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THEORETICAL NOTE

A Simple Game-Theoretic Explanation for the Relationship between Group Size and Helping

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Consistent with evidence from some psychological studies, this paper shows that as there are more people who can help someone in need, the lower is the probability that help is forthcoming. © 2001 Academic Press

1. INTRODUCTION

It is now well-documented in laboratory and field studies that the probability that an individual offers assistance to someone in need is lower when he is in a group than when he is alone.[1] Though the evidence is not as overwhelming, some studies also report that the more people there are who could help someone in need of assistance, the lower is the probability that anyone helps.[2] In this note, we develop a simple game-theoretic model in which the unique symmetric equilibrium exhibits both of these properties. The purpose is to show that such behavior is consistent with rational behavior based on accurate beliefs about what other people are doing.

2. MODEL

Assume there are N people, where $N \geqslant 2$. These people, referred to as players, are faced with a situation of having to decide whether or not to help someone who is in trouble. Players simultaneously decide whether or not to help so that a player's strategy set is $\{H(elp), I(gnore)\}$; that is, each player decides, at the same time, whether to offer *help* to the victim or to *ignore* the victim's need for assistance. A player's payoff measures how much she values the outcome to the game. A player

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[1] Latané and Nida (1981).
[2] Ibid.

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is assumed to care about whether the victim is helped, whether she helps the victim, and whether anyone else helps the victim. The payoffs are denoted

$a \equiv$ payoff to a player if she helps and no one else helps

$b \equiv$ payoff to a player if she does not help and someone else helps

$c \equiv$ payoff to a player if she helps and someone else helps

$d \equiv$ payoff to a player if no one helps

The following assumption is made on players' preferences.

Assumption. $a > d$ and $b > c$.

It is assumed that if it is required that a player does the helping herself, she prefers to see this person helped rather than not helped: $a > d$. It is also assumed that a player prefers not to help if someone else helps: $b > c$. This latter restriction can be motivated in a variety of ways. If one further assumes $a > b$, then this might capture the idea that a player wants to be the "hero" and this is only realized when she helps but no one else helps. Alternatively, if one assumes $b > a$ and $b > c$, then this would capture the idea that helping requires distasteful or risky effort and a player would prefer to avoid such effort. All this information is assumed to be commonly known to the players.

Latané and Nida (1981) identify three processes that might explain the empirical regularity that the likelihood of help is decreasing in group size. Two of these processes—*audience inhibition* and *social influence*—would appear to require that an individual's behavior is observable by others.[3] The situation might be one in which everyone is in visual contact and can observe whether or not anyone is offering assistance. In that our model has agents acting simultaneously, neither of these processes are operative in our setting. The third process is *diffusion of responsibility*, which only requires that each individual be aware that other individuals are present to offer help.[4] It is possible that this process is operative.

3. EQUILIBRIUM BEHAVIOR

A key assumption is that individual behavior is consistent with the conditions for a Nash equilibrium.[5] There are, of course, N (pure strategy) Nash equilibria for this

[3] Audience inhibition is when an individual is deterred from helping out of concern that her behavior will be judged inappropriate. Social influence is when a situation is ambiguous and an individual draws inferences from the behavior of others about what is going on. An individual may not help because she infers from the lack of help by others that this person is not worth helping.

[4] "The knowledge that others are present and available to respond, even if the individual cannot be seen by them, allows the shifting of some of the responsibility for helping to them" (Latané & Nida, 1981, p. 309).

[5] A Nash equilibrium is defined by N strategies, one for each player, such that a player's strategy maximizes his payoff given the strategies deployed by the other players and this condition holds for all players. For two excellent introductory game theory text books, the reader is referred to Binmore (1992) and Gibbons (1992).

game, each of which involves one of the players choosing H and the other $N-1$ players choosing I.[6] In light of the symmetric nature of the game—all players have the same choices available and the same preferences over outcomes—it is natural to focus on symmetric solutions. In this game, symmetric Nash equilibria necessarily have players using mixed strategies. A mixed strategy involves randomization and is represented by a probability of choosing H with the complementary probability being applied to choosing I; H and I are referred to as pure strategies. For a player to be content to let a random device determine whether she plays H or I, she must be indifferent between those two pure strategies. Letting p denote the probability that player j chooses H where $j \neq i$, player i is indifferent between her two pure strategies if and only if the following condition is satisfied:

$$(1-p)^{N-1}\,a + [1-(1-p)^{N-1}]\,c = (1-p)^{N-1}\,d + [1-(1-p)^{N-1}]\,b. \tag{1}$$

The l.h.s. of the expression is the expected payoff from choosing to help. With probability $(1-p)^{N-1}$, none of the other players helps so that player i realizes a payoff of a by having chosen to help. Here, $[1-(1-p)^{N-1}]$ is the probability that at least one other person helps, in which case player i realizes a payoff of c by also having helped. The r.h.s. of the expression is the expected payoff from choosing not to help the person in need.

Solving (1) for p, one derives the symmetric mixed-strategy equilibrium

$$p^* = 1 - \left(\frac{b-c}{(a-d)+(b-c)}\right)^{(1/N-1)}. \tag{2}$$

In other words, if each of the other $N-1$ players chooses to help with probability p^* then a player is indifferent between helping and ignoring and thus is content to help with probability p^*. Not surprisingly, p^* is decreasing in N. With more people available to help, each person offers assistance with lower probability. One could interpret this result, and what underlies it, as being consistent with the idea that assistance is less because responsibility is diffused.

What is more interesting is what happens to the probability that our unfortunate soul is helped by someone. Here, the idea that responsibility is more diffuse with more people offers no obvious prediction. To examine this question, let $Q(N)$ denote the equilibrium probability that at least one person helps:

$$Q(N) = 1-(1-p^*)^N = 1 - \left(\frac{b-c}{(a-d)+(b-c)}\right)^{N/(N-1)}. \tag{3}$$

It is straightforward to derive

$$\frac{\partial Q(N)}{\partial N} = \left(\frac{1}{N-1}\right)^2 \left(\frac{b-c}{(a-d)+(b-c)}\right)^{(N/N-1)} \ln\left(\frac{b-c}{(a-d)+(b-c)}\right) < 0. \tag{4}$$

[6] The proof is simple. Suppose one player chooses H and the other $N-1$ players choose I. Consider one of the latter players. If he chooses I, he receives a payoff of b while he receives a lower payoff of c if he chooses H. Thus, choosing I is optimal. Now consider the player who is choosing H. Her payoff from doing so is a, which exceeds the payoff of d from choosing I.

We then find that the more people there are to help, the *lower* is the probability that *anyone* helps. Since

$$\lim_{N \to \infty} Q(N) = \frac{a-d}{(a-d)+(b-c)} \tag{5}$$

and $(\partial Q(N)/\partial N) < 0$, then

$$Q(N) > \frac{a-d}{(a-d)+(b-c)} \qquad \text{for all } N. \tag{6}$$

Our victim can at least take solace in the fact that there is a lower bound to the probability that help is offered.

4. CONCLUDING REMARKS

The objective of this paper was to show that the observed relationship between group size and helping is consistent with people: (i) acting in their own best interests, (ii) having reasonable preferences, and (iii) having accurate beliefs about what other people will do. We would not attempt to argue, however, that this theory provides *the* reason for this phenomenon because we have failed to explain how individuals' behavior and beliefs might have evolved to being consistent with an equilibrium. In other words, what is missing is the dynamic that would result in an equilibrium being achieved. While the true explanation for this phenomenon might require irrational behavior, bizarre preferences, or systematic errors in forming beliefs about what others will do, our analysis shows that such is not obviously the case.

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