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A Behavioral Theory of Allocation in the Dictator Game

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A Behavioral Theory of Allocation in the Dictator Game

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Abstract

This paper attempts to explain the behavior observed in the dictator game without explicitly assuming a utility function. Alternatively, I consider the representative behavior of a society composed of heterogeneous individuals in terms of altruism and self-interest. Based on these two principles, I present an allocation that aggregates the society's preferences. The result depends crucially on the value of the resource under dispute for the dictator. Even if the value of the resource is extremely important for the dictator, the dictator cannot justify a share of the resource larger than 3/4 of the total. An allocation proposing more than this share of the resource cannot reach social consensus. On the other extreme, if the value of the resource is sufficiently unimportant for the society, an equal split of the resource emerges in the limit.

Keyword: Dictator Game; Allocation Rules; Altruism; Self-interest; Conflict Resolution.

JEL classification: C91, D03, D63, D74.

1. Introduction

During the last two decades, evidence has questioned the central role of self-interest in economics, management and decision theory. A large literature on endowment division games suggests that many agents do not act in accordance with this postulate, even in one-shot relations where reciprocity and other long-term considerations are absent (Dal Bó and Frechette 2016; Rand and Nowak, 2013). Therefore, understanding when and why people cooperate is a key issue not just for economics, management and decision theory, but also in all social sciences (Dreber et al, 2014; Gächter and Hermann, 2009; Kim, 2014). One important vehicle that has been widely studied in experimental economics, for evaluating self-interest, is the dictator game (Kahneman et al., 1986). In this game, the dictator splits some resource between herself and the receiver, whose role is entirely passive. The game-theoretic approach states that the dictator must keep everything to herself and give nothing to the receiver. However, experimental evidence indicates that dictator's share in average $20-30\%$ of the resource and often there is a double-peaked distribution with most dictators giving either nothing or the equal split (see Camerer (2003) and Engel (2011) for a review of the results). In some extreme cases, the dictator gives the full resource to the receiver.

So, why do economic agents not always behave according to their own self-interest? Several explanations have been put forward. For instance, the inequality aversion theory (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000) argues that individuals dislike inequity, which is measured through deviations from the equal share. Individuals are willing to forgo some monetary payoff to help others that are behind, but not ahead of them. Charness and Rabin (2002) suggest that people have social-welfare preferences; they care about their own payoff (Rawlsian perspective) but also about the social-welfare payoff (utilitarian perspective). In a series of experiments, Andreoni and Miller (2002) argue that altruism is rational and individual behavior can be rationalized by a utility function that depends on the recipient payoff.

As argued by Camerer (2003), this willingness-to-give is usually interpreted as altruism: a sacrifice of one's resources for the benefit of others. Along this line of research, many papers have also focused on the internal trade-off between selfish and altruistic motivations, concluding that the large majority of subjects want to offer the morally correct decision. Simultaneously, they also avoid to be considered as unfair (Aguiar et al., 2008; Brañas-Garza et al., 2010; Dreber et al., 2014; Güth et al., 2012; Konow, 2003; Rodriguez-Lara and Moreno-Garrido, 2012), regardless of their altruistic concerns (Dana et al., 2006).[1]

However, neither of the existing theories explains the behavior observed in the dictator game without assuming a utility function nor "What is the most adequate division that expresses the representative dictator's behavior in a society composed by heterogeneous individuals in terms of altruism and self-interest?" In the present paper, we attempt to answer these questions.

In order to do it, we combine the evidence obtained in the labs with the

[1]The behavioral literature is vast; it is impossible to discuss every pertinent contribution. This paper describes only a short, social sciences biased and not sufficiently representative sample of the existing contributions.

idea of altruism and self-interest. Contrary to the main normative standard (Andreoni and Miller, 2002; Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999; Köszegi and Rabin, 2006), we do not specify an explicit expected utility function, but a set of desirable principles that attempt to capture self-interest and altruism.[2]

We also do not attempt to rationalize individual human behavior; such would be far too complex, would be necessarily inconsistent and difficult to reconcile. For instance, some experiments show that while a large number of individuals offer nothing to the receiver, other individuals offer everything (Aguiar et al., 2008; Brañas-Garza et al., 2010; Camerer, 2003;Engel, 2011; Rodriguez-Lara and Moreno-Garrido, 2012; among others). Instead of justifying these and other types of individual behavior, we propose an allocation rule that can be able to receive sufficient aggregate support and reach a social consensus (Beersma and De Dreu, 1999).

The present paper intends to provide guidance in situations of dispute and division between groups of individuals, countries, companies, etc., where extreme forms of behavior are unlikely. Nonetheless, we also consider individual disputes by proposing the allocation that would result from the aggregated opinion of all the members in the society. In this context, we consider a distribution of possible behaviors that depend on conflicting, but non-contradictory principles of self-interest and altruism. Self-interest and altruism and are chosen because most of the behavior observed in the dictator game is explained and driven by these principles. Consequently, an allocation rule that aggregates these moral preferences emerges (Adler, 2016; Bicchieri and Xiao, 2009; Konow, 2005; List and Polak, 2010).

Our allocation rule predicts that higher the relative value of the resource under dispute the lower the dictator's willingness to give, and vice versa - a pattern consistently observed in the experimental data (Engel, 2011; Konow, 2005; Sefton, 1992; among others). In this context, if each possible allocation is equally relevant, the maximum amount of resource that the dictator can keep to herself cannot exceed 3/4 of the total. On the other hand, if the value of the resource is relatively unimportant the representative allocation

[2]Expected utility models neglect the cognitive processes behind the observed behavior. Such approach requires explicit assumptions with implications in the final conclusions (see Baron (2000) for a discussion on these and other issues). For a survey on self-interest and its inconsistencies, see Kim (2014) and the references therein. For a survey on axiomatic allocation methods, see Thomson (2001) and the references therein.

can be more uniform. The equal split allocation emerges in the limit. The model predicts that the representative allocation must be a number in the interval $(1/2, 3/4]$, that will depend on the importance that the resource has for the dictator.

The present paper narrows the gap between the large body of experimental results observed in the dictator game and the insufficient theoretical explanations for these observations. Our theory attempts to justify the existence of a socially acceptable split of the resource.

The paper is organized as follows. Section 2 defines the model. Section 3 presents the general result and discusses the uniform weighting case. Section 4 concludes.

2. The Dictator Game

In the **dictator game** (Kahneman et al., 1986), the dictator divides some resource x between herself $x_d \in [0, x]$ and the receiver $x_r = x - x_d$, where the subscripts "d" and "r" denote the dictator and the receiver, respectively. The pair of values that represent the individuals amount (or share, depending on the context) of the total resource (x_d, x_r) is called an allocation. Clearly, since $x_r = x - x_d$, it is enough to know the value of x_d or x_r in order to characterize the full allocation.

The idea of altruism states that the dictator may distribute part of the resource to the recipient. This definition is wide and allows extreme forms of altruism such as $x_d = 0$, i.e., to give everything to the recipient. This type of behavior can be rationalizable at the individual level in some contexts. For instance, it can be easily justified if the total amount to be split is relatively small with respect to the individual total wealth.

Specifically, since there is no restriction on the dictator's choice, any deviation from full appropriation can be interpreted as altruism and reflects the dictator's willingness to give some part of the endowment to the recipient.

Definition 1. *We say that a dictator is* ***altruistic*** *if* $x_d < x$.

On the other hand, the idea of self-interest states that the dictator should keep a higher amount of the endowment, i.e., the dictator must at least bias the allocation in her favor.

Definition 2. *We say that a dictator is* ***self-interested*** *if $x_d > x_r$.*

In resume, the set of possible allocations must be at the intersection of self-interest and altruism.[3]

Definition 3. *The set of possible allocations of a self-interested and altruistic dictator, called the* ***representative set*** *X, is composed of the values in the interval $(x/2, x)$.*

The set of possible allocations in Definition 3 is composed only by allocations that have chances of receiving sufficient support or reaching social consensus. In this context, an allocation suggesting a lower share of the resource to the dictator would be similar to a wasted vote because it has no chances of receiving support or reaching social consensus. The argument is identical to the one that motivates strategic voting (see Duverger (1954) for an early reference and Feddersen (2008) for a review).

The representative set reflects the dictator better strategic position with respect to the receiver. It also reflects the existence of a self-serving bias and the implicit idea that the dictator should not receive less than the receiver, but also not the full resource. These aspects together with justice and fairness principles may justify deviations from pure self-interested behaviors and the equal split (Konow, 2003).

3. The mean allocation

Our objective is to present an allocation that expresses the representative dictator's behavior in a society with different preferences regarding altruism and self-interest. The representative dictator can be seen as a social planner that aggregates all possible allocations into a single allocation rule. In what follows, we describe our modelling approach.

Consider a resource with value $x > 0$ that is divisible in $2m + 1$ smaller amounts of size $\varepsilon > 0$. For instance, ε may denote one euro or some fraction

[3]Note that altruism and self-interest are in general not well-defined concepts. For that reason, we have defined their meaning into our context. The reader is free to consider other interpretations. Our approach is flexible enough to accommodate such possibility.

of euro.[4] In particular, the choice of ε is useful when the value of x is not an integer, i.e., for given x and m, we can adjust ε to make $x(m) = (2m+1)\varepsilon$ hold true, where $x(m) = (2m+1)\varepsilon$ denotes the discretized value of the resource. For example, if the resource has value $x = 5$ with $\varepsilon = 1$, then $m = 2$, while if the resource has value $x = 9$ with $\varepsilon = 1$, then $m = 4$.

Consequently, $m = 1, 2, ...$, is linked to the value of the resource under dispute and will capture the effect of x on the final allocation.[5] In this context, given ε, a large (respectively, small) value of m implies that the dispute is (respectively, not) important for the dictator, and vice versa, i.e., a large value of x implies a large number of partitions of fixed and given size ε. In this sense, in qualitative terms, variations in m or x are equivalent exercises.

One implication is that the dictator is likely to become less (respectively, more) generous when the value of the resource becomes more (respectively, less) important. This issue is analyzed and discussed in more detail below.

Note also that the discretization is motivated by the fact that individuals tend to think in terms of a finite number of divisions instead of a continuum of divisions.

Example: *In order to get a better intuition about the diversity of possible allocations suppose that* $m = 3$. *In this case* $x(3) = 7\varepsilon$, *and the representative set of allocations is composed by three allocations. (1) The less altruistic and mainly self-interested allocations* $(6\varepsilon, 1\varepsilon)$. (2) *The less extreme allocation* $(5\varepsilon, 2\varepsilon)$. *(3) The more altruistic and less self-interested allocations* $(4\varepsilon, 3\varepsilon)$. *However, following the discussion in Section 2 and Definition 3, the representative set must ignore the fully self-interested allocation* $(7\varepsilon, 0)$, *as well as the allocation that give to the receiver more (or equal) than half of the resource, i.e.,* $(3\varepsilon, 4\varepsilon)$, $(2\varepsilon, 5\varepsilon)$, $(\varepsilon, 6\varepsilon)$ *and* $(0, 7\varepsilon)$.

[4] Since the representative dictator's allocation is going to be expressed as a share of the total resource, the parameter ε will cancel out and will not play any role in the share of the final allocation.

[5] We have considered $x(m) = (2m+1)\varepsilon$ because it satisfies two conditions. First, for any $m = 1, 2, ...$, we have an odd number of partitions of the resource. Consequently, the equal split allocation profile $((2m+1)\varepsilon/2, (2m+1)\varepsilon/2)$ is not considered because it is outside the representative set defined in Axiom 3, but we can consider the nearest allocation profile $((m+1)\varepsilon, m\varepsilon)$. Second, $2m+1$ allows always a non-empty representative set, e.g., even for $m = 1$ we always have at least the allocation, i.e., $(2\varepsilon, \varepsilon)$.

Formally, the set of possible allocations is given by the general expression $x_{d,j}(m) = (2m+1-j)\varepsilon$ with $j = 1, 2, ..., m$ (see the proof of Proposition 1 for a detailed explanation on how this expression is obtained). In terms of allocation profiles, we have $(x_{d,j}(m), x_{r,j}(m)) = ((2m+1-j)\varepsilon, j\varepsilon) \in X(m)$ for $m = 1, 2, ...,$ and $j = 1, 2, ..., m$, where $x_{r,j}(m) = x(m) - x_{d,j}(m)$ denotes the receiver allocation.[6]

The representative dictator considers all allocation profiles because each of these allocations can be proposed by some individual. Therefore, in order to express the relevance of each allocation, the representative dictator attributes to each allocation a non-zero weight, $w_j(m) > 0$ with $j = 1, 2, ..., m$, and $\sum_{j=1}^{m} w_j(m) = 1$. We can also think that each weight represents the mass of dictators in the population in support of a given proposal.

The preceding construction results in the following allocation rule.

Proposition 1. *The representative dictator's allocation is*

$$s_d(m) = \frac{\sum_{j=1}^{m} w_j(m)(2m+1-j)}{2m+1}, \tag{1}$$

where $w_j(m) > 0$ *is the weight associated with the allocation profile* $((2m+1-j)\varepsilon, j\varepsilon)$, *for* $m = 1, 2, ...,$ *and* $j = 1, 2, ..., m$.

Note that the parameter ε cancels out because the numerator and denominator in expression (1) are simultaneously scaled by ε.

The result in Proposition 1 expresses the aggregated behavior in the dictator game under the principles of self-interest and altruism. From this perspective, the allocation proposal is founded on robust psychological and behavioral arguments.

The question we ask and answer in Proposition 1 is not "How much resource an individual is willing to share with the receiver?", but "How much resource an individual or a group of individuals think that her society should share with the receiver?" Consequently, altruism must be understood not

[6] Then, the representative set is given by $X(m) = \{((m+1)\varepsilon, m\varepsilon), ..., (2m\varepsilon, \varepsilon)\}$ with $m = 1, 2, ...$ A similar discretization approach applied to sequential allocation problems appears in Osório (2017).

only with respect to the receiver, but also with respect to the dictator (Dalbert, 1999; Frohlich and Oppenheimer, 2001), and vice versa.

Proof. Let the expression for the weighted sum of the dictator's and the receiver's payoffs be $\overline{x}_d(m) = \sum_{j=1}^{m} w_j(m)\, x_{d,j}(m)$ and $\overline{x}_r(m) = x(m) - \overline{x}_d(m)$, respectively. The dictator mean share on the total endowment is $s_d(m) = \overline{x}_d(m)/x(m)$. We now consider $m = 1, 2, ...,$ until a pattern emerges. For $m = 1$ we have a unique profile $(2\varepsilon, 1\varepsilon)$. Therefore, $\overline{x}_d(1) = w_1(1)\, 2\varepsilon$ and $\overline{x}_r(1) = w_1(1)\, 1\varepsilon$. For $m = 2$ we have two profiles $(4\varepsilon, 1\varepsilon)$ and $(3\varepsilon, 2\varepsilon)$. Therefore, $\overline{x}_d(2) = w_1(2)\, 4\varepsilon + w_2(2)\, 3\varepsilon$ and $\overline{x}_r(2) = w_1(2)\, 1\varepsilon + w_2(2)\, 2\varepsilon$. For $m = 3$ we have three profiles $(6\varepsilon, 1\varepsilon)$, $(5\varepsilon, 2\varepsilon)$ and $(4\varepsilon, 3\varepsilon)$, and so on. Consequently, the general expressions for the dictator weight sum of payoff over all profiles is $\overline{x}_d(m) = \sum_{j=1}^{m} w_j(m)(2m + 1 - j)\,\varepsilon$, and the dictator mean share on the total endowment is given by (1) which is divided by $x(m)$. The receiver share is obtained by difference. ■

3.1. *Uniform weighting*

The result in Proposition 1 is general and does not assume any particular distribution. However, in order to obtain analytical results, we have to make some assumption regarding the distribution of possible allocations. In this context, the uniform distribution is the most focal distribution because it has implicit an impartial and equal treatment of all possible allocations. Moreover, the uniform assumption is the most neutral assumption, in particular, if we have no theory to support other distribution.

Corollary 1. *If $w_j(m) = 1/m$, for $m = 1, 2, ...,$ and $j = 1, 2, ..., m$, the representative dictator's allocation is*

$$s_d(m) = \frac{3m + 1}{2(2m + 1)}. \tag{2}$$

Expression (2) has the following interpretation. In a society in which every representative allocation is equally important and the value under dispute is equal to x (captured by m), independently of the preferences that each individual can have regarding altruism and self-interest, the agent in the dictator position should obtain at most the resource share $s_d(m)$, and leave the remaining for the receiver. In this sense, a share of the resource above $s_d(m)$ is not compatible with the aggregated norms and the moral of the society that the representative dictator or social planner expresses (Adler, 2016; Bicchieri and Xiao, 2009; Dalbert, 1999).

The proposed allocation endogenously replicates the empirical evidence suggesting that the value of the resource is determinant for the individuals' willingness to give (Engel, 2011;Konow, 2005; Sefton, 1992; among others): the higher the value of the resource, the lower the desire to be altruistic, and vice versa. Formally,

Corollary 2. *The representative dictator mean allocation* $s_d(m)$ *is strictly increasing, from* $s_d(0) = 1/2$ *to* $s_d(\infty) \uparrow 3/4$*, and concave in* $m \in (0, \infty)$.

In order to get a better intuition, note that the subjects that participate in experiments, as well as every agent in the society, has a finite exogenous wealth that is unknown or difficult to quantify by a third party (e.g., the experimenter or the social planner). However, despite this difficulty, the dictator's choice is not independent of her own wealth. It is the relative balance between the value of the resource under dispute and the agent wealth that determines the dictator's decision. Therefore, given these inference difficulties, x (and consequently m) expresses the relative importance of the resource with respect to the individuals' wealth.

For instance, $m \downarrow 0$ implies that the value of the resource has almost no importance for the dictator. In this case, the representative dictator splits the total endowment equally $s_d(0) = 1/2$.[7] On the other hand, $m \uparrow \infty$ implies the opposite. The value of the resource is extremely important for the dictator in relative terms. Consequently, the representative dictator keeps $3/4$ of the total resource for herself and shares only $1/4$ with the receiver.

An important observation derived from our theory is that it establishes an upper bound on the maximum amount of resources that the dictator can keep to herself. In other words, in a society in which all preferences are equally relevant, the receiver must receive at least $1/4$ of the total resource. There is no argument, which would receive aggregate support that supports a lower value.

For instance, consider two countries holding a dispute over some resource. The property rights are not well defined. However, Country A is in the dictator position, while country B is in the receiver position. The country A public opinion is diverse, some argue in favor of more equal splits, while other

[7]Without loss of generality, once we have obtained the expression of the representative dictator's allocation (2), we can consider $m = 0, 1, 2, \ldots$, but we can also vary m continuously in the interval $[0, \infty)$.

more conservative opinions support something close to the full appropriation of the resource. In this context, our theory suggests that the representative allocation must be a value in the interval $(1/2, 3/4)$, and that value will depend on the relative importance that the resource has for Country A. An allocation outside this interval will not receive support and has no chances of reaching social consensus.

The obtained results have some empirical support. Engel (2011) aggregates information of 129 published papers on the dictator game and found that dictators on average keep around 72% of the total endowment. This value is close to 75% predicted by our model when $m \uparrow \infty$, i.e., when the payoff of the experiment is relevant to the subjects. This is usually the case because in most experiments the subjects are students (Levitt and List, 2007), and students tend to have lower income than non-students. Consequently, they have a higher value for m. In line with our argument, Engel (2011) shows that on average non-students give more than students, and Hoffman (2011) shows that altruism increases with income. Therefore, in the sequel, if we consider more realistic values of m, the model delivers numbers that are closer to the observed empirical mean of 72%.

Lastly, the value of m depends on the relation between the value of the resource and the individuals' wealth, which in reality is difficult to quantify. Consequently, in applied work the value of m must be calibrated to the available data.

4. Conclusion

The challenge to solve conflicting situations between individuals with different bargaining positions is to offer a self-enforcing and consensual agreement. In the present paper, motivated by experimental and empirical results, we introduce human behavior like self-interest and altruism into dictator game type problems. We present a simple theoretical approach that aggregates the possible allocations into a single and representative allocation. In this context, there is an intentional balance between realism and simplicity with the objective to help researchers and practitioners in practical work.

The results obtained in most experiments reject the full rationality hypothesis, which creates an empty space in the theoretical literature. In this context, conflict resolution and economic theory need new models that are able to explain the results obtained in experiments. The present paper is an attempt in this direction.

However, behavioral theoretical models that can be used to solve practical problems, encounter difficulties: while most researchers reject full rationality and claim the need for behavioral model, when faced with behavior models, they criticize them for their assumptions. There is a lack of agreement on what are the appropriate behavioral assumptions. In this respect, our model should not be an exception. We acknowledge that the number of behavioral considerations that can play a role in the individuals' decision is large. In our simple setting, we introduce the two behavioral principles that are probably the most prominent in the literature: altruism and self-interest.

In more general terms, our approach intends to incorporate behavioral aspects into allocation problems and conflict resolution. In this respect, there are multiple possibilities in terms of further research: different theoretical treatments and principles, the imposition of additional properties and the relaxation of some existing properties, among others.

In our perspective, the future development of the allocation and conflict resolution literature passes through an increasing consideration of behavioral and psychological aspects inherent to the individuals that are involved in these conflicts. These individuals are the ones that ultimately accept or decline the terms of an agreement, therefore theory must get closer to them.

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