Investigating shame and selfishness in two-stage choice problems with interdependent alternatives

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***Abstract*— Decision makers often have to reason about the fairness of their choices, especially when many partners are involved. This situation has urged the use of preferences that could encode the notions of fairness and altruism. There are instances of problems that suggest that the partners of the decision maker have interdependent preferences over the possible alternatives and that they might influence each other. In this paper, we investigate payoffs between the decision maker and passive recipients on second-stage choice problems. We provide a canonical example with dependent and independent alternatives and show how it affects the fairness and private payoffs of the decision maker.**

***Index Terms*—Two-stage choice problem, Sequential decision-making, Utility theory, Altruism, Selfishness, Shame, Subjective norm, Dictator game**

I. Introduction

Fairness is a notion that has attracted researchers in areas such as economics, ethics, and philosophy. The relevance of this notion in decision making is particularly compelling due to its practicality in real-life situations that involve monetary outcomes. For instance, in a classic dictator game [1], [2], a decision maker that gets to anonymously divide an amount of money between herself and a partner who tends to not act selfishly by taking the whole amount for herself but chooses to give a portion to other participants. Such behavior suggests that decision makers can reason about fairness based on the partners' gain and their own. This setting has therefore urged for the use of preferences that could encode fairness and altruism [3], [4]. Certain situations however suggest that the recipients might have interdependent preferences over the possible alternatives and that they might influence each others' choices. In this paper, we propose to study the second-stage choice problems characterized by a decision maker with preferences over sets of payoff-allocations between herself and several passive recipients with interdependent payoffs. The recipients are only aware of the second-stage choice of the allocations made by the decision maker. Herein, shame is perceived as inflicted to the decision makers who do not choose the normatively best allocation in the second stage. We derive a representation that identifies the private ranking of allocations, subjective norm, as well as the shame of the decision maker, when the recipients have interdependent subjective rankings over the alternatives.

II. Related Work

In the field of decision-making, much attention has been given to axiomatic preference models as a way to represent self-control under the pressure of temptation [5], [6], [7], [8], [9]. These approaches explicitly incorporate the mental cost for self-control or "shame" in a utility function. In particular, one proposed model [8] focused on the mental cost incurred when people face an individual decision with a consequences that could violate morality and therefore making a decision that brings shame. This is because it has been empirically proved that human decision-making is not based on a single criterion, as it is the case in classical axiomatic economics, but on several value criteria, as shown in experimental psychology and behavioral economics. In this paper, we propose to focus on utility models equipped with morality and shame and investigate their behaviors.

In the context of self-control and temptation, axiomatic utility models have been used extensively [5], [6], [7], [8], [9] . For example, Gul and Presendorfer [5] first proposed a decision-making model based on self-control and temptation known also as the GP model. The GP model succeeded in representing self-control under temptation. Dillenberger and Sadowski [8] proposed an extended model that handles shame when people make individual decision under consideration of morality (i.e., a norm). Namely, a human is tempted to make a selfish decision while controlling herself based on a moral or normative rule. Dillenberger and Sadowski [8] identified "shame" as the moral cost an individual experiences if she is observed choosing an alternative that she perceives to be in accordance with a social norm (which might include, but is not limited to, considerations of fairness and altruism), instead of choosing an alternative that favors her own material payoffs". A recent paper [10] proposed to incorporate the Dillenberger and Sadowski model into automated negotiation and demonstrated a case where agents can reach a consensus in some cases with moral-based utility functions.

More classical forms of utility functions follow the standard utility model of Von Neumann and Morgenstern (NM) [11]. Furthermore, there have been many works on multi-criteria/attribute utility functions [12], [13] and time-dependent dynamic utility functions [14]. In this paper, we focus on

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an instance of such multi-attribute utility function but with the notion of interdependence between the outcomes of the decision makers involved in the problem.

In the following section, we provide the theoretical basis for shame and how it could be quantified using private payoffs or utility functions. This model will serve later to focus on the cases of dependent valuations.

III. The Model

We start from the single recipient case where the decision maker is interacting with one recipient. In this case, the decision maker is faced with a number of menus to choose from a set F of menus. Each menu is defined as sets of alternatives Menu $A_1 = \{a_1, a_2\} \in A$, Menu $A_2 = \{a_3, a_4\} \in A$, with each alternative composed of the private payoffs of the decision maker and the recipient. The utility of a menu is illustrated as following [8]:

$$U(A_1) = \max_{(a_1)\in A_1} \left[u(a_1) + \beta\varphi(a_1)\right] - \max_{(a_2)\in A_1} \left[\varphi(a_2)\right] \quad (1)$$

We define u as a_1 utility function over private payoffs, and $\varphi(a_1)$ is defined as the cost of shame (a_1). To illustrate the interplay between the private payoff of the decision maker and the shame attributed to choosing a menu, the equation 1 could be rewritten as the Equation (2) between the private payoff and the shame. The function β is defined as the shame of the choice in the face of alternatives that maximize the DM criteria [8].

$$U(A_1) = u(a_1) - \beta\left[\varphi(a_2) - \varphi(a_1)\right] \quad (2)$$

This formulation quantifies the urge to maximize the decision maker own private gain as well as the desire to minimize the shame of not choosing the fairest alternative within a set of menus. A canonical example with one decision maker and recipient is shown in Fig 1.

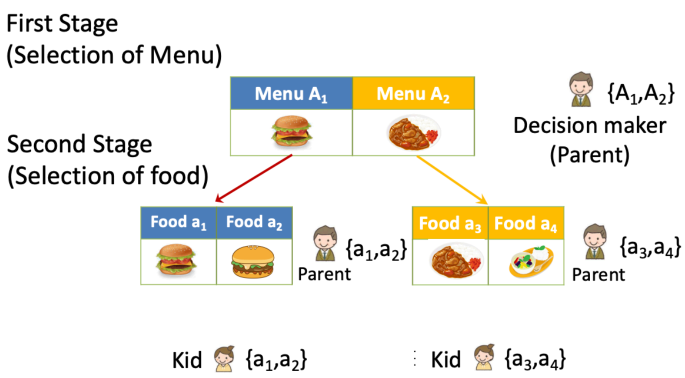

Fig. 1. Example of two-choice problem where parents choose a menu for the family in a restaurant

In this example, the sequential problem starts with the parent choosing a menu from a set of menus A_1, A_2. Each menu provides a set of meals for the recipient, or kid in this example. Each recipient has a ranking over the food items of each menu.

The recipient case is the case where the decision maker is responsible for the payoffs that depend on the decision maker's choice of menu.

A menu $A_1 \in A$ is a finite set of alternatives. Additionally, we could represent a menu A_1 as a matrix (3) $A_{N,M}$ for $N = 2$ individuals and $M = 2$ food items. We have Items represented by the 2 rows 2 columns of $A_{N=2,M=2}$. The matrix is indicated in the formula below.

$$A_{N,M} = \begin{bmatrix} a_1^1, & a_2^1 \\ a_1^2, & a_2^2 \end{bmatrix} \quad (3)$$

For instance, in the example of Fig.1, the utility function of kid 1 over menu A_1 is represented by vector $u(A_1) = \left[a_1, a_2\right]$ and the utility function of kid 1 over menu A_2 is represented by vector $u(A_2) = \left[a_3, a_4\right]$.

IV. Recipient Dependency

In the following, we illustrate how the dependence could arise based on the payoffs of the individuals. Table 1 shows a recipient's utility. Each recipient, or kid utility has two type u and φ. Table 2 and table 3 shows Independent and dependent, respectively.

TABLE I
Recipient's Utility

	Menu A_1				Menu A_2			
	food 1		food 2		food 3		food 4	
	u	φ	u	φ	u	φ	u	φ
DM	0.23	0.10	0.77	0.12	0.49	0.50	0.51	0.30
Kid	0.86	0.20	0.14	0.30	0.61	0.10	0.39	0.50

TABLE II
Independent case

Menu A_1		DM		
		Food 1	Food 2	marginal preferences
Kid	Food 1	0.15	0.49	0.64
	Food 2	0.31	0.05	0.36
marginal preferences		0.46	0.54	1.00

Menu A_2		DM		
		Food 3	Food 4	marginal preferences
Kid	Food 3	0.20	0.21	0.41
	Food 4	0.36	0.23	0.59
marginal preferences		0.56	0.44	1.00

TABLE III
Dependent case

Menu A_1		DM		
		Food 1	Food 2	marginal preferences
Kid	Food 1	0.25	0.39	0.64
	Food 2	0.21	0.15	0.36
marginal preferences		0.46	0.54	1.00

Menu A_2		DM		
		Food 3	Food 4	marginal preferences
Kid	Food 3	0.30	0.11	0.41
	Food 4	0.26	0.33	0.59
marginal preferences		0.56	0.44	1.00

The notion of dependence and independence will be formulated based on equation (2) defined previously where the utilities of two agents DM and Kid will be to give two conditional utility tables, one that is dependent and one that is independent. In the next section, we will use these utility values, or payoffs to compute U. In this case, we have a DM and Kid, where DM might influence Kid. The notion of interdependence between DM and Kid means that their preferences are dependent. Here, we investigate two cases based on the existence or nonexistence of conditional dependence between the alternatives of DM and Kid. Below we explain the calculations relative to these two cases. To simplify the calculation, we set β as 1.

A. Independence case

We calculate the two independence cases. In the first case, the cost of shame has been established, and in the second case, the cost of has not been established. Herein, we define p as a probability function. The probability p of Independence case is explained as $p(a_1) = p(a_1|a_2)$. The first case is that the cost of shame has been established. The decision maker select Menu A_1 and food a_1. We calculated the value of the case that the cost of shame has been established by the decision maker. The utility of the decision maker $U_{DM}(A_1)$ is defined as follows:

$$\begin{aligned} U_{DM}(A_1) &= u(a_1) + \varphi(a_1) \cdot p(a_1, a_1) - \varphi(a_2) \cdot p(a_2, a_1) \\ &= 0.23 + (0.10 \cdot 0.15) - (0.12 \cdot 0.49) \\ &= 0.23 + 0.015 - 0.0588 \\ &= 0.1862 \end{aligned}$$

On the other, the cost of shame has not been established when $p(a_3) = p(a_3|a_4)$. We define p as a probability function. The decision maker selects Menu A_2 for the kid. Suppose that the decision maker selects Menu A_2 and Food a_3. Food a_3 is the food selected by the decision maker and a_4 is the unselected food unit.

We calculated the value of the case that the cost of shame has been established by the decision maker. The utility of the decision maker $U_{DM}(A_2)$ is as follows:

$$\begin{aligned} U_{DM}(A_2) &= u(a_3) + \varphi(a_3) \cdot p(a_3, a_3) - \varphi(a_4) \cdot p(a_4, a_3) \\ &= 0.49 + (0.50 \cdot 0.20) - (0.30 \cdot 0.21) \\ &= 0.49 + 0.10 - 0.063 \\ &= 0.527 \end{aligned}$$

B. Dependence case

In the first case, the cost of shame has been established, and in the second case, the cost of has not been established. Herein, we define p as a probability function. p of Independence case is explained as $p(a_1) = p(a_1|a_2)$.

The first case is that the cost of shame has been established. The decision maker selects Menu A_1 and food a_1. We calculated the value of the case that the cost of shame has been established by the decision maker. The utility of the decision maker $U_{DM}(A_1)$ is as follows:

$$\begin{aligned} U_{DM}(A_1) &= u(a_1) + \varphi(a_1) \cdot p(a_1, a_1) - \varphi(a_2) \cdot p(a_2, a_1) \\ &= 0.23 + (0.10 \cdot 0.25) - (0.12 \cdot 0.39) \\ &= 0.23 + 0.025 - 0.0468 \\ &= 0.2082 \end{aligned}$$

On the other hand, the cost of shame has not been established when $p(a_3) = p(a_3|a_4)$. We define p as a probability function. The decision maker selects Menu A_2 for the kid. Suppose that the decision maker select Menu A_2 and Food a_3. Food a_3 is the food selected by the decision maker and a_4 is the food not selected. We calculated the value of the case where the cost of shame has been established by the decision maker. The utility of the decision maker $U_{DM}(A_2)$ is as follows:

$$\begin{aligned} U_{DM}(A_2) &= u(a_3) + \varphi(a_3) \cdot p(a_3, a_3) - \varphi(a_4) \cdot p(a_4, a_3) \\ &= 0.49 + (0.50 \cdot 0.30) - (0.30 \cdot 0.11) \\ &= 0.49 + 0.15 - 0.033 \\ &= 0.607 \end{aligned}$$

V. Discussion

The notion of dependence and independence are important for group decision making. we discuss below to dependence case and independence case.

A. Independence case

So far, we calculated four cases. In the independence case, as shown in the utility function and the cost of shame in table 1. The first two cases are regarding Independence cases where the cost of shame was established and not established. In the independence case, the first case is that the cost of shame has been established. In Table 2, the probability of menu and foods in independence case were shown. The utility function over private payoffs is $u(a_1)$ = 0.23. The decision maker's utility for a_1 is $U_{DM}(A_1)$ = 0.1862. The Kid is eager to consume Food a_2, but, kid was instructed by the decision maker to consume Food a_1. A utility function over private payoffs is less than the decision maker's utility. This indicates that the decision maker has recognized that the kid's utility was declining. In the other case, where the cost of shame has not been established, a utility function over private payoffs is $u(a_3)$ = 0.49. The decision maker's utility for a_1 is $U_{DM}(A_2) = 0.527$. Here, the Kid is eager to consume Food a_4, but, Kid was forced by the decision maker to consume Food a_3. The decision maker's utility (0.527) is more than a utility function regarding private payoffs (0.49). In other words, the cost of shame has not been established.

B. Dependence case

The case is that the cost of shame has been established. In Table 2, the probability of menu and foods in independence case were shown. The utility function over private payoffs is $u(a_1)$ = 0.23. The decision maker's utility for a_1 is $U_{DM}(A_1)$ = 0.2082. The kid is eager to consume Food a_2, but, kid was instructed by the decision maker to consume Food a_1. A utility function over private payoffs is less than the decision maker's utility. This indicates that the decision maker has recognized that the kid's utility was declining. In the other case (the cost of shame has not been established), a utility function over private payoffs is $u(a_3)$ = 0.49. The decision maker's utility for a_3 is $U_{DM}(A_2)$ = 0.607. Here, the Kid is eager to consume Food a_4, but, Kid was forced by the decision maker to consume Food a_3. The decision maker's utility (0.49) is more than a utility function regarding private payoffs (0.607). In other words, the cost of shame has not been established.

In both cases, independence or dependence, when the cost of shame is established, decision maker's utility is declining and when the cost of shame is not established, the decision maker's utility is not decreasing. Therefore, in both cases that the cost of shame is established or not established occur.

VI. Conclusion

In this study, we proposed two-stage choice problems characterized by a decision-maker with preferences over sets of payoff-allocations between herself and passive recipient with interdependent payoffs. We calculated four cases that would affect the decision maker's utility depending on the relationships between the decision maker's and the recipient. Future work is required to generalize the cases across the menus and to establish a theorem suitable for both dependency cases. The present paper is short and just presents the idea. Future works have to provide an extensive explanation of the limitations of the proposed approach and present a real case study.

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