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Within and Across Class Envy: Anti-Social Behaviour in Hierarchical Groups

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Abstract

Models of social preferences (i.e. inequality aversion), assuming society is defined by a hierarchy based on income or wealth, predict that the poor envy the rich. Reference Group Theory predicts that the poor (rich) envy others from the same social group or class. We report results from a game designed to stimulate feelings of envy. Players are defined both by their place within an overarching hierarchy as well as by their place within the hierarchy of their specific class (i.e. their reference groups). We find that, while across class envy is common; within class envy motivates the most anti-social behaviour.

Keywords: anti-social preferences, envy, hierarchy, reference group theory
JEL Classifications: C91, D003, D6

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1. Introduction

On the list of the seven deadly sins, "… envy is the deep, often hostile resentment you feel toward somebody who has something you want … "(Angier, 2009).[2] Theoretical perspectives on envy have a long tradition spanning disciplines such as philosophy, sociology, psychology, and economics (e.g., Russell, 1930; Schoeck, 1969). Regardless of disciplinary origin, all current definitions of envy include elements of: 1) one person lacking the status or possession of another and 2) the person desiring such status or possession.

Envy is a two-sided coin (Schoeck, 1969). Envy may be a destructive force. Envy can compel the envious to actively undermine and hinder the advancement of others and thus can create a hostile work and living environment (Smith and Kim, 2007; van de Ven, Zeelenberg, and Pieters, 2009).[3] Resources are expended in unproductive, from a societal perspective, attempts to harm the envied. Envy may also be a constructive force (e.g., Grolleau et al. 2009); it can compel the envious to strive harder in hopes of attaining the status of those who are advantaged. They may increase their productivity, may try to be more creative, and may do their

[2] Envy is evidenced by the "tall poppy syndrome" which dates as far back as Herodotus' *The Histories* (Book 5, 92f), Aristotle's *Politics* (1284a), and Livy's *History of Rome*, Book I. It is the social phenomenon of resenting, attacking, or criticizing successful people because their successes elevate them above or distinguish them from their peers.

[3] Hostile envy is also referred to as envy proper (Smith and Kim, 2007).

utmost to pull themselves up to the level of the envied.[4] The focus of this paper is destructive envy (or, more broadly defined, anti-social preferences).[5]

Regardless of its destructive or constructive nature, envy is persistent and universal and plays a deep social role.[6] Envy may help explain why humans are comparatively less hierarchical than other primate species, more prone to egalitarianism and to rebelling against the ones who have more than their 'fair' share. Envy may help explain human conflicts and acts of

[4] The existence of these two qualitatively different *forms* of envy has been documented across cultures, even though some cultures have distinct and specific words to distinguish among these two types of envy (i.e., the Netherlands, Poland) while others do not (i.e., the United States, Spain) (van de Ven et al. 2009).

[5] Interdependent preferences (both pro and anti-social preferences) have been modelled in a number of ways (see, for example, Fehr and Schmidt, 1999, and Charness and Rabin, 2002 for two of the more cited variations). Bolton and Ockenfels (2000) is a third, well cited, but slightly different variation. Sobel (2005) offers a simplified overview of the different models. A player's utility is assumed to be a function of both his own material allocation and his own allocation relative to the allocation of other players. A player is hypothesized to be altruistic if his utility is diminished when his allocation exceeds the allocation of the other; a player is hypothesized to be envious if his utility is diminished when his allocation is exceeded by the allocation of the other.

[6] It is clear that people feel envy, "… a 'painful emotion' characterized by feelings of inferiority and resentment produced by an awareness of another's superior quality, achievement, or possessions (Takahashi et al., 2009, p. 937)." Takahashi et al. (2009) reports evidence that suggests that the human brain is hard wired to give us a pleasurable feeling when a misfortune befalls someone we envy. Envy is such a pervasive phenomenon that it can be seen in other social animals. Monkeys, for example, are perfectly happy to work for cucumber slices until one monkey gets a preferred treat like grapes. The others then stop working for cucumbers and nurse a grudge (Angier, 2009).

terrorism, formation of political and social structures in different societies[7], economic schemes of different countries[8], and wage patterns and employment practices in the workplace.[9]

Envy tends to occur with greater frequency when the object's domain is of interest or relevance, particularly to one's self-concept (Salovey and Rodin, 1984; Takahashi et al. 2009; Tesser and Collins, 1988). One domain that is considered important to most people involves money, and several researchers have noted a relationship between wealth disparity and envy. Gino and Pierce (2009b) documented that with the mere presence of wealth, envious feelings were provoked, which led to unethical behaviour. Additionally, artificially creating financial wealth disparities through a lottery paradigm (i.e., negative equity) is associated with envy, and this condition also results in 'hurting' behaviour directed at the wealthy (Gino and Pierce, 2009a).

While envy may be a universal trait, the question remains, whom does one envy and who is the target for any destructive acts motivated by envy? Are the sources of envy and the targets of envious acts only persons higher up in the social hierarchy or is the focus narrower. That is, is a factory worker more envious of a Warren Buffett with his vast wealth or of the co-worker who received a bigger raise than he did? Reference Group Theory argues that individuals compare

[7] Lindholm (2008) argues that cultures prone to envy "… are likely to be social formations that subscribe to an ideal of equality and an ethos of competitive individualism … [where] … the onus of defeat and inferiority rests solely on the individual… This pattern stands in contrast to collectivist hierarchical traditional social formations … where envy [is] offset by a sacralization of differences within the collective (p.240)."

[8] Brennan (1973) shows that nonaltruistic individuals support redistribution programs because they value reducing the consumption of the rich. Banerjee (1990) demonstrates how progressive income taxation can be used to correct the distortion of envy.

[9] Dur and Glazer (2003) use a principle-agent model to study profit-maximizing contracts when a worker envies his employer. Envy might explain the uniform (varying only by seniority) pay scales used by many employers.

themselves not to just anyone but rather to people who are similar in many respects, for example, come from the same social group, have similar beliefs, values, income and/or aspirations.[10] The reference group is used as a standard to evaluate oneself. Models of social preferences (i.e. inequality aversion; see, for example, Mui, 1995, Fehr and Schmidt, 1999, Bolton and Ockenfels, 2000, and Charness and Rabin, 2002) predict that the poor envy the rich; Reference Group Theory predicts that the poor (rich) envy others from the same social group or class.

In this paper we report results from a game designed to stimulate destructive envy. The distinguishing feature of our game is that players are not just defined by their place within a simple hierarchy defined by endowments. Our players are randomly allocated to one of two types (rich or poor); the rich have larger per period endowments and higher expected returns from investing than do the poor. Thus players are defined both by their place within an overarching hierarchy, defined by cumulative earnings, and by their place within the hierarchy of their specific type. Players have two potential reference groups: all players and players of the same type. Players play in groups of ten and a player that decides to act on his envious feelings can select any one of the other nine players as the focus of this action.[11] Our design addresses

[10] The idea that subjective well-being depends on relative income is well supported in the literature (see, for example, Clark and Oswald, 1996, Watson et al, 1996, Luttmer, 2005, and Kingdon and Knight, 2007). Reference Group Theory has been applied to a variety of different economic questions (see for example, Knudsen, 2008, Leguizamon, 2010, Mangyo and Park, 2011, and Drago and Galbiati, 2012). There is considerable evidence that suggests social distance matters for pro-social behaviour (see, for example, Hoffman et al., 1996 and Charness and Gneezy, 2007). Social distance may also matter for anti-social behaviour.

[11] A feature of many games is that players do not choose who will be the focus of their actions. Play is in fixed pairs or in groups and, if in groups, any action may have an impact (not necessarily equally) on all members of the group. Players may only select their primary targets.

the question: what motivates envious acts, the vast differences in income or wealth between classes or the relatively minor differences in income or wealth within a class. It offers a direct test of hypotheses from models of inequality aversion and hypotheses derived from Reference Group Theory.

2. Literature review

2.1 Models of Social Preferences

A number of authors advance models that incorporate both pro and anti-social preferences.[12] A common feature of the more general models is what has been labelled, inequity aversion. Models by Fehr and Schmidt (1999) and Charness and Rabin (2002) assume that an individual derives positive utility for her own payoff and negative utility from the difference between her payoff and the payoff of other individuals. Both sets of authors also assume that the individual's utility loss when her payoff is less than the payoffs of others is greater than the utility loss when her payoff is greater than the payoffs of others. Assuming just two individuals, i and j, the utility function of individual i would be written as:

$$U_i(x) = x_i - \alpha_i \max(x_j - x_i, 0) - \beta_i \max(x_i - x_j, 0), \text{ with } \beta_i \leq \alpha_i \text{ and } 0 \leq \beta_i < 1. \quad (1)$$

In the model offered by Bolton and Ockenfels (2000), individual i's utility is a positive function of both i's own payoff and individual i's relative payoff ($x_i / \sum_{j=1}^{N} x_j$). The utility function of individual i would be written as:

$$U_i(x) = \alpha_i x_i - \beta_i/2 \left(\frac{x_i}{\sum_{j=1}^{2} x_j} - 1/2\right)^2, \text{ with } \alpha_i \geq 0 \text{ and } \beta_i > 0. \quad (2)$$

If i cares only about her own self-interest, then $\alpha_i/\beta_i \rightarrow \infty$, and if individual i cares only about her relative payoff then $\alpha_i/\beta_i = 0$.

[12] Sobel (2005) provides an overview of models that incorporate both pro and anti-social preferences.

Mui (1995) presents a model that focuses on the anti-social preference of envy and the sabotage of another's well-being that envy can lead to. He assumes the people compare their own well-being to that of others. If individual i's well-being lags behind that of individual j's (i.e. $x_i < x_j$), then individual i will be envious of individual j and may attempt to sabotage player j (at a cost) in an attempt to restore equity (i.e. $x_i = x_j$). A reduction in individual j's well-being enters positively into individual i's utility function (as long as $x_i < x_j$).[13]

All of the social preference models discussed assume social preferences are defined completely along one dimension, x. An individual's reference group is the whole group, independent of x_i, rather than any particular subset of the whole. The models predict that the greater is the difference $x_j - x_i$, the more envious individual i will feel towards individual j and, other things equal, the greater is the probability that individual i will act on those envious feelings.[14] Using our earlier example, this implies that the factory worker will be more envious of Warren Buffett and his wealth than of his co-worker who received the bigger raise.

Reference Group Theory assumes that individuals compare themselves to others from the same social group or income level. An individual's reference group is not the whole group, but rather a particular subset of the whole; those with similar x_is. The reference group hypothesis predicts that the parameter β_i in equations 1 and 2 should decline (beyond some point) as the difference $x_j - x_i$ increases. Envious feelings of individual i towards individual j and the probability that individual i will act on his/her envious feelings will decline as the difference $x_j - x_i$ increases. Again, using our earlier example, this implies that the factory worker consider

[13] Mui also incorporates an authority that may be able, with probability < 1, to detect sabotage and punish the instigator.

[14] Alternatively, the greater is the difference $x_i - x_,$, the more altruistic individual i will feel towards individual j and the greater is the probability that individual i will act on those altruistic feelings.

Warren Buffett and his wealth largely irrelevant but will be envious of his co-worker's bigger raise.

2.1 Evidence of Anti-Social Preferences

Evidence of anti-social preferences (i.e. envy, jealousy, or spite) is widely available. The Power-To-Take Game is a two-person, two stage game (Bosman and van Winden, 2002). Players earn income in an pre-game, unrelated activity. In the game's first stage, player A decides what percentage of player B's earnings, after stage two, he will take. In stage two, this information is revealed to player B. Player B can then choose to destroy none, some, or all of her earnings, thereby reducing the amount going to A. Bosman and van Winden (2002) report that the mean take rate is 58.5% and 21% of the B players destroyed income (with almost all destroying 99 or 100%). The probability of destroying income was positively correlated with the take rate. Bosman et al. (2006) compare individual and group decisions in the game. They find similar behaviour; take rates for individuals and groups are 58.5% and 60%, destruction rates are 18.7% and 20.8%, respectively. Albert and Mertins (2008) add some extra twists to the game. They have two takers and one respondent. In one treatment, the responder has no say in the determination of the take rate. In the second treatment, the take rate is a weighted average of the proposals of the two takers and the proposal of either the respondent or a computerized dummy. The respondent and dummy's proposals are given either low or high weight. The findings are consistent with earlier studies; destruction rates are positively correlated with take rates. Destruction rates are also higher when the respondent has no say in the take rate.

In Zizzo and Oswald's (2001) Money Burning Game a wealth distribution is created in a prior activity. Additional money is provided to a randomly chosen subset of players and this information is public knowledge. In the burning stage, players can pay to burn (eliminate) other

player's money; the price of doing so varies. Zizzo and Oswald find significant evidence of money burning: two-thirds of the players burned other players' money and burning does not decline much as the price of burning increases. The pattern of burning indicates that players who do not receive additional money were more likely to burn their advantaged fellow players. In the Zizzo and Oswald (2001) game, everybody can burn everybody else. As such, the decision to burn money is conditioned on the expectation of money burning by others. Zizzo (2003) amends the game design. He allows all subjects to make money burning choices but the choice of only one player, chosen at random, is actually implemented. The removal of the ability to retaliate against expected burning by others reduces the level of money burning but does not eliminate it. Zizzo also finds a stronger price effect: burning decreases as the price of burning rises.

In the Joy-of-Destruction Game, two paired players simultaneously decide how much of the other player's endowment to destroy (Abbink and Sadrieh, 2009). In one treatment the players have full information; in the second, their destruction decisions are hidden behind random destruction. The game is played over eight rounds.[15] They find that the frequency of destruction in the full information treatment is low (averaging 8.5% of all decisions) and declines to zero in the later rounds.[16] In the random destruction treatment, the frequency of destruction is almost 40% and is very stable across rounds. Abbink and Herrmann (2011) report results for a one-shot Joy-of-Destruction game. This eliminates the fear of retaliation that might affect players in a multi-period game. The frequency of destruction is 10% in the full information treatment and 26% in the random destruction treatment.

[15] Matched pairs of players are fixed for all rounds.

[16] There is an end period jump in the frequency of destruction in both treatments.

Beckman et al. (2002) measure the role of positional bias, including envy and malice in a social choice context concerning Pareto optimality with subjects drawn from the United States, Russia, China, and Taiwan. They find that: (a) when income positions are known in an income allocation, a Pareto improving income allocation faces opposing votes if it does not benefit everybody: non-beneficiaries oppose Pareto improvements especially when the recipient is in a relatively high income position; (b) the opposition is significantly stronger in China and Russia; (c) opposition against non-egalitarian Pareto improvements decreases even in China and Russia when subjects other than the main recipient (who receives a larger piece of the pie) are also given a small share; and (d) when income positions are not known, the opposition decreases significantly because envy and malice are not given play (in this case, opposition only represents impersonal equality concerns).

Saijo and Nakamura (1995) and Cason et al. (2002) report evidence of spiteful behaviour in public goods games. Saijo and Nakamura increase the marginal return sufficiently to make the dominant strategy full contribution. They report contributions less than the equilibrium level which they ascribe to "spiteful" behaviour. They argue that "…spiteful subjects care primarily about the ranking among subjects… (p. 537)." Cason et al. have their subjects play a two-stage game. In stage one, players (in a two-person group) simultaneously announce to their fellow player whether or not they will participate in funding the public good. In stage two, those who indicated they would participate choose their contribution levels (which may be zero). They report that American subjects who choose to participate when their partners did not still contributed amounts consistent with the Nash equilibrium prediction; the Japanese subjects were more likely to be spiteful (in the earlier periods) and contribute less than the Nash equilibrium prediction, punishing their partners.

In all of these studies, players are defined along one hierarchical dimension; a player has a larger or smaller endowment than the other player(s) and a player's reference group is assumed to be all other players. An additional feature of these games is that players have limited choices as to who will be the focus of their actions. Play is typically in fixed pairs. If play is in groups, any action taken has an impact (not necessarily equally) on all members of the group. It may not possible to determine who the primary target was.

3. The Experiment

Sixteen, ten-player sessions were conducted in the Saint Cloud State University Economics Research and Teaching Laboratory. Players are recruited by email and posters to participate in a three-part experiment and participation is on a first-come, first-served basis.[17] Players are randomly assigned to partitioned computer stations. No player participates in more than one session. There is no show-up fee. Players are instructed not to communicate with one another. General instructions are read aloud with experiment specific instructions provided on-line. Sessions last between 90 and 120 minutes.

Players are instructed to log onto the experiment site. After doing so, the program randomly allocates each player an ID number (1 – 10) and a type (A or B). Game instructions (for periods 1 – 30) are then provided (for both As and Bs) and players read them at their own

[17] The email list is comprised of persons who have expressed an interest in participating by e-mailing a sign-up e-mail address after being informed of the opportunity in large lecture classes. Posters are placed around campus and in dormitories. We attempt to run gender balanced sessions (i.e. the notices indicated that the first five men and five women will participate) but women did not volunteer as frequently as did men. If less than five women show, after waiting a reasonable length of time, a session is filled with the surplus men. Of the 160 players, 104 (65.6%) were male and 59 (36.9%) were Caucasian.

speed.[18] Players are informed that after 30 periods the game will change and that new instructions will be provided. Once all players have finished reading the instructions they play a practice period. Players are again given the opportunity to ask any questions. Players then begin play.[19]

For the first 30 periods, players play a repeated play investment/savings game with their earnings from each period accumulating. For these 30 periods, players can either invest or save their endowments. Type A players are provided with a $0.30 endowment in each period; Type B players are provided with a $0.15 endowment in each period. If either type player saves their endowments, that amount is added to their accumulated earnings account. Alternatively, players can invest their endowments. For both player types, the probability that their investment will have a positive payoff is 50%. Type A players have a net gain of $0.30 (for a total period earnings of $0.60) if their investments are successful and a net loss of $0.15 (for a total period earnings of $0.15) if their investments are unsuccessful; Type B players have a net gain of $0.11 (for a total period earnings of $0.26) if their investments are successful and a net loss of $0.05 (for a total period earnings of $0.10) if their investments are unsuccessful. The expected earnings per period is $0.375 (a 25% expected rate of return) for Type A players and $0.18 (a 20% expected rate of return) for Type B players. The different endowments and expected investment payoffs are intended to create an obvious and significant gap between the cumulative earnings of the As and Bs before the second stage of the experiment.

If players choose to invest their endowments, they determine their payoffs by selecting from one of ten playing cards arrayed on their computer screen. Five of the cards have a W on

[18] Players are informed that if they have any questions to raise their hands and an experimenter will come and answer their question(s) privately.

[19] Players made decisions at their own speed but the slowest player determined when the next period would begin.

their backs, indicating a positive payoff for the investments, and five have an X on their backs, indicating a negative payoff for the investments. The players select one of the cards and that card is turned over. Subsequently the remaining nine cards are turned over too.

At the end of each period 1 – 30, players are provided a summary of their and every other players' earnings for that period and their and every other players' cumulative earnings through that period (see the lower part of Table 1 for a sample). This periodic reinforcement of this steadily growing gap in cumulative earnings was intended to prime the players' envious feelings.

After period 30, players are provided new on-line instructions. As before, players read them at their own speed and are told to raise a hand if they had any questions. The endowments, investment and savings features all remained the same, but players are now permitted to spend \$0.05 to do harm to another player of their choice and players are permitted to spend \$0.05 to insure themselves against harm by another player. If, for example, player 1 pays to harm player 2 and player 2 had not paid to insure himself against harm, then player 2 loses \$0.20; if player 2 has purchased insurance, he loses nothing. A player can attack only one player per period (but more than one player can attack a given player) and insurance protects a player against all attacks in a given period. It is important to note that attacks are anonymous; the player attacked is not informed of the identity of his attacker(s). Finally, the \$0.05 paid to attack another and/or the \$0.05 paid for insurance reduces either the amount saved or the amount invested.[20] Table 2 details the earnings per period depending on the saving/investing choice, the decision to attack another, the decision to purchase insurance, and whether or not one is attacked. The second part of the session lasts for 60 periods.

[20] In this paper our focus is on the characteristics of those targeted for attacks. A separate paper addresses the issue of the characteristics of the attacker and the issue of insurance buying (see Grossman and Komai, 2012).

At the end of each period 31 – 90, players are provided a summary of their choices and outcomes as well as every other players' earnings for that period and their and every other players' cumulative earnings through that period (see Table 1 for a sample).

4. Results – Periods 1 – 30

We only briefly discuss the results from the first 30 periods. This part of the experiment is intended to create and reinforce the differences between the Type A and Type B players. In these periods players can only save and invest. On average players invest 85.1% of the time. Type B players invest at a marginally higher rate than Type A players, 87.6% vs. 82.5% (means test t-statistic = 1.69, p-value = 0.09).[21] By period 30, the differences between the Type A and Type B players is evident. In period 30, the mean cumulative earnings of Type A players are more than twice the mean cumulative earnings of Type B players ($11.39 vs. $5.38).

5. Results – Periods 31 – 90

5.1 Investment Rates

Beginning in period 31, players can attack other players. The mean investment rate for all players increases modestly, from 85.1% to 87.1% (paired means test t-statistic = 1.47, p-value = 0.14, two-tailed test). Type B players still invest at a higher rate than Type A players (88.2% vs. 86.0%, respectively), but the difference is not significant (means test t-statistic = 0.69, p-value = 0.49, two-tailed test). The increase is greater for Type A players than Type B players (from 82.5% to 86.0% and from 87.6% to 88.2%, respectively). Only the increase for Type A players is significant (Type A: paired means test t-statistic = 2.94, p-value = 0.004, two-tailed test; Type B: paired means test t-statistic = 0.24, p-value = 0.81, two-tailed test).

5.2 Who is Envied?

[21] The unit of measurement is the individual player

5.2.1 Hypotheses

We consider two competing hypotheses based on the predictions from the models of inequality aversion and Reference Group Theory.

H1 (inequality aversion): *The greater is the difference in cumulative earnings $x_j - x_i$, the more envious player i will feel towards player j and, other things equal, the greater is the probability that player i will select player j as the target for any envious act.*

H1a (reference group theory): *The smaller is the difference in cumulative earnings $x_j - x_i$, the more envious player i will feel towards player j and, other things equal, the greater is the probability that player i will select player j as the target for any envious act.*

5.2.2 Summary Statistics

We first review summary statistics illustrating the type of players targeted for attack in periods 31 – 90. In any period, a player has to decide whether to attack or not. If he chooses to attack, he has to select one player, from among the other nine players, to attack. Over periods 31 – 90, a total of 9,600 attack/not attack decisions are made (4,800 by Type A players and 4,800 by Type B players). The type of player attacked, if one is attacked, is an indicator of whom the attacker envies.

Table 3 breaks down the attack data by attacker type, attacked type, and relative cumulative earnings for the period prior to the period of the attack. Consistent with hypothesis *H1* are two facts: the majority (62. percent) of attacks are directed at the wealthy Type A players (1464 out of the total 2346); and wealthier players of either type are targets more often that are poorer players (62.4 percent). Inconsistent with *H1* is the observation that only 42.3 percent of these attacks on Type A players are by Bs attacking As. *H1* would suggest that Bs attacking As

would be the most common type of attack observed ; this target/attacker pairing would tend to maximize the difference in cumulative earnings $x_j - x_i$.

There are a number of observations consistent with hypothesis *H1a*. First, Type A players are the target of 69.4% of attacks made by Type A players and 54.9% of the attacks by Type B players. A χ^2 contingency table test indicates that As attack As significantly more often than Bs attack As ($\chi^2(1) = 51.87$, $p < 0.001$). Second, 57.7 percent of all attacks are within type attacks [i.e. As (Bs) attacking As (Bs)]. Third, players, who are targets of attack by players of the same type, tend to be wealthier than their attackers. For Type A (B) players attacked by other Type A (B) players, 61.7% (63.5%) of the time the target has higher cumulative earnings in the previous period than the attacker. A χ^2 contingency table test cannot reject the null hypothesis that wealthier As and Bs are equally likely to be targeted by their poorer type mates ($\chi^2(1) = 0.31$, $p < 0.58$). Finally, *H1* does not predict wealthier players attacking poorer players, but 867 (37.0 percent) of all attacks are of this type. Such attacks are consistent with *H1A*. A poorer player may be in the reference group of the attacker. If $x_j - x_i < 0$ but x_j has been increasing relative to x_i, closing the $x_j - x_i$ gap, player i might be envious and willing to act on that envy.

5.2.2 Regression Analysis

In any period, a player has up to nine other players that he could be envious of, but he can only attack one of them. We assume that if a player chooses to act on his envious feelings, his actions will be directed at the other player he feels most envious of. Our dependent variable is $Attacks_{ijt}$ which takes a value of 0 for all nine other player if player i chooses to not attack anyone; it takes a value of 1 for player j if player i attacks player j ($i \neq j$) in period t and a value

of 0 for the other eight players. Defining our dependent variable in this way gives us a sample size of 86,400 (= 9*9,600).

We estimate three regression models. In Model 1, we measure potential for envy as Dif_{ijt-1}, the difference in cumulative earnings between players i and j in period t-1 (i.e. cumulative earnings of player j - cumulative earnings of player i).[22] We also control for the player type of the nine possible targets (Target Type) and period (Period). See Table 4 for definitions of all regression variables. In Model 2 we allow for the effect of Dif_{ijt-1} to differ depending on the combination of player i's type and player j's type. The paired type, difference in cumulative earnings variables are: Difference AA_{ijt}, Difference AB_{ijt}, Difference BA_{ijt}, Difference BB_{ijt} (player i's type listed first). Support for *H1* would be evident if the coefficient for Difference $AB_{ijt} = 0$ and if for the other three difference variables Difference BA_{ijt} > Difference AA_{ijt} = Difference BB_{ijt}.

Finally, in Model 3 we include the squares of Difference AA_{ijt} and Difference BB_{ijt} (Difference AA_{ijt}^2 and Difference BB_{ijt}^2) to test if a player's reference group is comprised of players of the same type and if envious behaviour is primarily driven by the relative position within type.[23] If *H1* is correct, the coefficients for Difference AA_{ijt}^2 and Difference $BB_{ijt}^2 = 0$. *H1a*, on the other hand, predicts that a player interested in his relative position within type (i.e. his reference group) may be more inclined to attack others with cumulative earnings just above or just below his own. Doing so increases the chances that he will move ahead of those just in

[22] We use the lag of the difference in cumulative earnings since player i sees the cumulative earnings of all players at the end of period t-1 before deciding whether to attack another or not in period t.

[23] We do not include the pairings AB and BA since, in the case of the former, the difference is always negative and, in the case of the latter, the difference is always positive.

front of him and keep those just behind him from overtaking him. Support for *H1A* would be evident if the coefficients for Difference AA_{ijt}^2 and Difference $BB_{ijt}^2 < 0$.

Note that we do not control for player j's characteristics since player i only knows the cumulative earnings and player type of all players j ($i \neq j$).

Table 5 reports regression results for three models. The regressions are probit with random effects and clustering at the session level.[24] Model 1 indicates that Type A targets are significantly more likely to be chosen for attack than Type B targets, approximately 24% more likely. The insignificant coefficient for Dif_{ijt-1} suggests that targets are not selected for attack based on their higher (or lower) earnings relative to the attacker. Results for Models 2 and 3, however, suggest that the impact of earnings differences is a function of the target type/attacker type mix.

Results for Model 2 offer only minimal support for *H1*. The positive and significant coefficient for Difference AA_{ijt} indicates that poorer Type As target wealthier Type As for attack and the wealthier is an A, the greater the chance of being attacked.[25] Inconsistent with *H1* is the positive and significant coefficient for Difference AB_{ijt} suggesting that Type A players target the Type B players (albeit the wealthier Type B players). The negative and significant coefficient for Difference BA_{ijt} suggests that Type B players are more likely to attack the poorer rather than the wealthier Type As.

[24] We estimate our regression models using STATA 11.2 and GLLAMM (Rabe-Hesketh et al. 2005).

[25] This is also consistent with *H1a* since other As are in any A's reference group.

Since a log likelihood ratio test rejects the null hypothesis that the coefficients for the Difference AA_{ijt}^2 and Difference BB_{ijt}^2 are jointly equal to zero, we focus our discussion on Model 3.[26]

Our Model 3 results offer evidence supportive of *H1a*. For Type A targets, the significant coefficients for Difference AA_{ijt} and Difference AA_{ijt}^2 and Difference BB_{ijt} and Difference BB_{ijt}^2 indicate that the reference group is players of the same type. Wealthier As are more often targeted for attack by poorer Type As and those who are only slightly wealthier than the potential attacker of Type A are more likely to be targeted for attack. Attackers of type A appear to be trying to pull down those above themselves. For Type B targets, the less wealthier Bs are more often targeted for attack and those who are only slightly poorer than the potential attacker of Type B are more likely to be targeted for attack. Attackers of Type B appear to be trying to keep down those below themselves. The rich want to be top of the heap; the poor want to avoid being the bottom of the heap. It is important to stress that the players' final earnings were in no way determined by their rank or relative rank within the whole or within their group. The players' focus on relative rank is totally self-manufactured.

Model 3 results continue to suggest that when Type A players are the targets and Type B players are the potential attackers, the less wealthy As are more likely to be attacked. When Type B players are the targets and Type A players are the potential attackers, the more wealthy Bs are more likely to be attacked. [27]

[26] $\chi^2(2) = 6.32$, p-value = 0.043.

[27] Recall that Difference AB is defined as the earnings of the player B (the victim) minus the earnings of the player A (the attacker) and will be negative in all cases. So a $1 decrease in the earnings difference arises from either a $1 increase in the earnings of the player B or a $1 decrease in the earnings of the player A, *ceteris paribus*.

6. Discussion and Conclusion

Inequality aversion theory assumes social preferences are defined completely along one dimension, x (i.e. wealth or income). Models predict that the greater is the difference $x_j - x_i$, the more envious individual i will feel towards individual j and, other things equal, the greater is the probability that individual i will act on those envious feelings. Reference Group Theory assumes that individuals compare themselves to others from the same social group or income level. An individual's reference group is a particular subset of the whole; those with similar x_is. The reference group hypothesis predicts that envious feelings of individual i towards individual j and the probability that individual i will act on his/her envious feelings will decline as the difference $x_j - x_i$ increases.

Our game with its two types of players is designed to stimulate destructive envy. Its distinguishing feature is that players are defined both by their place within an overarching hierarchy, defined by cumulative earnings, as well as by their place within the hierarchy of their specific type. We explore what motivates envious acts, the vast differences in income or wealth between classes or the relatively minor differences in income or wealth within a class. It offers a test of competing hypotheses from models of inequality aversion and from Reference Group Theory.

Consistent with other studies, we find strong evidence of destructive envy related behaviour. More importantly, our results suggest that existing theories of inequality aversion are inadequate to explain the diversity in envious behaviour observed in our study. Our results are more supportive of Reference Group Theory. While the less wealthy do exhibit envy of the wealthier, we find evidence that both class (i.e. reference group) and one's position within one's own class driving behaviour. We find strong evidence of within class envy: the rich targeting the

rich and the poor targeting the poor. Within the rich community, the target of envy is usually a wealthier subject whose wealth is close to that of the attacker; the attacker may possibly be trying to improve his/her relative ranking. Within the poor community, the target of envy is usually a poorer subject whose wealth is close to the attacker; the attacker may possibly be trying to preserve his/her relative ranking.

Our results also add to the growing literature on the importance of social distance. Studies have shown that reducing social distance by, for example, reducing anonymity increase pro-social behaviour (i.e. altruistic giving).[28] Our results suggest that reducing social distance by creating a reference group (i.e. providing similar others that one can compare one's success or failure to) may increase anti-social behaviour (i.e. envious feelings and actions).

[28] See, for example, Hoffman et al. (1996) and Charness and Gneezy (2007).

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Table 1: End of Period Displays

You are:	Player 1
Insured:	No
You Attacked:	No one
Choice:	Invest
Result:	Lost
Attacked by other player:	No
Earnings:	15.0 cents

Player ID	**Type**	**Earnings***	**Cumulative Earnings***
1	B	10	157.0
2	A	60	420.0
3	A	60	495.0
4	A	60	420.0
5	A	15	465.0
6	A	60	405.0
7	B	26	212.0
8	B	26	190.0
9	B	10	153.0
10	B	10	121.0

* - Earnings reported in cents.

Table 2: Possible Outcomes and Earnings for Periods 31 to 90

Type	Save/Invest	Win	Harm	Insure	Attacked	Earnings	Type	Save/Invest	Win	Harm	Insure	Attacked	Earnings
A	Save	…	No	No	No	$0.30	**B**	Save	…	No	No	No	$0.15
A	Save	…	Yes	No	No	$0.25	**B**	Save	…	Yes	No	No	$0.10
A	Save	…	No	No	Yes	$0.10	**B**	Save	…	No	No	Yes	($0.05)
A	Save	…	Yes	No	Yes	$0.05	**B**	Save	…	Yes	No	Yes	($0.10)
A	Save	…	No	Yes	No	$0.20	**B**	Save	…	No	Yes	No	$0.10
A	Save	…	Yes	Yes	No	$0.20	**B**	Save	…	Yes	Yes	No	$0.05
A	Save	…	No	Yes	Yes	$0.20	**B**	Save	…	No	Yes	Yes	$0.10
A	Save	…	Yes	Yes	Yes	$0.20	**B**	Save	…	Yes	Yes	Yes	$0.05
A	Invest	No	No	No	No	$0.15	**B**	Invest	No	No	No	No	$0.10
A	Invest	No	Yes	No	No	$0.125	**B**	Invest	No	Yes	No	No	$0.067
A	Invest	No	No	No	Yes	($0.05)	**B**	Invest	No	No	No	Yes	($0.10)
A	Invest	No	Yes	No	Yes	($0.075)	**B**	Invest	No	Yes	No	Yes	($0.133)
A	Invest	No	No	Yes	No	$0.125	**B**	Invest	No	No	Yes	No	$0.07
A	Invest	No	Yes	Yes	No	$0.10	**B**	Invest	No	Yes	Yes	No	$0.034
A	Invest	No	No	Yes	Yes	$0.13	**B**	Invest	No	No	Yes	Yes	$0.067
A	Invest	No	Yes	Yes	Yes	$0.10	**B**	Invest	No	Yes	Yes	Yes	$0.034
A	Invest	Yes	No	No	No	$0.60	**B**	Invest	Yes	No	No	No	$0.26
A	Invest	Yes	Yes	No	No	$0.50	**B**	Invest	Yes	Yes	No	No	$0.173
A	Invest	Yes	No	No	Yes	$0.40	**B**	Invest	Yes	No	No	Yes	$0.06
A	Invest	Yes	Yes	No	Yes	$0.30	**B**	Invest	Yes	Yes	No	Yes	($0.027)
A	Invest	Yes	No	Yes	No	$0.50	**B**	Invest	Yes	No	Yes	No	$0.17
A	Invest	Yes	Yes	Yes	No	$0.40	**B**	Invest	Yes	Yes	Yes	No	$0.087
A	Invest	Yes	No	Yes	Yes	$0.50	**B**	Invest	Yes	No	Yes	Yes	$0.173
A	Invest	Yes	Yes	Yes	Yes	$0.40	**B**	Invest	Yes	Yes	Yes	Yes	$0.087

Table 3: Envied Type and Attacker Type

		Relative Cumulative Earnings (Target/Attacker)			
Target Type	Attacker Type	< 1	= 1	> 1	Total
A	A	308	15	522	845
B	A	373	0	0	373
B	B	186	0	323	509
A	B	0	0	619	619

Table 4: Definition of Regression Variables

Dependent Variables	**Definition**
$Target_{ijt}$	= 1 if player j was targeted by player i ($i \neq j$) for an attack in period t, 0 otherwise
Independent Variables	**Definition**
Target Type	=1 if target player is type A, 0 otherwise
Dif_{ijt}	Cumulative earnings (in dollars) of player j - Cumulative earnings of player i in period t
Difference AA_{ijt}	= Cumulative earnings (in dollars) of player j - Cumulative earnings of player i in period t if players i and j are both type A, 0 otherwise
Difference AB_{ijt}	= Cumulative earnings (in dollars) of player j - Cumulative earnings of player i in period t if players i is type A and player j is type B, 0 otherwise
Difference BA_{ijt}	= Cumulative earnings (in dollars) of player j - Cumulative earnings of player i in period t if players i is type B and player j is type A, 0 otherwise
Difference BB_{ijt}	= Cumulative earnings (in dollars) of player j - Cumulative earnings of player i in period t if players i and j are both type B, 0 otherwise
Difference AA_{ijt}^2	= Difference AA_{ijt} squared
Difference BB_{ijt}^2	= Difference BB_{ijt} squared
Period	= period number (t = 31, …, 90)

Table 5: Who is Envied

Variable	Marginal Probability Effects (Std. Err.)		
	Model 1	Model 2	Model 3
Target Type	0.239*** (0.076)	0.185** (0.076)	0.193*** (0.057)
Dif_{ij}	0.001 (0.008)	…	…
Difference AA_{ijt}	…	0.055*** (0.020)	0.082*** (0.018)
Difference AB_{ijt}	…	0.032** (0.013)	0.039*** (0.010)
Difference BA_{ijt}	…	-0.018** (0.009)	-0.020** (0.009)
Difference BB_{ijt}	…	-0.018 (0.018)	-0.059*** (0.021)
Difference AA_{ijt}^2	…	…	-0.020** (0.009)
Difference BB_{ijt}^2	…	…	-0.007** (0.002)
Period	-0.010*** (0.002)	-0.009*** (0.002)	-0.008*** (0.002)
Constant	-1.383*** (0.143)	-1.632*** (0.117)	-1.665*** (0.105)
L.L.R.	-9255	-9155	-9121
N **Individuals** *Sessions*	86400 **160** *16*		

+ Dependent variable: $Target_{ijt}$ = 1 if the if player j was targeted by player i ($i \neq j$) for an attack in period t, 0 otherwise.
Random effects with clustering by session.
*** - Significant at 1% level
** - Significant at 5% level
* - Significant at 10% level