Fairness in Cost Allocations: Proportionality vs. Equality

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ABSTRACT

Allocation problems in accounting require joint costs to be allocated among participating agents. In this setting, however, unfair allocations can stifle cooperation and lead to inefficient group outcomes. Then, what qualifies as fair enough for individual agents to agree to cooperate and extract joint benefits? Building on prior analytical literature that has offered perspectives involving joint cost allocations, we experimentally evaluate two common notions of fairness that present competing predictions in the cost allocation context – proportionality and equality. We operationalize two notions of fairness using a behavioral approach and examine which fairness notion prevails in cost allocation problems. More specifically, we examine fairness considerations in the cost allocation context using a modified ultimatum game, where joint cost savings can only be acquired through cooperation between two agents and individual contributions are varied transparently. Our experimental evidence suggests that fairness considerations in cost allocations coincide more with the proportionality notion when individuals make different contributions to create joint benefits. These findings provide important insights on the key rationale underlying the prevalent cost allocation method in accounting practices and the design of fair cost allocations that promote cooperation among agents.

Keywords: fairness, equality, proportionality, cost allocation, behavioral accounting, cooperation

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INTRODUCTION

Cost allocations are pervasive in accounting practice where participating agents incur joint costs with a shared goal of achieving cost savings. Tracing jointly incurred costs directly to each participating agent is often costly, demanding, and impractical. Firms, therefore, routinely allocate these joint costs to participating agents based on some convenient, reasonable cost drivers. Building on prior analytical work that yields game theoretical joint cost allocations schemes (Banker, 1981; Billera & Heath, 1982; Hamlen et al., 1980; Roth & Verrecchia, 1979; Shapley, 1953), our current study takes a behavioral approach to examine fairness considerations associated with cost allocation schemes.

Understanding the fairness considerations associated with cost allocation problems has become increasingly important. As the sharing economy rapidly transforms traditional notions of work (Etter et al., 2019), individuals are encountering new and consequential forms of cost sharing problems. For example, the growing popularity of co-working and co-living environments (e.g., WeWork, Impact Hub) raises issues around how to appropriately allocate costs across participating agents who use various services with different frequencies. In addition, issues regarding the increasing number of gig workers who benefit from coordination offered through digital platforms (e.g., Uber/Lyft, TaskRabbit, Instacart) but also contribute their own personal resources raise complex questions around the allocation of costs associated with delivering these services to consumers (Chai & Scully, 2019). Although reaching mutual agreements between participating agents often generates greater economic value for all agents (Forcadell, 2005; Garriga, 2009; Gemser & Leenders, 2011; Singh, 1997), cooperation is frequently stifled by concerns for fairness. People are in fact quite willing to give up materially significant financial benefits in order to reject practices or outcomes that they deem to be unfair (Bellemare et al., 2008; Fehr & Gächter, 2000; Güth et al., 1982). We adopt a behavioral accounting approach toward understanding how individuals perceive fair and unfair cost allocations.

Our objectives in this paper are threefold. First, we experimentally operationalize two common fairness notions – proportionality and equality – drawing on the game theoretical solutions prescribed for cost allocation problems. In particular, we focus on the analytical solutions driven from the Shapley value (Shapley, 1953) and Banker's modified Shapley value (Banker, 1981) that provide competing predictions in alignment with the proportionality and equality notions of fairness. Second, using the controlled experiment, we document experimental evidence suggesting proportionality as the prevailing fairness notion in the cost allocation context. Third, we provide insights into the role of fairness as a key rationale underlying the prevalence of the proportionality allocation method in accounting practices.

In our study, we are particularly interested in two common notions of fairness – proportionality and equality – within the context where individual contributions[1] vary transparently. We experimentally identify which of the two fairness notions prevails and promotes cooperation. Understanding fairness considerations in allocation problems is important because perceptions of fairness can drive cooperative behavior. Unfairness in allocation problems can be costly if inequity provokes resentments and conflicts (Dawes & Thaler, 1988; Fehr & Gächter, 2000; Fehr & Schmidt, 1999), as many of these conflicts end up in courts. Most court decisions for allocation problems often side with either the equality notion of fairness or

[1] In this paper, we use "contribution" and "consumption" interchangeably as we refer to a cost driver based on which joint benefits or cost savings are allocated using the proportional allocation method.

the proportionality notion, aligning with the fairness notions of our interest. We introduce two examples of legal cases below to highlight the common application of both the equality notion and proportionality notion of fairness in allocation problems that involves costly economic consequences for the involved parties.

State Contracting & Engineering Corp v. Condotte America, Inc. is an example where the equality notion of fairness is applied. Two counsels worked on a patent infringement case together and had a disagreement on the attorney fee allocation, one demanding more than the other based on their contributions. Since no official evidence existed to prove clear distinction in individual contribution levels, the court concluded that the attorney fee be split equally between the two counsels. For the case *United States v. Atlas Minerals and Chemicals, Inc., et al*. where the United States sued corporations that contaminated a landfill by disposing the hazardous waste, the court applied the proportional allocation method to split the cost among the sued corporations. The court held those corporations responsible for the cleanup cost based on the relevant “equitable factors” such as the relative volume and toxicity of the waste disposed by each corporation. These two cases illustrate that when information on individual contribution levels is available, legal arguments can justify the proportionality notion of fairness in allocation problems.

In our study, unlike these legal cases, we evaluate fairness notions in the cost allocation context where individual contribution levels are known, and conflict or resentment induced by unfair allocations is designed to drive the involved agent’s decision to either accept or reject cooperation. Yet, these court rulings are useful for our study because they provide us with social, institutional, and normative grounds to formulate our conjecture that the proportionality notion often prevails and promotes cooperation in cost allocation problems where individual contributions vary and are known. We conduct an experiment to examine which notion of fairness between proportionality and equality better aligns with individual fairness considerations in such cost allocation problems where individual contributions vary and are known. More specifically, we use a modified, anonymous, one-shot ultimatum game as an experimental tool to examine fairness considerations in economic decision-making. This controlled experiment setting allows us to focus on fairness considerations as a sole driver for cooperation, excluding alternative explanations for cooperation including reputation, reciprocity, or relationship building (Güth et al., 1982).

In a typical two-player, one-shot ultimatum game (Güth et al., 1982), the proposer allocates a sum of money between the proposer and the responder and offers allocations to the responder. The responder either *accepts* the offer (if deemed to be sufficiently fair) or *rejects* the offer (if deemed to be sufficiently unfair). If the responder accepts the offer, both players economically benefit from cooperation. If the responder rejects the offer, both players walk away with nothing. In our study, we modify the typical ultimatum game by casting a cost allocation problem within an ultimatum game framework. Utilizing special features of a cost allocation problem, we set up our experiment so that we can address our specific research question: which notion of fairness prevails in cost allocation problems and drives cooperation when individual contributions vary. In our modified context, instead of asking our participants to allocate an endowment, we frame the joint benefit as a cost savings that requires the cooperation of both players to realize. Each player incurs inevitable costs at varying degrees and if both players cooperate, they can both benefit from cost savings. In our context, not achieving cooperation thus becomes more costly for both players. Therefore, unfair cost allocations that lead players to reject cooperation have direct negative economic consequences to the players. We operationalize two notions of fairness as experimental treatments and compare the rate of rejection between the two treatments. Using the modified ultimatum game, we find that fairness considerations coincide more with the proportionality notion when individuals make different contributions to achieve join benefits through cooperation.

We derive our experimental treatments from the game theoretical solutions prescribed by the Shapley value (Shapley, 1953) and Banker's (Banker, 1981) modified Shapley value in a two-person cooperative game. The Shapley value allocates joint benefits or cost savings equally to the players in a two-person cooperative game, taking into account all possible orders of entry of the players into the game to allocate the expected marginal contribution. In contrast, Banker's modified Shapley value, which incorporates additional information on individual contribution levels, allocates joint benefits or cost savings in proportions with individual contribution levels. In our study, we design two experimental conditions based on these analytical allocation solutions. In one condition, cost savings are split between two participating agents equally, regardless of the individual contribution levels, yet as prescribed by the Shapley value and supported by the equality notion of fairness. In the other condition, cost savings are allocated between two agents proportionally based on their individual contributions, as prescribed by Banker's solution and as supported by the proportionality notion of fairness. Our study is the first to evaluate these competing fairness notions that align with the corresponding allocation solutions and experimentally identify which notion prevails in the cost allocation context.

With our study, we contribute to the accounting literature by shifting the focus beyond what has been done in accounting research so far. In accounting practices, joint cost allocation has been pervasive for a long time[2] and accounting researchers have recognized the importance of the design of joint cost allocation in pricing decisions, cost control and management, and fostering desired behavior at the managerial level (Banker, 1981; Banker et al., 1988; Hamlen et al., 1977, 1980; Roth & Verrecchia, 1979; Zimmerman, 1979). However, the importance of fairness considerations underlying the design of allocations have not yet received the kind of attention it deserves in the accounting literature. By examining fairness considerations in allocation problems experimentally at an agent level, our findings provide important insights into fairness not only as a key rationale underlying the prevalence of the proportional allocation method in accounting practices, but also as a central component in designing allocations that promote and sustain cooperation.

Our study also adds to the behavioral economics literature on other-regarding preferences, by exploring the cost allocation problem in a special context where cost contribution levels differ. More specifically, previous findings show that if the allocation share is considerably below the equal split (usually below 30% of the total endowment), most individuals perceive such allocation scheme as unfair and prefer to forego the material benefit that can only be achieved by cooperating with the other party. However, our study shows that in the cost allocation context where individual contribution levels vary and can be distinguished, the proportional split is rather more acceptable than the equal split. Thus, in the cost allocation context, more unequal (but proportional) allocation proposals can actually be perceived as fairer, leading to greater cooperation with the other party.

[2] For example, in the United Kingdom, the surviving evidence of cost allocations goes back to the business records of Welsh companies that engaged in metal work and iron manufacturing between 1700 and 1830 (Jones, 1985).

We proceed to the next section by introducing the discussion of fairness considerations in allocation problems in various fields of studies, including accounting, economics, behavioral economics, and the wider social sciences. Then, we describe our experiment and develop hypotheses to examine which allocation solution represents individual notion of fairness in the context where individual contribution levels vary. We conclude our paper with results and discussion.

LITERATURE ON FAIRNESS CONSIDERATIONS & ALLOCATIONS

Accounting Literature

Joint cost allocation has a long history of practice in accounting (Ahmed & Scapens, 2000; Balachandran & Ramakrishnan, 1996; Dasgupta & Tao, 1998; Hamlen et al., 1977; Moriarity, 1975). In the cost accounting context, a joint cost allocation problem arises when at least two agents use shared resources. Total costs incurred jointly are then allocated to each party based on the resource usage level, ideally. In practice, since tracking and measuring shared resource usage levels can be costly or impossible, joint costs are often allocated to each party based on the most appropriate cost driver (Balachandran & Ramakrishnan, 1981; Gangolly, 1981a; Tijs & Driessen, 1986; Zimmerman, 1979). Because the allocation process involves estimation to some extent, fairness becomes a particularly important concern in joint cost allocation problems, yet this factor has still been overlooked in accounting research (Horngren et al., 2002; Young, 1994).

Cost allocation is important in making managerial decisions such as budgeting decisions (e.g., Baldenius et al., 2007; Pfaff, 1994; Rajan, 1992; Zimmerman, 1979), pricing decisions (e.g., Cohen & Loeb, 1990; Lere, 1986), control and management systems (e.g. Gordon, 1951; Suh, 1987), financial reporting (e.g., Khumawala et al., 2005; Tinkelman, 1998), and performance evaluations (e.g. Reichelstein, 1997; Rogerson, 1997; Wei, 2004). Therefore, it is critical that the cost allocation method charges each responsible party a fair share of the total cost, reflecting true cost incurred by each party. Unfair allocations may create disutility and psychological tension in the workplace, which can result in undesired management behavior and decisions. Although the cost allocation method in accounting research, driven from the economic game theory, has been evaluated for its efficiency, optimality, and practicality, little has been studied as to whether the allocation is perceived as fair. Our study uses a behavioral approach to examine fairness considerations associated with the cost allocation methods.

Economics Literature: Game Theory

Using an axiomatic approach, scholars have proposed allocation solutions that align with both the equality and proportionality notions of fairness. The equal distribution of resources among players can be seen as a Nash equilibrium solution to the classic Nash bargaining game (Nash, 1950). Nash equilibrium is a set of each player's strategy that generates the best possible outcome for every player, taking into account other players' decisions. The equal distribution is also the outcome prescribed by the Shapley value mechanism in situations involving two players (Shapley, 1953).

The Shapley value is a unique solution to the cooperative *n*-player game that satisfies Shapley's axioms of symmetry, efficiency, and additivity (see Appendix A). The "symmetry" axiom implies that it is only the value added to the game by the player that matters in determining the allocation, not any other characters of the player – i.e. if any two players add the same value to any coalition, they should get the same allocations. The "efficiency" axiom states that the total amount distributed to all players adds up to the total value yielded by the cooperative game. The "additivity" axiom states that adding the allocations of two independent games yields the solution of the sum of those games. The Shapley value is the unique solution satisfying these axioms. It allocates to a player i the amount given by $\sum_{S\subset N} \frac{(s-1)!(n-s)!}{n!}[v(S) - v(S-i)]$, where N is the set of all n players, S is a subset of N comprising s players, and $v(S)$ is the value generated by the subset S of players. In effect, this method allocates the expected marginal contribution to each player. In the n-player setting, the Shapley value is determined considering all possible orders of entry of the players into the game, giving each player the expected marginal contribution. In the two-player case subset, the mechanism reduces to the solution that each player receives an equal allocation of the costs or benefits – same as the Nash equilibrium.

Analogous to Shapley's axiomatic approach to the justification of the Shapley value method, Banker (1981) proposes the proportional allocation method in the form of a unique mechanism that satisfies a set of axioms similar to the Shapley axioms (see Appendix A). Banker states Shapley's "efficiency" axiom as the "full cost allocation" axiom, which requires that $\sum_{i=1}^{n} x_i = c$, where c is the total cost (or benefit) to be allocated. This full cost allocation axiom ensures that all of the costs (or benefits) are allocated to the players – total burden is shared by all participants. The "symmetry" axiom requires that individuals who consume (or contribute) the same level of resources should be responsible for the same share of the costs (or benefits) – or more formally, that $q_1 = q_2 \rightarrow x_1 = x_2$, where q_i is the size of player i and x_i is the amount allocated to player i. Finally, Banker modifies Shapley's "additivity" axiom as the "additivity of players (or cost centers)" axiom, which requires that if a specific player (or cost center) k is subdivided into two players (or cost centers), f and g, such that $q_k = q_f + q_g$, then the sum of costs allocated to each of the two component players (cost centers), f and g, should be the same as the cost allocated solely to k, unless their resource consumption levels change.

Banker proposes the "additivity of cost centers" axiom to replace Shapley's "additivity" axiom because the Shapley value method determines allocations that are determined by the way players are organized rather than their resource consumption levels. Banker argues that unless the resource consumption levels of different players (or "cost centers") change, consolidating players into one player should not influence the amount allocated to other players. For example, consider two players, A and B, and their sub-players, A1 and A2 under A, B1 and B2 under B, who agreed to share the cost of using a shared resource. The best way to split the cost is to allocate it based on the number of days each sub-player uses the shared resource, as each needs to use the resource for a certain number of days. According to Banker's assertion, unless the number of days used by each sub-player changes, whether player A1 and player A2 enter the agreement as a single party or as two separate sub-parties should not influence the cost amount allocated to player B. However, according to the Shapley Value method, the allocated cost amount for player B differs from when sub-player A1 and A2 play as a single party against B to when they play as two separate sub-parties.

The axioms of the Shapley value – especially the "additivity" axiom – has been subject to criticism when applied to various situations and contexts in which the Shapley value does not necessarily seem to yield fair allocations (Banker, 1981). An alternative mechanism to allocate costs or benefits is the proportional allocation method. Proportional allocation method is widely applied in cost accounting systems. This method takes into account additional information on q_i, the relative magnitudes of resource consumption (or contribution) by each individual player i (Banker, 1981). If additional information on individual consumption (or contribution) levels is permitted to enter into the specification of the allocation mechanism, the common accounting method prescribes fair allocations to be in the proportions of the consumption (or contribution) by each player.

Based on these game theoretical solutions, we design our experiment to examine which notion between the equality notion and the proportionality notion better represents individual notion of fairness.

Behavioral Economics Literature

A classic demonstration of the fact that fairness matters is provided by the ultimatum game, first studied by Guth, Schmittberger, and Schwarze (1982). In a two-player ultimatum game, a proposer is given an endowment, y (usually in the amount of $10 in laboratory experiments), and the proposer offers a proportion of the endowment, x, to the responder. The responder can either accept or reject the offer, x. If the responder accepts the offer, the responder takes x and the proposer is left with y-x. If the responder rejects the offer, both players are left with a payoff of zero. Theoretically, a unique subgame-perfect Nash equilibrium predicts that when the game is played as a one-shot anonymous interaction game, a rational economic responder is expected to accept any offer $x > 0$ from the proposer since rejection of the offer would forego the material benefit of x. Behavioral findings, however, deviate significantly from these theoretical predictions: if the offer, x, is below 30% of the endowment, y, responders reject the offer at rates of around 40-60% (Camerer & Thaler, 1995).

These findings suggest that individuals often prefer the fair solution to the rational solution. When offered an unfair allocation, individuals prefer an inefficient outcome (getting zero) to an efficient but unfair outcome (getting $x > 0$). This indicates that motivations to achieve fairness can indeed outweigh self-interested materialistic desires. These findings are very robust and have been demonstrated in a number of industrialized societies and with stakes as much as several months' expenditures, giving further sustenance to the power and fundamental nature of the aspirations for fairness (Cameron, 1999; Hoffman et al., 1996; Roth et al., 1991).

Motivations to achieve fair outcomes promote socially efficient, cooperative outcomes. Research findings, both at the behavioral level and at the neural level, suggest that cooperation and fairness may be desirable in and of itself, not because of the subsequent material benefits. Behavioral studies document that when disciplinarian players – who are seriously concerned about achieving fair outcomes over unfair outcomes even at their own costs – are given the opportunity to sanction selfish players by imparting punishments for their selfish acts, those strongly motivated disciplinarians may be able to rationally induce some of the selfish players to realize fair outcomes that are socially efficient and eventually to cooperate towards achieving fair outcomes (Fehr & Gächter, 2000; Gürerk et al., 2006; Kahneman et al., 1986)[3].

Recent studies employing neuroimaging methods have even begun to uncover the proximal mechanisms involved in the implementation of the motivation to achieve fair outcomes. In particular, some evidence has revealed that mutual cooperation and the realization of fair outcomes can be intrinsically rewarding experiences, while unfairness can be distressing. For example, implementing a cooperative outcome in a prisoner's dilemma game yielded

[3] However, the same motivations that enable these disciplinarians may also prevent them from participating at all, sometimes leading to rapid degeneration in cooperation. An individual, who desires to achieve fair outcomes but anticipates others to behave in a selfish way, may choose not to participate at all, resulting in lower total contribution levels and inefficient outcomes. This behavior is observed in repeated public goods games and is especially apparent when punishment opportunities are available: while contribution levels in the first interaction towards the group investment are around 40-60%, these levels drop dramatically after observing others deviate from cooperation, to around 20% in subsequent interactions (Fehr & Gächter, 2000). This finding is alarming since it shows that the presence of a small number of selfish, uncooperative individuals may quickly lead to the deterioration of group collaboration.

increased activations in brain regions implicated in reward processing, including nucleus accumbens, caudate nucleus, and ventromedial orbitofrontal cortex (Rilling et al., 2002). Similar patterns were documented using a modified ultimatum game – in response to fair rather than unfair offers, increased activations in brain regions related to reward processing were observed, including ventral striatum, ventromedial prefrontal cortex, and orbitofrontal cortex (Tabibnia et al., 2008). Furthermore, transfers of money that generate equitable outcomes yielded increased activations in ventral striatum and ventromedial prefrontal cortex (Tricomi et al., 2010). However, when individuals receive unfair offers in an ultimatum game, they can experience more negative emotion, yielding increased activations in the right anterior insula that is associated with an increased likelihood to reject unfair offers (Sanfey et al., 2003). Finally, individuals tend to find it rewarding to punish players who behave towards unfair outcomes in a trust game, thus motivated to actually scold defectors and maintain fair and efficient outcomes (Quervain et al., 2004).

A wide swathe of behavioral evidence supports the importance of fairness considerations in allocation problems. Our study takes a closer look at fairness by examining two typical notions of fairness – equality and proportionality – in a cost allocation setting important in accounting. In our modified ultimatum game, we vary individual contribution levels and the proposed offer, such that if individual notion of fairness is better represented by the equality notion, equal allocations will be preferred regardless of the individual contribution level. On the other hand, if individual notion of fairness is better represented by the proportionality notion, allocations that are proportional to the individual contribution level will be preferred to the equal split. We find that individual notion of fairness is subject to change depending on the context and that the proportionality notion prevails when individual contributions vary in achieving joint benefits.

Philosophy and Sociology Literature

Philosophers and sociologists have recognized both equality and proportionality as appropriate notions of fairness. Although equal allocations have been justified as the fairest on moral grounds (see the expositions of Carens 1981, Nielsen 1979, Rawls 1971), unequal allocations can also be regarded as fair, as long as inequalities can be justified by suitable rights, duties, and conditions in basic social institutions (Adams, 1965; Boulding, 1958, 1962; Lamont, 1994; Nozick, 1974; Rawls, 1971). Boulding (1962) suggested two general principles underlying fairness perceptions in allocations, emphasizing the importance of one's need and contribution level when determining fair allocations. Rawls (1971) focused on one's need in fair allocation problems, asserting that the fairest allocation is the one that makes the most disadvantaged in society as comfortable as possible. On the other hand, Nozick (1974) focused on one's contribution level, postulating that a proportional allocation based on one's contribution or production is the fairest.

Adams (1965) postulates that individuals feel distress when the ratio of their rewards relative to their input is unequal to that of their colleagues[4]. Building on Adams' equity theory, the proportionality notion has been applied to a number of socio-economic settings as a fair allocation method, in settings such as scheduling (Moulin, 2008) and the rationing of indivisible goods (Moulin, 2002). Proportional allocations are also incorporated as fair allocations in behavioral economic preference models as well (Cappelen et al., 2007; Frohlich et al., 2004; Ho

[4] More formally, distress is thought to be experienced when $\exists i, j \ s.t. \ \frac{x_i}{q_i} \neq \frac{x_j}{q_j}$, where x denotes the reward for each individual i and j, and q denotes their inputs.

& Su, 2009; Konow, 2000). Frohlich et al (2004) extend the inequity-aversion model of preference (Fehr and Schmidt 1999) by including additional terms that generate disutility to a proposed allocation if the offered amount is below the proportional amount contributed, for either the proposer or the responder. Konow (2000) builds on the accountability principle from equity theory to prescribe the fair allocation of gains based on the proportion of input contributed by player *i*. Cappelen et al. (2007) provide a more general specification that allows each individual to hold his own fairness ideal, whether it be strictly egalitarian (considering equal allocations as fair), libertarian (giving each person exactly what he or she produces), or liberal egalitarian (corresponding to the Konow (2000) proportional specification) and characterizes disutility for unfair allocations as a convex function of deviations relative to the fairness ideal. Ho and Su's (2009) peer-induced fairness model is also built on a fairness principle similar to original equity theory ideas, calling for those that put in equal effort to be rewarded equally.

Connecting Prior Literature to Our Study

Drawing on prior studies from various fields on allocations and fairness, our study evaluates two common notions of fairness – proportionality and equality – in cost allocation problems. While prior studies suggest analytical solutions to joint cost allocation problems, our study is the first to use a behavioral approach to examine fairness considerations in the allocation schemes prescribed for accounting practices. We use a two-person cooperative game to evaluate fairness considerations underlying the two competing allocation methods that are prescribed analytically for accounting practices. Although our experimental design simplifies the key features of complex real-world allocation problems, we choose to use a controlled experiment because it allows us to directly compete two notions of fairness by operationalizing the analytical prescriptions for allocations as experimental conditions that align with either proportionality or equality notion of fairness. If individual conceptions of fairness in cost allocation problems coincide more with equality notion, participating agents will prefer equal allocations driven from the Shapley value. On the other hand, if individual conception of fairness in cost allocation problems coincide more with the proportionality notion, individuals will exhibit greater preference for proportional allocations driven from Banker's modified Shapley value. This design allows us to compare the acceptance rate of an equal allocation and the acceptance rate of a proportional allocation to experimentally identify the prevailing fairness notion in the cost allocation context.

Fairness considerations in allocation problems arise from comparing one's own allocation to the other. When, *ceteris paribus*, one's allocation is not equal to the other's, aversion to inequity surfaces, and allocations are assessed as unfair based on the equality notion of fairness. Many formal accounts of fairness motivations invoke this simple notion that equality is fair. For example, many political philosophers have endorsed equality as fair in political domains including opportunity, fundamental human worth, and basic moral rights (e.g. Boulding 1958, 1962, Carens 1981, Nielsen 1979, Nozick 1974, Rawls 1971). In game theory, equal allocations are prescribed by Nash (1950) equilibrium and the Shapley value (1953) based on the axiomatic properties that a fair, desirable allocation mechanism should satisfy[5]. The notion of equality in allocation problems has been studied in the economic decision-making setting where people use equality as a heuristic (Allison & Messick, 1990; Messick, 1993, 1995; Messick & Schell, 1992).

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[5] The Nash (1950) solution in a bargaining game yields equal allocation to two symmetric players. The widely applied Shapley Value (Shapley 1953) solution to *n*-player cooperative games prescribes distributions of payoffs corresponding to the weighted average of the marginal benefits that a player provides upon joining different sub-coalitions. When only two players are involved, the Shapley Value solution reduces to Nash equilibrium, assigning an equal share of benefits to each player, conditional on both players choosing to cooperate.

Equal sharing of monetary benefits or costs is commonly observed in the business practice context including profit sharing among joint venture partners (Dasgupta & Tao, 1998; Veugelers & Kesteloot, 1996). Although the perception of unfairness often converges with inequality, in a variety of circumstances, equality does not always lead to fair allocations. After recognizing inequalities in allocations with a discrepancy, differences in contributions are often evaluated to resolve the discrepancy. Enter the proportionality notion of fairness.

The proportionality notion often competes with the equality notion in assessing fairness in the context where one may deserve more than the other. For example, when Partner A of a joint venture contributes disproportionately more capital and greater contribution than Partner B, it is intuitively conceivable that Partner A may “deserve” a greater share of the total profit. The proportionality notion of fairness prescribes allocations to be matched with the usage levels or contribution levels and is at the core of accounting methods for cost allocations. In business practices, multiple parties often share resources or facilities to achieve economies of scale. Then, each party is charged a share of total costs that were incurred jointly, called joint costs or common costs. Since not all costs can be traced directly to a specific cost object, these joint costs are assigned to cost objects using an allocation method. In accounting practices, the proportional allocation method, among many others, has been used pervasively – costs are allocated in proportion to the cost objects’ contribution levels based on the most reasonable, appropriate, and convenient cost drivers. The proportional allocation solution has also been rationalized within the political philosophy and sociology literatures on the grounds that since individuals differ in their contribution, resources, and welfare, each involved party should meet the input requirements in order to share the outcome equally (e.g. Boulding 1958, 1962; Rawls 1971; Lamont 1994; Adams 1965). The axiomatic justifications have also been provided based on the axioms similar to the Shapley Value (1950) except for a slightly modified additivity property (Banker 1981). In our study, we directly compete these two notions of fairness using a controlled experiment to study which notion prevails in an allocation problem and leads to co-operation.

Both the equality and proportionality notions of fair allocations can be supported by several different arguments and are widely applied in maintaining social institutions. In this paper, we design and conduct an experiment to examine whether equal allocations or proportional allocations better represent individual notion of fairness in a cost allocation problem that is cast as the two-person one-shot anonymous ultimatum game. We describe the experimental design and develop research hypotheses in the following section.

EXPERIMENTAL DESIGN AND HYPOTHESES

We conduct an experiment to study individual intuition about fairness toward allocations determined by either the Shapley value method or the proportional allocation method based on Banker's modifications to the Shapley value axioms. Our experimental setting employs the ultimatum game framework as it allows for a calibrated assessment of the perceptions of fair outcomes that influence individual decisions for cooperation. The ultimatum game represents the cooperative problem by focusing on allocating the potential benefits that can be achieved only through collaboration. In a two-player ultimatum game, the proposer offers some of the benefits to the responder, who can decide to either accept or reject the offer. Only when the responder accepts the offer, both players are able to realize the benefits according to the agreed terms. In case the responder rejects the offer, both players receive zero. Within this ultimatum game framework, we design our experiment using the cost allocation problem.

The cost allocation problem can be cast as an ultimatum game. Consider two players, Player 1 and Payer 2, sharing a common resource. Sharing this common resource will cost only

c in total, whereas if they operated separately, it would cost c_1 for Player 1 and c_2 for Player 2, for total cost of $c < c_1 + c_2$. Therefore, by sharing a common resource, they can benefit from total cost savings of y, where $y = (c_1 + c_2 - c)$. When this cost allocation problem is cast as an ultimatum game, the proposer offers a portion of total cost savings, x, so that $0 \leq x \leq y$, to the responder. If the responder accepts the offer, cost allocations are in effect. Player 1 bears the cost $c_1 - (y - x)$ and Player 2 the cost $(c_2 - x)$, so that $c_1 - (y - x) + c_2 - x = c$. Similar representations can translate multi-player cost sharing situations into ultimatum games by designating one player as the proposer and the other as a responder, with the understanding that a common pooled resource sharing proposal will be agreed upon if and only if no responder rejects the offer. In addition, an independent external party can be cast as the proposer with all players in the cost sharing acting as responders. While this is not the only way the cost allocation game may be played, representing the cost allocation problem in this manner enables us to draw on the vast amount of experimental evidence accumulated in the behavior of players in the ultimatum game and calibrate how individuals perceive fairness of proposed cost allocations.

Participants were asked to play the responder role and decide whether to accept or reject the predetermined allocation offer. Every participant was given two scenarios of modified ultimatum games – in a randomized order – where players consumed resources equally in one scenario and unequally in the other. Individual preferences for various allocations offered in both the equal consumption and unequal consumption scenarios were assessed in a two-player setting. To examine participants' perceptions of fair allocations in different settings, we implemented a fractional factorial design (2x2) in which participants were randomly assigned to one of the four experimental conditions (see Table 1). We varied the following across the participants:

(1) the contribution level. All participants completed two tasks. In one task, all participants contributed (or consumed) an equal amount as the other player – "Contributed 50%". In the other task, the relative contribution level was varied and participants were randomly assigned to either the "Contributed 80%" condition, in which participants contributed four times more than the other, or the "Contributed 20%" condition, in which participants contributed four times less than the other player.

(2) the proposed offer. Participants were randomly assigned to either an equal split of the savings (50% of total) or lower offer (20% of total). The proposed offer remained the same in two tasks that each participant completed so that we can measure the within-subject difference for the same offer amount between two tasks – one task with equal contribution level ("Contributed 50%") and the other task with unequal contribution level (either "Contributed 80%" or "Contributed 20%").

We counterbalanced the order of the equal consumption and unequal consumption games. In addition, participants were randomly assigned either to a condition in which the offer was proposed by the other player or to a condition in which the offer was proposed by an external arbitrator; because the rejection rates in both games did not differ based on the order or the proposer type (χ^2s < 1), we report collapsed analyses in the results section for ease of exposition. Table 1 summarizes the four key experimental conditions by contribution levels and offers.

TABLE 1 ABOUT HERE

In the two-player setting, when both players consume equal amounts of resources, the Shapley method yields the same allocations as those yielded by the proportional allocation method: equal sharing of the total cost savings between the two. Each participant was asked to decide whether to accept or reject an offer made by the other player, where the players' resource consumption levels were randomly determined to be either equal or unequal. The responder's decision and behavior is of particular interest in our study because the responder's acceptance indicates not only the desire to cooperate but also fairness perception – the responder accepts the offer because the offer is perceived to be fair enough to motivate the responder to work towards cooperation. In many cooperative games, such as public goods games, uncertain anticipation of unfair outcomes prevents participation. In our ultimatum game interpretation, since we specify the offer as given (pre-determined and will not change) to the responder, we eliminate any risk of uncertainty for the responder. Therefore, our setting has the advantage that responder behavior reveals a desire to cooperate in conjunction with fairness perceptions towards allocations determined by either allocation method.

The predictions for our experimental conditions are summarized in Table 3 Panel A. If individual perception about fairness aligns better with the equality notion, cooperation will be achieved more frequently when offered an equal split. On the other hand, if individuals find their ideas about fairness more consistent with the proportionality notion, cooperation will be achieved more frequently when offered an allocation amount proportional to the contribution level. More specifically, if it is true that fairness is based on the equality notion (E), the rejection rate for a particular offer should be the same regardless of the contribution level:

Under the hypothesized assumption that fairness is based on the equality notion,

> *H1E (null): The 20% offer is rejected with the same frequency when the individual contributed 50% (or R[c50o20]) as when the individual contributed 20% (or R[c50o20]).*
>
> *H2E (null): The 50% offer is rejected with the same frequency when the individual contributed 80% (or R[c80o50]) as when the individual contributed 50% (or R[c50o50]).*

Under the hypothesized assumption that fairness is based on the proportionality notion,

> *H1P (alternative): The 20% offer is rejected more frequently when the individual contributed 50% (or R[c50o20]) than when the individual contributed 20% (or R[c50o20]).*
>
> *H2P (alternative): The 50% offer is rejected more frequently when the individual contributed 80% (or R[c80o50]) than when the individual contributed 50% (or R[c50o50]).*

METHOD

Participants

A total of 356 undergraduate students (45% female and 55% male) participated in the study for partial class credit. Table 3 shows the descriptive statistics of the participants who answered the demographic questionnaires. Participants (mean age = 21) categorized themselves in an above-middle economic condition (mean = 4.65 on a 7-point scale); 49% of the participants majored in Accounting, 40% in Marketing, and 9% in Finance. For our analysis, because we are interested in the within-subject difference between the two conditions in which the contribution levels are different, only those who completed both tasks could be included (N=353).

TABLE 2 ABOUT HERE

Procedure

Participants were randomly assigned to one of the four conditions (see Table 1) to play the responder role in two modified ultimatum games (or tasks) in the context of a cost allocation problem. For each task, participants read a hypothetical scenario in which they were considering a joint purchase decision with the other player, or a hypothetical roommate. The order of the two tasks given was randomized. In one task, participants were asked to consider the equal consumption scenario where both players consumed equal amounts of steak (“Contributed 50%”) in our experiment. In the other task, participants were asked to consider the unequal consumption scenario where two players consumed unequal amounts of energy drinks – some were asked to assume the role of a roommate consuming only a quarter of the other roommate's consumption level ("Contributed 20%") and others were asked to assume the role of a roommate consuming four times more than the other roommate's consumption level ("Contributed 80%"). In both tasks, the amount of total possible cost savings was \$10, in case participants accepted the offer as a responder. After deciding whether to accept or reject the offer, participants provided their minimum acceptable offer (between \$0 and \$10) and indicated the amount that they would have offered if they played the proposer role instead. These allocation values were selected to correspond to prior literature on the ultimatum game in the behavioral economics literature.

Participants subsequently answered five items relating to their feelings of compassion on the Dispositional Positive Emotions Scale compassion subscale (DPES; Shiota, Keltner, John 2006; $\alpha = .53$) and six items relating to their feelings of self-righteousness (Falbo & Belk 1985; $\alpha = .41$). All 11 items were on a scale of 1 to 7, where 1 indicated that participants strongly disagreed, 4 indicated that they were neutral, and 7 indicated that they strongly agreed (see Appendix B for 11 items). Finally, participants answered demographic questions.

RESULTS

The main results are summarized in Table 3 and Figure 1.

TABLE 3 AND FIGURE 1 ABOUT HERE

Participants, who were proposed the 20% offer (refer to the results reported in a dotted line), rejected the offer at a significantly higher rate when they contributed equal amount as the other player (R[c50o20] = 72%) than when they contributed only 20% toward the total cost savings (R [c20o20] = 34%). When participants were offered 50% of the total savings (refer to the results reported in a solid line), they rejected the 50% offer at a significantly higher rate when they contributed 80% (R[c80o50] = 32%) than when they contributed 50% (R[c50o50] = 12%). These main results support our hypothesized assumption for proportionality and show that when contribution levels are different, proportional allocations better represent the individual notion of fairness.

In addition, we observe some interesting between-subject differences. When the contribution level is the same, the 20% offer was rejected at a significantly higher rate than the 50% offer (R[c50o20] = 72% vs. R[c50o50] = 12%; difference = 60%, t=14.35). When the contribution level differs, those who contributed more toward the total savings than the other player, rejected the relatively lower offer as frequently as those who contributed 20% and were offered 20% (R[c80o50] = 32% vs. R[c20o20] = 34%).

As an additional analysis, we present a logit regression analysis (see Table 4) in which we control for additional participant characteristics, such as personality (in terms of compassion and self-righteousness), age, gender, economic condition, education level, whether the proposer was the other roommate or a third party (*Arbitrator*), and the order effect (*Unfair consumption task first*). We first run a logit regression (column (1) of Table 4) on whether participants rejected the offer or not in four conditions, using [c50o50] as our baseline (indicated by intercept). We find that participants are significantly more likely to reject the offer when they are in conditions [c50o20], [c20o20] and [c80o50] and less likely to reject the offer when they are in condition [c50o50]. In Model (2), we run the logit regression on whether the rejection choice is affected by individual characteristics and find no significant association with any characteristics (column (2) of Table 4). In the last column, (3), when we include all the condition variables and individual characteristics, we find that after controlling for individual characteristics, the experimental condition effects are robust, confirming that our results are not driven by individual demographic characteristics.

TABLE 4 ABOUT HERE

CONCLUSION

Various allocation methods have been proposed on analytical, social, institutional, and moral grounds to settle cost allocation problems. Our study focuses on fairness considerations associated with two competing allocation methods that are commonly applied in economic decision-making contexts – the equal allocation method and the proportional allocation method. Based on our experimental evidence, we conclude that individual conception of fairness seems to coincide more with the notion of proportionality in the context where the contribution levels of the involved agents are different and can be distinguished. We find that when both players contribute equally, equal allocations are perceived to be fair, which coincide with both notions of fairness. However, when the players contribute unequally, allocating the outcome proportional to the contribution level is perceived to be fair, which coincides more with the proportionality notion of fairness.

Allocation problems are prevalent in business practices where cooperation is imperative. Cooperation is critical for an organization’s success as it enables the involved parties to achieve greater economic benefits despite the costs involved (Forcadell, 2005; Garriga, 2009; Gemser & Leenders, 2011; Rustagi et al., 2010; Singh, 1997). In the process of cooperation, multiple parties – for example, corporations, joint venture partners, member-owners of cooperative entities, business unit managers, or project managers – bring individual contributions in the form of effort, time, and resources to accomplish a shared goal of acquiring benefits that are greater when achieved jointly than when achieved individually. Nevertheless, cooperative problems are often accompanied by a tension between self-interest and collective interests. This tension arises because costs are incurred at the individual level, while benefits are acquired jointly and shared among the cooperators. Thus, if joint benefits are allocated unfairly, individuals often exhibit aversion to one's own disadvantage by rejecting cooperation, which leads to a suboptimal outcome (Bellemare et al., 2008; Fehr & Schmidt, 1999; Güth et al., 1982).

Cooperation is a fundamental social behavior that holds human societies together (Fehr and Fischbacher 2004, Henrich et al. 2001, Tomasello and Vaish 2013). Many philosophical speculations and evolutionary theories have been developed around the puzzle of human tendency for maintaining cooperation. One theory points out that cooperation has proven to be the winning evolutionary strategy for human civilizations to thrive on many accounts – including foraging, hunting, carrying on wars, and building bridges and railroads – and has become an ethical social norm that has preserved social institutions (Boyd et al. 2001; Henrich 2006; Hill 2002; Hirshleifer 1985; Holländer 1990; Tomasello et al. 2012; Tomasello and Vaish 2013). Regardless of whether it is in human nature to cooperate or it is to embody an ethical social norm, humans tend to maintain cooperation (Bear and Rand 2016, Bowles and Gintis 2002, Fehr and Fischbacher 2004, Henrich et al. 2001, Rand et al. 2012, Rand and Nowak 2013, Tomasello and Vaish 2013).

Despite the positive outcomes of cooperation that human societies have benefitted from throughout many centuries of our history, in many cases, cooperation is not strictly preferred (De Cremer & Van Knippenberg, 2002; Fehr & Rockenbach, 2003; Fehr & Schmidt, 1999; Henrich, 2006; Hill, 2002). This is mainly due to the clash between self-interests and collective interests, especially when economic incentives are involved. Cooperators are expected to bring contributions and restrict self-interests at the individual level to achieve a collective goal. This tension between self-interests and collective interests tends to peak when individuals perceive unfairness in allocations of joint benefits (Güth et al. 1982; Fehr and Schmidt 1999). If potential cooperators perceive allocations to be unfair, they often exhibit aversion to inequity by rejecting cooperation, leaving everyone worse off, even at their own expenses (Balliet et al., 2011; Boyd et al., 2010; Fehr & Gächter, 2000). As such, fairness considerations that facilitate cooperation and promote achieving greater benefits are particularly important in business practices. Our study provides experimental evidence that individual fairness considerations in the cost allocation context coincide with the proportionality notion of fairness when individual contributions vary transparently.

Our findings suggests that the equity principle manifested in the proportional allocation method is preferred to the equality principle in accounting practice because it is perceived as fair, thus promotes cooperation that enables an organization to thrive. Cost allocation problems are ubiquitous in accounting practice as multiple agents or divisions share firm resources mainly to achieve cost savings from the economies of scale. When agents share facilities or resources and individual usage level can be distinguished or estimated, firms allocate joint costs to each agent based on the usage level of cost drivers. This practice not only reduces cost distortions, but also is perceived to be fair as allocated costs influence managerial decisions for performance evaluations, budgeting, and resource allocations. Thus, fairness considerations in cost allocations are crucial in facilitating cooperation among agents, which is imperative in achieving organizational success in the long term.

Our results also provide support for the common legal practice of applying both equality and proportionality notions of fairness depending on the context. In the case of allocating the attorney fee between the attorney and co-counsel, who is discharged before the settlement of case, because there is no supporting evidence that distinguishes the contribution level of each agent toward legal representation, the court rules that the fee be split equally between the two agents. In the case of allocating the cleaning costs of contaminated landfill, because the contribution level of each party is distinguishable based on the “equitable factors”, total cost is allocated proportionally to each corporation’s contribution level toward contamination.

Future research could examine cost allocation problems in greater complexity. While the current study controlled a number of complicating factors, further research could explore in more depth how aspects such as imperfectly observed costs, cooperation among a greater number of agents, or opportunities for repeated interactions and/or sanctioning may moderate behavior in the cost allocation context. Each of these dimensions could help to describe different classes of cost allocation problems that individuals encounter in the modern marketplace.

When designing allocations, fairness is an important consideration. The meaning of fairness has been given due consideration for a long time, going as far back as Plato’s *The Republic*, in which the concept of fairness is explored through Socrates’ lengthy dialogues. While the definition of fairness may seem to be straightforward, various contexts in which fairness perceptions are formed make the concept dynamic. Therefore, it is important to understand notions of fairness and which notion of fairness best represents individual intuition about fairness in a particular context so that the appropriate notion of fairness is considered when designing cost allocations.

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APPENDIX A

Axioms for Shapley Value (1953) and Banker's (1981) Modified Axioms for Proportional Allocation Method

1. Axioms for Shapley Value (1953)

Axiom 1 ("Symmetry"). The value is essentially a property of the abstract game. For each x in $\pi(U)$,

$$\emptyset_{xi}[xv] = \emptyset_i[v] \quad (all\ i \in U).$$

Axiom 2 ("Efficiency"). For each carrier N of v,

$$\sum_N \emptyset_i[v] = v(N).$$

Axiom 3 ("Law of Aggregation"). For any two games v and w,

$$\emptyset[v + w] = \emptyset[v] + \emptyset[w].$$

2. Banker's (1981) Modified Axioms for Proportional Allocation Method

Axiom A1 ("Full Cost Allocation"). The costs allocated to the user departments add up to the total cost of providing the service,

i.e. $\sum_{j=1}^{n} x_j = c$

Axiom A2 ("Symmetry"). If the amount of service provided to two user departments is the same, then the costs allocated to them must be the same,

i.e. $q_f = q_g \rightarrow x_f = x_g$

Axiom A3 ("Additivity of Cost Centers"). If a cost center k is subdivided into two cost centers f and g, such that $q_k = q_f + q_g$; then the costs allocated to each of the remaining cost centers remains the same as before when k was considered as a single entity. In other words, we do not want the allocation to change unless or until the amount of service usage changes with the reorganization.

APPENDIX B

Experimental Material – Personality Scales

After completing the two tasks, participants answered 11 items below relating to their feelings of compassion and self-righteousness. The first five items (Items 1 thru 5) were adopted from the Dispositional Positive Emotions Scale compassion subscale (DPES; Shiota, Keltner, John 2006; $\alpha = .53$). The next six items (Items 6 thru 11) had to do with participants' feelings of self-righteousness (Falbo & Belk 1985; $\alpha = .41$). All 11 items were on a scale of 1 to 7, where 1 indicated that participants strongly disagreed, 4 indicated that they were neutral, and 7 indicated that they strongly agreed with the statement. In our analysis, two separate variables were used for the self-righteousness items – *self-righteousness_me* for items focusing on oneself (Items #6, 7, and 11) and *self-righteousness_ppl* for items focusing on others (Items #8, 9, and 10)

Please indicate your level of agreement with the following statements. Answer with 7 if you strongly agree, with 0 if you strongly disagree, and with 4 if you are neutral.

Strongly Disagree	1	2	3	4 Neutral	5	6	7	Strongly Agree

1. It's important to take care of people who are vulnerable.
2. When I see someone in need, I feel a powerful urge to take care of them.
3. Taking care of others gives me a warm feeling inside.
4. I never notice people who need help.
5. I am a very compassionate person.
6. People who disagree with me are usually wrong.
7. I can benefit other people by telling them the right way to do things.

8. One person's opinions are just as valid as the next person’s.

9. Most people naturally do the right thing.

10. People generally make few mistakes because they do know what is right or wrong.

11. When people disagree with me, I figure they're just not up to my level of thinking.

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FIGURE 1. RESULTS

We graph the rejection rate of the offer in four conditions, by offer amount. When individuals are offered a 20% share (dotted line) of total benefits, the offer is rejected as frequently as 72% when they contribute the same amount (50%) as the other player in the game. However, when they contribute 20% to generate the total benefits and are offered a 20% share, the rejection rate drops to 34%. When individuals are offered an equal split (solid line) of total benefits, the 50% offer is rejected at a rate of 12% when the contribution level is also 50%. The rejection rate then goes up to 32% when they are offered 50% but contributed 80%. These results support the hypothesized assumption that fairness is based on proportionality:

H1P (alternative): R[c50o20] > R[c20o20]

72% > 34% difference = 38% (t = 7.49)

H2P (alternative): R[c50o50] < R[c80o50]

12% < 32% difference = -20% (t = -4.84)

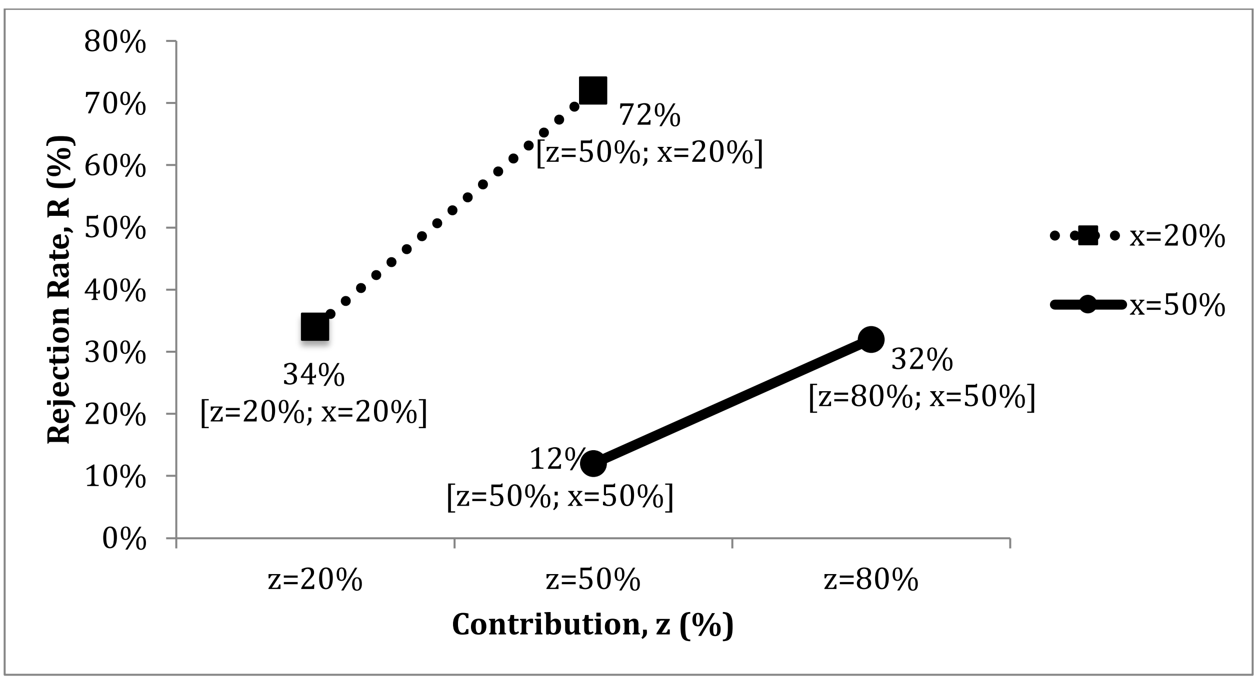

TABLE 1. EXPERIMENTAL CONDITIONS

A total of 356 undergraduate students participated in our experiment for partial class credit. Every participant assumed the responder role in a modified 2-person ultimatum game and was asked to either accept or reject the offer proposed. Each participant was asked to complete two tasks – one task in which both players contributed equally (Contributed 50%) and the other task in which one player contributed more (Contributed 80%) than the opponent (Contributed 20%). Each participant was randomly assigned to one of the two offers – either 20% or 50% of total benefit – and the offer remained the same for both tasks. For both tasks, either the opponent or an arbitrator proposed the offer. Since neither the task order effect nor the arbitrator effect was statistically significant, we collapse the conditions into four below and each subject made decisions in two conditions (tasks) that correspond to the randomly assigned offer. For example, Participant A, who was randomly assigned to the offer amount of 20%, was asked to make a decision whether to reject or accept the 20% offer in two conditions: [c20o20], where A contributed 20% and was offered 20%, and [c50o20], where A contributed 50% and was offered 20%. Participant B, who was randomly assigned to the offer amount of 50%, decided whether to reject of accept the 50% offer in two conditions: [c50o50], where B contributed 50% and was offered 50%, and [c80o50], where B contributed 80% and was offered 50%.

Offered %	**Contributed %**	**Conditions**	***N***
Offered 20%	Contributed 20%	[c20o20]	179
	Contributed 50%	[c50o20]	179
Offered 50%	Contributed 50%	[c50o50]	177
	Contributed 80%	[c80o50]	177
		Total	356

TABLE 2. DESCRIPTIVE STATISTICS

Upon the completion of two tasks, participants answered five items in regards to their feelings of compassion on the Dispositional Positive Emotions Scale compassion subscale (DPES; Shiota, Keltner, John 2006; $\alpha = .53$) and six items relating to their feelings of self-righteousness (Falbo & Belk 1985; $\alpha = .41$). All eleven items were rated on a 7-point Likert type scale ranging from 1 (strongly disagree) to 7 (strongly agree), with 4 indicating neutral. Subsequently, participants answered demographic questions. The economic condition was self-reported on a scale of 1 to 7, where 1 indicated that the participant felt "distressed" and 7 indicated that the participant felt "comfortable". Here, we show the descriptive statistics for only those who reported their information.

Demographic Variables	N	Mean	Std. Dev.	Min	Max
Age	345	21.02	2.70	18	45
Economic Condition	341	4.65	1.52	1	7
Educational Level	347	2.72	0.75	1	5
Compassion	352	0.057	0.867	-2.658	1.613
Self-Righteousness ("I" or "me")	342	-0.002	0.853	-1.913	2.564
Self-Righteousness ("people")	342	0.172	0.787	-2.116	2.164
Gender	344	Male = 55%; Female = 45%			

TABLE 3. HYPOTHESES AND RESULTS

Panel A. Hypotheses

We postulate two sets of hypothesized assumptions based on the two notions of fairness – equality and proportionality. Based on the equality notion, the rejection rate of an offer – whether it be 20% or 50% – is not influenced by the contribution level and we state our hypotheses under the equality notion as nulls. Based on the proportionality notion, on the other hand, the rejection rate of an offer is affected by the contribution level, such that for the same amount of an offer, when the contribution level is higher than the offer, the rejection rate will be higher. The 20% offer is rejected more frequently when individuals contributed 50% than when contributed 20% (H1P). The 50% offer is rejected more frequently when individuals contributed 80% than when contributed 50% (H2P).

Offer	Hypothesized assumption (E): Fairness is based on equality	Hypothesized assumption (P): Fairness is based on proportionality
Offered 20%	**H1E** (null): R[c50o20] = R[c20o20]	**H1P** (alternative): R[c50o20] > R[c20o20]
Offered 50%	**H2E** (null): R[c50o50] = R[c80o50]	**H2P** (alternative): R[c50o50] < R[c80o50]

TABLE 3. HYPOTHESES AND RESULTS (CONTINUED)

Panel B. Paired t-test Results

Because we examine the within-subject difference between the two conditions with different contribution levels for each subject, we require that each subject complete both tasks to be included in our analysis. Two subjects were excluded from the 20% offer (N=177) and one subject from the 50% offer (N=176). We used the two-sided test although our hypotheses call for a one-sided test.

Offer	Hypothesized assumption (P): Fairness is based on proportionality
Offered 20% (N=177)	**H1P** (alternative): R[c50o20] > R[c20o20] **72% > 34%** **difference = 38% (t = 7.49)**
Offered 50% (N=176)	**H2P** (alternative): R[c50o50] < R[c80o50] **12% < 32%** **difference = -20% (t = -4.84)**

TABLE 4. LOGIT MODELS WITH CONTROL VARIABLES

Examining all conditions simultaneously, we show the condition effect on the likelihood of rejecting the offer, after controlling for individual characteristics. In all three models, the dependent variable is *Reject*, a binary variable (i.e. Reject=1 if the offer was rejected and 0 if accepted). In Model (1), we first show the condition effect where the [c50o50] condition is the base line (refer to the intercept). [c50o20], [c20o20], and [c80o50] are binary variables. In Model (2), we examine whether individual demographic characteristics affect the rejection choice. Finally, in Model (3), we include the condition variables and demographic variables.

Model(1): Reject = $\alpha_0 + \alpha_1$ [c50o20] + α_2 [c20o20] + α_3 [c80o50] + ε

Model(2): Reject = $\beta_0 + \beta_1$ Age + β_2 Female + β_3 EconomicCondition + β_4 EducationLevel

+ β_5 Compassion + β_6 Self-righteousness_me + β_7 Self-righteousness_ppl + ε

Model(3): Reject = $\gamma_0 + \gamma_1$ [c50o20] + γ_2 [c20o20] + γ_3[c80o50] + γ_4 Age + γ_5 Female

+ γ_6 EconomicCondition + γ_7 EducationLevel + γ_8 Compassion

+ γ_9 Self-righteousness_me + γ_{10}Self-righteousness_ppl

+ γ_{11}Unequal consumption task first + γ_{12}Arbitrator + ε

TABLE 4. LOGIT MODELS WITH CONTROL VARIABLES (CONTINUED)

DV=Reject	**Model (1)***	**Model (2)***	**Model (3)***
[c50o20]	**2.939**		**3.035**
	(0.000)		**(0.000)**
[c20o20]	**1.323**		**1.278**
	(0.000)		**(0.000)**
[c80o50]	**1.228**		**1.263**
	(0.000)		**(0.000)**
Age		0.057	0.062
		(0.092)	(0.115)
Female		0.082	-0.083
		(0.621)	(0.659)
EconomicCondition		-0.044	-0.053
		(0.425)	(0.399)
EducationLevel		-0.039	-0.078
		(0.756)	(0.578)
Compassion		-0.067	-0.034
		(0.482)	(0.754)
Self-righteousness_me		0.046	-0.028
		(0.635)	(0.799)
Self-righteousness_ppl		-0.072	-0.141
		(0.495)	(0.235)
Unequal consumption task first			-0.028
			(0.878)
Arbitrator			-0.017
			(0.926)
intercept	**-1.999**	-1.426	**-2.774**
	(0.000)	(0.040)	**(0.001)**
N	709	656	656
Pseudo R^2	0.159	0.006	0.171