variable. Each set of co-actors was observed by each audience size (1, 2, 4, and 8 others) in a Latin-Square design to control for order effects, producing audience size as a within-subjects variable. This resulted in a 4 (Co-Actors) × 4 (Audience Size) mixed design. For this sample, 14 students were in the one-actor condition, there were 13 replications of two co-actors, 10 replications with four co-actors, and 6 replications in eight co-actor's conditions. The observers for the audience condition were undergraduates and a few graduate students enrolled in an upper-level experimental social psychology course for which this research was a lab project. The students who served as audience members also served as experimenters for other sessions of the experiment when they were not audience members.

2.3. Task performance

The participants performed a manual dexterity task of using a slant-tipped tweezer to transfer, one at a time, uncooked rice kernels from a bowl in front of them into a shallow tray in the center of the table, approximately 30 inches in front of each of the participants. The tray measured 8½ inches by 11 inches and was one inch deep. The students could use only one hand to hold the tweezer and could use the other hand to hold the bowl, but were discouraged from moving the bowl closer than 12 inches from the tray. The students were to remain seated during task performance and told to work efficiently and quickly (i.e., the behavior standard was to accurately and quickly transfer rice kernels to the tray). This task required no extensive training, could be learned quickly, required no prior experience, and the instructions were relatively straightforward. Moreover, it was clear that each individual's performance would not be identifiable once placed in the collective tray. Additionally, the behavior of interest was under the individual's control, such that effort had the primary impact on performance, and the audience's presence could be justified.

All of the co-actors in a condition performed the task at the same time for three minutes. A cassette player announced when the participants were to "Start" and "Stop, put your tweezers down" while performing the rice kernel transfer task. At the end of the task performance period, the tray and the bowls of rice were removed. The rice kernels for a trial and replication were measured by weighing the rice kernels (in grams) and counting the rice kernels. These two measures of task performance were highly correlated ($r = 0.977$), so the number of rice kernels transferred per member was used as the objective measure of task performance.

2.4. Measures

There was a manipulation check for the perceived number of members in the audience for each of the four trials. Participants responded by circling one value from 0 to 12 in their recollection of the number of audience members for each trial on the post-session questionnaire.

Effort: Subjective effort was reported on a seven-point response scale from extremely little to extremely much effort on each trial on a post-performance questionnaire. Moreover, students responded at the end of the study to the post-session

questionnaire (perceived effort) with their recollection of how much effort they exerted for each of the four three-minute performance sessions using the same seven-point response scale. Given the Latin-Square design involved, this measure could reveal perceived effort changes as a function of audience size.

The post-session questionnaire also included the participants' perceptions of their degree of effort as a function of the number of co-actors performing the task with them (four items). The students responded whether they thought they would have done more (extremely = 1), less (extremely = 7), or an equal (= 4) amount of work if they performed the task with no, one, three, or seven others. Consequently, this experiment involved three different measures of perceived effort on task performance as a function of the number of co-actors and audience size.

Arousal: Rated arousal was measured on five semantic differential items (1 = extremely, 7 = extremely) with the endpoints of unaroused-aroused, alert-peaceful, frenzied-sluggish, calm-excited, and tense-sleepy. This scale was developed by examining arousal-related semantic differential descriptor pairs identified by Osgood et al. (1957) and selecting those items that reflected arousal and apprehension similar to those mentioned in the research on the self-attention perspective and social impact theory. The five items had reasonable intercorrelations and internal consistency (α = 0.78), consequently, responses to the five items were summed to make a composite score.

Difficulty of the task: Participants responded to two items assessing the perceived difficulty of the rice transfer task on seven-point semantic differential items for each trial of the task (easy-hard, challenging-undemanding). Although the participants found the task moderately challenging ($M = 4.63$), there were no effects of the manipulations on this variable, so it will not be discussed further.

Perceived obstacles. Task performance should align with the effort made, however, participants might believe that a variety of factors could act as obstacles to performance. On each post-performance questionnaire, participants indicated how frequently there were obstacles that interfered with their performance on a seven-point infrequently to frequently semantic differential.

Involvement with the task. A concern with the performance of repetitive, mundane tasks in research is that participants may be uninvolved when performing the task. To assess this, participants rated how involved they were in performing the rice transfer task on the post-session questionnaire with one item on a seven-point uninvolved-involved semantic differential.

Comparative performance. The last item on the post-session questionnaire asked participants for their assessment of their level of rice transferring task performance relative to average on a seven-point (1 = extremely below average to 7 = extremely above average) response scale. Although responses were consistent with the better-than-average effect ($M = 4.58$) (Zell et al., 2020), there were no significant effects of the number of co-actors on this measure, so this comparative performance will not be discussed further.

2.5. Procedure

Students waited in an open area until they were invited to enter a lab with three

adjacent rooms of equal size (approximately 10 feet by 12 feet). Students were randomly assigned to the Co-Actors condition and the order of audience sizes as a function of which room they were assigned. Participants were seated at a table and told to put their coats and bags off to the side and out of the way so that audience members could pass around the room. The students were given a code number, which they used for marking their materials while maintaining anonymity and confidentiality.

After receiving the introductory instructions, the experimenter described the rice kernel transfer task and modeled it for the participants. The participants were then given one minute to practice the rice transfer task. At this point, the experimenter replaced the rice bowls for each student and the tray and brought the audience into the room. Participants were told that the observers were students in a social psychology class who were interested in how the participants performed the task and were also there to make sure the participants followed the specified instructions. The audience members positioned themselves evenly around the table, standing behind the participants.

After completing a three-minute performance trial, the audience left the room, taking the bowls and trays with them. At that time, participants completed a post-performance questionnaire (PPQ) for that trial, which included self-report measures (perceived effort, obstacles, and arousal). This sequence of audience entry-instructions-task performance-audience exit-PPQ was repeated for each of the four trials, which also manipulated audience size.

After the completion of the four trials, participants completed a post-session questionnaire, which contained the manipulation check, self-report of perceived effort on the four trials, perceived involvement, and comparative performance measures. Upon completion of the post-session questionnaire, the participants were debriefed and their questions answered before they were excused from the experimental session.

3. Results

Mean values for the critical dependent variables are presented for the number of co-actors in **Table 1** and for audience size in **Table 2**. The statistical results of the number of co-actors and audience size manipulations on the log transformations of the task performance and self-reported effort measures were not different from the untransformed data, so the following results focus on untransformed data. For task performance and measures from the post-performance questionnaire, 4 (Co-Actors) × 4 (Audience Size) repeated measures analyses of variance were conducted. Differences in degrees of freedom reported indicate responses for which there were missing values.

A manipulation check was conducted for the perceived number of members in the audience for each of the four trials. A significant difference was observed for the manipulated audience size, $F(3, 372) = 241.92$, $p < 0.0001$. Participants did perceive that audience size increased with manipulated audience size (audience of 1 $M = 1.27$, audience of 2 $M = 1.87$, audience of 4 $M = 3.78$, audience of 8 $M = 6.57$). There were no effects of the number of co-actors ($p > 0.59$) or of the co-actors by audience size interaction on perceived audience size ($p > 0.38$).

Table 1. Mean values for the effects of the number of co-actors on key dependent variables.

	1	2	4	8
Number of Co-Actors	($n = 14$)	($n = 13$)	($n = 10$)	($n = 6$)
Task Performance	68.21	68.06	74.68	67.86
Self-Reported Effort	5.09	4.04	4.26	4.19
Rated Arousal	27.59	25.37	23.60	23.93

Table 2. Mean values for the effects of audience size on key dependent variables.

Audience size	1	2	4	8
Task Performance	70.80	68.95	69.01	69.73
Self-Reported Effort	4.17	4.13	4.39	4.42
Rated Arousal	23.67	24.54	24.57	25.38

Co-actors and audience size effects

Task performance. In contrast to social impact theory and the self-attention model predictions, task performance per person did not decrease as the number of co-actors increased, $F(3, 39) = 1.47$, $p > 0.23$. Similarly, task performance did not increase as audience size increased, $F(3, 114) = 0.80$, $p > 0.49$, with average differences of less than two rice kernels among the audience sizes. The co-actors by audience size interaction were also non-significant, $F(9, 114) = 0.76$, $p > 0.65$. Given that the predicted patterns were not detected, tests of the precise predictions provided by the equations as illustrated in **Figures 1** and **2** would have limited value and were not conducted.

Self-Reported effort: As the number of co-actors increased, subjective effort decreased, but not significantly, $F(3, 124) = 2.08$, $p > 0.10$, and as audience size increased, subjective effort increased, but not significantly, $F(3, 368) = 1.95$, $p > 0.12$ (see **Tables 1** and **2**).

The perceived effort based on the different trials, which can indicate the influence of audience size, did show a significant effect of audience size, $F(3, 372) = 5.05$, $p < 0.002$. Consistent with predictions, as audience size increased (Ms 1 = 4.26, 2 = 4.43, 4 = 4.45, 8 = 4.72), participants' perceived effort increased as well. There were no effects of the number of co-actors ($p > 0.30$) or the co-actors by audience size interaction ($p > 0.96$) on these ratings of perceived effort.

The participants' perceptions of the degree of effort they would have made if they performed the task with different numbers of other students (co-actors) revealed a significant effect of the number of co-actors, $F(3, 124) = 2.88$, $p < 0.04$. However, the effect was not linear but indicated that anticipated performance with three other people ($M = 4.05$) would produce less than perceptions of performing with one ($M = 3.73$), seven ($M = 3.77$) others, or by oneself ($M = 3.84$). The audience size ($p > 0.81$) and the co-actors by audience size interaction effects ($p > 0.61$) were not significant in this analysis.

Rated arousal: Rated arousal was consistent with predictions, with arousal decreasing as the number of co-actors increased, $F(3, 124) = 3.77$, $p < 0.02$, and

increasing as audience size increased, $F(3, 368) = 6.20$, $p < 0.0005$ (see **Tables 1** and **2**). This finding lends support to the predictions of the self-attention perspective as well as social impact theory and is consistent with prior findings (Jackson and Latané, 1981; Mullen, 1983). Note that the general patterns of responses were consistent with predictions of the self-attention and social impact approaches, however, they were sufficiently variable that tests of the precise predictions provided by the equations and illustrated in **Figures 1** and **2** were not viable. Moreover, it is important to note that the effects of the number of co-actors and audience size were not conditioned upon each other, with the interaction term being non-significant, $F(9, 368) = 0.97$, $p > 0.46$.

Perceived obstacles: The participants generally perceived that obstacles were more frequent as audience size increased, $F(3, 356) = 2.94$, $p < 0.04$. In particular, audiences of one ($M = 3.46$) and two ($M = 3.38$) were perceived to have fewer frequent obstacles than audiences of four ($M = 3.77$) and eight ($M = 3.78$). This finding is of interest because the audience merely observed the participants and did not interact with them while the task was being performed. The number of co-actors did not influence perceptions of obstacles ($p > 0.48$) nor did the co-actors by audience size interact ($p > 0.97$).

Involvement with the task: The ratings of involvement in the task indicated that the students generally perceived less involvement as the number of co-actors increased, $F(3, 124) = 3.80$, $p < 0.02$. Specifically, with one actor ($M = 5.57$) there was higher involvement than with two co-actors ($M = 5.15$) and four co-actors ($M = 5.15$), which had more involvement than for eight co-actors ($M = 5.00$). Importantly, participants rated that they were on average at least slightly involved when performing the task, indicating they had an inherent motivation for performing the task, which might help explain why no audience or co-actor effects were observed for task performance.

4. Discussion

This experiment manipulated the number of co-actors and audience size to test predictions of social impact theory's psycho-social law and the self-attention perspective's Other-Total Ratio. Tests of these predictions were conducted on an objective measure of task performance on a manual dexterity task as well as a variety of subjective judgments, including those of arousal and effort on the task. Consistent across the analyses is that the number of co-actors and audience size did not influence the measure of objective task performance. However, these manipulations did influence some subjective reactions participants had about their effort and the conditions of their task performance, such as the arousal they experienced. Hence, there was some support for the general predictions of social impact theory and the self-attention perspective for subjective measures such as internal experiences but not for objective assessments reflecting external conditions. This set of findings is consistent with some reviews of the literature (Mullen, 1985). Moreover, the objective task performance results are consistent with a meta-analysis examining performance gains and losses (Torka et al., 2021) in that the experimental conditions did not produce performance gains (audience) or performance losses (co-actors). Also, consistent with a meta-analysis (Torka et al., 2021), perceived effort did show increases with audiences (i.e., gains) but no significant differences in perceived effort with co-actors

(i.e., losses).

This experiment is unique among those studying predictions of audience size and the number of co-actors. Specifically: (a) both audiences and co-actors were manipulated systematically; (b) the audience members and the co-actors were real persons, not imagined or implied; (c) the manipulations were structured so that the number of co-actors or audience fit logarithm values; (d) reliable measures were taken of both overt task performance as well as subjective judgments; (e) the predictions of the self-attention perspective and social impact theory could be compared directly for their differences (see **Figures 1** and **2**); (f) unlike some earlier reports (Latané, 1981; Mullen, 1983), the predictions were made a priori for measures taken in this experiment; (g) the research was conducted in a lab unaffiliated with either self-attention perspective or the social impact theory adherents, and (h) performance was assessed on a task for which effort would be the main contributor to performance.

This research contributes to our knowledge regarding a fundamental question of social behavior; how does the presence of others influence individuals' actions and reactions (Allport, 1954; Davis, 1969)? In particular, this experiment manipulated the number of co-actors that are related to phenomena such as social loafing. Moreover, the experiment included a manipulation of audience size that resonates with topics such as evaluation apprehension and social facilitation. Importantly, this experiment manipulated both the number of co-actors and audience size simultaneously with actual others so that the actions and reactions of individuals could be investigated in a complex social situation that those individuals might face in their lives. Not surprisingly, given this complexity, the results of the experiment were conditioned by the objective or subjective nature of the dependent measure as well as the number of others as co-actors and audience.

4.1. The self-attention perspective

This experiment tested the Other-Total Ratio predictions from the self-attention perspective. Given the precision of these predictions, the observations for task performance and self-reported effort were not supportive of this model. The only variables that were generally consistent with the Other-Total Ratio prediction were arousal and perceived effort as a function of audience size. These findings are consistent with the accumulated evidence claimed to support the Other-Total Ratio, which has focused on tension, arousal, nervousness, and conditions such as stuttering (Mullen, 1983, 1987). The self-attention perspective proposes that heightened self-focus results in greater feelings of arousal. Importantly, the self-attention perspective deserves credit for the precise Other-Total Ratio predictions, which go beyond generic claims that audiences and co-actors have influences on individuals.

A closer examination of the self-attention literature may provide plausible explanations for the non-significant results on task performance and self-reported effort as well as the significant effects on perceived effort. Recall that self-attention is hypothesized to foster conformity to a salient behavioral standard. If there is no salient behavioral standard, then a person's self-focus becomes directed at whatever self or behavioral dimension is foremost in the person's awareness (Scheier and Carver, 1980). The instructions given in this experiment were that the participants were to work

efficiently and quickly, with the intent that the salient behavioral standard was to achieve higher levels of performance. However, instead of focusing on the level of performance, the participants *may* have seen efficient execution of the task as the behavioral standard. If this were the case, in the presence of audiences increasing in size, the participants' arousal would increase, resulting in more attention to not making mistakes. Consequently, performance would not increase, but perceptions of expending more effort would be enhanced, consistent with the Other-Total Ratio. This pattern of results would be consistent with the claim that focusing attention on specific aspects of the task (i.e., quality) may impair performance on a different task dimension (i.e., quantity) (Martens and Lander, 1972). Thus, if the participants focused their attention on the quality of performance, they would not be focusing on the quantity of task performance, and consequently, no audience effect would be observed for the number of rice kernels transferred. Future research should ensure that standards of performance are controlled. And even more would be learned about the effects of self-attention if standards of behavior were manipulated (e.g., quantity or quality; speed or accuracy; promotion versus prevention) to show that the effects of self-attention can be observed for different dimensions of performance or behavior as well as for different kinds of subjective reactions.

4.2. Theory of social impact

The elaborate predictions of social impact theory were also tested with the observations from this experiment. Given the precision of the predictions when both the number of co-actors and audience size varied (**Figure 2**), the hypotheses were not supported for objective task performance or self-reported effort. These findings are surprising given the observed impact of the number of co-actors in task performance demonstrated in social loafing (Karau and Williams, 1993) and the number of audience members for social facilitation (Bond and Titus, 1983). Yet, the predictions from combining the equations for sources and targets of impact do provide insight into the potential processes of social influence. Moreover, contrary to Mullen (1983, 1985), this research demonstrates that the predictions of the theory of social impact can be specified a priori and tested as such and that predictions can be tested for sources and targets simultaneously.

Consistent with the social impact theory, differences were observed in subjective judgments and reactions to the experimental setting. Although not fitting the precise predictions of social impact theory (**Figure 2**), arousal was influenced by both the number of co-actors (targets) and audience size (sources), as predicted by social impact theory. Moreover, perceived obstacles were found to increase with greater audience size, and ratings of involvement with the task decreased as the number of co-actors increased, results that would not be predicted by the Other-Total Ratio but are consistent with the theory of social impact. Unfortunately, the responses observed in this experiment lead to questions about the robustness of the predictions of the theory of social impact to subjective and objective measures of responses to social situations.

4.3. Factors co-varying with the number of others

One finding that was revealed once this experiment was analyzed is the way that

the number of others affects factors that are also considered important for their influence upon individuals' actions and reactions. Recall that the self-attention perspective implied that salience and proximity moderate the impact of the subgroup on an individual. Moreover, note that the theory of social impact includes strength and immediacy as two additional factors that influence social impact. When experimental control is used with manipulations of the number of co-actors or the audience size, the resulting social situation also indirectly varies the salience, immediacy, strength, and proximity of the others. When audience size changed, the immediacy and proximity of the other members likely increased, as well as the salience and strength of the audience members. Moreover, as the number of co-actors changed, the immediacy and proximity of co-actors likely also varied, as did the salience and strength of the number of those co-actors. The rooms used for the experiment were of similar size, but the psychological space the individual participants experienced changed on more than one dimension of the number of co-actors or audience size that was manipulated. Research that has studied the combined effects of strength and immediacy, with or without numbers, has demonstrated that they interact with each other. So, an important conclusion that can be drawn is how immediacy, salience, strength, and proximity are variables that co-vary with the number of others that were manipulated in this experiment.

An important consideration for future research is how to disentangle the important factors believed to contribute to the influence of others on an individual. When the number of others is manipulated, the proximity, salience, immediacy, and strength of the others have to be controlled in some creative fashion (e.g., in virtual social settings). Traditional experimental conditions with fixed-size rooms and tables of a constant size will inadvertently confound other factors related to the influence of the number of others. So, although the experiment was designed to control for other variables as the audience size and number of co-actors varied, in hindsight, it can be seen that the number of others co-varied with the salience, proximity, strength, and immediacy of the others. Hence, although the formal properties of the Other-Total Ratio and the psycho-social law provided precise predictions as illustrated in **Figures 1** and **2**, it is now obvious that the key parameters of social impact and self-attention are likely to co-vary in a complex fashion in any social setting in which they are studied systematically.

4.4. Distraction-conflict theory

One plausible explanation for the observed results of this experiment is provided by the distraction-conflict theory of social facilitation (Baron, 1986). Distraction-conflict theory assumes that heightened arousal influences the impact that audiences and co-actors have on task performance. Arousal occurs due to the presence of others, which leads to two competing response tendencies: (1) to direct attention toward others (the audience) and (2) to direct attention toward the task at hand. Recall that the main effect of audience size was found in the measure of perceived obstacles to task performance. It can be argued that the audience served to distract participants sufficiently so as to reduce optimal performance. There was also a significant main effect, indicating the impact that increasing audience size can have on arousal.

Moreover, this increase in arousal can represent increased conflict between the two competing response tendencies. As both the theory of social impact and the self-attention model expect, there may have been increased performance due to increasing audience size, but it may have been effectively neutralized by the increasing distractions also presented by the observers, who could have been seen as obstacles. Further research would be necessary to test this distraction-conflict explanation for the findings of the influence of the number of co-actors and audience size on the responses of individuals.

4.5. Limitations

Researchers are expected to point out the limitations of the research that is conducted. Among the many limitations of this experiment is that the sample size is not as large as desired. Yet, almost no other research has even included the large numbers of real co-actors or live audiences that were manipulated in this experiment (e.g., eight co-actors performing a task in front of an audience of eight observers). Unfortunately, we did not have a desirable number (e.g., 30) of replications of these conditions. Hopefully, researchers will be able to build upon this experiment by producing conditions that involve different levels of the number of co-actors and audience sizes that have large sample sizes (Tindale et al., 1990).

The earlier discussion also highlighted other limitations of this research. In hindsight, some ingenious method could have been constructed to systematically vary the number of others and audience size without impacting the proximity, salience, strength, and immediacy of the social influences. Alternatively, it might have been possible to systematically vary the dimensions of strength/salience and immediacy/proximity to determine how the number of others influences individuals under differing conditions of strength/salience and immediacy/proximity (Sedikides and Jackson, 1990; Williams and Williams, 1983). Additionally, the research could have been conducted such that both quantity and quality of task performance would have become the salient behavioral standard. Of course, this would have required two-fold more participants, which was already below the desired amount. Additionally, it would be more gratifying if a task were used that would satisfy the requirements for testing the self-attention and social impact frameworks, yet would occur in people's everyday social or working lives. Clearly, each of the limitations of this experiment provides avenues for future research that explore how the real presence of others influences the thoughts, feelings, and actions of individuals.

4.6. Summary

The hypotheses based on the theory of social impact and the self-attention perspective were partially supported. The number of others present can be seen as having an influence on an individual's responses along a continuum from external events to internal experiences. The number of co-actors and audience size did not influence task performance; they were an objective, external result of influence. For self-reports of effort, which are an external expression of internal motivation, the patterns of results were consistent with predictions, but not always significantly. With rated arousal, which reflects internal, subjective experiences, the impact of the number

of co-actors and audience size was consistent with the general predictions. These results advance our understanding of how the influence of the number of others on an individual is moderated by the external-internal nature of responses in the context of real co-actors performing in front of a live audience.

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