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The Double-Edged Sword of Rewards for Participation in Psychology Experiments

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Abstract

This quasi-experimental study examined participation rates and sample characteristics of participants recruited with and without the offer of course credit. In Sample 1, where course credit is not usually offered, credit was added in one condition (N =195) and not in the other (N = 175). In Sample 2, where credit is usually offered, it was maintained in one condition (N = 92) and removed in the other (N = 178). Results in both samples revealed that participation rates were higher in the credit conditions; they plunged when customary rewards were taken away. Results also revealed evidence of sample bias. More specifically, the motivational characteristics of participants and nonparticipants differed in all conditions except the new credit condition.

Résumé

Cette étude quasi-expérimentale s'est penchée sur le taux de participation et les caractéristiques des participants recrutés avec ou sans l'offre de crédit de cours. Dans le cas de l'échantillon 1, où un crédit pour le cours n'était habituellement pas offert, un crédit a été ajouté dans une condition (N = 195) et ne l'était pas dans l'autre (N = 175). Pour l'échantillon 2, où le crédit est habituellement offert, il a été maintenu dans une condition (N = 92) et enlevé dans l'autre (N = 178). Les résultats dans les deux groupes à l'étude ont révélé que le taux de participation était plus élevé dans les conditions où un crédit était offert; la participation diminue de façon drastique lorsque les récompenses habituelles étaient enlevées. Les résultats ont également révélé une preuve de biais de l'échantillon. On constate notamment que les caractéristiques motivationnelles des participants et des non-participants différaient dans toutes les conditions, sauf dans la nouvelle condition où un crédit était offert.

An important challenge common to all research with human participants is recruiting a sufficient number who are representative of the population targeted, all in an ethical manner. Given the obvious ethical barrier to forcing unwilling individuals to participate in experiments, most research projects rely on volunteers recruited by invitation or the offer of some kind of incentive. A common incentive in North American universities is the provision of course credit – either in the form of bonus points or course requirement – to students in return for their participation in research through an organized subject pool. Sieber and Saks (1989) estimated that approximately 74% of graduate psychology departments in the United States have a subject pool, while Landrum and Chastain (1999) put the number at 32.7% for undergraduate programs. Does the use of a subject pool affect participation rates? Do they alter the distribution of research participants? The purpose of this study is to examine those issues.

Rate of Participation

One issue related to incentives is their effect on participation rates, an important consideration for the efficiency and cost-benefit impact of research. Research demonstrates that financial incentives resulted in higher participation rates for daily-diary measures (Lynn, 2001) and a community-based intervention research (Guyll, Spoth, & Redmond, 2003), and had no effect on recruitment for one laboratory study (Gribbin & Schaie, 1976). Korn and Hogan (1992) compared the effects of small and large course credits and financial incentives on students' reported willingness to participate. They found that larger incentives (5% grade points or $10) resulted in a greater willingness to participate than did smaller incentives (1% or $2) or the absence of a reward. However, the study did not measure actual participation.

A survey of Canadian universities (Lindsay & Holden, 1987) reported a participation rate of 47% for extra credit subject pools and 74.7% for course credit subject pools. There was no information on rates of participation in completely voluntary recruitment systems. Given these findings, the first goal of this research is to determine whether the provision of course credit in return for participation results in higher rates of participation.

Self-Selection Bias

A second issue is self-selection bias. Many studies have examined the potential bias caused by the self-selection of volunteers in studies, linking voluntarism with numerous personality and demographic characteristics such as sex, socio-economic status, openness to experience, extraversion, locus of control, and intelligence (Kinder, 1976; Levitt, Lubin, & Brady, 1962; Martin & Marcuse, 1958; Rosenthal & Rosnow, 1975). Possible differences in motivational characteristics between volunteers and nonvolunteers also have been suggested (Horowitz, 1969; Rosenthal & Rosnow, 1975). However, these studies did not directly measure motivation, nor did they provide a clear definition or theoretical framework of motivation.

The possibility that specific recruitment procedures could exacerbate or reduce self-selection bias also has been the subject of study. To gauge the effect of recruitment practices on volunteers and sample bias, researchers have examined such topics as the influence of individual or group time slots on experiment sign-up sheets (Jackson, Procidano, & Cohen, 1989), the point in the semester when the study was conducted (Evans & Donnerstein, 1974) and the subject matter under study (Kendrick, Stringfield, Wagenhals, Dahl, & Ransdell, 1980; Saunders, Fisher, Hewitt, & Clayton, 1985; Silverman & Margulis, 1973). Another study on potential bias created by methodology examined differences between paid and unpaid volunteers from the same subject pool. The authors concluded that unpaid participants demonstrated superior ability and task-related performance, and also differed from paid participants in personality characteristics (Rush, Phillips, & Panek, 1978). It is important to point out that all of these studies examined the effects of specific recruitment procedures within existing subject pools. Therefore, it would seem important also to examine the potential effects of the subject pool itself on sample bias. To our knowledge, no studies have directly tested this question. Therefore, the second goal of this research was to examine whether the provision of course credit in return for participation affects the sample characteristics of those who participate and do not participate in a laboratory study.

Any number of traits or demographic characteristics could have been used in examining the effects of recruitment strategies on resulting sample characteristics. We opted to examine one participant characteristic: their trait-like motivation, conceptualized according to the Self-Determination Theory (SDT; Deci & Ryan, 1985). We made this choice for two main reasons.

First, SDT has successfully explained how people's motivational orientations relate to a wide variety of variables representing psychological functioning (e.g., well-being, resilience, persistence in an activity, greater intensity; see Ryan & Deci, 2000; Vallerand, 1997, for reviews). This means that if a recruitment procedure affects the motivational orientations represented in the sample, it also may have indirect effects on more general psychological functioning characteristics, thereby resulting in a threat to the external validity of the study that is not limited to the motivation variables examined.

Second, we are proposing to use SDT as the theoretical framework to examine the effects of course credits (a type of reward) on participation rates and motivation. It seems likely that some may participate in a study purely for the credit, while others may participate for interest's sake or out of a desire to be part of something important (Novak, Seckman, & Stewart, 1977). Each of these reasons and more are covered by SDT with corresponding levels of self-determination. It is therefore possible to formulate specific hypotheses with respect to the motivational characteristics of those who will participate in the different conditions. SDT is discussed in more detail below.

Self-Determination Theory

According to the Self-Determination Theory (Deci & Ryan, 1985, 1991; Ryan & Deci, 2000), there are three basic types of motivation: intrinsic, extrinsic, and amotivation. Intrinsically motivated behaviours are the prototypes of self-determined behaviours. They are performed purely for the pleasure and satisfaction of the activity and occur in the absence of external constraints or material rewards.

People engage in extrinsically motivated behaviours for instrumental reasons (Deci, 1975). Four types of extrinsic motivation have been proposed: external regulation, introjection, identification, and integration. External regulation represents the prototype of extrinsically motivated behaviours and refers to behaviours that are controlled by external sources such as rewards or constraints imposed by another person (Deci & Ryan, 1985). With introjected regulation, the formerly external source of motivation has been internalized so that its presence is no longer needed to initiate a behaviour. Instead, these behaviours are reinforced through internal pressures such as guilt, anxiety or emotions related to self-esteem (Ryan & Connell, 1989). Identified regulation is a behaviour that an individual chooses to perform because it is congruent with his or her values and goals (Deci & Ryan, 1985). The behaviour is still per-

formed for extrinsic reasons (e.g., to achieve personal goals), but it is internally regulated and self-determined. Integrated regulation refers to behaviour that is performed not only because an individual values its significance, but also because it is consistent with his or her self-identity (Deci & Ryan, 1985). The last type of motivation is amotivation. Individuals are amotivated when they do not perceive a relationship between their actions and the outcomes that follow these actions. This type of motivation is characterized by someone who engages in an activity without having a clear understanding of why he or she is doing it. In other words, he/she lacks a sense of purpose.

Much research showing the differential relations of the motivational subtypes to various psychological and behavioural consequences now supports the validity of the self-determination continuum. Specifically, self-determined forms of motivation have been found to be positively associated with positive consequences and negatively associated with negative consequences. Conversely, nonself-determined forms of regulation have been found to be positively associated with negative consequences and negatively associated with positive consequences (e.g., Blais, Sabourin, Boucher, & Vallerand, 1990; Ryan & Connell, 1989; Vallerand & Bissonnette, 1992).

In sum, because self-determined motivation is associated with greater curiosity, interest, and involvement, it is highly possible that recruiting participants on a voluntary basis may attract individuals with a self-determined motivation profile. The provision of course credits as an incentive may attract less self-determined participants as well, resulting in a more normally distributed motivational profile. Self-determined motivation is thus a dependent variable in this study, in contrast to many studies that examine the effects of motivation on other behaviours.

The Effects of Incentives

Deci and Ryan proposed a subtheory called the cognitive evaluation theory (CET; 1980) to describe the conditions that favour and impede intrinsic and self-determined motivation. According to the theory, events or conditions that support an individual's perceived autonomy and competence enhance intrinsic motivation, whereas events that negatively affect perceived autonomy and competence diminish intrinsic motivation. Rewards and incentives can therefore have a positive effect on intrinsic motivation if their informational aspect, supporting competence, is salient and a negative impact if their controlling aspect is salient (Deci, Koestner, & Ryan, 1999).

Reward contingencies can be classified into different categories, which differ in the extent to which they are generally perceived to be controlling or as providing competence feedback. The reward of interest to this study – provision of class credit for participation – could be considered an engagement-contingent reward because students know they will get the credit simply by agreeing to take part in the initial stages. (For ethical reasons, participants are always informed they can withdraw at any time without penalty.) Overall, engagement-contingent rewards have been shown to undermine intrinsic motivation because people have to engage in the task to get the reward, something that is likely to be experienced as controlling, and is unlikely to increase perceived competence (Ryan & Deci, 2000). So although the offer of class credits may increase participation, theoretically they also are likely to undermine intrinsic motivation for participation, suggesting that if they were removed, participation could plummet.

Overview of the Study

The goal of this research is to compare how different recruitment procedures affect the rates of participation in laboratory experiments and the characteristics of those who decide to participate.

Using a quasi-experimental design, we created two samples of participants. In the first sample, we recruited students from a university that does not use a subject pool. In a second sample, we recruited participants from a university that does use a subject pool. Given that participants come from different universities with different credit traditions, we are proposing to examine the two samples separately. At the university that relies on completely voluntary participation (Sample 1), two conditions were examined: one under which participants were recruited as usual, and another where students were offered points for participation in different studies. We hypothesized that participation rates would be higher in the credit condition. We also hypothesized that when no credit is offered, students who participate in a laboratory study would have a more self-determined style of motivation than those who do not participate. Finally, we hypothesized that in the credit condition, this bias would be eliminated: Participants would not differ from nonparticipants in their trait-like motivation. At the second university (Sample 2), which uses a subject pool and, as a norm, offers bonus credits in return for participation, one condition maintained the habitual course credits, while the second condition eliminated the offer of course credits. We hypothesized that withdrawal of the customary reward for participation (i.e., bonus points) would lead to a much lower participation rate than in

the group that received its habitual credits. We further hypothesized that the students who did participate in the credit removal condition would have a very self-determined style of motivation as compared to nonparticipants. Finally, we hypothesized that there would be no motivational differences between participants and nonparticipants in the credit condition.

Method

Participants

Sample 1. A total of 370 undergraduate psychology students from a university that does not normally offer course credits for participation (University of Ottawa, Canada) formed the sample of this study. The sample comprised 79 men and 291 women, with an age range of 17 to 55 years, and a mean of 21.17 years.

Sample 2. This sample, from a university that usually offers course credits for participation in experiments (University of Rochester, NY), consisted of 270 participants, including 98 men and 172 women. The age ranged from 16 to 40, with an average of 19.6 years.

Procedure

The procedure was identical at both universities, with the exception of the specific information communicated to students about their condition, described below. All students in several lower level psychology classes were invited to complete a short motivation questionnaire during regularly scheduled class time. On the first page of the questionnaire, the students were asked to give their name and telephone number in order to create a sample of participants, from which names would be randomly drawn for a future, unrelated study. It was specified that leaving one's name and telephone number in no way constituted an obligation to participate in the upcoming study. Classes were randomly assigned to credit and no-credit conditions. In Sample 1, for the no-credit condition, the idea of credit for participation was never mentioned, as would be the norm (N = 175). In the credit condition, students were informed that some course credits in that class were reserved for participation in psychology experiments (N = 195). In Sample 2, participants in one condition were told that they would receive the customary course credits if they chose to participate in the experiment (N = 92).

1 We included more participants in the credit removal group, given the hypothesis that the rate of participation would be lower.

TABLE 1
Rates of Participation According to Recruitment Condition

	No credit received		Credit received	
Sample 1 (No-credit norm)	64/175	36%	140/195	72%
Sample 2 (Credit norm)	7/178	4%	45/92	49%

Participants in the second condition were told that due to the nature of the experiment, it would not be possible to give course credits (N = 178).[1] Participants were given this information before being asked for their contact information; over 95% of students in each condition completed the questionnaire and left their contact information. Several weeks later all participants were telephoned. If they were not reached, a minimum of four calls were made in an effort to contact them. When contacted, the participants were asked whether they would be willing to participate in a laboratory experiment and, when necessary, were reminded of the stipulations of the condition to which they were attached. The answer was recorded. If the participant agreed to participate in the laboratory experiment, a date at which the experiment would be conducted was agreed upon. Participants got a reminder of their appointment the day before the scheduled time; when that time arrived, the participants' presence or absence was recorded. Participants who showed up then participated in experiments related to other ongoing studies.

Measures

The Global Motivation Scale (Pelletier, Dion, & Levesque, 2004; Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004; Sharp, Pelletier, Blanchard, & Levesque,

2 Sharp et al. (2003) reported results from five studies that supported the validity of the scale. Results of confirmatory factor analyses from both American and Canadian samples supported the factor structure of the scale, revealed satisfactory internal consistency, and supported the self-determination continuum. The construct validity of the scale was substantiated further in the third and fourth studies. Correlations among the subscales reveal a simplex pattern confirming the self-determination continuum and the subscales of the GMS were related to antecedents of motivation (attachment styles, perceptions of autonomy support, and competence), constructs associated with motivation (self-control, vitality, ego-depletion, and motivation for different life domains), and consequences of motivation (psychological well-being, and success/failure at self-regulation) in a manner predicted by self-determination theory. In the fifth study, the GMS was administered on two occasions (six week interval) and revealed adequate test-retest reliability. Copies of this poster and/or of the complete scale are available from the authors.

TABLE 2
Mean (and *SD*) Global Self-Determination of Participants and Nonparticipants as a Function of Recruitment Condition

		No credit received	Credit received
Sample 1 (no-credit norm)	Did not participate	9.86 (8.77)	11.73 (6.96)
	Participated	12.62 (8.10)	11.75 (6.67)
Sample 2 (credit norm)	Did not participate	11.18 (7.49)	10.39 (8.44)
	Participated	18.54 (9.30)	14.54 (7.53)

2003). This scale is composed of 18 items grouped in six subscales (three items per subscale) corresponding to the motivational constructs proposed by Deci & Ryan (1985, 1991). The scale is designed to measure the trait-like aspect of individuals' motivational orientation. Participants responded to the statement: "In general, I do things..." on a 7-point Likert scale, ranging from 1 (Does not correspond at all) to 7 (Corresponds completely). The constructs measured are posited to be on a continuum according to their underlying level of self-determination. From the most to the least self-determined forms, they are the following: intrinsic motivation (e.g., "…because I like making interesting discoveries") $\alpha = .93$; extrinsic motivation by integrated regulation (e.g., "…because they reflect what I value most in life"), $\alpha = .88$; extrinsic motivation by identified regulation (e.g., "…because I choose them as a means to attain my objectives"), $\alpha = .76$; introjected (e.g., "…because otherwise I would feel guilty for not doing them"), $\alpha = .85$; externally regulated (e.g., "in order to attain prestige) $\alpha = .78$; and amotivation (e.g., "Even though I believe they are not worth the trouble…"), $\alpha = .86$.[2]

In agreement with past studies, these constructs were computed to create a global self-determination index (Green-Demers, Pelletier, & Ménard, 1997; Pelletier, 2002; Vallerand 1997). The SDI provides a parsimonious measure of individuals' general level of self-determination and displays high levels of validity and reliability (e.g., Blais et al., 1990; Fortier, Vallerand, & Guay, 1995; Grolnick & Ryan, 1987; Vallerand & Bissonnette, 1992). This index is calculated by weighting the constructs according to their placement on the self-determination continuum as follows:

SDIj = 3 (IM) + 2 (INTEG) + (IDEN) - (INTRO) -2 (ER) - 3(AMO)

Coding of Participation in the Psychology Experiment

A dichotomous variable was created, with those who participated being assigned a score of 1 and those who did not participate a score of 0.

Results

Participation

The analyses for participation examined whether rates of participation varied across credit and no-credit conditions (see Table 1).

Sample 1. Pearson's chi square analysis revealed that the rate of participation in the subject pool (course requirement) condition (71,8%) was significantly higher than that in the no-credit group (36,6%), $\chi^2(1, N = 370) = 46.26$, $p < .01$.

Sample 2. In the subject pool (extra-credit) condition, 48.8% participated; when the credit was removed 3.9% participated. This drop in participation was highly significant, $\chi^2(1, N = 270) = 78.92$, $p < .01$).

Motivational Characteristics of Participants.

The question of interest here was whether participants differed from nonparticipants in the various recruitment conditions. The specific characteristic of interest was participants' trait motivational orientation. We hypothesized that, in both samples, participants would have a more self-determined global motivation than nonparticipants (i.e., be nonrepresentative) when no credit was offered, and that there would be no difference between participants and nonparticipants when credit was offered. Means are presented in Table 2. In order to test this hypothesis, specific comparisons were planned: Participants were contrasted with nonparticipants in each of the conditions (resulting in two orthogonal planned comparisons per sample). More specifically, in each sample, the first contrast examined differences between participants and nonparticipants in the no-credit condition by assigning them weights of 1 and -1, respectively, while assigning those in the credit condition weights of 0. The second contrast looked at differences between participants and nonparticipants in the credit condition by assigning them weights of 1 and -1, respectively, while assigning those in the no credit condition weights of 0. One-tailed p levels are reported.

Sample 1. In the no-credit condition, a significant Levene test revealed heterogeneity of variances. Planned contrasts that do not assume equal variances were therefore conducted, revealing a significant difference in the motivational characteristics of participants and nonparticipants, $t(140.32) = 2.10$, $p = .019$, $\eta^2 = .024$. In the credit condition, the means were almost identical, and no significant differences were found, $t(95.45) = 0.01$, $p = .50$.

Sample 2. Planned contrasts revealed that in both conditions, participants were significantly more self-determined than nonparticipants (no credit group, $t(265) = 2.45$, $p=.008$, $\eta^2 = .064$; credit group, $t(265) = 2.58$, $p = .006$, $\eta^2 = .035$).

Discussion

The main goal of this study was to examine how different recruitment procedures for psychology studies affect participation rates and the sample's motivational characteristics. We expected the offer of credit in return for participation would result in greater participation and improve the representativeness of the sample. Overall, the results confirm our hypotheses.

Dealing first with the effects of rewards on rates of participation, our results reveal that levels of participation were significantly higher in the credit conditions. This is important because most researchers aim for the highest possible participation rates. The information regarding the percentage of participation according to condition therefore will be helpful in determining the most efficient ways of recruiting participants. These results also are theoretically important in that they are consistent with the Self-Determination Theory's predictions regarding the undermining effect of rewards on motivation. Although rewards lead to more participation, when they are removed there is an important drop in participation. This drop in free-choice participation is consistent with SDT's prediction of a drop in intrinsic motivation following administration and removal of rewards.

With respect to the sample characteristics, it is clear that the recruitment procedure also was related to the motivational characteristics of the participants, and thus to the representativeness of the sample. In the condition in which participants fulfilled a course requirement for taking part (Sample 1, credit received), participants did not differ in their motivational characteristics from nonparticipants. That is, in this condition, the individuals sampled were representative of the larger population from which they self-selected. However, in all other conditions, participants were significantly different from nonparticipants. Although effect sizes were small, participants showed higher levels of self-determined motivation than nonparticipants in these conditions. This suggests that subject pool systems can have effects on the quality of the findings, above and beyond their facilitation of research. It would appear that relying on completely voluntary participation may result in a biased sample, with overrepresentation of the more self-determined trait-like motivational orientation.

This is in agreement with self-determination theory in that when there are no external contingencies, those who generally undertake activities for more self-determined reasons are more likely to participate and persist than those who are motivated by less self-determined factors (Pelletier, Fortier, Vallerand, & Brière, 2001; Vallerand, Fortier, & Guay, 1997). However, when rewards are offered, the possibility of participating in a laboratory experiment should attract those who generally are motivated by more extrinsic reasons as well, thus providing a sample that is more representative of the varied motivational characteristics of the population. It is important to note that in the condition where the habitual credit was offered, participants still differed from nonparticipants. There is a possibility that this is due to a habituation or contrast effect, and that the offer of a larger-than-normal credit would have been necessary to level the difference.

This finding is a cause for concern because it suggests a fairly pervasive sample bias. When samples are not representative, the results of the study become applicable only to the sample studied. The scope of the experiment is thus greatly limited, and where generalization was desirable, its importance is also adversely affected. If the results are applied to the general population regardless (perhaps unwittingly), the resulting bias could lead to an overestimate or underestimate of the population parameters. Added to this is the fact that self-determined motivation has been found to be related to many other variables, such as curiosity, performance, persistence, vitality, quality of learning, life satisfaction, and psychological well-being (Vallerand 1997). This suggests that it is likely to have deleterious effects not only on studies of self-determination, but others as well. A sample bias could thus interact directly or indirectly with the variables studied, producing misleading results. For example, if self-determination correlated with the dependent variables under study, this would result in an increase of the homogeneity of the sample of volunteers. This reduction in individual variation on the dependent variable could result in the acceptance of the null hypothesis when in reality

it was false (Rosenthal & Rosnow, 1975). Furthermore, although this study specifically examined participation in a laboratory study, other types of studies that rely on a subsample of volunteers, such as questionnaires that are completed at home to be returned at a later date, likely are subject to similar participation biases.

The notion that rewards can augment participation and heterogeneity of sample characteristics is positive news. However, offering rewards (i.e., credits) could also create more pervasive effects. In the condition in which rewards were removed, the rate of participation in the laboratory study dropped dramatically, with only very self-determined individuals showing up. This suggests that offering rewards such as course credits is a double-edged sword. The provision of rewards may boost participation rates and the representativeness of samples; remove them, and levels of participation may shrink and create a more dramatic sample bias.

It is important to recognize the limitations of this study. The reliance on different universities with different credit traditions means it is not possible to directly compare the bonus and course-requirement subject pool conditions. As a result, this study cannot conclude that higher rates of participation in the course-requirement credit condition, as compared to the bonus condition, are due to the credit stipulations themselves, a novelty effect, or other differences at the universities. Further, in Sample 2, the drop in participation is limited to participation in the study advertised as part of this research. It is possible that students participated (for credit or otherwise) in other studies on or off campus. Nonetheless, the fact that participation in the same study dropped so dramatically depending on whether credit was offered is reason enough to pause. It is also important to underline that the subject pool population consists of university students and is thus itself self-selected from a larger population. It is possible that differences between participants and the general population would be even larger than differences between participants and their student population comparison. In addition, it would be interesting to further this research and examine the effects of the various conditions on other participant characteristics that may be involved in sample bias, such as intelligence, openness to experience, and extraversion (Kinder, 1976; Levitt, Lubin, & Brady, 1962; Martin & Marcuse, 1958; Rosenthal & Rosnow, 1975). Another line of research could directly examine the effects of the samples' motivational characteristics in the different conditions on dependent variables during the experiments themselves. This could be achieved by taking the procedure used here one step further with a comparison of actual performance or responses during the laboratory study itself across the groups.

Overall, this study provides some important information on the effects of recruitment conditions on participation rates and sample characteristics. It seems clear that offering rewards for participation, particularly when participation fulfills a course requirement, increases participation rates as well as the representativeness of the resulting sample's motivational characteristics. On the other hand, if participants are used to being rewarded for their participation, it seems that the removal of that reward may prove costly. Researchers should keep these things in mind when developing their recruitment strategies. Awareness of the undermining phenomenon as a result of credits for participation can encourage researchers to ensure an emphasis on participants' autonomy in the decision to participate or not, as well as underlining the interesting facets of volunteering that go beyond simply receiving credit. Whenever samples are not completely random, the possibility of bias exists. Finding existing differences, and acknowledging them, can be an important step in creating more valid laboratory experiments. The more knowledge we obtain on sample bias – from where and when it occurs to why it happens – the better the odds of circumventing bias. This in turn will contribute to a more accurate picture of how social processes operate.

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