Reciprocity Under Risk *

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This version: November 26, 2019

Abstract

Do agents reciprocate in risky environments based on the allocation *after* the resolution of risk (ex-post motive) or *in expectation* (ex-ante motive)? Recent theoretical work has integrated both motives into one model of social preferences under risk. However, this work has been limited to static environments only. We experimentally study giving and reciprocity in a sequential environment with risk to further illuminate the relationship between an ex-ante and ex-post motive in social preferences. We find, contrary to extant theory, that ex-ante and ex-post *reciprocal* motives operate through separate psychological channels. In other words, a change in the ex-ante portion of the utility of an agent cannot be consistently compensated for with a corresponding change in the ex-post portion. Our results also shed light on how reciprocity changes in environments with risk, pointing to one bridge between laboratory and field gift exchange.

JEL Codes: D90, D81, J22
Keywords: ex-ante reciprocity, ex-post reciprocity, reciprocity, risk

*We would like to thank Alexandr Alekseev, Prateik Dalmia, PJ Healy, John List, Kota Saito, and anonymous referees for helpful comments and fruitful discussions. We also acknowledge helpful feedback from seminar participants at SUNY Binghamton.

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Giving is often subject to some risk. An employer can offer stock options or health insurance to an employee. Donors can give assets to a charitable organization. Parents can invest in college savings plans for their children. Physicians make decisions that can only affect their patients' *chances* at healing. Consider a more stark example: high polluting countries can agree to reduce emissions for the chance to reduce the effects of climate change. In response to such gifts, recipients can reciprocate in ways that are subject to risk. Employees can decide not to shirk on the job, but the effects thereof on their employers' profit will be subject to aggregate and idiosyncratic shocks. Charities can publish the names of donors, but the subsequent effect on the donors' reputations is not certain. Children can invest in end-of-life care for their parents, but this may not necessarily improve their quality of life. Patients can leave a positive review of their doctor, but it is not certain that this will improve the lot thereof. Low polluting countries can reward countries who reduce emissions by reducing bilateral tariffs, but how this affects growth is subject to risk.[1]

When choosing how to respond to a risky gift, what does the recipient care about? Do they care about the *final allocation* between themselves and the giver after the resolution of all risk? Or do they care about the *expected allocation*? We experimentally study a sequential giving environment to investigate the interplay between ex-post (final allocation) and ex-ante (expected allocation) reciprocal motives. In our Stochastic Gift Exchange Game (SGE), players are endowed with tokens that represent a 0.1% chance at a single prize (i.e. at most, only one agent will end up winning the prize).[2] They then trade these tokens as in the standard Gift Exchange Game (DGE): player 1, the Firm, gives a Wage to player 2, the Employee, who then responds by exerting costly Effort.[3] We find substantial evidence of reciprocity in SGE, but that Wages are substantially smaller than in

[1]In each of these examples, the timing of when a recipient finds out about the outcome of a gift varies considerably. For example, a child will likely know the outcome of their parents' college investment decision before making end-of-life care decisions for them, but a low polluting country will likely have to make the decision to reduce tariffs without knowing the outcome of a "gift" of pollution reduction on the part of another country. In our experiment, we focus on environments where both agents must make decisions *before* knowing the outcome of a gift in order to shut down an ex-post reciprocal motive (explained in more detail in Section 1). The examples given here are merely meant to illustrate that risk is a non-trivial aspect of environments with reciprocity. We view varying the timing of information revelation in such a bilateral environment as important and worthy of future research, though it is beyond the scope of the current paper.

[2]We use such a mutually exclusive prize for i)simplicity of the environment and ii) to introduce tension between ex-ante reciprocity and ex-post fairness (explained in more detail in Section 1. We view the study of other lotteries in SGE as potentially fruitful, though it is beyond the scope of the current paper.

[3]In all discussion below, we use the historical terminology of DGE (i.e. a "Firm" offering a "Wage" to an "Employee" who then exerts costly "Effort") for consistency with the extant body of literature, though we emphasize that our environment is generalizable to many sequential bilateral exchange environments with risk.

DGE. This effect remains when accounting for risk preferences. Of course, risk in such a bilateral exchange in the real world may not be equal between the two agents. To investigate whether the "source of the risk" matters, we also study variants of SGE where the endowments are asymmetric. In Wage-SGE, the Firm is endowed with the same tokens as in SGE, but the Employee is endowed with, and can transfer, cash. In Effort-SGE, the opposite is true. We find that it does not matter which player is endowed with tokens: Wages and Effort are equal across Wage-SGE and Effort-SGE. Perhaps surprisingly, however, whether there is an asymmetry in endowments does matter: Effort is lower in Wage-SGE and Effort-SGE (where the Firm and Employee have different endowments) than in SGE (where both Firm and Employee are endowed with tokens), though Wages are the same. In other words, Employees hold onto more of their endowment (by providing lower Effort) in Wage-SGE and Effort-SGE than in SGE, conditional on the same Wages. We interpret this as an "endowment effect" where individuals are sensitive to their own power to affect the expected allocation between the two players. No such endowment effect exists in SGE or DGE, since agents are trading the same good (tokens in SGE and cash in DGE) between themselves. The result is that expected payoffs are lower with asymmetric risk (in Wage-SGE and Effort-SGE) than in either SGE or DGE.

Despite a long history of investigations of reciprocity in the lab and field, surprisingly little attention has been paid to studying reciprocity in the presence of risk.[4] Several laboratory studies utilize lotteries in extensions of DGE to study the effects of giving *intentions* on reciprocal motives.[5] Rubin and Sheremeta (2015) and Davis and Kerschbamer (2017) study an extension of the gift-exchange game with random shocks added to the outcome for the firm.[6] While risk is introduced in these gift-exchange games, their results are not capable of meaningfully commenting on the existence and relative strength of an *ex-ante* reciprocal motive as distinct from an *ex-post* motive.

[4]See Fehr et al. (1998); Charness et al. (2004); Brandts and Charness (2004); Karni et al. (2008); Owens and Kagel (2010); Filiz-Ozbay et al. (2016), and others for laboratory studies of Gift Exchange and Falk (2007); Bellemare and Shearer (2009); Kube et al. (2012) for studies in the field.

[5]There is also a small body of literature on trust in environments with risk. For example, Vranceanu et al. (2012) investigate behavior in an investment game where there is a small exogenous probability that trade will be broken. Fairley et al. (2016) and Houser et al. (2010) investigate the relationship between trust and risk preferences. Finally, in a meta-analysis of trust games, Johnson and Mislin (2011) find that behavior depends on whether experimenters use a random incentive scheme. In each of these cases, risk is exogenously determined and not a function of the strategy of the agents involved, as in our SGE. As such, they are unable to comment on the existence and form of ex-ante reciprocal preferences.

[6]Toussaert (2017) also utilizes lotteries to study intentions, though in an extension of the trust game.

There are two reasons why this is true. First, Wages are deterministic in their experiment, affecting the expected payoff for the Employee *for sure*. The same is true for Effort. Random shocks come in the form of augmentations of the profit outcome of the firm based on the employee's choice of Effort. In our SGE, both transfers are entirely probabilistic, shutting down any room for an ex-post reciprocity motive. Second, both Rubin and Sheremeta (2015) and Davis and Kerschbamer (2017) include a "bonus" stage, where the Firm can observe (subject to treatment variation) some combination of output, Employee Effort, and the shock, and reward (or punish) the Employee accordingly. SGE (and standard DGE for that matter) does not include such a stage. The additional incentives that such a "bonus" stage entails limits the applicability of the results of Rubin and Sheremeta (2015) and Davis and Kerschbamer (2017) to questions concerning ex-ante vs. ex-post motives. It should be emphasized, however, that the intent of Rubin and Sheremeta (2015) and Davis and Kerschbamer (2017) was to study the effects of giving *intentions* on reciprocal responses, not on distinguishing between ex-ante and ex-post reciprocal motives. We are focusing on the latter in the current work.

Our experiment is most closely related to that of Brock et al. (2013). They study variants of the Dictator Game where the Dictator is endowed with some combination of cash and tokens, just as in the current study. They focus on the presence of ex-ante and ex-post fairness concerns in a static setting and show that behavioral models that exclude either of these two forces are incapable of admitting their results. In this study, we show that the same is true for sequential environments (i.e., models of reciprocity must include both ex-ante and ex-post factors).

Our results cannot be explained cleanly by either i) extensions of extant models of reciprocity to environments with risk or ii) extensions of static models of "ex-ante" and "ex-post" preferences to sequential environments. Because of the mutually exclusive nature of the lottery implied by transfers of tokens between agents in SGE, expected utility extensions of Rabin (1993), Bolton and Ockenfels (2000),Falk and Fischbacher (2006), and Cox et al. (2007) may predict positive Wages and Effort, but do not predict that Effort is an increasing function of the Wage (i.e. that Effort is *reciprocal* and not *altruistic*). One problem with the application of these models to our environment is that they are primarily based on ex-post reciprocity, that is, a reciprocal motive based on the final allocation of wealth between the two agents. The inclusion of intentions-based reciprocity in Rabin (1993) and Falk and Fischbacher (2006) is not enough to overcome this modelling issue in our environment.

However, Saito (2013) offers a model that combines such ex-post concerns with ex-ante preferences, where the latter is a preference based on the *expected allocation* between the two agents. The Expected Inequality Aversion (EIA) model of Saito (2013) was formulated for static environments, but could easily be extended to incorporate reciprocal motives. In EIA, agents have preferences according to the following value function:

$$V(p) = \underbrace{\delta U[E_p(x)]}_{\text{Ex-Ante Preferences}} + \underbrace{(1-\delta)E_p[U(x)]}_{\text{Ex-Post Preferences}} \tag{1}$$

where $E_p(\cdot)$ is the expectation operator according to the lottery p and $U(x)$ is the Inequality Averse utility function of Fehr and Schmidt (1999) for x, a vector of monetary payments for the two agents. The mixture of ex-ante and ex-post preferences is described by a single parameter δ. In this model, ex-ante preferences are captured by evaluating the utility function U at the certainty equivalent of the lottery faced. Ex-post preferences are captured simply by the expected utility of the lottery. At first glance, it may seem that simply substituting a utility function meant to capture reciprocal motives, such as that of Falk and Fischbacher (2006), for the Fehr and Schmidt (1999) utility function used in the EIA model might be able to admit our results. However, this does not overcome a more fundamental issue inherent to modelling ex-ante and ex-post preferences in this way. By describing the mixture of ex-ante and ex-post preferences with a single parameter δ, Saito (2013) implicitly assumes that any change in the ex-ante allocation can be directly compensated with a change in the ex-post allocation. In other words, these preferences should be stable to changes in the endowment, ruling out the existence of an endowment effect. In Section 3 we suggest a simple extension of the EIA model that could admit our results at the cost of one additional model parameter.

Finally, our results provide one possible explanation for the lack of robustness of gift exchange in the field, perhaps best exemplified in Gneezy and List (2006). They find that in response to a one-time cash gift, effort increases in the short term, but decreases over time. In our experiment, we find that effort provision is significantly lower when the returns to effort are subject to risk, conditional on a deterministic wage. We argue that a substantial amount of effort provision in the field is subject to risk, including in the door-to-door fundraising task in Gneezy and List (2006), which could explain why effort provision in the field is not nearly as robust as in the lab. We discuss this further in Subsection 3.2.

The rest of the paper is organized as follows. In Section 1 we present the experimental design. Section 2 presents our findings regarding the presence of ex-ante reciprocity and how risk augments reciprocity. We discuss the implications of our results for both the Gift Exchange body of literature and the larger body of literature at the intersection of social and risk preferences in Section 3.

1 Experiment

We ran 16 sessions of the experiment at the Experimental Economics Laboratory at the University of Maryland, College Park.[7] In each session, 16 subjects participated, for a total of 256 subjects. Subjects earned an average of $22.25 USD, inclusive of a $7 show-up fee. Due to the stochastic nature of payoffs, a function of our experimental design, there was considerable heterogeneity in cash earnings: the minimum payoff was $8 USD; the maximum payoff was $45 USD; and the standard deviation was $8.66. Sessions lasted approximately 90 minutes. The experiment was programmed in zTree (Fischbacher, 2007).

In each session, subjects completed 5 tasks: i) a Stochastic Gift Exchange Game which varied by treatment, ii) the Deterministic Gift Exchange Game, iii) Self Holt-Laury (2002) risk elicitation procedure, iv) Other Holt-Laury (2002) risk elicitation procedure, and v) Questionnaire(s). The order was fixed, moving from Task One to Task Five in each session. Tasks are described in detail below.

1.1 Stochastic Gift Exchange

In the first task, subjects played eight one-shot Stochastic Gift Exchange Games (SGE). For each SGE, a subject was randomly matched with another subject in the lab. No subject played the SGE with the same partner more than once. Subjects in the first eight sessions played the standard SGE described in this section. In the remaining eight sessions, subjects completed one of two variations of SGE, explained in Section 2.3.

In SGE, there are two players, a Firm and an Employee.[8] Roles were assigned to subjects in the first period and remained fixed for each of the eight SGE that were played in a given session. The game contains two stages: Stage One in which the Firm makes a decision and Stage Two in which the Employee makes a decision. In Stage One, the Firm starts with 100 virtual "tokens" and can choose how many they would like to give to the Employee. The Employee then receives five times that number of tokens. In Stage Two, the Employee is given 100 additional tokens and can

[7]An additional eight sessions were run under an alternative feedback mechanism. Results are available upon request.

[8]The terminology "Person 1" and "Person 2" were employed in our instructions for the roles of "Firm" and "Employee," respectively.

choose how many (out of 100) they would like to give to the Firm. The Firm then receives five times the number of tokens given to them by the Employee.

Each token held by the Firm or Employee at the end of Stage Two represents a $\frac{1}{1000}$ chance at a single prize of \$20. The prize can be won by the Firm, the Employee, or by neither; there is no event wherein *both* the Firm and Employee win a monetary prize. Note that the initial endowments of 100 tokens each implies an ex-ante endowment of a 10% chance of winning the prize, with the remaining 80% held by the experimenter. At the end of Stage Two, the expected payoff (in USD) for each player $i \in \{Firm, Employee\}$ is as follows:

$$\pi_i(\tau_i^t, \tau_j^t) = 20 \cdot \frac{100 - \tau_i^t + 5\tau_j^t}{1000} \tag{2}$$

where τ_i^t refers to the chosen transfer of tokens from player i to player j.

Note that only by transferring the entirety of both endowments from one player to the other may a pair ensure that the prize would be won by either the Firm or Employee. In this sense, trade is ex-ante Pareto Optimal, a feature shared by both the Deterministic Gift Exchange game described in 1.2 and in other studies of reciprocity that share a similar payoff structure.[9]

At the end of each round of SGE, both the Firm and Employee are given feedback regarding i) the chosen Wage, ii) the chosen Effort, iii) whether either the Firm or Employee won the prize, and iv) whether they themselves won the prize. Subjects were paid for one of the eight rounds of SGE, chosen at random with equal probability at the end of the SGE task.

1.2 Deterministic Gift Exchange

Subjects completed one round of DGE in Task Two and were randomly matched with another participant in the room. They had the same roles as were assigned previously for SGE. The Deterministic Gift Exchange (DGE) game was standard and works as described above for SGE, except that payoffs were deterministic. Instead of receiving 100 tokens, subjects were given 100 Experimental Currency Units (ECU). Again, in Stage One, the Firm chose how many of 100 ECU they would like to transfer to the Employee. The Employee was then given five times that number of ECU. In Stage Two, the Employee chose how many of 100 ECU they would like to transfer back

[9] Both Brandts and Charness (2004) and Owens and Kagel (2010) use similar linear payoff functions.

to the Firm. At the end of Stage Two, the number of ECU held by player i is as follows:

$$\pi_i(\tau_i^{ecu}, \tau_j^{ecu}) = 100 - \tau_i^{ecu} + 5\tau_j^{ecu} \tag{3}$$

where τ_i^{ecu} refers to the chosen transfer of ECU from player i to player j. At the end of this Task, ECU was converted to USD at a rate of 50 ECU to $1 USD. Note that this exchange rate implies that if a pair chose strategy profiles in SGE and DGE such that $(\tau_{Firm}^t, \tau_{Employee}^t) = (\tau_{Firm}^{ecu}, \tau_{Employee}^{ecu})$, it would lead to equal expected monetary payoffs across SGE and DGE.

1.3 Self Holt-Laury Risk Elicitation Task

After completing both the SGE and DGE tasks, subjects were asked to complete the risk preference elicitation task described in Holt and Laury (2002). In this task, the subject was to make ten decisions, choosing between two options in each decision. Each decision had a "safe" option and a "risky" option, as given in the original Holt and Laury (2002) experiment. At the end of this task, two lotteries (per subject) were conducted: one to decide which of the ten decisions to use for payment, and one to realize the outcome of the subject's choice for that decision. Subjects were then informed of their payoff from this task.

1.4 Other Holt-Laury Risk Elicitation Task

Because SGE involves strategy choices that i) involve risk and ii) involve another agent's payoffs, we would like to measure potential "other-regarding" risk preferences. That is, it is possible that a subject's choices among risk alternatives may depend on whether that choice is made for oneself or *on behalf of* another person. To this end, we repeated the risk preference elicitation task of Holt and Laury (2002), but instead informed subjects that they would be choosing on behalf of another subject in the lab. They were also informed that another subject in the lab would be choosing on their behalf, but that these people (i.e. the person for whom subject X is choosing and the person choosing on behalf of subject X) may not be the same. This matching was completed anonymously and such that every subject made decisions for one other subject in the room, but without explicit partner matching.[10]

1.5 Questionnaire

Finally, each subject completed a short demographic questionnaire.[11] Subjects were asked about their age, gender, self-reported SAT and ACT scores, and GPA. In addition, there was an open-ended field where subjects could give some narrative justification for the decisions that they made in the experiment.

2 Results

Our subject pool is balanced in terms of age and gender. The average age of our subjects was 20.125 years and 45.31% were female. Subject statistics, including self-reported SAT, ACT, and GPA , are reported in Table 1 below.

Table 1: Subject Statistics

	Mean	Std. Dev.	Min	Max	Observations
Age	20.125	1.611	16	29	256
Female	0.453	0.499	0	1	256
SAT	1844.976	308.847	1,000	2,400	210
ACT	29.913	3.829	18	36	104
GPA	3.365	0.431	1.7	4	254

SAT, ACT, GPA observations were dropped if the subject submitted infeasible response
4, 29, and 2 observations dropped for SAT, ACT, and GPA, respectively

As mentioned previously, there are several motivations for studying the presence of reciprocity in an environment with risk. We consider each of them in turn in the following subsections.

[10]Specifically, each subject was randomly assigned an id number from 1 to 16 in the experimental program. Subject i then made decisions on behalf of subject $i + 1$, with Subject 16 making decisions on behalf of Subject 1. These id numbers were never revealed to subjects during this task.

[11]Several of the additional eight sessions run under an alternative feedback mechanism also included a Big 5 trait questionnaire. These responses are not included in this work, but are available upon request.

2.1 Does Ex-Ante Reciprocity Exist?

Leading models of reciprocity, including Falk and Fischbacher (2006), Bolton and Ockenfels (2000), and Cox et al. (2007), do not predict the presence of any gift exchange in our environment when incorporated into an expected utility model. More precisely, these theories *can* lead to positive wages and effort, but imply no sensitivity of effort to the proffered wage.

From Figure 1 below, we can see both positive wages offered by the Firm in SGE and positive Effort in response. There is also little evidence of learning: no discernible trend in Wage or Effort by Period can be detected. Finally, offered Wages, but not Effort, are somewhat lower on average in SGE relative to DGE. These differences are explored further in Section 2.2

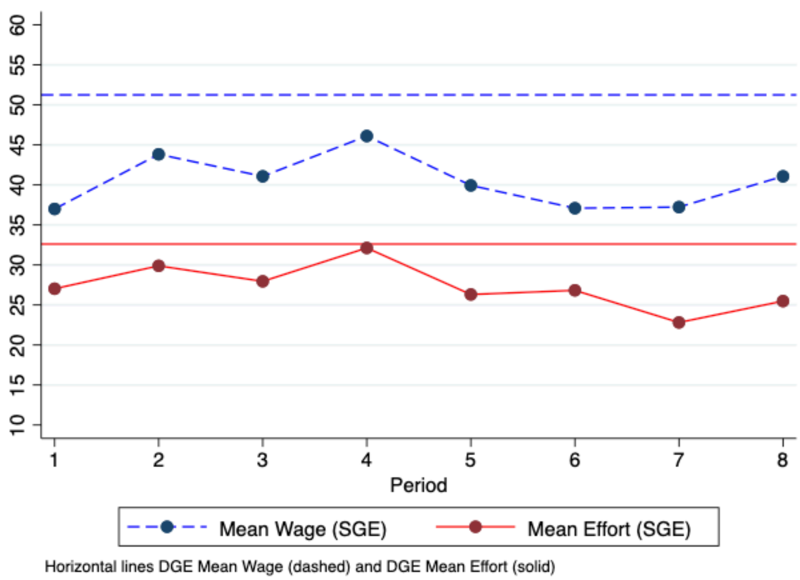

Figure 1: Mean Wage and Effort by Period

Provided Effort levels are also sensitive to the Wage offered in SGE. Figure 2 shows an overall positive relationship between offered Wage and Effort in response in SGE: average Effort is roughly 10 tokens in response to Wages offered between 0 and 19 tokens, which increases to roughly 58 tokens in response to offered Wages between 80 and 100 tokens. This effect remains when controlling for subject-level heterogeneity in the tobit regression specifications given in Table 2: the coefficient on Wage is positive and significant in each model specification where the dependent variable is Effort. Furthermore, the coefficient on Wage is significantly greater than 0.2, indicating that a strictly positive Wage was profitable in SGE in expectation.

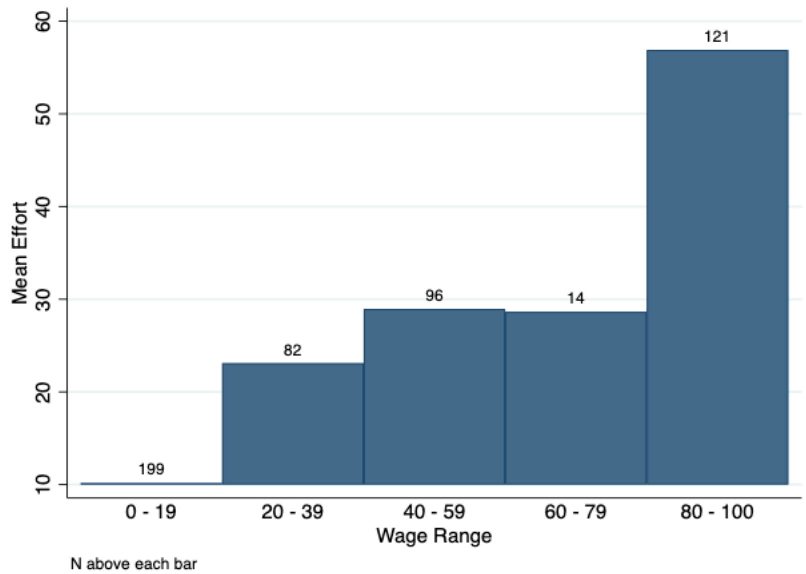

Figure 2: Mean Effort by Wage: SGE

Taken together, the analysis above leads us to our first result:

Result 1 *Ex-ante reciprocal motives exist in SGE:*

- *Mean Wages and Effort are both positive in SGE*
- *Effort provided by Employees is sensitive to the size of the Wage in SGE*
- *Positive Wages are profitable in expectation*

Table 2: Effort Sensitivity to Wage: SGE

	(1) Effort	(2) Effort
Wage	0.676***	0.674***
	(0.0819)	(0.0821)
Period	-1.287	-1.295
	(0.789)	(0.789)
GPA		-5.378
		(5.087)
Female		3.235
		(7.609)
Observations	512	512

Standard errors in parentheses

Tobit regressions with lower limit equal to 0 and upper limit equal to 100

Tobit estimated sigma output not included

Robust standard errors clustered at the subject level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.2 Does Gift Exchange Differ Between SGE and DGE?

Having established that gift exchange does indeed exist in SGE, we now turn to explicit differences between Wages and Effort between SGE and DGE. There are several reasons why we might expect differences in either Wages or Effort between the two environments. First, SGE involves an element of risk not present in DGE: one token transferred may not actually result in a change in the ex-post allocation of the recipient. As such, we might expect risk preferences to have an effect on Wages and Effort in SGE, but not in DGE. Additionally, subjects are only able to choose transfers based on *ex-ante* reciprocal motives in SGE, since no transfer can chance the set of feasible *ex-post* allocations of the two players. In DGE, ex-ante and ex-post reciprocal motives coincide: a transfer of one ECU from one player to the other increases the allocation of the recipient in *expectation* (trivially) and in *actuality*. Thus, if ex-post reciprocity matters, we may expect lower levels of Wages or Effort in SGE relative to DGE.

Mean Wages and Effort are given in Table 3. On average, subjects offer about 10.83 fewer tokens in the Wage in SGE relative to DGE (significant at the $\alpha = 0.05$ level). However, overall Effort levels are not different between the two environments. These effects survive in tobit regression specifications in Tables 4 and 5, which control for potential learning (i.e. controlling for

Period) and individual heterogeneity. As seen in Table 4, subjects with higher GPAs offer higher Wages and Female subjects offer fewer, on average.[12] The same is not true for Effort provided in response. Additionally, there appears to be no learning in terms of sensitivity of Wage to Period; however, Effort provided does decrease with each Period.

Table 3: Mean Wage and Effort by Stochasticity

	DGE	SGE	Difference
Wage	51.25	40.42	-10.83**
	(4.872)	(1.595)	
	64	512	
Effort	32.61	27.30	-5.305
	(4.168)	(1.474)	
	64	512	

Std. Errors in Parentheses
Only DGE observations from SGE sessions included
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Determinants of Wage: SGE and DGE

	(1) Wage	(2) Wage
SGE	-21.98***	-21.55***
	(7.635)	(7.577)
Period	-0.843	-0.804
	(0.872)	(0.856)
GPA		37.83***
		(11.54)
Female		-19.08**
		(8.951)
Observations	576	576

Standard errors in parentheses
Only DGE observations from SGE sessions included
Tobit regressions with lower limit equal to 0 and upper limit equal to 100
Tobit estimated sigma not included
Robust standard errors clustered at the subject level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[12] We view the detection of lower Wages offered on the part of our Female subjects as merely the result of controlling for gender in our regression specifications, not as a fundamental result about gender differences in giving. Ex-ante fairness concerns, ambiguity attitudes, and other preferences may differ between men and women, none of which is controlled for in these specifications.

Table 5: Determinants of Effort: SGE and DGE

	(1) Effort	(2) Effort
Wage	0.720***	0.711***
	(0.210)	(0.215)
Stochasticity	-3.063	-3.549
	(8.607)	(8.760)
Wage * Stochasticity	-0.0347	-0.0259
	(0.219)	(0.221)
Period	-1.329*	-1.333*
	(0.802)	(0.800)
GPA		-3.314
		(4.934)
Female		1.159
		(7.710)
Observations	576	576

Standard errors in parentheses

Only DGE observations from SGE sessions included

Tobit regressions with lower limit equal to 0 and upper limit equal to 100

Tobit estimated sigma not included

Robust standard errors clustered at the subject level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This fundamental difference in Wages offered between SGE and DGE is not limited to simply the mean. As can be seen in Table 6, more subjects offered a Wage of zero in SGE, though this difference is not statistically significant. Additionally, fewer subjects offered half of their endowment or all of their endowment (i.e. Wage $= 50, 100$, respectively) in SGE. Figure 3 presents the CDF of Wages in SGE and DGE, indicating a difference between these two distributions in the direction of lower Wages overall in SGE. While Table 6 seems to indicate that fewer subjects responded with Effort of 50 or 100 in SGE, Figure 4 shows that these two CDFs are not statistically different from one another.

Table 6: Wage and Effort Frequencies: SGE and DGE

		Zero	Fifty	One Hundred
Wage	SGE	.109 (.014) 512	.107 (.014) 512	.164 (.016) 512
	DGE	.047 (.027) 64	.188 (.049) 64	.344 (.06) 64
	Difference	.063	-.08*	-.18***
Effort	SGE	.25 (.019) 512	.084 (.012) 512	.096 (.013) 512
	DGE	.313 (.058) 64	.156 (.046) 64	.188 (.049) 64
	Difference	-.062	-.072*	-.092**

Only DGE observations from SGE sessions included
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, given that there are meaningful differences between Wages offered in SGE relative to those DGE, it may be a concern that the bulk of laboratory studies of gift exchange exclusively focus on variants of DGE. Moreover, given that gifts in the real world can involve stochastic elements (e.g. stock options, equity, retirement benefits, policy changes, user reviews, etc.), this points to

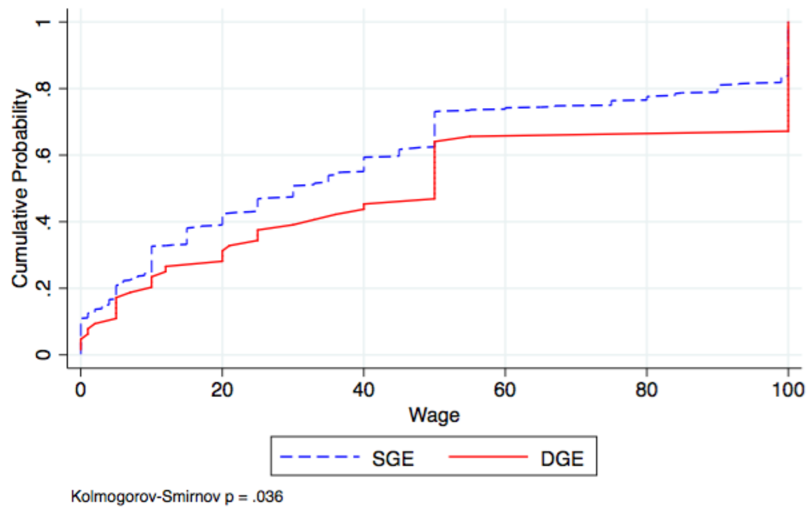

Figure 3: Wage CDF: SGE and DGE

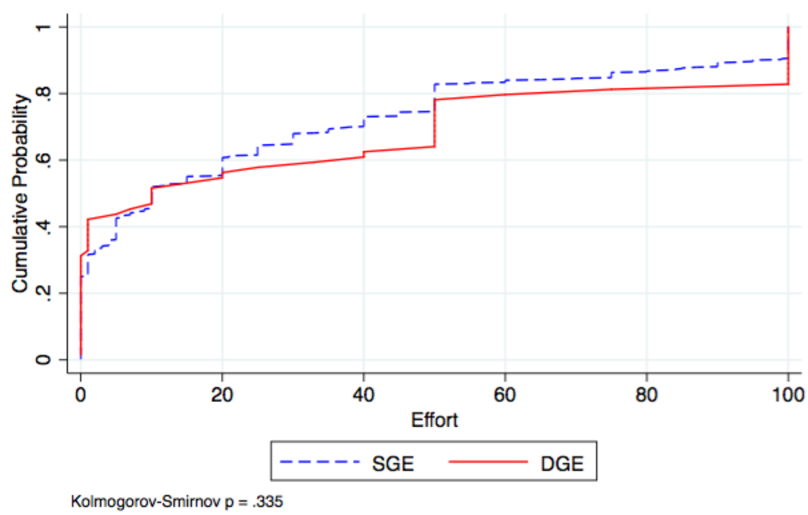

Figure 4: Effort CDF: SGE and DGE

a weakness of the current body of literature on gift exchange in terms of external validity. We then ask to what extent measures of reciprocity taken in DGE can proxy for behavior in SGE. The results in Table 7 are not promising in this regard. These tobit regressions were conducted with Wage in SGE as the dependent variable, using Wage in DGE by the same subject as the primary independent variable. We control for both learning (i.e. Period) and individual heterogeneity by

GPA and gender. In neither model is the coefficient on Wage DGE close to 1, which would indicate that Wages in DGE are a perfect proxy for Wages in SGE. The coefficient is positive and significant, but much variation in Wages under SGE is left unexplained by Wages in DGE alone.[13] The degree to which Wages in SGE vary even controlling for Wages in DGE can further be seen in Figure 5. Confidence intervals at on the 95% level are quite wide and do not indicate much precision in the estimation of Wages in SGE using Wages in DGE alone.

Table 7: DGE as Proxy for SGE

	(1) SGE Wage	(2) SGE Wage
DGE Wage	0.682***	0.560***
	(0.108)	(0.128)
Period	1.029	-1.491*
	(0.858)	(0.904)
GPA		6.084**
		(2.754)
Female		0.646
		(7.514)
Observations	512	512

Standard errors in parentheses

Tobit regressions with lower limit equal to 0 and upper limit equal to 100

Tobit estimated sigma not included

Robust standard errors clustered at the subject level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Taken together, the analysis in this section leads us to our next three results:

Result 2 *Wages are lower in SGE than in DGE:*

- *Mean Wages in SGE are lower than in DGE*
- *Cumulative distribution functions are different between SGE and DGE in the direction of lower Wages in SGE*

[13] In an ideal setting, we could report the R^2 from these regression specifications as a measure of "variance in Wages under SGE explained by a DGE proxy." However, tobit regressions, which are required for this analysis due to the upper and lower limits on the strategy space for our subjects, have no R^2 statistic. Pseudo-R^2s can be reported, but offer no similar interpretation in this setting. Recognizing the limits of OLS with censored data, we also conducted OLS analogues of Model 2 in Table 7 with and without DGE Wage on the right-hand side of the equation. Including DGE Wage increases the R^2 from 60.3 to 68.46, indicating that DGE Wage can only explain approximately 8.5% of the variation in SGE Wages.

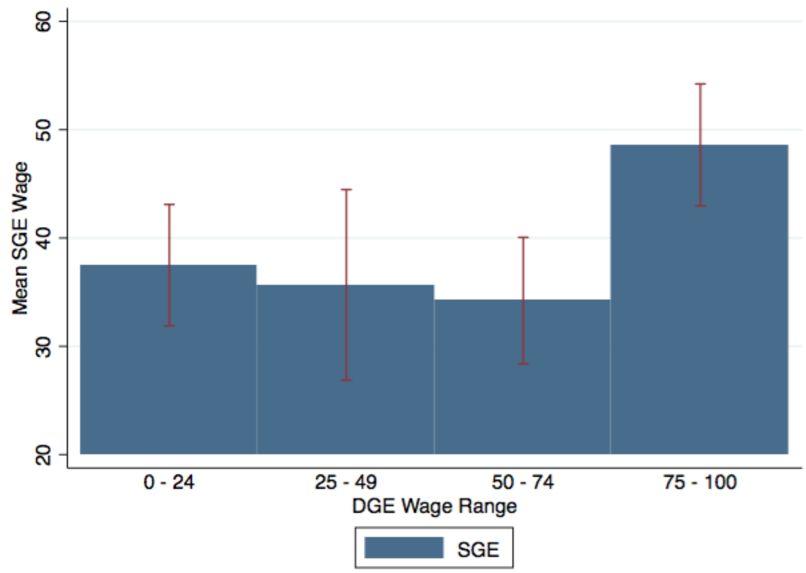

Figure 5: Mean Wages in SGE by DGE Wage Range

- *There are fewer observations of Wages at* 50 *and* 100 *in SGE than in DGE*

Result 3 *Effort levels are equal across SGE and DGE.*

Result 4 *Wages in DGE are a poor proxy for Wages in SGE:*

- *The coefficient for "DGE Wage" with "SGE Wage" as the dependent variable is significantly less than one in all relevant regression specifications*

- *Conditional on Wages in DGE, there is significant variation in Wages in SGE for the same subject*

2.3 Does the Source of Risk Matter?

Given that i) reciprocity exists in the presence of risk and ii) there is a systematic difference in reciprocal behavior between environments with risk (SGE) and environments with none (DGE), it is natural to ask whether the *source* of risk matters. In SGE, both Wages and Effort are probabilistic: giving one token only increases the *expected* payoff of the recipient, but cannot affect it for sure. Moreover, there is a fundamental asymmetry in SGE due to its sequential nature (i.e. Wages are offered *before* an Effort response is chosen).

In order to investigate whether the source of risk matters, we implemented four sessions each of two variants on the SGE: a Wage-SGE and an Effort-SGE. Recall that in SGE, both the Firm and Employee were endowed with 100 tokens, but in DGE both were endowed with ECU. Both players were endowed with the same good. In the two variants of SGE that we conducted, we instead endowed the Firm and Employee with *different* goods with one receiving tokens and the other receiving ECU. ECU were converted to cash directly at a rate of $1 USD to 50 ECU, just as in DGE. Tokens each gave a 0.01 percent chance at a mutually exclusive $20 prize, just as in SGE. Table 8 below describes these endowments and the expected payoffs of each player conditional on transfers τ_j^i, denominated in USD.

Table 8: Wage- and Effort-SGE Endowments and Payoffs

	Endowment		Expected Payoffs (in USD)	
	Firm	Employee	Firm	Employee
Wage-SGE	100 tokens	100 ECU	$20 \cdot \frac{100-\tau^t_{Firm}}{1000} + \frac{5\tau^{ecu}_{Employee}}{50}$	$20 \cdot \frac{5\tau^t_{Firm}}{1000} + \frac{100-\tau^{ecu}_{Employee}}{50}$
Effort-SGE	100 ECU	100 tokens	$20 \cdot \frac{5\tau^t_{Employee}}{1000} + \frac{100-\tau^{ecu}_{Firm}}{50}$	$20 \cdot \frac{100-\tau^t_{Employee}}{1000} + \frac{5\tau^{ecu}_{Firm}}{50}$

These asymmetric endowments contribute to asymetric abilities to affect the ex-ante and ex-post allocations between the two players. In Wage-SGE, the Firm could affect only the ex-ante allocation of the two players, whereas the Employee could affect both the ex-post allocation and, trivially, the ex-ante allocation. The reverse is true in Effort-SGE. Does this asymmetry lead to different Wage or Effort levels in these variants relative to SGE? We answer this and related questions in this section.

Table 9 below displays Wage and Effort levels for all four variants of gift exchange that we utilize in this study. Overall, Wage and Effort are lower in variants of SGE than in DGE. This effect largely remains when we control for individual-level heterogeneity, risk preferences, learning, and the size of the Wage offered in Table 10. In all tables the row labelled “Dem Controls” indicates whether GPA, Period, and Female are included in the regression, but coefficient outputs are not. “Risk Pref” indicates whether risk preference measures from the Self HL and Other HL are controlled for in the regression. We do not report coefficients on these measures as they are not statistically significant in any model specification. Notably, Effort is no lower in SGE than in DGE once controlling for the size of the Wage (which is lower in SGE than in DGE, as previously mentioned).

Table 9: Wages and Effort

		Mean	Std. Error	Median	Observations
Wage	SGE	40.42	(1.595)	30	512
	Wage-SGE	42.59	(1.688)	25	256
	Effort-SGE	41.68	(1.699)	25	256
	DGE	54.773	(1.684)	50	128
Effort	SGE	27.305	(1.474)	10	512
	Wage-SGE	18.84	(1.209)	5	256
	Effort-SGE	23.805	(1.459)	8	256
	DGE	34.156	(1.699)	20	128

Note: Minimum = 0 and Maximum = 100 for all of the above.

Table 10: Treatment Effects

	(1) Wage	(2) Effort	(3) Wage	(4) Effort
Full SGE	-22.10***	-4.352	-21.83***	-7.266
	(6.362)	(6.070)	(7.262)	(7.167)
Wage SGE	-26.23***	-23.55***	-27.89***	-32.16***
	(9.816)	(7.269)	(10.25)	(8.587)
Effort SGE	-21.77**	-13.06*	-19.60*	-16.83**
	(9.379)	(7.618)	(10.25)	(7.936)
Wage		0.640***		0.690***
		(0.0605)		(0.0665)
Constant	12.94	18.09	18.48	20.06
	(27.92)	(16.39)	(32.07)	(18.40)
Observations	1152	1152	999	990
Dem Controls	Yes	Yes	Yes	Yes
Risk Pref	No	No	Yes	Yes

Standard errors in parentheses

Base case is DGE

Tobit regressions with lower limit equal to 0 and upper limit equal to 100

Tobit estimated sigma not included

Robust standard errors clustered at the subject level

Some subjects dropped from Models 3 and 4 because of irrational HL preferences

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

From Table 9, we can see that Wage levels are roughly the same across all treatments with some risk, ranging from 41.68 on average in Effort-SGE to 42.59 on average in Wage-SGE, with SGE in the middle at 40.42. None of this variation is statistically significant (Mann-Whitney $p > 0.10$ in each case). There is, however, significant variation in mean Effort across treatments with risk. Effort is lower on average in both Wage-SGE and Effort-SGE than in SGE (Mann-Whitney $p < 0.01$ for Wage-SGE vs SGE; Mann-Whitney $p < 0.05$ for Effort-SGE vs SGE). However, effort is not significantly different between Wage-SGE and Effort-SGE (Mann-Whitney $p > 0.10$). These differences in Effort levels are also present in the entirety of the Effort distribution. Figures 6 and 7 display CDFs for Effort between SGE and Wage-SGE and Effort-SGE, respectively. Both are significantly different in the direction of lower overall effort in both Effort-SGE and Wage-SGE.

Table 11 explores the extent to which these asymmetric endowments lead to differences in Effort responses. In Table 11, Stochastic Wage is a dummy variable that indicates whether the Wage was stochastic, as in SGE and Wage-SGE. Stochastic Effort is defined analogously (i.e. it is equal to one for SGE and Effort-SGE and equal to zero otherwise). Asymmetric Endowment is a dummy variable that indicates whether the endowments (tokens or ECU) were asymmetric between the Firm and the Employee. It is thus equal to one for treatments Wage-SGE and Effort-SGE and zero otherwise. From Table 11 we can see that having either a stochastic wage or effort itself has no effect on Effort. However, having asymmetric endowments between the Firm and Employee reduces Effort by between 16.13 (without controlling for risk preferences) and 20.86 (controlling for risk preferences) token-equivalent units.

Taking these results together, we say that Effort is lower in Wage-SGE and Effort-SGE than in SGE.

Taken together, the analysis above gives us our next results:

Result 5 *The source of risk does not matter for Wages and Effort:*

- *Wages are lower in SGE, Wage-SGE, and Effort-SGE relative to DGE, equally and regardless of the source of risk*

- *Effort levels are equally lower in both Wage-SGE and Effort-SGE relative to DGE*

Result 6 *Asymmetries in risk matter for reciprocal Effort:*

Table 11: Risk Determinants of Effort

	(1) Effort	(2) Effort
Wage	0.640***	0.690***
	(0.0605)	(0.0665)
Stochastic Wage	-7.422	-11.30*
	(5.884)	(6.661)
Stochastic Effort	3.070	4.031
	(5.052)	(5.664)
Asymmetric Endowment	-16.13***	-20.86***
	(5.169)	(5.756)
Constant	18.09	20.06
	(16.39)	(18.40)
Observations	1152	990
Dem Controls	Yes	Yes
Risk Pref	No	Yes

Standard errors in parentheses

Tobit regressions with lower limit equal to 0 and upper limit equal to 100

Tobit estimated sigma not included

Robust standard errors clustered at the subject level

Some subjects dropped from Model 2 because of irrational HL preferences

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

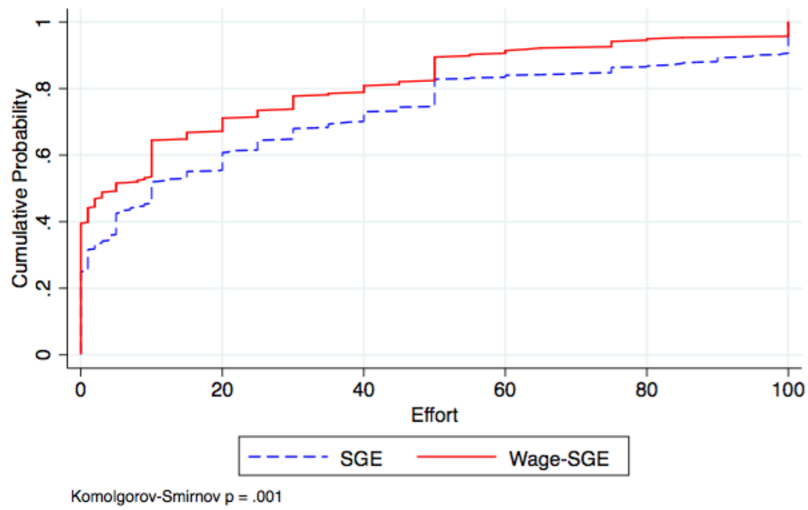

Figure 6: Effort CDF: Wage-SGE and SGE

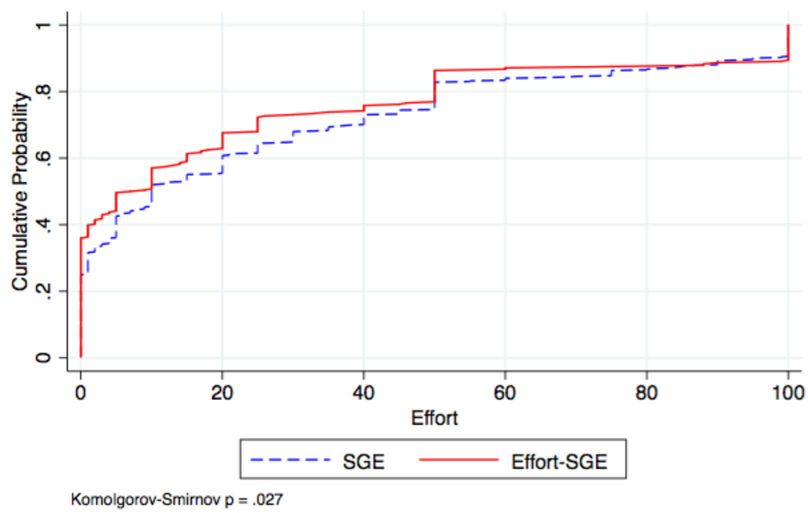

Figure 7: Effort CDF: Effort-SGE and SGE

- *Effort levels are lower in the presence of asymmetric endowments (i.e. in Wage-SGE and Effort-SGE)*

3 Discussion

In the above we have shown that i) gift exchange exists in environments with risk; ii) there are significant differences in Wages and Effort offered in environments with risk relative to those with none; and iii) the *source* of risk does not affect reciprocity, but the *asymmetry* of risk in the form of endowments does. Our results have implications for both how scholars should interpret laboratory findings regarding reciprocity and how these results should feed into the development of new theories of social preferences under risk. We turn to each of these implications in turn in the following subsections.

3.1 On Gift Exchange With Risk

To our knowledge, no leading model of reciprocity, including Falk and Fischbacher (2006), Bolton and Ockenfels (2000), and Cox et al. (2007), predicts reciprocity in SGE. This is partly due to the reliance of these models on reciprocity coming from two channels: reciprocal intentions and outcome. We interpret "reciprocity regarding outcome" as *ex-post* reciprocity. Due to the asymmetrical nature of the ex-post allocation and the nature of transfers in SGE, we have effectively shut down this channel for reciprocal motives: subjects have no way to either offer wages or effort to affect the ex-post outcome *for sure*. Another way of stating this is that trade from one player to another can only increase the probability of an ex-post unfair outcome (i.e. one player winning $20 and the other player winning nothing). As such, models of reciprocity based *exclusively* on the ex-post allocation will predict no trade in our environment.

Reliance on the ex-post allocation alone is a modelling issue that had previously been identified in the gift exchange body of literature. As such, Falk and Fischbacher (2006) and related models include measures of the "intentionality" of a gift, such that a recipient can identity and reward "good intentions" that do not necessarily positively affect the ex-post allocation. We have also shut down this channel as a meaningful source of variation between SGE and DGE. A gift of a positive number of tokens in SGE can be nothing other than fully intentional, exclusively meant to increase the expected payoff of the recipient. One might expect then that Falk and Fischbacher (2006) or related models may predict positive gift exchange in SGE. However, the psychological game presented in Falk and Fischbacher (2006) is not easily modified to include risk regarding the allocation, since it already includes an ad-hoc notion of risk regarding the intentions of the players through the use of higher-order beliefs. An expected utility treatment of this model to generate predictions for SGE does not generate our results.

As such, similar to the lesson of Brock et al. (2013), we view a contribution of this work as identifying a need for further generalizations of extant theories of reciprocity to include a notion of "ex-ante" reciprocal concerns. A treatment of such concerns as merely "positive intentions" as would be required in Falk and Fischbacher (2006) is not sufficient to explain both i) positive Wages in SGE and ii) sensitivity of Effort to Wages in SGE. Moreover, reliance on ex-ante reciprocity alone would not be sufficient, exemplified by the endowment effects we document across our Wage-SGE and Effort-SGE treatments relative to SGE. We agree with the argument of Brock et al. (2013) that a proper model of social preferences under risk must accommodate *both* ex-ante and ex-post concerns. One may think that a reasonable first pass would be to take an approach similar to that taken in Saito (2013) for social preferences under risk. We propose such an approach in Subsection 3.3.

3.2 Bridging the Lab to Field Reciprocity Gap

There has been mixed evidence on the external validity of lab results from gift exchange experiments. While gift giving in the field increases charitable donations (see Falk (2007)) and leads to better service (as measured by time spent with patient and politeness) and fewer unnecessary antibiotic prescriptions by doctors (see Currie et al. (2013)), it does not affect worker productivity (see Gneezy and List (2006)).

Our results provide an explanation for these seemingly puzzling results from the field. In all of these field experiments, the initial gift is deterministic. However, returns to effort vary across different field experiments in terms of their riskiness. Donating to charity, providing better service, not prescribing unnecessary antibiotics, or working overtime represent deterministic effort on the part of the worker, but worker productivity is risky.

In Falk (2007) and Currie et al. (2013), the receiver provides a deterministic response. In that regard, their environments are similar to DGE and consistent with the standard lab results of gift exchange: deterministic gift giving leads to deterministic reciprocal responses. On the other hand, worker productivity is not deterministic in Gneezy and List (2006), so the typical lab experiment is not the right comparison; instead our Effort-SGE treatment is the right lab counterpart since gift is deterministic but the returns on effort is stochastic. We show in our Effort-SGE treatment that, conditional on giving a deterministic gift, effort levels are lower when the returns to effort are subject to risk. This is inline with field experiments where the return on effort is stochastic. Interestingly, in the field experiment of DellaVigna et al. (2019), workers exhibit both stochastic effort (productivity) and deterministic effort (willingness to work overtime) in response to a deterministic gift. Again in line with our lab findings, they find the deterministic gift has an effect only when the effort is deterministic.

3.3 On Ex-Ante vs Ex-Post Reciprocity

We have seen in the Wage-SGE and Effort-SGE treatments that Employee subjects prefer to keep more of their endowment when they are endowed with ECU, conditional on the size of the Wage offered. For example, in Wage-SGE when a subject is given tokens but can only respond with ECU, they give less than when they can respond with tokens in kind. The analogous is true for Effort-SGE. What we've identified is a form of the endowment effect wherein subjects prefer to keep what they already own. However, notice that tokens and ECU are effectively the same good: both tokens and ECU represent lotteries over monetary prizes, with ECU merely being degenerate versions of tokens with the same expected value.

What is different between a token and an ECU is that the former can affect ex-ante allocations only, while the latter can affect both the expected payment and the ex-post allocation with probability one. In our view, we are thus documenting an endowment effect with regards to ex-ante vs ex-post *reciprocity motives* rather than strict *goods*. Consider a gift of 1 token from Firm to Employee in Wage-SGE. The Firm has increased the expected payoff of the Employee, but has not affected the set of feasible ex-post allocations. When the Employee can only respond by using ECU, they are forced to compensate *ex-ante* giving with *ex-post* giving. The reverse is true in Effort-SGE. Because we see that Effort levels in both Wage-SGE and Effort-SGE are lower than SGE, but not Wages, we argue that Employee subjects are biased toward their own endowments. Such behavior is not consistent with current interpretations of the interplay between ex-ante and ex-post motives in analogous static environments (i.e., in the literature on fairness with risk).[14]

As we mentioned in the Introduction, one might assume that the Expected Inequality Aversion (EIA) model of Saito (2013) could admit our results. In this model, decision makers maximize a value function that is a weighted sum of *ex-ante* fairness motives and *ex-post* fairness motives. This value function is given by the following:

$$V(p) = \delta U[E_p(x)] + (1-\delta)E_p[U(x)] \tag{4}$$

where $E_p(\cdot)$ is the expected value according to some lottery p, $U(\cdot)$ is an inequality aversion utility function of Fehr and Schmidt (1999), and $\delta \in [0,1]$ is a measure of the strength of the ex-ante fairness motive of the decision maker. An extension into sequential settings might substitute the Fehr and Schmidt (1999) $U(x)$ in the above with a utility function capable of explaning reciprocity (e.g. Cox et al. (2007)). Ex-ante motives are described by a preference for equality *in expectation*, given by $U[E_p(x)]$ above. Ex-post motives are described by the standard inequality averse utility function extended to the expected utility case, given by $E_p[U(x)]$. Any model that combines ex-ante and ex-post motives in this way will imply that actions taken taken to affect the ex-ante portion of the decision maker's value function can be directly compensated with commensurate actions to affect the ex-post portion: for any change Δ in $U[E_p(x)]$, a change of $\Delta' = \frac{\delta}{(1-\delta)}\Delta$ in $E_p[U(x)]$ will have the same effect on $V(p)$.

This implication is not borne out in our data. While Wages remain constant across SGE, Wage-SGE, and Effort-SGE, Effort levels are systematically lower in the latter two. This cannot be explained by any model that relies on ex-ante and ex-post motives being separable. Lower Effort in Wage-SGE relative to SGE can only mean that Employee subjects believe that fewer ECU are required to compensate for a given gift of tokens (i.e. Wages in SGE and Wage-SGE). This would imply a particular rate of exchange between ex-ante and ex-post motives. However, since Wages are also equal across SGE and Effort-SGE, this rate of exchange should then imply *higher* Effort in Effort-SGE, since the Wage now affects ex-post motives in the form of ECU. This is not the case

[14] We would like to note that this behavior is also not consistent with subjects simply viewing tokens as less valuable than ECUs of the same expected value, perhaps due to risk aversion left unmeasured by the Holt and Laury (2002) tasks. If this were true, we may expect that Effort is lower in Wage-SGE than in SGE, since Employees have to respond with higher-valued ECU in response to lower-valued tokens. But, we would then expect Effort to be *higher* in Effort-SGE than in SGE, conditional on the size of the gift. Figure 7 shows that this is clearly not the case.

in our data, where we find lower Effort levels in Effort-SGE relative to SGE. The result is a form of the endowment effect, not on the good that makes up the endowment, but on which motive, ex-ante or ex-post, the endowment is capable of affecting. When endowed with the ability to affect only the ex-ante allocation, as in SGE and Effort-SGE, Employee subjects seem to care more about giving in expectation. When endowed with the ability to affect the ex-post allocation, as in Wage-SGE, they seem to care more about giving in terms of the final allocation.

A simple modification to EIA might correct this insufficiency. Consider the following value function:

$$\hat{V}(p) = \mu \hat{U}[E_p(x)] + \eta E_p[\hat{U}(x)] \tag{5}$$

where E_p is as above, $\hat{U}(x)$ is the utility function of Cox et al. (2007), and $\mu, \eta \in [0, 1]$ are subject to the following restrictions:

$$\mu + \eta = 1 \tag{6}$$

$$\mu > \eta, \qquad \text{if } w \text{ is a non-degenerate lottery} \tag{7}$$

$$\mu < \eta, \qquad \text{otherwise} \tag{8}$$

where $w \in \mathcal{L}$ is the endowment of the decision-maker, an element of the set of lotteries over monetary outcomes, $\mathcal{L}$.

In contrast to EIA, the relative preference for ex-ante and ex-post reciprocity contained in $\hat{V}$ is now determined by two parameters. μ describes the strength of the the ex-ante preference and η describes the strength of the ex-post preference. Here, preferences are dependent on the endowment in that the form of the endowment w (i.e. whether w is a degenerate lottery or not) determines the relative size of μ and η. Such preferences would then be consistent with the endowment effect that we observe in our laboratory results.

One could also consider a model of loss aversion a la Tversky and Kahneman (1991), modified to consider "ex-ante" vs "ex-post" domains instead of the traditional "gain/loss" framework. Similarly, models incorporating status quo bias, such as Masatlioglu and Ok (2005) or Dean et al. (2017), could be extended into the an ex-ante/ex-post framework. These theoretical questions are beyond the scope of the current work, but we view them as fodder for interesting further exploration.

4 Conclusion

We experimentally investigate the Stochastic Gift Exchange game to show that i) ex-ante reciprocity exists, ii) Wages are lower when any element of risk, and iii) ex-ante and ex-post reciprocal concerns are not directly substitutable. These results, in particular our results on Effort provision being lower in response to stochastic Wages, conditional on Effort being stochastic, may help to guide policy in compensations schemes. For example, since Effort levels are equal across SGE and Effort-SGE in our experiment, this may suggest that if Effort is risky some some field setting (e.g. managerial or CEO effort in a large firm) the principal may want to offer deterministic gifts rather than risky ones. This effect would be compounded in the field by any risk aversion on the part of the principal. Further study of these and related issues would be necessary to document to what extent our results extend to environments where the principal has a choice between risky and deterministic gifts.

Finally, considering the fact that our results provide a bridge between laboratory and field gift exchange, it would be worthwhile to further study the effects of risk in gift exchange in the field. To our knowledge, no previous studies of gift exchange in the field experimentally varied the amount of risk involved in either the gift or effort provision. We view this as an important extension of the current work.

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Appendix A Instructions

A.1 Part 1: SGE

Thank you for participating in the experiment today. At this time, please be sure that your cell phone is turned off. At no point during this experiment are you allowed to use your cell phone or any other electronic device. You are also not permitted to speak with any other participant in the room. Failure to follow these rules may result in your expulsion from the experiment and forfeiture of any cash earnings you may have otherwise received.

The experiment today is broken into 2 parts. Part 2 is divided into several sub-parts. Your earnings for these parts are independent. These are the instructions for Part 1.

At the end of the experiment, you will receive the sum of the earnings from all parts of this experiment and the $7.00 show up fee. You will receive this amount privately in cash before you leave the lab today.

Part 1

This is an experiment on decision-making. You will be assigned one of two roles: Person 1 and Person 2. Your role will remain fixed throughout the experiment. As there are 16 participants in the lab today, 8 of you will be assigned to be Person 1 and 8 of you will be assigned to be Person 2, with decisions in the experiment being made in pairs.

In each of 8 periods, you will be matched with another participant of the opposite role. This matching will occur so that you will never participate with the same person more than once. You will never learn the identity of the other participant with whom you are matched.

The Decision Environment

In each period, decisions are made in two stages: Stage 1 in which Person 1 makes a decision and Stage 2 in which Person 2 makes a decision. In each period, each Person starts out with 100 tokens. These tokens are virtual and do not have any monetary value directly. You will decide whether to give any of your tokens to the person with whom you are matched and your earnings will depend on the number of tokens you each hold at the end of Stage 2.

Stage 1: In Stage 1, only Person 1 will make a decision. Person 1 will be told how many tokens he/she currently holds (100) and will be asked how many tokens he/she would like to give to his/her Person 2. Person 1 may give anywhere from 0 to 100 tokens to Person 2.

Stage 2: In Stage 2, only Person 2 will make a decision. Person 2 will be told i) how many tokens Person 1 has given them, ii) how many tokens this transfer has become (explained in detail below), and iii) how many new tokens he/she has (100) to give to Person 1. Person 2 will also be asked how many of his/her tokens he/she would like to give to Person 1. Person 2 may give anywhere from 0 to 100 tokens to Person 1.

On Tokens: When tokens are given from one Person to another, they are multiplied by 5. That is, if Person 1 gives X tokens to Person 2, Person 2 will receive 5X tokens. If Person 2 then gives Y tokens to Person 1, Person 1 will receive 5Y tokens. At the end of Stage 2, the number of total tokens held by each Person in the pair will be as follows:

Person 1's Tokens = 100 - tokens given to Person 2 + 5 (tokens given by Person 2)

Person 2's Tokens = 100 - tokens given to Person 1 + 5 (tokens given by Person 1)

Earnings

Earnings in each period are determined by a lottery that depends on the number of tokens held by each Person in the pair. The prize for winning this lottery is $20. There is only one prize to be won in this lottery, so that there are only three potential outcomes: 1) Person 1 wins the lottery, 2) Person 2 wins the lottery, and 3) neither Person 1 nor Person 2 wins the lottery.

The lottery works as follows: out of 1000 tokens (in each pair of participants), one token is the "winning token." Whoever holds this winning token wins the prize of $20. Thus, the more tokens you have at the end of Stage 2, the more likely you are to win the lottery.

At the end of Stage 2 if Person 1 holds the winning token, Person 1 wins the prize of $20. If Person 2 holds the winning token, Person 2 wins the prize of $20. If neither holds the winning token, no one wins the prize of $20.

Though you will make decisions in each of 8 periods, only 1 period will count toward your earnings for this part of the experiment. This period will be chosen at random at the end of the experiment. When making decisions, you will not know which period will be chosen.

Summary

The following is a summary of how the experiment works in each round:

- You are assigned a role as either Person 1 or Person 2 (this is the same for all rounds)
- There are 1000 tokens, one of which is the "winning token". Whoever holds this token at the end of the round wins $20 in that round
- Stage 1: Person 1 is given 100 tokens and can give any amount from 0 to 100 to Person 2. Person 2 then receives 5 times this number of tokens
- Stage 2: Person 2 receives 5 times the number of tokens given by Person 1 and 100 additional tokens. Person 2 can give any amount from 0 to 100 to Person 1. Person 1 will then receive 5 times this number of tokens
- The lottery is then resolved - whoever owns the "winning token" is wins the prize of $20 for that period. You are told a) whether anyone in your group won the lottery and b) whether you won the lottery.
- At the end of 8 periods, one is selected at random and you will be paid for that period.

A.2 Part 2: DGE

These are the instructions for Part 2. This is an experiment on decision-making. You will be assigned the same role as you had from Part 1 of this experiment.

You will be matched with another participant of the opposite role for just one period.

Part 2

Decisions are made in two stages: Stage 1 in which Person 1 makes a decision and Stage 2 in which Person 2 makes a decision. Each person starts out with 100 tokens. These tokens are virtual. You will decide whether to give any of your tokens to the person with whom you are matched and your earnings will depend on the number of tokens you hold at the end of Stage 2.

Stage 1: In Stage 1, only Person 1 will make a decision. Person 1 will be told how many tokens he/she currently holds (100) and will be asked how many tokens he/she would like to give to Person 2. Person 1 may give anywhere from 0 to 100 tokens to Person 2.

Stage 2: In Stage 2, only Person 2 will make a decision. Person 2 will be told i) how many tokens Person 1 has given them, ii) how many tokens this transfer has become (explained in detail below), and iii) how many new tokens he/she has (100) to give to Person 1. Person 2 will also be asked how many of his/her tokens he/she would like to give to Person 1. Person 2 may give anywhere from 0 to 100 tokens to Person 1.

On Tokens: When tokens are given from one person to another, they are multiplied by 5. That is, if Person 1 gives X tokens to Person 2, Person 2 will receive 5X tokens. If Person 2 then gives Y tokens to Person 1, Person 1 will receive 5Y tokens. At the end of Stage 2, the number of total tokens held by each person in the pair will be as follows:

Person 1's Tokens = 100 (tokens) - tokens given to Person 2 + 5 (tokens given by Person 2)

Person 2's Tokens = 100 (tokens) - tokens given to Person 1 + 5 (tokens given by Person 1)

Earnings

In contrast to Part 1 of this experiment, the tokens you have at the end of stage 2 will be converted to cash directly. The exchange rate will be as follows: 50 tokens = $1 USD.

A.3 Part 3: Self HL

These are the instructions for Part 3.

This is an experiment on decision-making. You will be faced with a number of options to select. You will be asked to select one from each row of displayed options.

The Decision Environment

In this portion of the experiment you will make 10 decisions. Each decision will be between two options: Option A and Option B . You will make these 10 decisions, but only one of them will be used in the end to determine your earnings. The screenshot below displays what you will see for each of these decisions.

A virtual 10-sided die will be used to determine your earnings. Imagine this die having 10 faces, labelled with the numbers "1" through "10". When rolled, each number 1-10 can occur with equal chances. The virtual die will be rolled twice: once to determine which of your decisions to use and once to determine your earnings for the option you choose from Option A and Option B for that decision. Even though you will make 10 decisions, only one of these Decisions will be used to calculate your earnings, but you will not know ahead of time which of these decisions will be used. Each decision has an equal chance of being used.

Please look at Decision 1. Option A pays $2.00 if the roll of the virtual 10-sided die is 1 and pays $1.60 if the number that is rolled is 2-10. Option B pays $3.85 if the roll is 1 and $0.10 if the roll is 2-10. The other pairs in the subsequent rows are similar, except that as you move down the table, the chances of the higher payoff for each option increase. In fact, for the last pair of options, each option pays the higher payoff for sure (so the roll of the virtual die is not needed).

In each row, you must check one checkbox selecting one of either Option A or Option B. Clicking the checkbox on the left means you are choosing Option A for that row and clicking the checkbox to the right means you are choosing Option B for that row. Thus, in total, you will have chosen 10 of these options.

Usually, when people make choices in this type of task, they start by selecting only options on one side (A or B), then switch to the other side at some point, selecting only the other option for the remainder of the rows; it is uncommon and not usually optimal for people to "switch sides" (going from Option A to Option B or vice versa) more than once.

Earnings

At the end of this part of the experiment, one row will be chosen at random and the virtual 10-sided die will be rolled for the option you have selected for that row.The earnings that result from that roll will be your earnings for this part of the experiment.

A.4 Part 4: Other HL

These are the instructions for Part 4.

This is an experiment on decision-making. You will be faced with a number of options to select. You will be asked to select one from each decision of displayed options.

The Decision Environment

The environment you face in this part of the experiment is exactly the same as what you have seen in Part 3. For reference, a screenshot of this environment is displayed below:

Period

1 of 1

Remaining time [sec]: 0

	Option A	I choose Option A	I choose Option B	Option B
Decision 1	1/10 of $2.00, 9/10 of $1.60			1/10 of $3.85, 9/10 of $0.10
Decision 2	2/10 of $2.00, 8/10 of $1.60			2/10 of $3.85, 8/10 of $0.10
Decision 3	3/10 of $2.00, 7/10 of $1.60			3/10 of $3.85, 7/10 of $0.10
Decision 4	4/10 of $2.00, 6/10 of $1.60			4/10 of $3.85, 6/10 of $0.10
Decision 5	5/10 of $2.00, 5/10 of $1.60			5/10 of $3.85, 5/10 of $0.10
Decision 6	6/10 of $2.00, 4/10 of $1.60			6/10 of $3.85, 4/10 of $0.10
Decision 7	7/10 of $2.00, 3/10 of $1.60			7/10 of $3.85, 3/10 of $0.10
Decision 8	8/10 of $2.00, 2/10 of $1.60			8/10 of $3.85, 2/10 of $0.10
Decision 9	9/10 of $2.00, 1/10 of $1.60			9/10 of $3.85, 1/10 of $0.10
Decision 10	10/10 of $2.00, 0/10 of $1.60			10/10 of $3.85, 0/10 of $0.10

OK

Again, in each decision you must check one checkbox selecting one of either Option A or Option B. Clicking the checkbox on the left means you are choosing Option A for that decision and clicking the checkbox to the right means you are choosing Option B for that decision. Thus, in total, you will have chosen 10 of these options.

Usually, when people make choices in this type of task, they start by selecting only options on one side (A or B), then switch to the other side at some point, selecting only the other option for the remainder of the decisions; it is uncommon and not usually optimal for people to “switch sides” (going from Option A to Option B or vice versa) more than once.

Earnings

Contrary to part 3 of this experiment, your choices in each decision will not affect your own earnings; you are choosing for another participant in the room. You will be randomly matched with another participant in the room. At the end of this part of the experiment, one decision will be chosen at random and the computer will resolve the lottery that you have chosen for that decision. The outcome of that lottery will be the payoff for the person you are matched with for this part of the experiment. Another participant in the room will be choosing in this part of the experiment and their choices will affect your earnings in this same way. It is not guaranteed that the person you are choosing for is also choosing for you.

At the end of the experiment, you will receive the sum of the earnings from all 5 parts of this experiment and the $7.00 show up fee. You will receive this amount privately in cash before you leave the lab today.