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Albert Liu April 06, 2022

Economic conformity: eliciting conformity in a public goods game

by

Albert Liu

Kelli Lanier
Adviser

Economics

Kelli Lanier

Adviser

Maria Arbatskaya

Committee Member

Sara Botto

Committee Member

Krzysztof Karbownik

Committee Member

Ho Jin Kim

Committee Member

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Abstract

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Consumer behavior is highly dependent upon the opinions and reviews of others. This invisible force where heterogeneous individual preferences converge is known in psychology as conformity. Conformity has become a main driver for demand across multiple industries and businesses, including fast-fashion, TikTok, and other "hype"-driven goods and services. This study investigates the duration, degree, and extent of experimentally-induced conformity utilizing the public goods game as a lens of analysis. The control was a standard five-round public goods game, while the experimental condition induced peer pressure to measure conformity. Through this methodology, we consider the mean token contributions by participants as a form of *willingness to pay* (as a form of price) for conformity (as a form of product) to a group's dynamics. We find that the proportion of people who fully conform to an immediate conforming pressure is approximately 19% and the proportion of people who at either *partially* or *fully* conform is approximately 63% of people. Gender and ethnicity did not affect who had conformed significantly. Further, the mean willingness to pay increased by approximately 0.50 of the original mean willingness to pay when initially faced with a conforming pressure. This change may be influenced by group size or MPCR, as participants in a group size of 3 with an MPCR of 0.333 had a higher initial willingness to pay compared to participants in a group size of 4 with an MPCR of 0.25. While this change in the price point of conformity only lasts for one iteration of decision making, it resurfaces in the long-term, where the mean willingness to pay was approximately 0.87 higher than the mean willingness to pay without a constant conforming pressure. Third, learning behavior of participants converged in the presence of constant conformity pressure, with participants having an approximately equal probability of continuing to conform or becoming independent over time. These results have important implications for sustainable business projections and behavioral economic modelling to accurately predict demand of goods which exhibit conformity pressure.

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1. Introduction

Conformity is the tendency for people to change their behaviors, perceptions, or opinions in accordance with a group, even if the decision is wrong (Asch, 1956). The conformity of consumer preferences has woven itself into the fabric of consumer culture and has further manifested in the market through industry fast fashion fads, social media trends such as TikTok, and herd market behavior such as the collective short squeezes of GameStop shares from a Reddit community (Lucchini *et al.,* 2021). Marketers have long underscored the importance of conformity in influencing consumer behavior with brands. In 1989, Bearden and colleagues created a two-dimensional scale known as the Consumer Susceptibility to Interpersonal Influence (CSII), exploring just how vulnerable the average consumer is to conformity pressure when purchasing goods (Bearden *et al*., 1989). Today, brands have become so prominent in our lives that children of ages two-to-three are able to exhibit brand awareness (Valkenburg and Buijzen, 2005). With young children becoming increasingly influenced by modern brands, studies raise concerns that children receiving an endless barrage of advertisements encouraging consumerist behavior may suffer from physical, emotional, or social deficits: particularly with young girls being sold products with the allure of conforming to a feminine ideal (Hill, 2011).

Conformity's online presence has also been growing rampantly, with the COVID-19 pandemic forcing many businesses and interactions to occur primarily online (Sardjono *et al.*, 2020), conformity can be found online. In one case study published in 2020, online shopping in China on Alibaba increased by 710 million people since 2018, representing an increase of 16.4% and 78.6% of internet users (Zhang, 2021). This shift of shopping from in-person to online formats also shifts marketing strategies online, manifesting in an onslaught of online advertisements, reviews, and

discussion boards surrounding products. Excess demand caused by conformity pressure – such as people rushing to stores to hoard toilet paper during the quarantine period based on social media scares (Kluger, 2020) – wreaks havoc on the delicate equilibrium between demand and supply. Recently, many stores had either oversupplied products, such as luxury brands facing declining demand across the masses (Arnett, 2020), or undersupplied their products, such as the 2020 toilet paper shortage across retail locations.

As conformity is a prominent as a driver in demand and subsequently utilized in marketing strategies (Zhang, 2021), it becomes ever more important to understand the dynamics of conformity and how it occurs. The current paper aims to evaluate the magnitude of conformity over a progression of time in economic decision-making. Although there is an extensive body of research investigating the determinants of conformity, literature quantifying the level of conformity by individuals and how that level evolves over time is lacking. This study uses a between-group experimental economics design, utilizing a variation of the public goods game as a means to quantify conformity.

The study at hand utilizes a public goods game methodology to quantify several aspects of conformity. First, we aim to quantify the proportion of the population that would conform to an immediate conforming pressure. Second, we quantify how the average person's *willingness to pay* increases in the face of constant conforming pressure over time. Lastly, we investigate the learning behavior of individuals in the face of constant conforming pressure in economic decision-making.

The results of this study are significant for several reasons. As previously mentioned, conformity pressure can result in excess demand, causing shortages in the supply chain. Understanding (1) the proportion of population who would conform to immediate conforming pressure, (2) the increase

in price of the good(s) in question, and (3) how that behavior changes over time may allow businesses to more accurately project the demand and create more sustainable business models to meet this demand. Further, the results of this study may help young children who must deal with the constant conforming pressure become aware of the challenges of conformity. These findings provide a further foundation for behavioral economics in modeling consumer behavior.

2. Literature Review

2.1 Conformity and consumerism

In 1955, social psychologist Solomon Asch published a study on the effect of peer opinions on individual decisions. Asch had participants match the length of a target line with lines of varying lengths aloud, not knowing that seven confederates in the group had agreed upon their responses in advance. Ultimately, 36.7% of participants reported errors in the length of the line, conforming to a unanimous, but incorrect confederate group (Asch, 1955).

Since the Asch study, an increasing number of studies have focused on understanding the motivations driving conformity, the factors influencing conformity, and further mathematically modeling conformity. Deutsch and Gerard categorized motivations to conform as either *normative* or *informative*, where *normative* motivation means one strives to be liked by the group and *informative* motivation means one strives to be considered "right" by the group (Deutsch and Gerard, 1955). Many factors affecting conformity have been identified: majority size (Asch, 1955; Insko *et al.*, 1985; Latane, 1981; Rosenberg, 1961), task objectivity (Asch, 1955; Deutsch and Gerard, 1955), gender or sex (Cooper, 1979; Eagly, 1978; Eagly and Carli 1981; Bond and Smith, 1996), age (Pasupathi, 1999; Wijenayake *et al.*, 2021), culture (Milgram, 1961; Bond and Smith,

1996), self-confidence (Campbell *et al.,* 1986), and mode of judgement (Asch, 1956). These studies found that generally, conformity rates increased with larger majority sizes, more subjective answers to tasks, and more collectivist national cultures. Further, conformity tended to decrease with older ages, higher levels of self-confidence, and when changing the mode of judgement from public to silent. Specifically, when participants were asked to judge the lines silently as opposed to publicly, the rate of incorrect answers among participants decreased from the original 36.7% to 12.5% (Asch, 1956).

Conformity is transitioning online as more interactions are being held over the internet, and research is shifting its focus to study this transition. A recent study investigated three facets of online social presence: user representation (generic or specific online profiles), interactivity (whether there was discussion), and response visibility (whether responses were seen by others) (Wijenayake *et al.,* 2021). These researchers found an overall conformity rate of 30%, where conformity is highest in the presence of having discussion and public responses and lowest without either discussion or social presence (Wijenayake *et al.,* 2021).

At the intersection of online shopping, conformity, and consumerism is a recent case study of Single's Day in China, or November 11. On Single's Day, which arose as the antithesis of Valentine's Day and is now the largest online shopping day in the world, Zhang notes three major manifestations of utilizing conformity psychology to entice consumers: endorsements by celebrities, the visibility of positive comments, and the adoption of pressuring marketing strategies (Zhang, 2021). The effects of these marketing strategies and advertisements have been historically studied since the advent of television ads. In a laboratory experiment measuring purchasing intention in response to repeated advertisement exposure, the purchasing intention of the

advertised brands significantly non-linearly increased by as much as 0.6 over 6 repetitions of ad exposure (Sawyer, 1973). Several studies find that this effect is mediated by brand loyalty and other factors including price, features, and the display of the products and advertisements (Sawyer, 1973; Tellis, 1988). Recently, in a field experiment tracking cookies of internet advertisements data at a financial tools provider finds that internet display advertising generally increases visitation to the firm's website (Hoban and Bucklin, 2015).

A study by Kang and colleagues identifies a recent phenomenon that serves as a useful tool for explaining conformity, supplementing normative and informative motivations: the fear of missing out (Kang *et al.*, 2019). The fear of missing out pressures consumers to resolve the anxiety of not belonging with a group, subsequently causing the development of a stronger tendency to imitate the behavior of others (Kang *et al.*, 2019). In this process, culturally associated brands emerge where the upsurging conformity pressure causes a similar increase in the purchasing of culturally associated brands (Kang *et al.*, 2019). With conformity pressures rising in prominence as a driver in demand and marketing strategy, it becomes ever more important to understand the dynamics of conformity.

2.2 Economic studies

The motivations, factors, and models that determine conformity have been documented extensively in previous economic literature. In 1994, Douglas Bernheim developed a theory at the cross-section of economic rationale and psychological conformity: individuals have consumer preferences determined by status (public perceptions) and intrinsic utility of the consumed good (Bernheim, 1994). In this model, when an individual gains a sufficient degree of status relative to the intrinsic utility of an economic decision, individuals may conform to a single, homogenous

standard of behavior, despite their heterogeneous underlying preferences (Bernheim, 1994). This model explains why individuals conform to singular decisions, while also explaining why people with extreme preferences do not conform (Bernheim, 1994).

Bernheim and Exley follow up on their conformity model by utilizing a sequence of 10 decisions in an experiment to study whether conformity motivated by *belief mechanisms* or *preference mechanisms* cause social equilibria (2016). Bernheim and Exley define belief mechanisms as mechanisms where a norm is promoted among individuals with heterogeneous preferences paralleling normative motivations for conformity (2016). Preference mechanisms are defined as mechanisms in which an individual's unfixed preferences are exposed to social influences, indicating informative motivations for conformity (Bernheim and Exley, 2016). Each decision has the participant expend some level of effort at some level of benefit to themselves or others. Bernheim and Exley ultimately found that the motivation for convergence was highly dependent on the treatment entailed, including the anonymity of their decision and who the decision benefit (Bernheim and Exley, 2016).

One of the most popular standards for studying social dilemmas and the effects of social influence in experimental settings is the public goods games. Economists Isaac and Walker utilized one of the first computerized versions of a public goods game to evaluate the free-rider phenomenon through 10 rounds of decision-making (Isaac and Walker, 1988). Each round, each participant is given an endowment of 10 tokens as an in-game currency and is told to allocate their tokens between a private good and a public good. A participant's profit for each round is based on the raw amount allocated to the private good plus to a factor of the total group allocation towards the public good. By following the contributions that people make towards their group over the game's

duration, the model allows experimental economists to study the effects of various treatments on economic decisions in social dilemmas. While public goods games have not been typically used to study conformity, several background studies involving voluntary contribution mechanisms (VCM) in linear public goods games identify important factors affecting contributions towards a group or a public good. Understanding these factors is important when designing for the study at hand, in inducing conformity and confirming external validity.

First, contributions are motivated more by competition than cooperation (Augenblick and Cunha, 2015). Augenblick and Cunha study these motivations by utilizing in-group and out-group politic dynamics: in a cooperative treatment, participants received the reference amount from an in-group member (e.g., how much a Democrat contributed, if the participant was a Democrat); in the competitive motivation, participants received the reference amount from an out-group member (e.g., how much a Republican contributed, if the participant was a Democrat). Augenblick and Cunha found that people in the competitive treatment contributed at *double* the out-group reference amount whereas people in the cooperative treatment gave a similar amount of money to the in-group reference amount, while both treatments yielded similar rates of contribution (2015).

Second, participants tend to give less at the end of the game, as they no longer need to participate and would rather keep their endowment (Gonzalez *et al.*, 2005). Further, the time-horizon of the game (or announcing how many rounds the game would last) did not appear to alter the results significantly (Gonzalez *et al.*, 2005).

Third, making each participant's decisions in the public goods game transparent to their group increases the contributions and amount of collusion (Fiala and Suetenz, 2017). Fiala and Suetenz

further discovered a leadership effect, where a leader sets a reference amount, and the rest of the group follows with similar allocations (2017).

Fourth, in a public goods game experiment, females have been found to contribute significantly more than males, but this difference vanishes as the game progresses (Cadsby and Maynes, 1998). Cadsby and Maynes speculate that this behavior does not imply that females are more altruistic than males, but that the difference may instead be attributed to females being better than men at interpreting and responding to their group's behavior, while men tend to pursue their own strategy rather than attend to the group's dynamics (1998). However, women tended to contribute significantly less compared to men when in mixed social class groups, indicating that social differences may impede women's collective action capacity (Marshall and Paler, 2020). In a meta-analysis, gender did not significantly affect the contributions in public good games (Zelmer, 2003).

Fifth, there are mixed results in literature regarding the influence of personality traits and contributions in the public goods game. In a one-shot public goods game, the contributions toward the public good were shown to decrease for participants who were measured to be more rational by the Rational-Experiment Inventory – revised 40 scale (Lang *et al.*, 2018). In the same study, personality traits measured by the Big Five Inventory (BFI) personality traits had no significant effects on contribution levels (Lang *et al.*, 2018). Another recent study finds consistent personalities correlated with the participants' strategies played in the public goods game: a consistent cooperative and consistent defective personality trait (Salahshour, 2021).

Lastly, utilizing a trust game model, participants send significantly more money (around 15%) more to other participants who are in ethnicities that the participant is familiar with (Mantilla *et al.*, 2021). Thus, in a public goods game where the participant does not know the identities of their

group members, ethnicity should not affect the amount of money contributed. In understanding these factors and correlates influencing the public goods game, the study at hand can better design a game that captures conformity without introducing unnecessary confounding factors.

2.3 Profit maximization strategies in VCMs

Understanding the profit-maximization strategy for VCMs involving linear public goods games is a priori to data analysis surrounding the motives of playing the public goods game. A traditional public goods game calculates earnings as:

$$(1)\ \pi_i = x_i + m\sum x_{i,g}$$

Where $\boldsymbol{\pi}_i$ represents the individual's profits, x_i represents the value of tokens the individual has kept, m is a multiplicative factor known as the marginal per capita return (MPCR), and $\sum x_{i,g}$ is the sum of tokens each group member (including the individual) has contributed to the group.

Experimenters typically select a value for the MPCR where the MPCR multiplied by the group size (N) is greater than 1 (Zelmer, 2003; Balliet *et al.*, 2011). Generally, for groups of size 4, experimenters select an MPCR ranging from 0.3 to 0.4, for which MPCR multiplied by the group size of 4 is 1.2 to 1.6. In this study, we define *MN* as the MPCR multiplied by the N.

$$(2)\ MN = \mathrm{MPCR} \times \mathrm{N}$$

This parameterization of the MPCR causes a dilemma between individual good and social good at a fixed group size. Specifically: to maximize individual own income, participants would contribute

nothing to the public good (the Nash equilibrium); whereas to maximize social good, participants should contribute their entire income to the public good (a Pareto efficient outcome).

Previous experiments have found that on average, people behave differently from both the pro-social and individual strategies. In most studies with standardly parameterized MCPR values in public goods games, most individuals contribute 40 - 50% of their initial endowment at the beginning of the experiment, and although contributions decrease over iterations, most people tend to contribute 10 - 20% of their endowment size to the group (Burton-Chellew and West, 2013; Fehr and Fischbacher, 2003).

Thus, considering the MN is one of the defining features affecting contributions in VCM games. The first component, MPCR, is known economically to affect whether an individual decides to contribute. In a recent study, the effects of various MPCRs within the range of 1/N and 2/N with a fixed group size of 3 ($1 < MN < 2$) was investigated utilizing a one-shot public goods game framework iterated over 10 rounds (van den Berg *et al.*, 2021). In this study, the average contributions declined from 0.38 to 0.17 with the lowest MPCR (0.367) and from 0.68 to 0.61 in the treatment with highest MPCR (0.833) (van den Berg *et al.*, 2021).

Group size is the other determinant of MN, although research thus far has not drawn straightforward conclusions regarding how group size affects contributions. In a meta-analysis, Zelmer found that group size did not significantly affect contributions in public good games (Zelmer, 2003). Nosenzo and colleagues found a positive effect of group size in low MPCR conditions and a negative effect of group size in high MPCR conditions (Nosenzo *et al.*, 2015). In another study, increasing group size from 2 to 4 only weakly positively affected contributions

(Lugovskyy *et al.*, 2017). Overall, there is little evidence that group size significantly effects contributions in public goods games.

3. Methodology

With the consideration of the factors which affect either conformity levels or the contribution levels in a public goods game, this study investigated three main hypotheses. (1) If people conform in economic decision-making, then the price point of the product purchasing should increase in the face of a conforming pressure. (2) If people conform in economic decision-making, then we expect to see similar proportions in an economic decision compared to psychological literature in similar conditions. (3) Given a constant conforming pressure over 5 iterated decisions, we expect people to change their behavior overtime.

3.1 Recruitment

Participants were recruited from the Emory University College of Arts & Sciences student population. These participants were recruited through ListServ emails, word-of-mouth, professors' announcements, and academic extra credit incentives. Students who were willing to participate marked their availability for experiment session timeslots on a Google Form. These students were randomly assigned to sessions of 6 to 10 participants based on their responses. The sessions were hosted in various classrooms reserved in the Rich Memorial Building on the Emory University main campus. For participant privacy, participants were instructed to sit at least one chair or desk away from others. This study adhered to Emory's sanitization and mask precautions throughout the duration of the study. This study was approved by the Emory Institutional Review Board. All participants provided informed consent prior to data collection.

3.2 Survey

All participants were required to take a survey on Qualtrics. This survey contained three components: a demographic questionnaire, an abridged version of the Big Five Index personality test, and a post-game evaluation.

3.2.1 Demographic questionnaire.

Participants self-reported their age, gender identity, race or ethnicity, number of economic classes taken, and approximate family income.

3.2.2 Abridged Big Five Inventory personality test.

Participants took a shortened version of the Big Five Inventory (BFI), a personality test focusing on 5 primary assortments of personality (John and Srivastava, 1999). This shortened version included only the nine questions pertaining to *Agreeableness*, the major personality trait of interest in this study. This abridged inventory is included in the Appendix as Supplemental Figure 1.

3.2.3 Post-game survey.

Once participants completed the public goods game, participants were redirected to complete a post-game evaluation of the game. First, participants received a free-response question to explain what motivated their decisions in the game. Next, participants received 5-point scales to rate how much they had been motivated by the amount of money made in the game and other participants' decisions in the game, with 1 indicating "Disagree Strongly" and 5 indicating "Agree Strongly". This survey is included in the Appendix as Supplemental Figure 2.

3.3 Public goods game

All participants received a paper copy of instructions for either a standard public goods game or a modified public goods game. The control and experimental group instructions are included in the Appendix as Supplemental Figures 5 and 6, respectively.

For both groups, before beginning the game, participants were made aware of the game's raffle compensation mechanism, in which a random number generator would select participants eligible to win cash earnings. Participants were told that the amount awarded by the raffle depended on their earnings during the experimental public goods game in addition to chance.

In the control group, participants worked in groups of either 3 or 4 people for 5 decision-making rounds of the standard public goods game. Each participant was randomly assigned a participant ID. These participants were issued 10 tokens per round, an in-game currency, and instructed to allocate the tokens between investments towards themselves or contributions towards the group. Each participant's values were then recorded by a member of the research team and were subsequently used to calculate the group contribution that each participant received from their group. The participants did not know the identity, quantity, or direct allocation decision of their other group members. Groups were made by randomly grouping participant ID numbers. The payoff or earning calculation varied from a standard public goods game: instead of using a multiplicative factor to calculate the group contribution distribution, this number was calculated by taking an average of each group member's group contribution. The participant could calculate their earnings by adding together the group contribution received and their investment in themselves.

The experimental public goods game changed several conditions to induce a feeling of peer pressure for each subject. First, participants were told that allocation decisions would be made public but that the identity of which person contributed what amount would remain anonymous. Second, after each initial round of the public goods game, participants received experimentally-manipulated information that the rest of their group contributed a full investment toward the group (10 tokens). Third, after revealing the direct allocation decisions and the average group contribution, participants were given the opportunity to change their decision. This final decision for each round was kept private. Outside of these changes, the payoff methodology for individual and group contributions was identical to the control group.

3.4 Study Design

The present study compared outcomes across two public goods game conditions: a standard condition and an experimental condition. Data collected from the standard public goods game served as a control group. In the experimental condition, participants were allowed to change their decision once per round. The token contributions for each group – control, experimental initial, and experimental final – were aggregated across each round of the public goods game.

Data analysis includes means token contribution analysis, conformity analysis, and regression modeling. Means token contribution analysis investigates how the token contributions of participants change over the progression of the game. Conformity analysis investigates the amount of people exhibiting various degrees of conformity. This conformity analysis will further break down to investigate if gender identity or race/ethnicity are underlying factors behind conformity in economic decisions. Regression modelling specifications investigated variables mentioned in literature which may affected the degree of conformity or final token contributions in round 1.

3.4.1 Conformity Induction and Quantification

Conformity is induced in the experimental condition through several facets. First, allocation decisions are made public anonymously, as this would allow participants to see their peers' direct contributions and induce a feeling of wanting to collaborate or collude (Fiala and Suetenz, 2016). Second, participants received experimentally-manipulated information that the rest of their group contributed the entirety of their endowment to set 10 tokens as a reference point – where if they viewed these confederate values as an in-group, they would be cooperatively motivated and contribute tokens near the reference amount (Augenblick and Cunha, 2015). Lastly, participants in the experimental condition were allowed to change their decision after seeing the contributions of their other group members.

Thus, the experimental condition collects two measurements: an initial and a final decision, with exposure to a conformity pressure as the treatment. Conformity is directly quantified in this study via the positive change in the participants' token contributions after seeing the confederates' amounts as a reference point to which to conform to. This operational definition is consistent with background literature definitions of conformity (Asch, 1955).

In this study, *full conformity* (or simply conformity) occurs when a participant changes their initial decision to match the exact reference point of the confederates: 10 tokens. *Partial conformity* occurs when a participant changes their token contribution in the positive direction, but does not fully match the reference point of the confederates. *Independent* participants either do not change or lower their initial token contribution.

3.4.2 Economic Spending and Conformity modeling

The model of public goods game run in this study calculates earnings differently than the standard public goods game:

$$(3)\ \boldsymbol{\pi}_i\ =\ x_i\ +\ \boldsymbol{\mu}_{\sum x_{i,g}}\ =\ x_i\ +\ \frac{1}{n}\sum x_{i,g}$$

Where $\boldsymbol{\pi}_i$ represents the individual's profits, x_i represents the value of tokens the individual has kept, and $\boldsymbol{\mu}_{\sum x_{i,g}}$ is the average of the sum of token contributions of each group member (including the individual).

In this study, the MPCR is parameterized to where MN is set equal to 1 dependent on group size. By this framework, an individual's dominant strategy is consistent with a standard VCM where the participant should not contribute any of their endowment towards the public good, which is the Nash equilibrium. However, this payoff mechanism prevents the pro-social solution found in standard VCMs. This can be shown by calculating the group profit (Π), taken as the sum of all group member profits:

$$(4)\ \Pi\ =\ \sum_{i=1}^{n}\pi_i\ =\ \sum_{i\ =\ 1}^{n}[x_i\ +\ \boldsymbol{\mu}_{\sum x_{i,g}}]$$

Which can be simplified to:

$$(5)\ \Pi\ =\ \sum_{i\ =\ 1}^{n}x_i\ +\ x_g$$

Where when the total endowment is 10 tokens, can be further simplified to:

$$(6)\ \Pi\ =\ n\ \times\ 10$$

As shown, the total utility of the group is constant, where regardless of the decisions of everybody inside each group, the total group profit remains the same. Consequently, there is no consideration for a social solution in this payoff methodology.

This payoff methodology exhibits two major advantages for this study: (1) having a non-fixed group size streamlines the session-building process with added flexibility, and (2) there is no dilemma between the social solution and the practical individual profit maximization solution.

As there is no tension between the social and individual solution, why would participants contribute tokens to the public good? Specifically, if a person decides to contribute their tokens to the group, that decision is not one motivated by maximizing profits. Rather, for each token that is contributed to the group, rather than to the individual, the individual loses 0.75 tokens from their total earnings (Table 1).

Table 1

Earnings calculated in the experimental condition (group size of 4).

Tokens contributed to group	Mean group contribution	Tokens kept	Total Earnings
10	10	0	10
9	9.75	1	10.75
8	9.5	2	11.5
7	9.25	3	12.25
6	9	4	13
5	8.75	5	13.75
4	8.5	6	14.5
3	8.25	7	15.25
2	8	8	16
1	7.75	9	16.75
0	7.5	10	17.5

Economically, we cannot explain this behavior unless we include interpersonal factors. As established by previous literature, when participants value their status from contributing to the good as sufficiently important relative to the intrinsic utility from investments towards themselves, those individuals may conform to a "single, homogenous standard of behavior, despite heterogeneous underlying preferences" (Bernheim, 1994). As stated prior, this behavior may be either normatively or informatively based, where participants contribute tokens to either be "liked" by their group or to be considered "right" by their group (Deutsch and Gerard, 1955). Consequently, in this study, the token contributions represent the participant's *willingness to pay* (as a form of price) to match their group's dynamics (as a form of product), especially when purchasing the product is not in their best interest (Table 1).

Several alternative explanations of behavior may explain token contributions: *altruism*, *reciprocity*, or *mimicking*. First, one could interpret token contributions as *altruism*, where participants derive utility from the act of giving. Previous literature, however, finds that individual contributions to a public good in a VCM was inconsistent with models of altruism (Croson, 2007). Further, this study utilizes a change in token contribution allocation to quantify conformity. This isolates conformity from altruism, as conformity requires a change in decision-making. Second, one could interpret token contributions as *reciprocity*, where people contribute tokens in response to the number of tokens contributed by others. Previous literature has found that models of *reciprocity* are consistent with token contributions, with nearly 92% of participants demonstrating a positive correlation between their own token contribution and the group's token contribution (Croson, 2007). In this study, the existence of *reciprocity* may serve to confirm the existence of *informative conformity* – namely, it is only "fair" or "right" to contribute as many tokens as the other group members (Deutsch and Gerard, 1955). While this study does not investigate the link

between reciprocity and informative conformity, further studies may wish to delineate these concepts more extensively. The concept of *mimicking*, where people simply write what they see, is covered more extensively in Section 5.3.

To summarize, we consider token contributions to be indicative of the participant's willingness to pay as a price to match their group's dynamics as a product. This study thus parallels consumer behavior in the market: the subjects are consumers with their own preferences, and the confederates are influencers or advertisers who attempt to sell their product. The subject decides whether to buy the product, despite their own individual heterogeneous preferences. Consequently, the scale of token contributions allows this experiment to uniquely scale the level to which the subjects value matching their group's dynamics. As this VCM entails 5 rounds of decision-making, we further investigate the learning behavior of participants.

4. Results

A total of 11 sessions were run, each with 6 to 10 participants. Four sessions were run with the control condition, and seven sessions were run with the experimental condition. While the session treatments were randomized, most control sessions were held prior to experimental conditions. Thus, this experiment includes a total of 80 participants, with 32 participants given the control treatment and 48 participants given the experimental treatment. Participants reported having taken a range of 0 to 12 economic classes (M = 3.67, SD = 2.65). In the abridged BFI personality test assessing a participant's *Agreeableness* on a scale of 9 being the least amenable to cooperation and 45 being the most, participants in this study scored from 16 to 45 (M = 33.94, SD = 5.77).

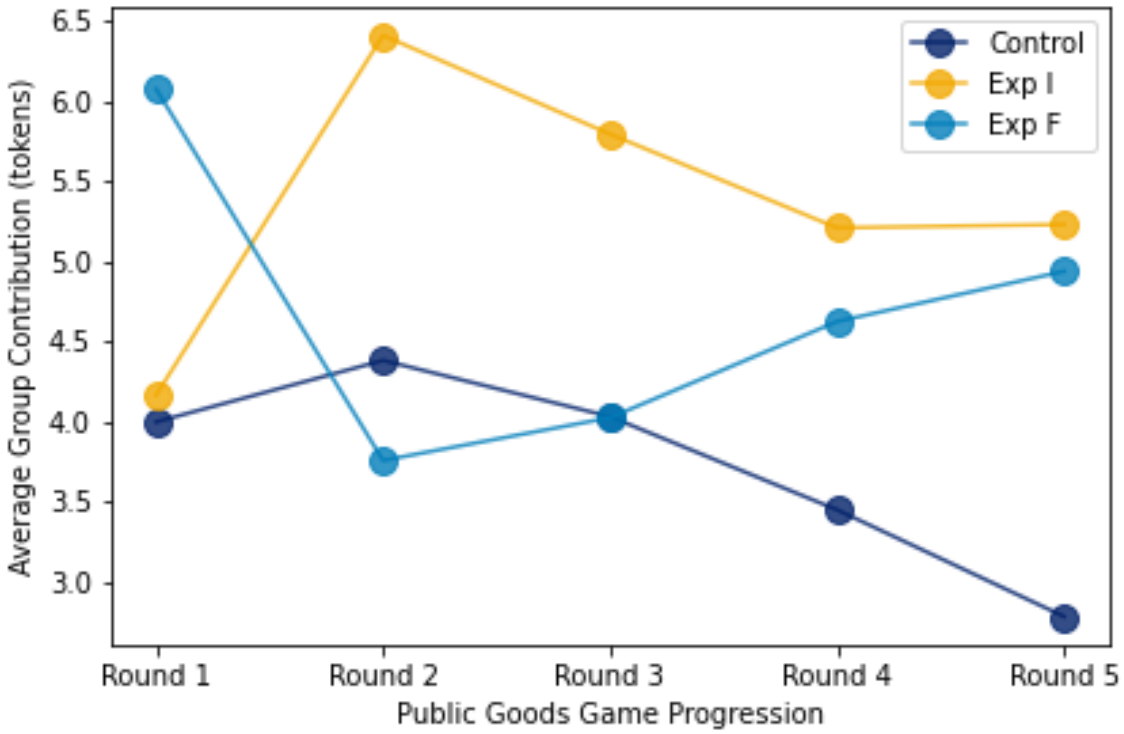
Descriptive statistics summarizing the subjects by gender, approximate family income, race or ethnicity, and post-game survey results are included in Supplemental Tables 1 to 5 in the Appendix. The study participants had several notable demographics. The overall sample is female-leaning, with females representing 58.75% (47/80) of the sample (Supplemental Table 1). Further, there is a disproportionate number of participants who identified as Asian, representing 62.50% (50/80) of the sample (Supplemental Table 3). Gender and race/ethnicity are further investigated in Section 4.3.

4.1 Quantifying the duration and degree of conformity

To investigate hypothesis (1), where we expect the price to increase in the face of conforming pressure, we analyze the progression of the mean token contribution over five rounds of the public goods game. To understand this progression, the mean token contribution towards the group was calculated for the control decision, and experimental decision for each of the five rounds (Figure 1). In the experimental condition, participants were allowed to change their decision once they had been shown the contributions of other group members. This resulted in an experimental initial (Exp I) contribution and an experimental final (Exp F) contribution.

Figure 1

Progression of the mean contribution in the public goods game, pooling data across group size



n = 32 for control n = 48 for exp	Control contribution tokens, μ (sem)	Initial exp contribution tokens, μ (sem)	Final exp contribution tokens, μ (sem)
Round 1 [2,3]	4.00 (0.3360)	4.17 (0.2997)	6.07 (0.4376)
Round 2 [1,3]	4.38 (0.4316)	6.41 (0.4191)	3.76 (0.4917)
Round 3 [1,3]	4.03 (0.4352)	5.79 (0.5490)	4.02 (0.5390)
Round 4 [1]	3.45 (0.4220)	5.21 (0.5758)	4.63 (0.5662)
Round 5 [1,2]	2.79 (0.4575)	5.22 (0.5949)	4.94 (0.5928)

Superscripts indicate the results of a hypothesis test ($\alpha = 0.05$) where:

[1] There is a significant difference between control and initial experimental decision.

[2] There is a significant difference between control and final experimental decision.

[3] There is a significant difference between initial experimental decision and final experimental decision in a paired t-test.

Two one-way ANOVA tests on the mean token contribution between each round were performed for both the experimental initial and final token contributions to determine if people were changing their decisions per round. Respectively, the F-statistics were calculated to be 2.74 ($p = 0.029$) and 2.94 ($p = 0.021$) for the initial and final group means. These results indicate that there is a significant difference in the mean token contribution between each round.

4.1.1 Beginning of experiment (Round 1)

In round 1, the respective means for the control, initial experimental, and final experimental decision were 4.00, 4.17, and 6.07 tokens respectively. Two-sample t-tests found that while the mean initial experimental token contribution was not significantly different than the mean control token contribution, the mean final experimental contribution was significantly different than both the control and initial experimental decision.

A histogram of the distribution of the difference between initial and final experimental token contributions can be found in the Appendix as Supplemental Figure 7. Specifically, the final experimental mean contribution was 1.91 tokens higher than the initial experimental mean contribution. This change was found to be significantly different ($\alpha = 0.01$) than no change in a one-sample t-test, matching the results of the two-sample paired t-test.

Thus, there are two main results: (1) the mean control token contribution did *not* significantly differ from the mean initial experimental token contribution, and (2) the mean control token contribution *did* significantly differ from the mean final experimental token contribution. Result

(1) indicates that prior to any exposure of peer pressure, participants initially make the same decision. This establishes the validity of result (2), where once participants are presented with a confederate where everyone (except the participant) contributes all 10 of their tokens to the group, the participants increase their own contribution to the group. The participants are choosing to conform to match their token allocation closer to the other members of their "group". This concept of conformity is discussed further in section 5.2 and 5.3.

4.1.2 Middle of experiment (Round 2 and 3)

In round 2, the respective means for the control, initial experimental, and final experimental decision were 4.38, 6.41, and 3.76 tokens. Two-sample t-tests found that there was a significant difference between the control and initial experimental decision, but no significant difference between the control and the final experimental decision.

The results of round 2 inverted the results of round 1: (1) the mean control token contribution was significantly different than the mean initial experimental token contribution, and (2) the mean control token contribution was not significantly different than the mean final experimental token contribution. Result (1) indicates that people wanted to appear as though they were contributing highly to their group. Result (2) indicated that they did not actually want to contribute that highly to their group. We speculate that people are exhibiting conformity in this fashion, where they wish to appear as though they are cooperating with the group. However, we cannot speak to the motivation of the participants whether this was influenced *normatively* or *informatively*.

In round 3, the respective means for the control, initial experimental, and final experimental decision were 4.03, 5.79, and 4.02 tokens. Two-sample t-tests found a significant difference

between the control and experimental initial decision, while no significant difference between the control and the experimental final decision. This round continued the differences seen in round 2.

4.1.3 End of Experiment (Round 4 and 5)

In round 4, the respective means for the control, initial experimental, and final experimental decision were 3.45, 5.21, and 4.63 tokens. Two-sample t-tests found a significant difference between the control and experimental initial decision. The respective means in round 5 were 2.79, 5.22, and 4.94. Two-sample t-tests found significant differences between the control and both experimental decisions, but no significant difference between the initial and final experimental decisions.

Overall, results of rounds 4 and 5 depict a convergence of the mean initial and mean final experimental token contribution and the divergence of the mean experimental contribution and the mean control contribution. Specifically, in round 5, the experimental final token contribution is 2.43 tokens higher than the control token contribution. This result emphasizes that the methodology's induction of conformity causes the willingness to pay to converge at a higher point than the willingness to pay without a constant conformity pressure. Further, while round 5's experimental initial and final mean token contributions have no significant difference, fewer people change their decisions at the end of the experiment as opposed to the beginning of the experiment.

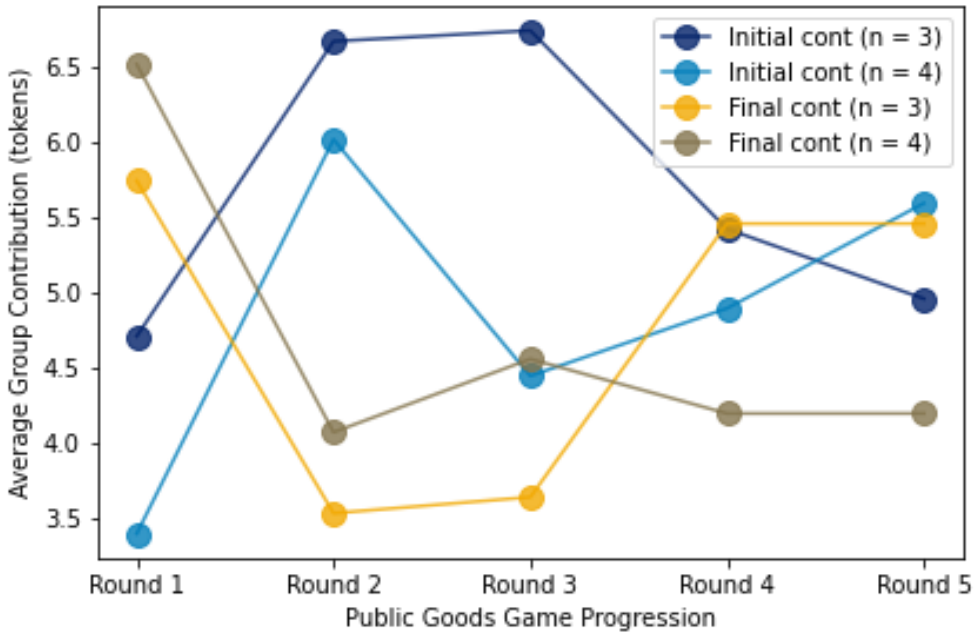
4.1.4 Group size

In the previous graph and justified by this study's payoff methodology in holding MN constant, groups of size 3 and 4 are pooled to calculate the mean values. Thus, we investigate whether

pooling the data across group sizes significantly altered our results in the experimental condition (Figure 2).

Figure 2

Initial and final experimental mean token contribution across group sizes of 3 and 4



	N = 3, initial tokens, μ (sem)	N = 4 initial tokens, μ (sem)	N = 3 final tokens, μ (sem)	N = 4 final tokens, μ (sem)
Round 1 ‡	4.71 (0.41)	3.40 (0.38)	5.75 (0.59)	6.52 (0.65)
Round 2	6.68 (0.52)	6.02 (0.70)	3.54 (0.60)	4.08 (0.84)
Round 3 ‡	6.75 (0.62)	4.45 (0.92)	3.64 (0.62)	4.56 (0.96)
Round 4	5.43 (0.69)	4.90 (1.00)	4.57 (0.74)	4.70 (0.97)
Round 5	4.96 (0.75)	5.60 (0.99)	5.46 (0.74)	4.20 (0.97)

‡ There is a significant difference between N =3 and N =4 initial mean token contributions.

* There is a significant difference between N =3 and N =4 final mean token contributions.

When testing with two-sample t-tests, group size only had a significant difference two conditions: the round 1 initial experimental contribution and the round 3 initial contribution. In round 1, groups of size 3 had a mean token contribution of 4.71 while groups of size 4 had a mean token contribution of 3.40. In round 3, groups of size 3 had a mean token contribution of 6.75 while groups of size 4 had a mean token contribution of 4.45. No significant differences between group sizes of 3 and 4 were found in the final contribution token amount.

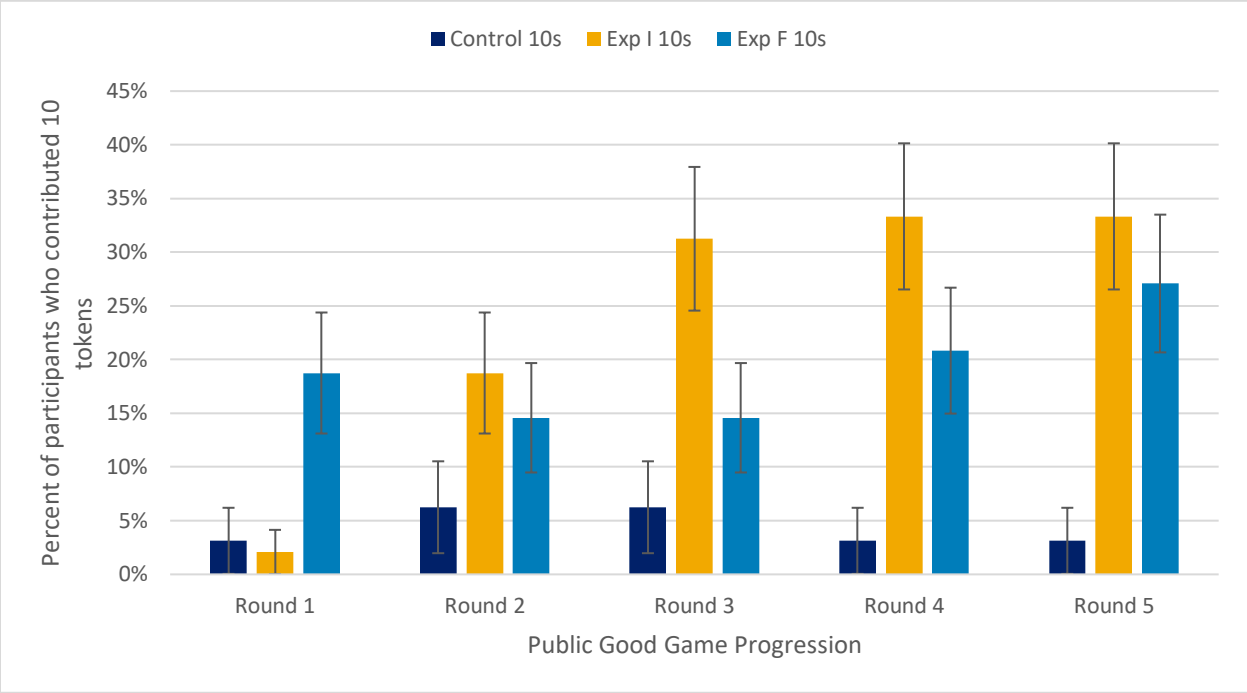
While previous psychological literature finds that majority size effects conformity (Asch, 1955; Insko *et al.*, 1985; Latane, 1981; Rosenberg, 1961), previous experimental economic literature did not draw a straightforward conclusion whether group size significantly affects contributions (Zelmer, 2003; Nosenzo *et al.*, 2015; Lugovskyy *et al.*, 2017). This study, which exists at the cross section of both fields, subsequently investigated group size in whether it effects the contributions seen in the experimental condition. We find that group size only exhibited a significant effect in the initial decision, and only within round 1 and round 3 of decision making. This adds to the existing experimental economic literature as group size does not have a straightforward relationship with contributions, especially given the setting of conformity in the experimental condition. In this study, we must consider the willingness to pay in the initial contribution of round 1 in the context of group size – specifically, people in a group size of 3 contributed significantly more tokens than people in a group size of 4. Further, it is important to remember the specifications of the game, where the value of MN is fixed to 1, implying that the MPCR for the group size of 3 is higher than the MPCR for the group size of 4. Thus, this increase in contribution may instead be attributed to the increase in MPCR, which is consistent with previous literature indicating that increasing MPCR correlates with increasing contributions in a one-shot public goods game (Zelmer, 2003; van den Berg *et al.*, 2021).

4.2 Quantifying the probability or proportion of fully conforming participants

To investigate hypothesis (2), where we expect to see that the amount of people conforming in psychological literature should be consistent with the proportion of conformity in an economic decision, we analyze the proportion of participants who fully conformed in the experimental game. Subsequently, this is done by counting the number of participants who had full contributions towards the group, or in other words, contributed all 10 tokens to the group (Figure 3).

Figure 3

Proportion of people who had full contributions to the group (10 tokens)



	Control 10 proportion n = 32	Initial exp 10 proportion n = 48	Final exp 10 proportion n = 48
Round 1 [2,3]	0.0313	0.0208	0.1875
Round 2	0.0625	0.1875	0.1458
Round 3 [1,3]	0.0625	0.3125	0.1458
Round 4 [1,2]	0.0313	0.3333	0.2083
Round 5 [1,2]	0.0313	0.3333	0.2708

Superscripts indicate the results of a hypothesis test ($\alpha = 0.05$) where:

[1] There is a significant difference between control and initial experimental decision.

[2] There is a significant difference between control and final experimental decision.

[3] There is a significant difference between initial experimental decision and final experimental decision.

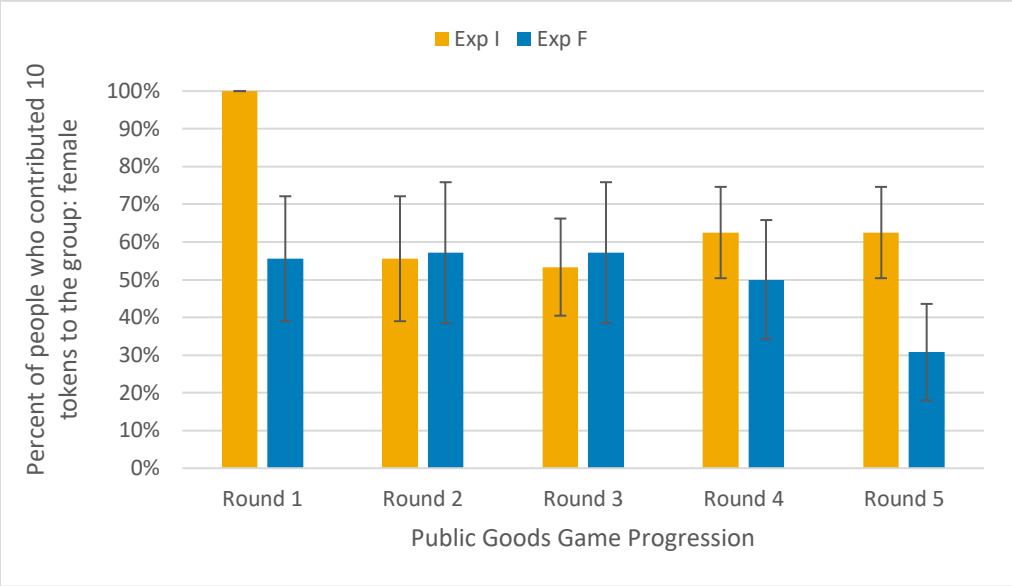
There is a significant difference between the initial and final experimental proportions of people who fully contributed their tokens, increasing from 0.02 to 0.19 (from 1 to 9 participants) or approximately 17% (8/48) of the sample. Results from round 1 may be used to directly estimate a proportion of people who conform in the face of a unanimous small group. This proportion could suggest that when *immediately* faced with a unanimous spending decision, either: (1) the chance that someone conforms is 17%; or (2) the amount of people who conform is 17% of the population.

There is a significant difference between the control proportion and both experimental decisions of people, increasing from approximately 3% of the control sample to 33% of the initial experimental proportion or 27% of the final initial proportion. Overtime, while participants seem less likely to change their token contributions between the initial and final experimental decisions, the experiment proportion of people who fully contribute converges significantly above the control proportion of people who fully contribute their tokens. Specifically, this increase is approximately 24% from the control to the experimental final decision in the final iteration of the game. This proportion suggests that when facing *constant, unanimous* pressure to conform, in the *long-term,* either (1) the chance that someone fully conforms is 24%, or (2) the amount of people who fully conform is 24% of the population.

The number of conforming individuals was further broken down by gender and ethnicity. These variables are of interest in this study as they are represented at disproportionately, where this study has an excess of female participants in comparison to male participants and an overrepresentation of Asian participants. These analyses are based on isolating the people who had fully contributed their tokens to the group and grouping them by gender (Figure 4) and race or ethnicity (Figure 5).

Figure 4

Proportion of people who had fully contributed to the group who were female



	Initial exp 10 proportion: female	Initial number exp 10s	Final female exp 10 proportion: female	Final number exp 10s
Round 1	1.000	1	0.556	9
Round 2	0.556	9	0.571	7
Round 3	0.533‡	15‡	0.571	7
Round 4	0.625	16	0.500	10
Round 5*	0.625	16	0.308	13

‡One participant mistakenly recorded the number in the wrong column.

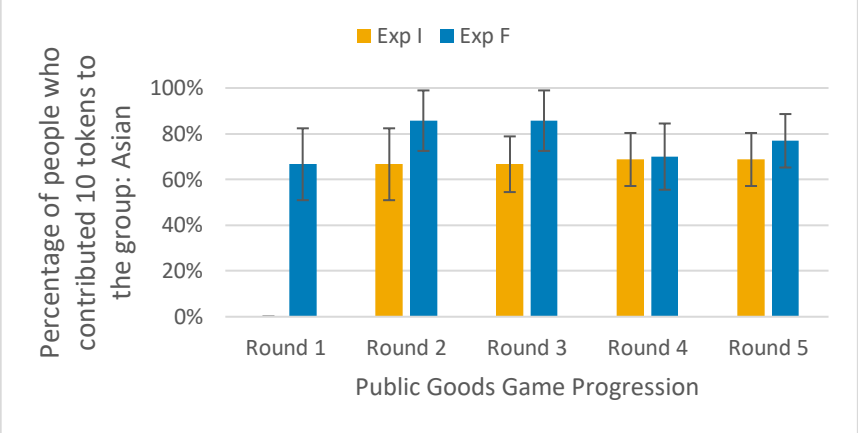
* There is a significant difference ($\alpha = 0.05$) between the initial and final female proportions.

Each initial and final proportion for every round was compared against the inherent proportion of women in the sample (26/48) to determine if the women in the sample behaved disproportionately. No significant differences were found, indicating that the overrepresentation of women did not skew the results of this study.

Further, two-sample z-tests were performed to examine whether there was a significant difference between the initial and final proportion of women who had fully contributed to their group. Only round 5 had a significant difference ($p < 0.05$), where the proportion of females who had fully contributed their tokens to the group in round 5 decreased from 0.625 to 0.308. These results are consistent with literature, in which women are more likely to change their decision compared to men as the game progresses (Cadsby and Maynes, 1998).

Figure 5

Proportion of people who had fully contributed to the group who were Asian



	Initial exp 10 proportion: Asian	Initial number exp 10s	Final exp 10 proportion: Asian	Final number exp 10s
Round 1	0	1	0.6667	9
Round 2	0.6667	9	0.8571	7
Round 3	0.6667‡	15‡	0.8571	7
Round 4	0.6875	16	0.7	10
Round 5	0.6875	16	0.7692	13

‡One participant mistakenly recorded the number in the wrong column.

Each initial and final proportion for every round was compared against the inherent proportion of Asians in the sample (32/48) to determine if the Asians in the sample behaved disproportionately.

No significant differences were found, indicating that the overrepresentation of Asians did not skew the results of this study.

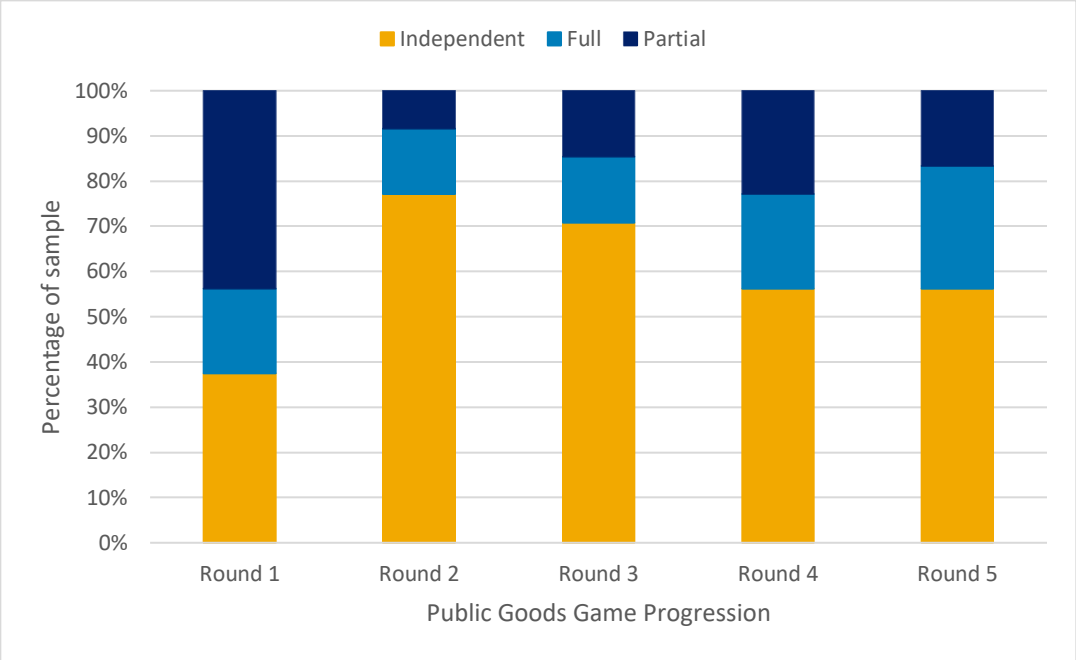
Further, two-sample z-tests for each round were performed to examine if there was a significant difference between the initial and final proportion of Asians who had fully contributed to their group. No significant differences were found, indicating that Asians tended to not change their decision.

4.3 Partial conformity and learning behavior

To investigate hypothesis (3), where we expect to see the conformity levels changing overtime, we conduct an analysis of independent, partially conforming, and fully conforming participants over the experimental game. This further captures the varying degrees of conformity and to investigate the learning behavior over time when exposed to a constant conforming pressure. The definitions of these terms utilized for this analysis can be found in Section 3.4.1.

Figure 6

Progression of percentage of partially conforming, fully conforming, independent, and conforming participants (N = 48)



	Fully	**Partially**	**Independent**	**Conforming**
Round 1‡*	19% (9)	44% (21)	38% (18)	63% (30)
Round 2*	10% (7)	8% (4)	77% (37)	23% (11)
Round 3*	10% (7)	15% (7)	71% (34)	29% (14)
Round 4	21% (10)	23% (11)	56% (27)	44% (21)
Round 5	27% (13)	17% (8)	56% (27)	44% (21)

Two-sample z-tests for proportions ($\alpha = 0.05$) were performed between each group and round:

‡ There is a significant difference between partial and full proportion.

* There is a significant difference between the independent and conforming proportion.

The percentage of fully conforming participants started from approximately 19 % in round 1 and ended at 27 % round 5. The percentage of partially conforming participants started at approximately 44% in round 1 to 17% in round 3. Overall, the percentage of at least partially conforming participants decreased in round in round 2 and increased in round 5. The percentage of independent participants showed complementary behavior to those who were conforming, increasing from round 1 to round 2 and decreasing from round 2 to round 5.

Two-sample z-tests for proportions between the partial and full conforming proportions only identified a significant difference in round 1. Further z-tests between the proportion of participants who were independent and those who had conformed found significant differences in the first 3 rounds, indicating that the proportion of conforming and independent participants seemingly converges in the middle by the end of 5 decision-making time points.

Overall, this analysis is useful in identifying the learning behavior of participants. In the first decision-making time point, most of the population (63%) conforms to various degrees, where partially conforming people change their contribution to align more closely with the group (44%) while fully conforming people change their contribution to exactly match the group's decision (19%). By the second time point, the majority flips to where most people (77%) are independent. This reflects the mean token contribution data seen in Section 4.1 and depicts a change in attitudes against conformity in the second round. However, by the end of the experiment, the proportion of conforming people and independent people converge to approximately 50% each. This is particularly interesting, as over iterated decision-making time points, people are either independent or conforming, consistent with the experimental literature identifying 'consistent cooperative' and 'consistent defective' personalities (Salahshour, 2021).

4.4 Regression Results

Regression analysis was conducted as a measure of internal validity, specifically investigating whether certain factors may have affected the contribution amount. The final decision in round 1 of how many tokens a participant had chosen to contribute to their group was chosen as the dependent variable for OLS regression analysis. This variable was isolated as it represents the token contribution amount following the participants' first exposure to their confederate group's decisions. In the experimental condition, this meant the first time being shown that all their group members had contributed all 10 of their tokens towards their group. Thus, this decision was most likely to be impacted by peer pressure, as opposed to the following 4 rounds, where the participants were likely to be adapting to this stimulus. As reported in Table 2, this final decision in round 1 was best represented by an exponential relationship with the other variables investigated.

Independent variables investigated include any variable which may affect the levels of conformity as indicated in psychological studies or any variable which may affect the token contribution amount as indicated in experimental economic literature.

Table 2 reports the results of OLS regression modelling of specifications (1) to (5) pertaining to isolated categorical variables, including adjusted independence, gender, group size, family income, and race or ethnicity. Table 3 reports the results of OLS regression modelling of specifications (6) to (11) pertaining to singly isolated numerical variables, including economic class count (ECC), the BFI abridged survey score, and two discrete quantitative variables of the post-game survey questions whether others' decisions and money motivated them (respectively PGS Peers, PGS Money), with 1 representing "Strongly Disagree" and 5 representing "Agree Strongly". Quadratic relationships for ECC and BFI were tested in specifications (10) and (11).

Table 2

OLS regression results – isolated categorical variables

Dep. Var.: Final token contribution, round 1

	(1)	(2)	(3)	(4)	(5)
Indep. [False]	0.849				
	(0.883)				
Gender [Male]		-1.603*			
		(0.856)			
Group size			0.775		
			(0.890)		
Family income [Less than 20,000]				3.778	
				(3.241)	
Family income [Between 80,000 and 200,000]				0.878	
				(1.234)	
Family income [More than 200,000]				1.083	
				(1.255)	
Race/ethnicity [Black or African American]					3.672
					(2.992)
Race/ethnicity [Hispanic]					0.005
					(1.779)
Race/ethnicity [Other]					3.672
					(2.992)
Race/ethnicity [White]					-1.783*
					(1.030)
Intercept	5.595***	6.808***	3.425	6.328***	5.222***
	(0.662)	(0.579)	(3.072)	(0.521)	(1.025)
Observations	48	48	48	48	48
R^2	0.020	0.072	0.037	0.136	0.016
Adjusted R^2	-0.002	0.051	-0.028	0.056	-0.005
F Statistic	0.925	3.510*	0.758	1.694	0.567

**Note: ***p<0.1. **p<0.05. ***p<0.01.

Table 3

OLS regression results – isolated numerical variables

Dep. Var.: Final token contribution, round 1

	(6)	(7)	(8)	(9)	(10)	(11)
PGS Peers	0.211					
	(0.409)					
PGS Money		-0.266				
		(0.418)				
ECC			0.775		-0.955**	
			(0.890)		(0.453)	
BFI				0.090		-0.802
				(0.076)		(0.531)
ECC^2					0.092**	
					(0.044)	
BFI^2						0.014*
						(0.008)
Intercept	5.187***	7.185***	6.304***	3.100	7.703***	16.573*
	(1.775)	(1.804)	(0.759)	(2.551)	(0.988)	(8.318)
Observations	48	48	48	48	48	48
R^2	0.006	0.009	0.003	0.030	0.093	0.088
Adjusted R^2	-0.016	-0.013	-0.019	0.008	0.052	0.047
F Statistic	0.265	0.404	0.140	1.398	2.300	2.170

**Note: ***p<0.1. **p<0.05. ***p<0.01.

The following categorical variables had significant coefficients when isolated and regressed on the final token contribution in round 1: gender [specification (2)], race/ethnicity for participants who identified as white [specification (5)]. These values were -1.603, -1.783, respectively. The numerical variables for ECC and the BFI [specification (10) and (11)] had significant coefficients when regressed on the final token contribution. The R^2 for each specification (1), (2), (5), (10), and (11) is 0.111, 0.072, 0.016, 0.093, and 0.088 respectively. Only the F-statistic for specification (1) was significant where $p < 0.05$, while the F-statistic for specification (2) was significant where $p < 0.1$.

A correlation matrix (Table 4) was calculated for all quantitative variables, prior to combining all variables of interest in combined models [specification (12) to (13)] (Table 5). In specification (12), an interaction between PGS Peers and Gender was added, and in specification (13), a quadratic relationship for PGS Peers and PGS Money were investigated.

Table 4

Correlation matrix of quantitative variables

	FTC R1	BFI	ECC	PGS Money	PGS Peers
FTC R1	1.00	0.17	-0.06	-0.09	0.08
BFI	0.17	1.00	-0.15	-0.02	0.02
ECC	-0.06	-0.15	1.00	0.22	-0.00
PGS Money	-0.09	-0.02	0.22	1.00	-0.09
PGS Peers	0.08	0.02	-0.00	-0.09	1.00

FTC R1 stands for final token contribution round 1. No strong correlations between quantitative variables were found in this matrix.

Table 5

OLS Regression Results – combined specifications

Dep. Var.: Final token contribution, round 1

	(12)	(13)	(14)
Indep. [True]	0.595 (1.058)	0.408 (1.039)	0.536 (1.125)
Gender [Male]	-1.247 (1.005)	-6.591 (4.329)	-6.716 (4.540)
Family income [Less than 20,000]	4.503 (3.465)	4.711 (3.270)	4.799 (3.424)
Family income [Between 80,000 and 200,000]	1.613 (1.391)	0.979 (1.359)	0.769 (1.512)
Family income [More than 200,000]	1.699 (1.417)	1.566 (1.429)	1.468 (1.502)
Race/ethnicity [Black or African American]	4.039 (3.336)	4.897 (3.170)	4.869 (3.297)
Race/ethnicity [Hispanic]	0.312 (2.097)	-0.776 (2.127)	-0.482 (2.327)
Race/ethnicity [Other]	4.561 (3.778)	7.009 (4.150)	8.493 (5.696)
Race/ethnicity [White]	-1.740 (1.192)	-1.615 (1.171)	-1.659 (1.213)
PGS Peers	0.318 (0.499)	-0.669 (0.624)	1.172 (4.704)
PGS Money	0.227 (0.528)	-0.091 (0.514)	0.049 (2.438)
ECC	0.024 (0.180)	-0.745 (0.521)	-0.760 (0.539)
BFI	0.107 (0.087)	-1.151* (0.617)	-1.148* (0.637)
ECC ^{2}		0.075 (0.047)	0.078 (0.051)
BFI ^{2}		0.020** (0.010)	0.020* (0.010)
PGS Peers: Gender [Male]		1.437 (0.997)	1.487 (1.052)
PGS Peers ^{2}			-0.256 (0.645)
PGS Money ^{2}			-0.028 (0.353)
Intercept	-0.796 (4.062)	25.197 ** (11.648)	22.019 (15.239)
Observations	48	48	48
R^2	0.229	0.437	0.440
Adjusted R^2	0.032	0.146	0.092
F Statistic	1.118	1.501	1.264

Note: *p<0.1, **p<0.05, ***p<0.01

Following these combined specifications, an F-test (F-stat = 2.841, $p < 0.10$) was performed to evaluate if ECC and BFI had quadratic relationships with final token contribution in round 1, indicating with a relatively low power that there may be a quadratic relationship present. A Breusch-Pagan test for heteroskedasticity was performed on the combined model [specification (10) and the combined model including squared values [specification (10)] (LM = 8.81 and 13.60,

$p > 0.05$; F-stat = 0.59 and 0.77, $p > 0.05$ respectively). Thus, for both models, the variance is constant and homogenous or homoscedastic.

The model with the greatest predictive power is specification (13), with an R^2 of 0.437 and an F-stat 1.501, indicating that the presence of coefficients is not better than a model without the coefficients. Specification (14) decreased the F-statistic from specification (12). Only the quadratic coefficient of BFI was found to be significant at ($p < 0.05$) in this specification.

5. Discussion

5.1 Quantifying the duration and degree of conformity

Evaluating whether the payoff methodology altered the game results is key to establishing the integrity of the experimental methodology. In the control condition of the public goods game, the mean token contribution began at 4.00 tokens (0.40 of the initial endowment) and decreased to 2.79 (0.279 of the initial endowment), consistent with literature (van den Berg *et al.*, 2021). Thus, this study's control condition replicates previous experimental literature, indicating that the payoff methodology employed by this study did not alter the behavior of participants.

A simple explanation to the behavior where people change their contributions may simply be *mimicking*, where participants see 10s and write 10s. If this explanation were to be true, then the number of participants who contribute all their tokens should remain relatively the same for the entirety of their initial decision and the entirety of their final decision, causing the mean token contributions between each round to remain relatively stable. Results from the ANOVA tests indicate that the variance between group means exceeds the variance between observations, the mean token contributions were not the same across the five rounds for both the initial and final

experimental condition. Because varying numbers of people have placed differing values for the initial and final values, the alternative mimicking explanation is not likely. Further, mimicking may be a form of conforming, in which people do not evaluate their situation yet still alter their behaviors to be in accordance with the group.

5.1.1 Beginning of the experiment (Round 1)

Round 1 highlights the effects of peer pressure, as illustrated by a spike in group contributions. In this experiment, the mean token contribution is representative of the willingness to pay to match their groups' dynamics. Specifically, round 1 showcases that when faced with a unanimous group, a participant's willingness to pay immediately increases by approximately 50% (1.91 tokens) from the original willingness to pay (4.00 tokens) or 20% from their total endowment (10 tokens). Alternatively, this number could represent a proportional increase, where given constant conformity pressure, the proportion of people willing to pay increases by 20%. This number further alludes to the existence of partially conforming individuals, discussed further in Section 5.3.

5.1.2 Middle of experiment (Round 2 and 3)

Round 2, where the initial and final token contribution amounts invert from their values in round 1, is essential in the progression of conformity over time: the immediate effects of conformity on inflating willingness to pay lasted only one decision period.

This change in behavior may have two possible explanations, as suggested by the free responses that participants provided in the post-game survey. First, the participants may have been suspicious of the behavior of their group and may have realized their group was comprised of confederates or manipulated data. One short response in the post-game evaluation is indicative of this, where the

participant wrote, “I think we got tricked as the contribution of my teammates every round is 10, so to maximize my own earning I contribute[d] 0 to the group.” However, we also have participants who were suspicious of their group, yet came to an alternate conclusion, such as a participant who indicated, “Initially, I was suspicious of committing all 10 of my tokens to the group project due to the anonymity of the experiment. After I saw in the 2nd round that my team continued to contribute 10 tokens, I did too, wanting to be cooperative with the group.” Thus, we cannot determine whether this first reason caused the behavior to change. Practically, whether the participants deduced the existence of confederates does not alter the consequences of their decisions. This is as indicated in literature where people receive a barrage of suspicious or otherwise harmful (to self-image) product endorsements daily and continue to cave into consumerism (Hill, 2011; Zhang 2021). The second possible explanation may simply be that the short-term effects of conformity itself do not last more than one round. We investigate how conformity changes over time further in section 5.2 and 5.3.

5.1.3 End of Experiment (Round 4 and 5)

Rounds 4 and 5 highlight how in the long-term, when faced with constant and unanimous pressure towards a decision, the mean token contribution settles at a higher point than without the unanimous pressure. Thus, this may allude to the long-term effects of constant positive product endorsements, as the willingness to pay increases by 2.43 tokens from the original 2.79 tokens (approximately 87%).

5.1.4 Group size

The difference between group sizes in the initial decisions cannot alone affect the definition of conformity we use. The definition of conformity depends on whether participants are changing their initial decision to a final contribution. As there are no significant differences between group size in the final experimental contribution, we pool the data between both group sizes of 3 and 4. Group size is investigated further in Section 5.4 utilizing OLS regression analysis.

5.2 Quantifying the probability or proportion of conformity

In the control condition, there were always one or two participants who decided to contribute their entire endowment to the group. One of these participants indicated that they "decided to cooperate" as they were "playing multiple times", choosing to fully contribute their tokens to the group in the first 3 rounds, then reversing this decision and keeping all tokens in the last 2 rounds. This is likely to have been a mistake by the participant in developing a strategy to maximize profits at the beginning of the experiment. This may have skewed the direction of our conformity estimates where they may underestimate the number of fully conforming individuals, discussed further in the next section.

5.3 Partial conformity and learning behavior

Overall, this analysis sheds light into a branching of learning behavior. People have an approximately equal chance of either being independent or conforming by the end of five iterated decision-making time points. This trend is one where the people who conform, or purchase the good of conformity, increases non-linearly over iterated decisions. Subsequent, this study is consistent with the existing marketing literature where increased advertisement exposure non-linearly increases purchasing intention (Sawyer, 1973; Tellis, 1988; Hoban and Bucklin, 2015).

In the previous section, conformity was measured by the difference in proportion of people who contributed 10 tokens between the initial and final decision. However, this failed to capture the participant who initially contributed 10 and changed her final contribution to 0, losing a point of data in the fully conforming data. All participants where the change between initial and final decision was ≤ 0 did not have a final contribution of 10. Conformity as portrayed in this section may be more accurate, while in the previous section, the control group may skew the level of conformity downwards.

These learning behaviors have practical implications on companies who wish to model behavior overtime more accurately. Businesses should expect that the proportion of people who conform to purchasing these goods increases non-linearly over purchasing decision-making time points. Overall, given a constant pressure to conform to purchasing a good overtime, people who are not willing to pay are simply not willing to pay, while those who are willing to pay will continue to be.

5.4 Regression Results

First, we consider specifications (1) through (11), where variables are isolated against the FTC, R1. All specifications exhibited low predictive power, with the maximum R^2 within these specifications valued at 0.136. While several coefficients were found to be significant [specification (2), (5), (10), and (11)], the F-statistic was only significant ($p < 0.10$) for specification (2). Thus, only the coefficients for the male gender ($p < 0.10$) are interpreted: people who are male contribute 1.603 tokens less than females in the final token contribution of round 1.

Several isolated variables found to be insignificant are interesting. First, whether the participant is independent at the end of the survey is not correlated with the final token contribution in round 1. Further investigation could use logit regression modelling to predict whether a person is independent based on their contributions in each round. Second, group size was not significantly correlated with the final token contribution in round 1. This supports the pooling between group sizes as done in previous section and is consistent with some experimental economic literature (Zelmer, 2003).

Combining all variables in one model led to greater predictive power, but no combined specification [specification (12) to (14)] entailed coefficients with more significance than a model without any coefficients, as indicated by the p-value. Thus, while the coefficient for a quadratic relationship between the BFI personality test is significant, it neither has predictive power or overall significance when combined in a specification with all other variables of interest. These findings are consistent with experimental literature, indicating that the BFI personality test generally is not indicative of token contributions (Lang *et al.*, 2018).

5.5 Study design, strengths, and limitations

5.5.1 Study design specifications

The study design specifications limit the applicability of this paper's findings. This study design had several key features.

First, subjects in the experimental group faced a *unanimous* group decision. In practicality, this is an attempt from the methodology standpoint to mirror how people face a barrage of advertisements

from brands to induce consumer behavior (Valkenburg and Buijzen, 2005; Hill, 2011; Zhang, 2021).

Second, the *group size* was pooled across this experiment, where MN is fixed to a constant value of 1. Thus, it may be of interest to generate a larger sample and to control for the effects of group size with a fixed MPCR value, as majority size in psychological literature affects the rate of conformity (Asch, 1955; Insko *et al.*, 1985; Latane, 1981; Rosenberg, 1961).

Third, the task was conditionally *objective*, where there was a clear economic solution. This solution is discussed in Section 3.4.2, where the dominant strategy to maximize individual profits is to contribute no tokens in each round. However, only participants who either met the conditions would know this objective solution, as they could either have (1) calculated this solution at the beginning of the experiment, or (2) had prior knowledge in VCM methodologies. *Task objectivity* generally leads to less conformity (Asch, 1955; Deutsch and Gerard, 1955), which is consistent with the result from this experiment where participants who had taken more economic classes generally contributed less tokens.

Fourth, the *age* of the sample was fixed to participants ranging from 18 to 23 years of age, or primarily included in the Gen Z generation. This age group of participants may have different competencies compared to older generations, leading to differing levels of conformity (Wijenayake *et al.*, 2021).

Group identities were kept *anonymous* (each actor was private), but the decisions in the experimental condition were dispersed among confederates. This creates a form of social presence, which in previous psychological literature, increases levels of conformity (Wijenayake *et al.*,

2021). However, there was no discussion allowed, which lowers levels of conformity (Wijenayake *et al.*, 20221).

Interestingly, for select groups in the experimental condition, the real group members' (from randomizing participant numbers) contributions matched the confederate group members' contributions. Thus, this methodology does not comprehensively capture the dynamics of conformity, and subsequently may not completely represent the nature of conformity over time. Specifically, we utilized a *constant* conforming pressure for each round. Whereas practically, conforming pressure is generally not *constant* over time.

5.5.2 Strengths

This study successfully captured several quantifiable properties of conformity in economic decision-making. The strengths of this study include its isolation of conformity methodology, simplicity in design, quantitative and qualitative metrics, novelty, and relevance to real-world consumer behavior.

First, this study successfully isolated conformity utilizing a non-traditional VCM public goods game payoff methodology. Specifically, this study utilized a simple change to the standard public goods game payoff methodology, where instead of parameterizing a multiplicative factor, a group average was calculated. The implications of this isolated conformity as a motivating factor, as discussed in Section 3.4.2. Further, while the payoff methodology was non-traditional, the control condition found that people still behaved consistently with previous literature (van den Berg *et al.*, 2021) in contributing around 0.40 to 0.50 of their total endowment in the first round and around 0.20 to 0.30 of their endowment by the end of the experiment.

Second, the design of this study was simple. The design entailed a simple public goods game that could be implemented and designed quickly. Participants had a fair understanding of the game and understood the rules efficiently. Most sessions lasted a total of twenty minutes, which benefited the recruitment of this study. Although initially designed to be implemented on computers, we were also successful in converting the computerized public goods game to a paper version.

Third, the surveys employed by this study generated both quantitative and qualitative data from participants. Qualitative values included utilizing the BFI personality test and employing a post-game survey to solicit free-response descriptions of the motivations behind the decision-making during the experimental games. Quantitative values were collected from the public goods game, which were subsequently able to quantify varying levels of conformity. The usage of the public goods game design further allowed us to investigate the learning behavior of participants over the progression of the game.

Lastly, this study's primary strength lies in its novelty and relevance to conformity in modern day consumer culture. Although there is an extensive body of research investigating factors that determine conformity, there is a gap in the literature when it comes to quantifying the level of conformity exhibited and how that number evolves overtime. Specifically, when facing conformity pressure in the short term, a subject's willingness to pay increases by approximately 50% of their willingness to pay without that pressure. Overtime, when facing constant conformity pressure, a subject's willingness to pay increases by approximately 87% of their willingness to pay without that pressure. Further, approximately 63% of people exhibit some degree of conformity immediately in response to conformity pressure. Lastly, given repeated exposure to a conformity

pressure learning behavior converges to where half of the sample becomes independent while the other half conform.

5.5.3 Limitations

Despite this paper's novelty and relevance, this study faced several shortcomings that can be addressed and improved upon in future extensions.

First, the sampling of this study could be expanded and improved. Although this study was able to recruit a sample size greater than 30 per treatment group, a larger sample would improve the statistical power of the study and may yield more significant findings. Further, the sampling method was not truly random – many students participated due to extra credit incentives or association with the research team. This may have biased the nature of the participants recruited. Namely in this study, there was an overrepresentation of the "Asian" demographic and underrepresentation of other demographics, such as those from low approximate family income brackets.

Second, the survey method could be expanded and improved. The survey components of this study relied exclusively on self-report data, which may not be as accurate or precise as more objective metrics. Consequences of such may have surfaced in the study, such as when BFI coefficients in different specifications of the regressions analysis contradicted each other. Time restrictions also limited the BFI element of the survey to items pertaining to *Agreeableness*, without the use of a control variable. If this study were to be repeated, we advise future research to allot enough time for the full BFI survey and other non-self-report measures.

Order effects present another potential issue with this study. The survey was presented simultaneously as the public goods game, so that the participants could take the survey while waiting for the research team to collect decisions, to finish each session as quickly as possible. This may have caused certain order effects, where people being asked whether they "*like to cooperate with others"* may influence whether they actually cooperate with others. Although this was consistent across both the control and experimental groups, future studies may wish to time the delivery of survey items to minimize potential confounding from order effects.

Lastly, this study cannot speak to the motivation behind the conformity of participants. While the did collect qualitative data through the free-response question asking participants to explain "*What motivated your decisions in this game*", the qualitative responses did not provide enough specificity into which behaviors specifically they had been explaining. Several contradicting excerpts are utilized in the discussion section, which although are interesting, are not too helpful in interpreting the motivations behind the decisions. To better address the motivation behind conformity, we could have asked participants they had made the decision after each round, as opposed to just at the end of the overall game. These missed data collection opportunities may have been useful in tracking the qualitative data across each round to better match participant motivations and sentiments to their decision throughout the game.

5.6 Future directions

Based on the strengths, limitations, and specifications of this study, future studies are highly encouraged to further explore the quantification of conformity over time more comprehensively.

This study was restricted by a limited sample size, reliance on self-report data, mishandling of survey questionnaires, missed data collection opportunities, and limited time and recruitment resources. Future studies may subsequently improve upon this current paper by increasing the allotted time and recruitment resources, offering comprehensive surveys, collecting further qualitative data, and testing various levels of conformity pressure. Specifically, the group size and unanimity of the decisions could be altered. More inclusive and representative samples may find more significant variables at play in conformity.

Future variations of this study may choose to investigate the effects of rewarding or sanctioning conformity behavior, as is reflected in the real-world through the acceptance or shunning of individuals who embrace or withdraw from societal trend. This can be done simply by adding an additional reward or sanction to the individuals' profit if their token contribution matches that of their group members. Rewards and sanctions would further support the point at which people are willing to pay to conform to their group. Future studies may also choose to introduce different facets of controlling for conformity and incorporate them one-by-one, instead of all-at-once. Further, it may be worthy to utilize different sizes of endowments. In this experiment, the endowment was 10 tokens and the value of a token was not disclosed to participants during the experiment. Thus, it may be worthy of exploring the effects of different magnitudes of decisions on conformity in economic decisions. Lastly, different models of games may be explored, such as one-shot VCMs which may be able to isolate motivations and conformity differently.

6. Conclusion

This study utilized a simple design to quantify a complicated concept, with the objectives to (1) investigate the proportion of people who would conform to an immediate conforming pressure, (2)

identify the magnitude of the increase in willingness to pay for the good(s) in question, and (3) monitor the change in that behavior over time.

A public goods game model was used where conformity was induced through three facets: making group contributions public anonymously, inducing peer pressure utilizing confederates, and allowing participants to change their decision. The payoff methodology differed from the traditional VCM payoff, employing an average instead of a multiplier. This dramatically shifted the motivations behind decisions in the game: the dominant strategy as predicted with economic models is contributing no tokens towards the public good, and any decision is a socially optimal decision. The advantage of this payoff strategy isolated conformity as the main motivation for token contributions towards the public good.

Establishing conformity as the main motivation for token contribution thus parallels consumer behavior in the market. In this study, participants represent a type of "consumer" while the confederates reflect the conforming pressures present in the marketplace. Consequently, the scale of token contributions – or willingness to pay – uniquely scales the level of conformity or the amount that participants value conforming with their group.

Overall, we find that the proportion of people who fully conform to an immediate conforming pressure is approximately 0.19 and the proportion of people who at least partially conform is approximately 0.6. Further, immediately following conforming pressure, the average willingness to pay increases by approximately 50% of the original willingness to pay. This effect holds true in the long-term, where when facing a constant conformity pressure, an individual's willingness to pay is approximately 87% higher than their willingness to pay without the conforming pressure. Lastly, the learning behavior of participants converges in the presence of constant conformity

pressure, where individuals had an equal probability of continuing to conform or becoming independent over time.

Total regression analysis only indicated that gender significantly affected the final token contribution in round 1, with males giving 1.603 tokens less than females. Future studies should aim to investigate logit regressions alongside OLS regressions in utilizing variables to predict whether an individual either is independent or conforms. It is important to remember that conformity behavior is far more nuanced and complex in practice when compared to this experiment. In this experiment, the conforming pressure was kept constant and induced through a unanimous confederate group. Future experiments should ensure the comprehensiveness and quality of the surveys presented and aim to collect a larger sample size to find more robust results.

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Appendix

Supplemental Figure 1

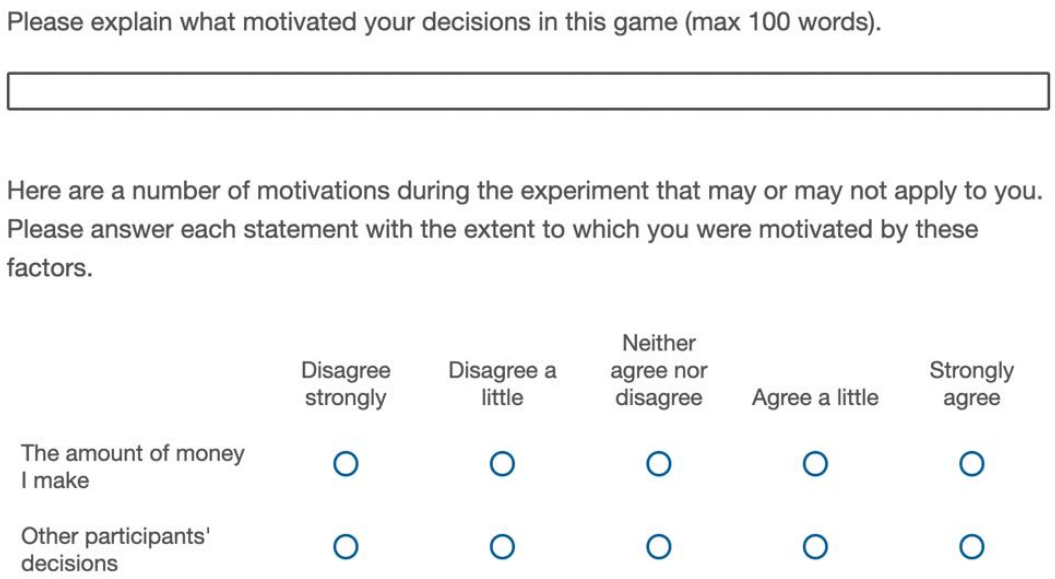
Abridged BFI personality test

Here are a number of characteristics that may or may not apply to you. Please answer each statement with the extent to which you agree or disagree with the statement.

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
Tends to find fault with others	○	○	○	○	○
Is helpful and unselfish with others	○	○	○	○	○
Starts quarrels with others	○	○	○	○	○
Has a forgiving nature	○	○	○	○	○
Is generally trusting	○	○	○	○	○
Can be cold and aloof	○	○	○	○	○
Is kind and considerate to almost everyone	○	○	○	○	○
Is sometimes rude to others	○	○	○	○	○
Likes to cooperate with others	○	○	○	○	○

Supplemental Figure 2

Post-game evaluation



Supplemental Figure 3

Control group public goods game template

ROUND ## – You have 10 tokens to distribute between columns 1 and 2. Once you have made the decision, place the paper at the top of your desk.

Amount to be transferred (1)	Income from kept tokens (2)	Group contributions (3)	Total income (2 + 3)

Once everyone in the session had made their token allocation, the research team collected these numbers and calculated the average group contribution. This number was then written in the "Group contributions" column. Participants were instructed to calculate their total income by adding column (2) and column (3).

Supplemental Figure 4

Experimental group public goods game template

ROUND ## – You have 10 tokens to distribute between columns 1 and 2. Once you have made the decision, place the paper at the top of your desk.

Your contribution to the group [1]	Income from kept tokens [2]

Group member 1 contribution	Group member 2 contribution	Group member 3 contribution	Average group contribution [3]	Total income [2 + 3]

Once you have viewed the other group member decisions, you will be given the chance to change your decision.

Your contribution to the group [1]	Income from kept tokens [2]

Once everyone in the session had made their token allocation, the research team collected these numbers. The token contribution value of each confederate (10) was written in the "Group member contribution" columns, and the average group contribution was calculated based on the confederate numbers. This number was then written in the "Group contributions" column. Participants were instructed to calculate their total income by adding column [2] and column [3].

Once completing all 5 rounds of the public goods game, participants were instructed to complete the post-game evaluation.

Supplemental Figure 5

Control group public goods game participant instructions

This is an experiment in the economics of decision-making. You will be given an identification number at the beginning of the experiment. Only this number, not your name, will be used to identify your answers and decisions.

Matchings: The experiment consists of a series of rounds. In each round, you will be matched with the same group of 4 people (you and 3 other people) for all 5 rounds of the experiment. *You will not know who the other 3 people in your group are.* The decisions that you and the other people in your group make will determine the amount you earn.

Investments: You begin each round with 10 tokens called an "endowment," which may either be kept or invested. The 3 people you are matched with will each decide how many of their tokens to keep, and how many to invest. You will not be able to see the others' decisions until after your decision is submitted.

Earnings: The payoff to you will equal:

(1) The tokens you kept for yourself, "**Income from kept tokens**"
(2) The "**Income from the project**", which is **the average contribution of all group members** (including you)

Your **total income** is therefore: **Income kept from tokens + Income from project**

Compensation:

1) Participants will receive extra credit from participating professors.
2) In addition to professors who will provide extra credit, a random payment method will be utilized. Participation in the study is not required to enter the Raffle. The raffle will randomly select participant, who will be paid depending on the outcomes of their decisions in the game.

Please raise your hand if you have any questions at this point, and an experimenter will be over shortly.

Supplemental Figure 6

Experimental group public goods game participant instructions

This is an experiment in the economics of decision-making. You will be given an identification number at the beginning of the experiment. Only this number, not your name, will be used to identify your answers and decisions.

Matchings: The experiment consists of a series of rounds. In each round, you will be matched with the same group of 4 people (you and 3 other people) for all 5 rounds of the experiment. *You will not know who the other 3 people in your group are.* The decisions that you and the other people in your group make will determine the amount you earn.

Investments: You begin each round with 10 tokens called an "endowment," which may either be kept or invested. The 3 people you are matched with will each decide how many of their tokens to keep, and how many to invest. You will not be able to see the others' decisions until after your decision is submitted.

At the end of each round, we will tell you the amount each member of your group contributed. You will have the chance to change your decision once after you view the others' contributions.

Earnings: The payoff to you will equal:

(3) The tokens you kept for yourself, "**Income from kept tokens**"
(4) The "**Income from the project**", which is **the average contribution of all group members** (including you)

Your **total income** is therefore: **Income kept from tokens + Income from project**

Compensation:

3) Participants will receive extra credit from participating professors.
4) In addition to professors who will provide extra credit, a random payment method will be utilized. Participation in the study is not required to enter the Raffle. The raffle will randomly select participant, who will be paid depending on the outcomes of their decisions in the game.

Please raise your hand if you have any questions at this point, and an experimenter will be over shortly.

Supplemental Table 1

Descriptive statistics: Participants' gender by experimental treatment

	Male	Female	Total
Control	11	21	32
Experimental	22	26	48
Total	33	47	80

Supplemental Table 2

Descriptive statistics: Participants' approximate family income

	Family Income
4	Lower than $20,000
16	Between $20,000 and $80,000
29	Between $80,000 and $200,000
31	More than $200,000
80	Total

Supplemental Table 3

Descriptive statistics: Participants' race or ethnicity

	Race or Ethnicity
50	Asian
3	Black or African American
8	Hispanic
20	White
1	Other

Participants could indicate more that they identify with more than one race or ethnicity.

Supplemental Table 4

Descriptive statistics: Participants' post-game survey whether they were motivated by others' decisions

	Post-game survey: peers
4	Disagree strongly
5	Disagree a little
8	Neither agree nor disagree
26	Agree a little
36	Agree strongly
1	Did not indicate
80	Total

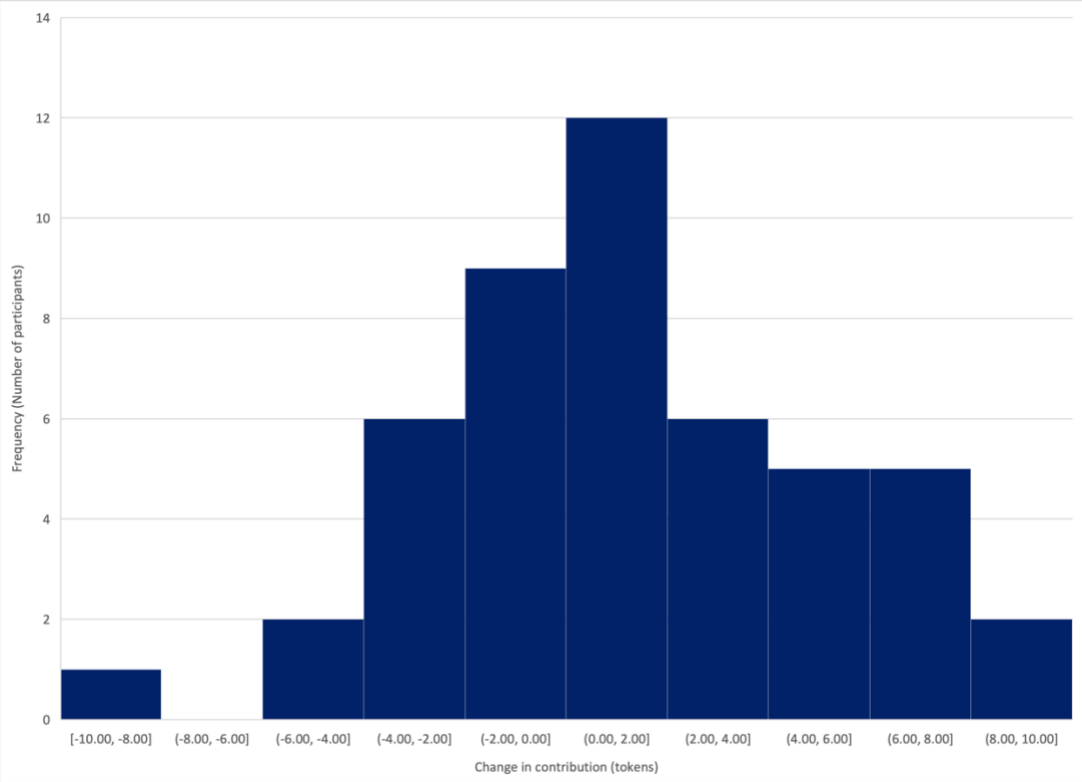
Supplemental Table 5

Descriptive statistics: Participants' post-game survey whether they were motivated by money

	Post-game survey: money
3	Disagree strongly
8	Disagree a little
6	Neither agree nor disagree
26	Agree a little
36	Agree strongly
1	Did not indicate
80	Total

Supplemental Figure 7

Distribution of the difference between initial and final token contributions (n = 48)



The mean of the change in contribution was calculated as the initial token contribution subtracted from the final token contribution (Exp F – Exp I). The mean of the change in contributions was calculated to be 1.91, with a standard error of 0.59. A one-sample t-test was conducted to see if this change in contribution differed from 0, resulting in a t-statistic of 3.25 and a p-value of 0.002.