Self-Image and Economic Behavior

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Abstract
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The second paper presents an analysis of PWYW in competition which explains its entry and limited spread in the market. Sellers choose their pricing schemes sequentially while consumers share their surplus. We show that the profitability and popularity of PWYW depend not only on consumers' preferences, but also on market structure, product characteristics and sellers' strategies. While there is no equilibrium where PWYW dominates the market, given a sufficiently high level of surplus-sharing and product differentiation, it is chosen by the second mover to avoid Bertrand competition.

The third paper is motivated by conflicts of self-interests which often lead to expression of emotion to unrelated parties. We study non-instrumental verbal expression in binary ultimatum games, where receivers can comment either privately or to a third-party audience prior to accepting or rejecting the offer. The potential for gossip is sufficient to induce image concerns in senders, resulting in fairer offers in the audience treatment. Consequently, despite insignificant effect on receivers' behavior, the possibility of verbal expression to an audience is found to increase co-operation and hence welfare. There is demand for verbal expression even when it is unobserved or not triggered by negative stimulus. We find no evidence that this is motivated by self-esteem.

In the fourth paper, we manipulate the information subjects can share on the web concerning socially sensitive actions (public good contribution) and visibility (selfie) to determine the effect on social image, as captured by the price subjects demand for publication. The overall conclusion from the experiment is that theory about social reputation can predict subjects' social-signaling behavior. People take costly decisions to "filter" information about themselves (in retrospect) before it is published. We also report results of a more exploratory nature and find that taking a selfie has a strong negative impact on cooperation among frequent selfie takers, but not on other subjects.

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Abstract

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Lund, 21 December 2016
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Introduction

1 Background

Standard economic theory is based on the assumption that humans are rational and that such rationality is motivated by pure self-interest. While this theory has the advantage of simplicity, there are numerous empirical anomalies that cannot be accounted for by the assumption of rational and purely selfish actors. People often display behavior that is short-sighted or self-destructive, such as not saving enough for retirement or having unhealthy eating habits. On the other hand, they are also more pro-social than predicted by theory: people donate to charity, volunteer their time to help strangers on online discussion forums, recycle and vote.

The supposed irrationality of pro-social actions is the focus of this thesis. The behaviors displayed in the above-mentioned examples suggest a natural interpretation that humans are altruistic, an assumption that has been incorporated into more recent models of economic behaviors. The decision-maker is assumed to have other-regarding preferences where she cares not only about her pure material outcomes, but also the consequences of her actions on others.

Nonetheless, there are also many behaviors that cannot be explained solely by other-regarding preferences. As argued by Andreoni (1988), if people are purely altruistic and incorporate the welfare of others into their utility for decision-making, charities should not exist in rich economies where the presence of social welfare policy removes the need for private giving. Hence the desire to still contribute to charity must present an additional private benefit to the agent, a type of "warm glow" which implies impure altruism (Andreoni, 1990) where people give to char-

ity because they "feel good".

What actually contributes to this feel-good factor? To start with, visibility seems to matter. Charitable donations are often rewarded with small visible tokens of appreciation, such as pins or bracelets, which donors willingly display to their peers. Larger donations attract naming rights for cultural or educational facilities. When generosity is a trait that is valued in society, people derive pay-offs when they are perceived by others as possessing that social trait. Social image or the approval of others can therefore be a sufficient motivation for agents to act prosocially. Ellingsen and Johannesson (2008) for example argue that sensitivity to others' approval and disapproval, and hence image-seeking behavior, can indeed be motivated by evolutionary arguments regarding partner selection: individuals who can signal favorable characteristics have superior mating capabilities and hence a better chance of survival. Hence it is not surprising that people are sensitive to the "audience effect" and the "chilling effect": knowing that others are watching leads people to take their public reputation into account and thus behave more prosocially or refrain from behavior that is considered antisocial or deviate from the social norms.

What about when no-one is watching? When social reputation should not matter, should people be expected to act selfishly? Even if the degree of publicity is important, some people make donations to charity also when they are fully anonymous.[1] One interpretation is that people care not only about the image they project to others, but also their self-image: they do not want to think of themselves as selfish and consequently undertake actions that signal their pro-sociality to themselves. We appeal to the same argument used above: when an individual values a particular trait, she derives pay-offs from knowing that she conforms to that ideal. While it is easy to manipulate self-assessment of moral values, past actions are a more reliable signal to the self that one is "the kind of person who behaves in this way" (Bénabou and Tirole, 2006, p. 1657). Hence, as Batson (1998) writes, "The ability to pat oneself on the back and feeling good about being a kind, caring person, can be a powerful incentive to help". Moreover, the need to maintain coherence between action and value when pro-social action is costly has been shown to result in "willful ignorance" where an agent actively avoids information that may reveal the negative consequences of the chosen action to the self, thus creating a moral "wiggle room" to behave selfishly (Dana et al., 2007). To continue with the example of charitable giving, donors avoid information that can reveal the inef-

[1] However, the social image factor is likely to be a stronger motivation for giving, as anonymous donations only make up a mere 1% of charitable donations (Glazer and Konrad, 1996).

fectiveness of charities to maintain their self-image from contribution (Niehaus, 2014).

The role played by image concerns in economic decisions, as discussed above, call for approaches to modelling behavior that depart from standard economic theory. Bénabou and Tirole (2006) model an agent who derives reputational gain from being perceived as pro-social and having low concerns for material incentives, where the reputation, and hence social image, increases the more visible her pro-social act is. The model has a straightforward self-signaling reinterpretation where the visibility of the pro-social act translates to the salience or ease of recall of the action. This model allows us to parse out the utility of various components of image, including the reputationally sensitive content and the increase in visibility, as done in the fourth paper of this thesis.

The utility derived from self-image is formally modeled in Brekke et al. (2003) where each individual experiences moral satisfaction from conforming to the morally ideal action. In this model, each individual sets an internal benchmark for contribution to a public good by maximizing total welfare assuming everyone else acts the same way. Self-image is then derived by choosing an effort level that matches the socially optimal effort level. She then maximizes her own utility which incorporates self-image as well as other material components, including consumption of private goods, leisure and the public good itself. Samahita (2013) extends this model by assuming a concave and monotonically increasing self-image function, allowing agents to "buy" image by contributing more effort or money to the public good. This extension allows us to rationalize over-contribution to public goods, such as participating in voluntary tourism when non-participation is morally ideal, and overpaying for green products (Nyborg et al., 2006) or in a voluntary pricing scheme as studied in the first paper of this thesis.[2]

2 Contribution of the Thesis

In light of the presence of image concerns for decision-making, many other seemingly irrational behaviors can now be rationalized. This thesis contains four papers that study image concerns and their economic implications in three unique set-

[2]In voluntary tourism, or "voluntourism", participants from developed countries go on a working holiday to developing countries where they perform activities such as building houses, schools or other infrastructure with the aim of contributing to the local community.

tings. Specifically, the first and second papers concern a voluntary pricing scheme called "Pay-What-You-Want" (PWYW) and present theoretical models to explain consumer and firm behaviors when consumers have non-standard preferences, such as self-image concerns. The third paper is a laboratory experiment studying self-image maintenance as a motivation for verbal expression in bargaining. The final paper studies individual valuation of social image components in a laboratory experiment which closely mimics social media interaction, with a novel aspect that elicits behavior when self-image is made salient by exposing subjects to a literal interpretation of their self-image: the selfie.

Paper 1: Pay-What-You-Want Pricing Schemes: A Self-Image Perspective

The first paper studies the importance of pro-social behavior in markets using the increasingly popular "Pay-What-You-Want" (PWYW) pricing scheme. Under PWYW, a good is up for sale, and a buyer can choose to pay whatever she wants, including zero. Despite the standard economic prediction of free-riding, numerous experimental and empirical studies have found that under PWYW fewer individuals choose to purchase the good and those who do tend to pay a higher price in comparison with a fixed-price scheme (Gneezy et al., 2012; Regner and Barria, 2009). In particular, when the purchase of the good involves a pro-social element such as a donation to charity, even fewer individuals buy, at an even higher price (Gneezy et al., 2010). As suggested by Gneezy et al. (2012), the purchase decision in PWYW is a way of signaling to the self that the individual is unselfish towards the seller, and, in the case of PWYW with a donation, that she cares about social responsibility.

We develop a theoretical model incorporating self-image into the buyer's utility function to account for the above-mentioned empirical irregularities. In a PWYW situation, the seller offers buyers the opportunity to choose how much they are willing to pay, which is atypical of the traditional market mechanism. Some buyers may thus like to reciprocate the seller's goodwill by paying at least what is considered the good's fair value, even without having to do so. As per Samahita (2013), we model the PWYW situation as an opportunity for (self-)image consumption such that buyers' self-image increases monotonically with the amount paid. Different buyers with different image sensitivities may lead to different optimal prices. In particular, some individuals end up over-paying relative to the good's fair value. The excess payment signals to the buyer's self that she is generous, contributing to

a higher self-image.

Nonetheless, the desire to "buy" self-image may be constrained by material factors such as how valuable the good in fact is. We thus introduce heterogeneity in the good's consumption utility, which generates different purchase decisions across individuals. An image-sensitive individual who would have overpaid will abstain if the consumption value of the good is too low, despite the image gain. On the other hand, an image-insensitive individual whose optimal price is lower than the fair value incurs self-image loss were she to make a purchase; and similarly requires a sufficiently high consumption utility from the good to tolerate this loss. An individual will only buy if the consumption value of the good plus the image gain (or net the image loss) exceeds her optimal price.

Our model thus contributes an intuitive explanation for the previously unaccounted field evidence of lower purchase rate and higher average price under PWYW. When a good is sold at a fixed price that is lower than its threshold fair value, adopting PWYW can lead to a lower utility as consumers either have to pay more to maintain his self-image, or incur image loss otherwise. Given a sufficiently high number of image-sensitive individuals making a purchase, the average price under PWYW will exceed the fixed price. An increase in the threshold value from a charity component demands yet a higher contribution to maintain self-image, thus decreasing the buyer's utility and further lowering the purchase rate.

Paper 2: Pay-What-You-Want in Competition

In this follow-up paper, we take on an industrial organization framework and analyze the implications of consumers' social preference on firms' decisions and market outcomes. In particular, we address the puzzle of PWYW's partial spread in markets: despite the existence of social preferences in consumers, how does PWYW escape the adverse selection problem, in which selfish buyers self-select into its market and free-ride? On the other hand, empirical examples of PWYW show a distinct cluster of sellers operating in certain industries characterized by imperfect competition against fixed-price sellers, selling non-resalable goods with low marginal cost, with some level of product differentiation. If indeed PWYW has the potential to generate more profits than fixed-pricing, why has PWYW not completely penetrated these industries, much less the market?

While previous studies have focused only on the role of consumer preferences to

motivate PWYW payments (Kim et al., 2009; Gneezy et al., 2012), and theoretical models typically assume a monopolist seller (Chao et al., 2015; Isaac et al., 2015), our analysis is the first serious attempt to scrutinize the performance of PWYW in a more realistic duopoly setting while still capturing consumers' social preferences.[3] Sellers are assumed to choose their pricing schemes sequentially while consumers either free-ride or share their surplus as per an exogenous social norm.

We show that the profitability and hence popularity of PWYW depend not only on consumers' preferences, but also on market structure, product characteristics and sellers' strategies. The parameters that are predicted to sustain the choice of PWYW by a seller include a low cost for the good, a high level (or not too high, in case of product differentiation) of surplus-sharing, a low proportion of free-riders and an intermediate range of product differentiation. While there is no equilibrium in which PWYW dominates a market, given a sufficiently high level of surplus-sharing and product differentiation, PWYW is chosen by the second-mover to avoid Bertrand competition against the first-mover who sets a fixed price. This serves as a theoretical basis for the later entry of PWYW seen in the market. However, in markets with low surplus-sharing or extreme levels of product differentiation, fixed-pricing dominates. This is what we see in completely homogeneous markets such as gasoline or highly differentiated markets with exclusive brand names. We conduct a comprehensive review of the empirical observations of PWYW, confirming the model's predictions.

Paper 3: Venting and Gossiping in Conflicts: Verbal Expression in Ultimatum Games

The third paper studies self-image maintenance as a motivation for verbal expression in a laboratory ultimatum game, and the effect on cooperation. This is motivated by post-conflict non-instrumental verbal expression to unrelated parties, such as when customers complain on social media about companies who provide bad service, clients who pay large amounts of money to talk to a therapist about personal conflicts, or those who use the more traditional form of a private diary

[3]Chen et al. (2009) is a closely related paper that considers two sellers competing in a Hotelling model, with the equilibrium finding that either both choose PWYW, or both choose fixed-pricing. A key difference in this paper is the assumption that some fair consumers have a preference for a fixed-priced good, thus accounting for the mixed equilibrium in which PWYW competes against fixed-pricing.

to express emotion. When these actions take place after the conflict has already occurred, and expressing emotion involves monetary or effort cost but has no effect on the outcome of the conflict, these behaviors are clearly irrational according to standard economic theory which predicts that a rational agent should be indifferent to non-instrumental communication. What motivates agents to take these actions, and in some cases pay for it? Does it have any effect on future bargaining outcomes? While previous studies of verbal expression in the lab such as Xiao and Houser (2005) have found that expressing emotion does promote cooperation, it has been directed at the offending party (the sender in the ultimatum game) which does not allow us to distinguish among various motives: does verbal expression make the offended party (the receiver) feel better by letting her vent negative emotion, does it allow her to deny the implied inferiority from receiving, and accepting, a low offer, or does sending a disapproving message to the sender substitute for punishment? In situations where direct communication between counter-parties is not possible it is important to establish which of the three mechanisms are in play as punishment through negative message is no longer allowed.

We conduct an experiment of non-instrumental verbal expression in binary ultimatum games, where receivers can comment either privately or to a third-party audience prior to accepting or rejecting the offer. As far as we are aware, this is the first economic experiment studying the pure effect of verbal expression in private. A low offer is expected to trigger negative emotions in the recipient, which may lead to a rejection. How then does allowing verbal expression affect future cooperation, as indicated by the decision to accept or reject the offer? Psychological studies have so far found inconclusive evidence regarding the effect of expressing negative emotions. Some have reported that people feel better after relieving the pressure built up by the negative emotion (Pennebaker and Beall, 1986), while others argue that expressing negative emotion primes aggressiveness (Bushman, 2002). Additionally, a low offer may be perceived by the receiver as a threat to her self-image, and rejection is one way to refute this. Verbal expression provides a cheaper alternative for the receiver to deny this implied inferiority, and hence may result in a lower rejection of unfair offers. Studies such as Ong et al. (2012) also indicate that people appreciate the opportunity to voice their opinion to an unrelated third-party and behave more cooperatively as a result. Hence, while the effect of private verbal expression is unclear, the presence of an audience is predicted to decrease rejection.

If senders anticipate the reduced rejection in the Audience treatment, a rational re-

sponse would be to offer more unfair offers. On the other hand, verbal expression to a third-party creates the potential for gossip, which may trigger image concerns in senders. This is indeed what we find: more senders choose the fair offer in the Audience treatment than in the control. Consequently, despite insignificant effect on receivers' behavior, the possibility of verbal expression to an audience is found to increase cooperation and hence welfare. The insignificant effect of verbal expression on receivers' behavior shows that the role of emotion expression in increasing cooperation found in previous literature is mainly driven by the possibility to give negative feedback, which is not present here.

Furthermore, we find that there is demand for verbal expression, even when it is unobserved or not provoked by a negative stimulus. We find no conclusive evidence that this is motivated by low self-esteem, as measured using the Rosenberg self-esteem inventory (Rosenberg, 1965). This suggests that the main role of verbal expression in increasing cooperation is through its potential in increasing the generosity of senders, rather than increasing the co-operation of receivers provoked by low offers, and motivates the importance of third-party intermediaries in economic exchanges.

Paper 4: Curating Social Image: Experimental Evidence on the Value of Actions and Selfies

The final paper studies how people value their social image, in particular the choice to publish or hide information that can be reputationally sensitive. This is inspired by modern social media interaction where users have the possibility to, and indeed selectively do, edit their posts and decide who to share these with within their social media network. We study this in a laboratory experiment by letting subjects play a two-person public good game (henceforth PG) and subsequently eliciting their reservation prices for publishing their name, by itself or with their PG contribution and/or selfie, on a public webpage. The PG contribution and selfie can be considered two "ingredients" of a subject's social image, making up the moral or reputationally sensitive component and impacting the visibility of the signal she projects to her peers.

Consistent with predictions made in Bénabou and Tirole (2006) on social image, increasing the visibility of reputationally sensitive information increases the subjects' unwillingness to publish, and the premium demanded increases the more

subjects free-ride in the PG. We are also able to confirm the less obvious prediction that the variance of bids increases when PG contribution or selfie is added, showing the presence and heterogeneity of image concerns in individuals. Our results overall suggest that people are willing to pay to maintain a highly curated image of themselves.

A novel aspect of our design is that we expose a random subset of subjects to a literal interpretation of their self-image, the selfie, by asking them to take a selfie prior to playing the PG. We are thus able to explore whether the increased salience of self-image is sufficient to promote cooperation, or if, in line with the behavioral addiction hypothesis, selfie-taking triggers a self-centric mindset that promotes selfish behavior. While in general selfie-taking has no overall effect on cooperation, among those who report to be frequent selfie-takers outside the lab, taking a selfie in the experiment is found to have a substantial and significant negative effect on PG contribution. This suggests the possibility of an addiction mechanism affecting frequent selfie-takers but not others.

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Pay-What-You-Want pricing schemes: A self-image perspective

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ABSTRACT

Pay-What-You-Want (PWYW) pricing schemes are becoming increasingly popular. We develop a model incorporating self-image into the buyer's utility function and introduce heterogeneity in consumption utility and image-sensitivity, generating different purchase decisions and optimal prices across individuals. When a good's fixed price is lower than a threshold fair value, PWYW can lead to a lower utility. This may result in a lower purchase rate and higher average price, accounting for previously unexplained field experimental evidence. An increase in the threshold value decreases the buyer's utility and may further lower the purchase rate, resulting in a further increase in purchase price.

1. Introduction

"Pay-What-You-Want" (PWYW) is a recently emerging pricing scheme in which a good is up for sale and the buyer, should he decide to buy, chooses the price to pay for it.[1] A famous example, which illustrates its attractiveness to a seller, is the release of the band Radiohead's album "In Rainbows" in 2007, which at the time was highly anticipated. Fans were able to download the album from the band's website for any price they chose, including zero. Standard economic theory predicts that the optimal financial decision for the buyer would be to pay nothing and get the album for free. However, hundreds of thousands of fans chose to pay a positive amount for the album, and the band in fact profited from this pricing format, making more money than from digital downloads of all their other studio albums combined.[2] Is this success merely due to the publicity surrounding the album's release, or is there something more beyond the standard economic theory?

Pure PWYW, which is the focus of this paper, has no minimum price to protect the seller.[3] Despite this, its adoption by various sellers in the food industry, such as 'Wiener Deewan' in Vienna and 'Lentil as Anything' in Melbourne,

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[1] "Pay-What-You-Want" is also known in the literature as "Pay-As-You-Wish", "Pay-As-You-Feel" and "Pay-As-You-Like".

[2] See http://archive.wired.com/entertainment/music/magazine/16-01/ff_yorke?currentPage=all. Accessed on 14-08-2014.

[3] A variant of PWYW with a minimum price is known as "Name-Your-Own-Price" (NYOP). See Kim et al. (2009) for a detailed explanation of the different participative pricing schemes.

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shows its potential for success. On the other hand, there are also PWYW ventures which have not been as successful (for example, 'Terra Bite Lounge' in Seattle which returned to a fixed-price scheme after adopting PWYW for a period of time). Although formal PWYW situations have only recently emerged and the pricing scheme is not yet widespread, the same principle of choosing what to pay is in fact found in another common phenomenon that is tipping. In many countries, it is a social norm for good restaurant (or other) services to be rewarded with a good tip from the customer. Although in this case the service has already been provided, just like PWYW the customer is under no obligation to pay an amount above zero. Despite this, the level of the tip is often above this minimum.

Besides the above real life examples, several field experiments (see, for instance, Gneezy et al., 2012; Kim et al., 2009) also support the theory that individual behaviour in PWYW situations does indeed deviate from what is normally predicted by standard economic theory. These findings indicate that despite the option to "buy" the good for free, fewer individuals decide to purchase the good and those who do tend to pay a higher price in comparison with the typical fixed-price scheme. In particular, when the purchase of the good involves a pro-social element such as a donation to charity, even fewer people buy, at an even higher price. These decisions contrast with standard predictions regarding optimal consumer financial decision-making.

Our paper is the first to present a model explaining the experimental evidence of lower purchase rate and higher average price in PWYW compared to a fixed-price scheme. We do this by introducing a self-image component in modelling individual behaviour when presented with a PWYW opportunity. As proposed by Gneezy et al. (2012), the purchase decision in PWYW is a way of signalling to the self that the individual is unselfish towards the seller, and, in the case of PWYW with a donation, that he cares about social responsibility (Gneezy et al., 2010).

Self-image, as a motivation for over-participation in activities (including but not limited to pro-social activities), is not a new concept. For example, individuals have been known to over-pay for fair-trade/green products (Shaw et al., 2000; Nyborg et al., 2006; Doran, 2009), engage in over-education (Gallice, 2009) and over-participate in voluntary activities (Brekke et al., 2003; Samahita, 2013). In a PWYW situation, the individual partakes in a voluntary pricing scheme which is atypical of the traditional market mechanism. Sellers offer buyers the possibility to choose what to pay, and many consumers reciprocate by paying a positive amount. A buyer who merely desires to be fair towards the seller would stop at paying the good's fair price, but the fact that some individuals over-pay relative to the good's fair value suggests that PWYW is also seen as an opportunity for image consumption.

In our model, we investigate the individual's purchase decision and his utility maximizing choice of contribution level. Individuals are heterogeneous in their consumption utility and image-sensitivity, resulting in different purchase decisions at varying prices. Our findings show that when a good is sold at a fixed price that is lower than the fair value threshold, a lower purchase rate can arise under PWYW. We also investigate the effect of an increase in this fair value, which is predicted to result in an even lower purchase rate and an even higher average price under certain conditions. Finally, we present a simulation study using a quadratic self-image function which supports our results and shows the potential for PWYW to be welfare-improving.

The rest of this paper is organized as follows: Section 2 provides a review of the PWYW literature. Section 3 presents the model and its predictions, which are further explored in the simulation study in Section 4. The findings are discussed in Section 5, and Section 6 concludes.

2. Literature review

PWYW can be seen as a class of participatory pricing mechanisms where a buyer has full control over the price setting (Kim et al., 2009). Besides the famous Radiohead example, this relatively new pricing strategy has been implemented in many areas including music, restaurants, accommodation, and soccer clubs (Mantzaris, 2008; Isaac et al., 2010; Riener and Traxler, 2012; Gautier and Klaauw, 2012). To investigate the reasons behind the apparent success of these PWYW examples, recent studies have explored empirical data collected from PWYW sellers as well as results from PWYW experiments under various conditions. The findings of these papers are reported in the top half of Table 1. In summary, a PWYW pricing scheme does attract non-zero payments. While as expected some PWYW consumers under-pay, there are also situations in which the average price is in fact higher compared to other fixed-price schemes, and the purchase rate lower. In some cases PWYW results in an increase in the seller's revenues. It is this heterogeneity in findings that we seek to explain.

While PWYW contribution could be strategically motivated by a selfish desire to keep the seller in the market (Schmidt et al., forthcoming; Mak et al., 2015), this cannot be the case in one-shot interactions such as the temporary settings of Gneezy et al. (2010, 2012) and Kim et al. (2009). The existing theoretical literature on PWYW has also appealed to consumers' social preferences to enable PWYW to survive in the market.[4] These are presented in the bottom half of Table 1. Chen et al. (2009), for example, show that if a sufficient number of consumers are fair-minded, PWYW can be more profitable than fixed-pricing even with the presence of free-riders. Alternatively, a consumer could be motivated by a social cost for free-riding (Fernandez and Nahata, 2009). Isaac et al. (2010) incorporate social norms for contribution levels, consistent with the survey results in Regner (forthcoming) who furthermore found consumers motivated by reciprocity and guilt. More recently, Schmidt et al. (forthcoming) conducted a laboratory experiment to disentangle the various social preferences of buyers and found that outcome-based social preferences are the main reasons driving consumer contribution under PWYW.

While such explanations can account for the positive prices paid and the opt-out behaviour of some consumers

[4] See Rabin (1993) for a detailed discussion of incorporating a pro-social preference for fairness into the model.

Table 1
Existing PWYW empirical studies and theoretical explanations.

Paper	Empirical studies and experiments
Gautier and Klaauw (2012)	NYOP scheme attracts individuals with low pro-social reputational concerns and results in lower average price.
Gneezy et al. (2010)	Charity component increases demand under PWYW relative to a high fixed price.
Gneezy et al. (2012)	PWYW results in lower demand than a low fixed price, explained using identity and self-image concerns.
Gravert (2014)	PWYW prices are significantly higher with a self-signalling nudge.
Jang and Chu (2012)	Distribution of PWYW prices is bi-modal at 0% and 100% of product value, explained in terms of self-signalling and social cues.
Kim et al. (2009)	PWYW prices are significantly greater than zero, PWYW can increase seller's revenues.
Kim et al. (2013)	PWYW prices increase with external reference price and reputation, while they decrease with social distance.
León et al. (2012)	High proportions of selfish customers, attributed to framing of PWYW campaign.
Regner (2014)	Tipping is motivated by reciprocity and reputation concerns. Customer's tipping history determines researcher's effort level.
Regner and Barria (2009)	Consumers pay more than minimum and even higher than suggested price, explained in terms of reciprocity.
Regner and Riener (2013)	Reduced anonymity led to higher payments but lower purchase rate.
Riener and Traxler (2012)	Payments are positive, but decline with time. Increased demand results in higher revenues. Explained in terms of social norms.
Schmidt et al. (forthcoming)	Outcome-based social preferences and strategic considerations to keep seller in the market. PWYW more successful in isolation.
Paper	**Theoretical explanations**
Chao et al. (forthcoming)	Low marginal cost of production and psychological cost of consumer paying too little compared to reference price.
Chen et al. (2009)	Existence of fair minded consumers with sufficient generosity, the good has low marginal cost, high concentration of low WTP consumers, and a competitive marketplace.
Fernandez and Nahata (2009)	Positive valuation of the good and a social-cost for free-riding.
Isaac et al. (2010)	Social norm for minimum contribution.
Mak et al. (2015)	Forward looking consumers with firms threatening to switch to fixed-price schemes.

in PWYW, they do not sufficiently explain the field experimental evidence of a higher average price and lower purchase rate compared to other fixed-price schemes. It is unclear why a fair or norms-motivated consumer would pay more than the corresponding fixed price or the reference fair price. Similarly, guilt, outcome-based social preferences, or reciprocity alone cannot account for the over-contribution under PWYW, and neither can the assumption of a forward-looking selfish consumer wanting to keep the seller in the market. Self-image, on the other hand, can rationalize these buyers' behaviour as found in Gneezy et al. (2012), Jang and Chu (2012) and Gravert (2014). A consumer motivated by self-image derives utility from higher contribution as it sends a signal to himself that he is generous or fair-minded.

Image-motivated consumption has been evidenced in many instances (Kahsay et al., 2014; Penz and Stöttinger, 2008; Bagwell and Bernheim, 1996), and even in stock-market investment where decisions are influenced by firm image. Similar to consumers' payment of premium price for products from ethical firms, investors may also place a monetary value on image enhancement of their investment decisions (Glac, 2009). Nagy and Obenberger (1994) underline the role of firm reputation, firm status, feelings about the firm's products and services, and perceived ethics of the firm in influencing investment behaviour, while Helm (2007) suggests corporate reputation as an important determinant of initial investment decisions. Similarly, corporate image influences customers' satisfaction and loyalty (Bloemer et al., 1998; Martensen et al., 2000), as consumers who value image may choose products or services from socially responsible or ethical firms.

In PWYW situations, higher payments not only signal socially responsible attributes of the individual to himself, but also to others if payment is made publicly. However, the findings on social-image in PWYW are divided: Kim et al. (2013) and Regner and Riener (2013) find that anonymity reduces PWYW payments, while Gneezy et al. (2012) find that public signalling has either no effect (theme park experiment) or a negative effect on PWYW payment (restaurant experiment), arguing that public-signalling may crowd out the self-signalling strength. We agree that this is a complex issue and have chosen to leave the social aspect for further research. Instead, we focus on self-image as a step towards understanding the heterogeneity in buyers' PWYW behaviour which is previously unexplained in the literature.

Our theoretical model thus contributes by filling this gap, while additionally providing a framework for the analysis and welfare consequences under a non-traditional market mechanism as well as presenting a novel application of self-image in economic modelling.

3. The model

In order to isolate the effect of self-image, we start with a model in which we focus on a simple additive utility function. Individual i's utility from purchasing a good is defined as

$$U_i(c) = \underbrace{u_i(x) - c}_{\text{net material utility}} + \underbrace{f_i(c, r)}_{\text{self-image}} \quad c, r \geq 0.$$

x is a vector of the good's characteristics. $u_i(x)$ is a concave increasing function representing the consumption utility of the good to the individual. c is the price paid for the good, which is the posted price in a fixed-price scheme, or the price chosen by the individual in PWYW. The consumption utility less the price paid results in the net material utility of the good to the individual.

The source of moral contention, which determines self-image, is whether or not the individual pays what is considered fair by the seller. This payment serves to signal to himself that he is fair and generous, possibly also in order not to appear cheap. Hence f is a function of the contribution level c and the seller's fair price r where, following Samahita (2013), it is increasing in the contribution level c at a decreasing rate: $f_c > 0, f_{cc} < 0$.[5] To motivate our choice of a Kantian monotonically increasing function, we argue that in the context of voluntary payments no upper bound applies. Individuals can always pay an amount higher than r to signal their generosity. They can then be viewed as "neurotic perfectionists" (Hamachek, 1978) whose self-esteem monotonically increases with effort level. Moreover, self-image is decreasing in the reference price parameter r, since an increase in r makes the choice of c relatively lower in comparison: $f_r < 0$. We therefore define $f(c, r) = 0$ whenever $c = r$, by construction of the model. The utility from no purchase is normalized to zero.

Consumers want to pay what is fair and price fairness is an important issue for consumers (see, for instance, Rabin, 1993; Xia et al., 2004; Anderson and Simester, 2008). There are different but related views on the concept of price fairness (see Xia et al., 2004 for an extensive review). According to Haws and Bearden (2006), price fairness is a buyer's judgement of a seller's posted price, which may be affected by social norms (Xia et al., 2004). The judgement may also be based on previous prices, competitors' prices, and profits Bolton et al. (2003), while Kahneman et al. (1986) identified the reference transaction, the distribution of outcomes, and the context of the firm's action as other important determinants. Under fixed-pricing, the consumer has to pay the posted price regardless of whether it is fair or not, so in our model any utility or disutility is absorbed in the net material utility since no choice in payment is made to affect self-image.

This is, however, different when it comes to PWYW. Under PWYW, there is no posted price to act as a guide for what is considered fair by the seller. Consumers are instead given the opportunity to determine the price for the firms. Therefore, in the absence of a given price, consumers are assumed to consider and adopt the good's exogenous fair value v as the reference price against which their eventual payment would be judged. The assumption that consumers equate the existing reference price with the exogenous common fair value may not be far from reality, especially in PWYW situations. As argued in Kahneman et al. (1986, p. 730), reference price is used to judge the fairness of a price because "any stable state of affairs tends to become accepted eventually". This value is obtained exogenously from word-of-mouth or knowledge of close substitute products. While each individual may have his own private source of information regarding this fair value, we argue that the existence of a commonly held belief is a reasonable assumption for many familiar goods.

In a fixed-price scheme, the posted price p is set by the seller and is therefore used by the buyer as a clear signal of the seller's fair price, even though it may differ from the exogenous fair value v. Note that a difference in p and v may have other consequences for self-image.[6] For simplicity we disregard this element and appeal to strategic ignorance to avoid any image loss for the individual.[7] If the posted price is lower than the exogenous fair price, the individual will simply be happy that he finds a bargain, without self-image consequences related to fairness. In the same way, if the posted price is higher than the exogenous fair price, the individual does not derive any image gain for purchasing the good at the high price.

To summarize, in PWYW,

$$r = v \gtreqless c$$

while in a fixed-price scheme

$$r = p = c.$$

Consequently, self-image is zero in a fixed-price scheme.

Heterogeneity is achieved through variations in the individual's consumption utility and self-image function. The individual's consumption utility can take any positive real value, $u_i(x) \in \mathbb{R}^+$. We also characterize individuals based on their image-sensitivity, which is determined by the steepness of their self-image functions.

Definition 1. An individual j is globally more image-sensitive than another individual i if:

$$\frac{\partial f_j}{\partial c}(c, r) > \frac{\partial f_i}{\partial c}(c, r) \quad \forall c.$$

This means that j derives more marginal benefit from contributing an extra dollar than i, although both individuals have the same marginal cost of contributing which is 1.

Solving the model

To solve the PWYW model with $r = v$, the individual first solves the following maximization problem:

$$\max_c U_i(c) = u_i(x) - c + f_i(c, v).$$

He then compares the utility from buying at the preferred price with the utility of not buying, which is zero, to make the purchase decision.

[5] Brekke et al. (2003) present an alternative 'consequentialist' self-image function where $f_i(c, r) = -a(c - r)^2, a > 0$. In our model, such hump-shaped function gives rise to a situation in which all individuals under-contribute in PWYW.

[6] For example, there may be other signalling concerns when a low price is observed for fair-trade or luxury goods (Sirgy, 1982; Bagwell and Bernheim, 1996), or if the individual suspects that the seller has been unethical to be able to charge a low price.

[7] See for example, Carrillo and Mariotti (2000), Dana et al. (2006, 2007) and Bénabou and Tirole (2011) for the literature on strategic ignorance and self-serving biases. Alternatively, we argue that if the individual felt any image loss, he could have paid more than the posted price and the seller would hardly refuse this payment. Yet we do not see this in practice — giving support to our strategic ignorance reasoning and fairness towards the seller as the main source of self-image.

The first step gives the following first-order-condition:

$$\frac{\partial f_i}{\partial c}(c, v) = 1.$$

Let the optimal value of c satisfying the above condition be c^*. Then, if individual j is more image-sensitive than individual i, it follows that $c_i^* < c_j^*$.[8]

Assuming a reasonable value of v which is neither extremely low nor high, an economy composed of heterogeneous individuals with varying self-image functions making a PWYW purchase will result in some individuals under-paying and others paying at least v or higher.

Observation 1. *Consider individuals i and j, and fair value v such that* $\frac{\partial f_i}{\partial c}(v, v) < 1 \leq \frac{\partial f_j}{\partial c}(v, v)$. *It then follows that* $c_i^* < v \leq c_j^*$.

Proof. See Appendix. □

We now make the following definition regarding image-sensitivity in absolute terms:

Definition 2. An individual i is classified as image-insensitive if $c_i^* < v$. Another individual j is classified as image-sensitive if $c_j^* \geq v$.

Upon calculating his optimal buying price, the individual needs to make the decision of whether to buy or not. This is done by comparing the utility when he buys, $U_i(c_i^*) = u_i(x) - c_i^* + f_i(c_i^*, v)$, with the utility of not buying which is zero. This is where $u_i(x)$ plays a role.

The image-insensitive individual has a value of c_i^* less than v, which results in self-image loss. He will buy if the gain in net material utility by paying a low price, $u_i(x) - c_i^*$, outweighs the self-image loss. On the other hand, the image-sensitive individual has c_i^* higher than v which generates self-image gain. He will buy if this gain is higher than the net material loss incurred in paying a high c_i^*, or if his consumption utility $u_i(x)$ is high enough.

PWYW and fixed-price schemes

Next we compare purchase rates under PWYW with purchase rates under a fixed-price scheme to investigate how the introduction of PWYW affects consumer market participation. The purchase rate is defined as the percentage of buyers in the economy.

Proposition 1. *The purchase rate is weakly higher under PWYW than a fixed-price scheme at price* $p \geq v$.

Proof. See Appendix. □

When the posted price is equal to or is higher than the fair price, both image-sensitive and image-insensitive individuals may gain from moving to a PWYW pricing scheme. This result is intuitive, since the image-insensitive individual can free-ride and choose a low price, with little loss in self-image. The image-sensitive individual is able to pay his optimal price and "buy" self-image. As a result, individuals who do not buy the good in the fixed-price scheme may be turned into a buyer under PWYW, while those who buy the good in the fixed-price scheme will still buy under PWYW. Hence, PWYW leads to a weakly higher purchase rate compared to a fixed-price scheme.

Proposition 1 implies that to investigate the lower purchase rate under PWYW, we need to focus on the case where the fixed price is lower than the fair price threshold.

Proposition 2. *The purchase rate is weakly lower under PWYW than a fixed-price scheme at price* $p \leq c_i^* - f_i(c_i^*, v)$ $(\leq v)$ $\forall i$.

Proof. See Appendix. □

Compared to a fixed price which is lower than the fair value of the good, a PWYW scheme may lower an individual's utility. This result is counter-intuitive, but can be explained by the self-image component. The image-sensitive individual has to pay his high optimal price, while the image-insensitive individual has to consider the image loss associated with paying a low optimal price without much gain in his net material utility. If the sufficiency condition holds for all individuals in the economy, PWYW will result in a weakly lower purchase rate than under a fixed-price scheme as the reduction in utility may turn a buyer into a non-buyer.

Moreover, Proposition 2 guarantees that the image-sensitive individual, should he still make a purchase under PWYW, will pay a price higher than the fair price v and thus the fixed price p. For the image-insensitive individual, should he still make a purchase under PWYW, he will pay c_i^* which might be higher or lower than p. Thus, if there is a sufficiently high number of image-sensitive individuals making a purchase, the average price under PWYW will be higher than the fixed price p.

Variation in PWYW fair value

Suppose now that the exogenous fair value v is varied, for example due to a pro-social component in the good. Typically, a fair-trade version of a good will attract a higher fair value than a non-fair-trade version. We then have the following proposition:

Proposition 3. *An increase in fair value v results in a weakly lower purchase rate.*

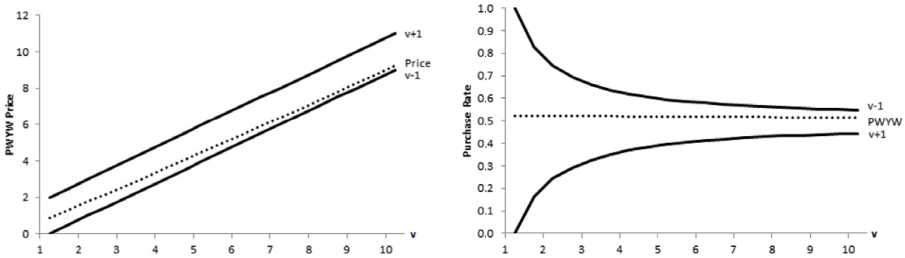
Proof. See Appendix. □

As per the assumption that $f_r < 0$, if an increase in fair value is not followed by an increase in contribution level, self-image loss results. Such increase, such as through the introduction of a pro-social component, also demands an increase in contribution level to maintain self-image. However, a higher contribution also reduces the net material utility, and hence the total utility of making a purchase. If this decrease is sufficiently high, a buyer can be turned into a non-buyer, thus lowering the purchase rate.

With the condition

$$\frac{\partial c^*}{\partial v} > 0$$

[8] From Definition 1, if j is more image-sensitive than i we have $\frac{\partial f_j}{\partial c}(c, v) > \frac{\partial f_i}{\partial c}(c, v)$ $\forall c$. At the optimal contribution level for i, $\frac{\partial f_j}{\partial c}(c_i^*, v) > \frac{\partial f_i}{\partial c}(c_i^*, v) = 1 = \frac{\partial f_j}{\partial c}(c_j^*, v)$. Hence, due to the concavity of f, $c_i^* < c_j^*$.



(a) PWYW price. (b) Purchase rate.

Fig. 1. Price and purchase rate comparison.

and a sufficiently high number of image-sensitive individuals still making a purchase, the average price will be higher.[9]

4. Simulation

As our model has shown in the previous section, PWYW in different settings can give rise to different outcomes. In particular, its profitability for the seller and the welfare consequences will depend on the distribution of individuals' consumption utility and image-sensitivity. In this section we illustrate the PWYW outcomes and welfare implications using the assumption of an economy with uniformly distributed preferences.

Consider the following utility function:

$$U_i(c) = u_i(x) - c + \mu_i\left((c - v) - \frac{1}{2}(c - v)^2\right)$$

$$\mu_i > 0;\ c < v + 1.$$

That is, the self-image function takes the quadratic form. μ acts to differentiate the image-sensitivity amongst individuals, with a more image-sensitive individual having a higher μ_i and vice versa. Note that the use of μ is currently restricted to *relative* image-sensitivity, as per Definition 1.

The optimal value of c is calculated by the process described in Section 3, and is given by

$$c_i^* = 1 + v - \frac{1}{\mu_i}.$$

Therefore, the range of μ describing *absolute* image sensitivity, as per Definition 2, is as follows: an individual is image-insensitive if $\mu_i < 1$. He is image-sensitive if $\mu_i \geq 1$.

We assume a uniformly distributed consumption utility and image-sensitivity:

$$u_i(x) \sim U(0, 2v)$$

$$\mu_i \sim U\left(\frac{1}{1+v}, 1 + \frac{v}{1+v}\right)$$

such that $c_i^* > 0\ \forall i$, and half the population are image-insensitive and the other half image-sensitive. While these assumptions may seem arbitrary, absent any other information we argue that it is reasonable to assign an equal proportion of individuals to both image-sensitive and -insensitive types. Similarly, we assign half the population to a type that under-values the good and another that over-values the good in terms of consumption utility.

We run simulations across 10,000 individuals in the economy, with the following parameters: $1 \leq v \leq 10$, and p taking a high value of $v + 1$ or a low value of $v - 1$. The good is assumed to have zero marginal cost. Some brief analytical results are presented in the Appendix, together with the numerical results of the simulation, while graphical results are shown here.

Fig. 1(a) shows that with image concerns, the average PWYW price exceeds the low fixed price. However, as v increases, this difference becomes smaller as fewer image-sensitive individuals make a purchase.

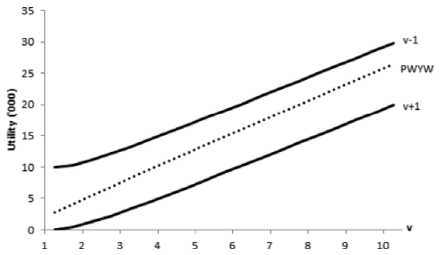
As predicted in Proposition 1, when $p = v + 1$ PWYW always yields a higher purchase rate and utility for the consumers. On the other hand, according to Proposition 2 the opposite would occur when the fixed price is lower than the fair value. The utilities of both image-sensitive and -insensitive individuals are reduced by going to PWYW, since the image-sensitive individuals now have to pay their higher optimal contributions while the image-insensitive individuals lose image by paying their low optimal prices. These are seen in the purchase rate comparison in Fig. 1(b) and the utility comparison in Fig. 2(a).

Fig. 2(c) also shows that profits under fixed-pricing exceed PWYW profits for high values of v. Similar to Chen et al. (2009), PWYW is more beneficial to a seller for goods with low fair values, where individuals are less concerned about under-paying and losing image. At higher fair values, the seller is better off using a fixed-price scheme. Overall, from a total welfare point-of-view, PWYW is preferred to a fixed price higher than the fair value, but not to a fixed price lower than the fair value (Fig. 2(b)).

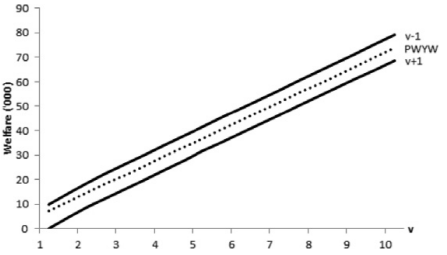
5. Discussion

The simple self-image model above successfully captures the different behaviours of individuals when faced with PWYW pricing schemes. While self-image concerns are more likely to arise in pro-social purchases where payment is more consequential, the concerns of being fair to

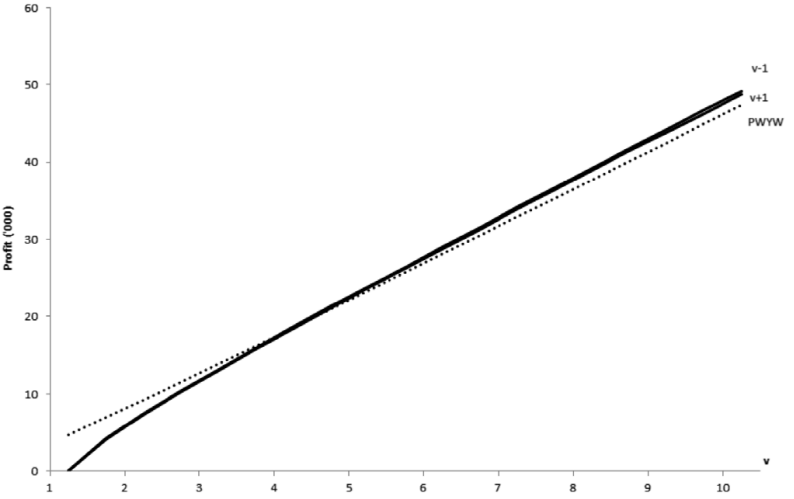
[9] This condition is fulfilled by, for example, the quadratic self-image function.



(a) Utility.



(b) Welfare.



(c) Profit.

Fig. 2. Utility, welfare and profit comparison.

the seller or not appearing cheap exist both when the good has a pro-social dimension or is a pure market good.

Given an accurate guess of the exogenous fair price v, any difference between v and the fixed price p is due to the seller's competitive strategy. If the seller aims to increase revenue by setting a fixed price that is higher than the fair value, individuals will naturally prefer the PWYW scheme due to their ability to choose a low price or derive self-image benefits at a high price. As the simulation results show, when the fixed price exceeds the fair value, PWYW is preferred and gives consumers a higher total utility. At low fair values, PWYW even benefits the seller. Overall, PWYW yields a higher total welfare.

It is when the seller's chosen fixed price is lower than the fair value that individual behaviour deviates from what is expected in standard economic theory, giving rise to a higher average purchase price and lower purchase rate.

The lack of participation in PWYW schemes, despite the possibility to pay a zero amount for the good, can be explained by the reluctance of individuals to pay a price deemed fair or suitable for the good when that optimal price is too high compared with the good's consumption utility to the individual. Rather than paying a lower price or nothing, thus incurring a loss in self-image, the individual chooses to opt out of the scheme. Compared to a fixed-price scheme, PWYW can therefore result in a lower purchase rate.

The higher average price can also be explained by self-image. An individual's optimal contribution c^* is determined by utility maximization which takes self-image into account, and it is found at the point where the slope of the self-image function is equal to the slope of the cost function. This optimal price is higher than v for image-sensitive individuals, and is therefore also higher than the fixed price p. With a sufficiently high number of image-sensitive individuals making a purchase, the average price will be higher under PWYW than under the fixed-price scheme.

The model therefore contributes by accounting for the heterogeneity in PWYW behaviour without contradicting the results of existing theoretical models. For example, similar to Fernandez and Nahata (2009) who use a social cost for free-riding, we show that with a psychological cost of a loss in self-image some customers would opt for a fixed-price good. However, our model also allows

Table 2
Field experimental results (Gneezy et al., 2010, 2012).

	Tour boat experiment results			Theme park experiment results		
	FP $5	FP $15	PWYW	FP	PWYW	PWYW + Charity
Purchase rate	64%	23%	55%	0.50%	8.39%	4.49%
Average price	$5	$15	$6.43	$12.95	$0.92	$5.33

Table 3
Experimental results (Kim et al., 2009).

	Buffet lunch		Cinema regular		Cinema discounted		Hot beverages	
	FP	PWYW	FP	PWYW	FP	PWYW	FP	PWYW
Unit sales	157	253	394	273	139	113	872	813
Average price	€7.99	€6.44	€6.81	€4.87	€4.43	€3.11	€1.75	€1.94
Elicited v[a]		€7.85		€7.38		€4.71		€1.92

[a] Authors' own calculation. On average, customers pay 82%, 66%, and 101% of their internal reference prices in the buffet lunch, cinema and hot beverages experiments respectively (Kim et al., 2009, p. 51).

for the persisting free-riding behaviour seen in practice. Moreover, our model is also able to rationalize the previously unexplained results, notably those observed in Gneezy et al. (2012, 2010) and Kim et al. (2009), reported below.

Table 2 shows that tour boat photos for sale at a low fixed price of $5 attracts the highest purchase rate, followed by a PWYW treatment which yields an average price of $6.43, while a high fixed price of $15 attracts the lowest purchase rate. Despite being able to buy the photo at $5, the passengers' commonly held belief about the fair price v, as implied by our model, appears to be higher than $5, as a result causing those who intended to pay a lower amount to drop out instead of under-paying. As stated in Gneezy et al. (2012), the PWYW participants were told that the normal price was $15, but they were unaware of the other treatment with a $5 selling price. With no information on fair value in their experiment, it is clear that for the participants the important driver of behaviour is not the information on prices, but the commonly held exogenous belief about the fair value — if this threshold was below $5, the average PWYW price could have been lower. Similar results were obtained in the theme park experiment, whereby a high fixed price of $12.95 yields an extremely low purchase rate, but the adoption of PWYW increases the purchase rate, at a much lower average price.

In both experiments by Gneezy et al. (2012, 2010), the actual fair price v is unobservable. We have assumed that individuals obtain this value exogenously and concede that there may be problems associated with the uncertainty of this value for goods with complex characteristics, though it is not the case in the examples discussed here. As our simulation results show, however, given some minimal assumptions regarding the distribution of individuals PWYW yields an average price which is very close to the unobserved fair value for comparison purposes.

Furthermore, Kim et al. (2009) include a question about the buyer's internal reference price in their survey of PWYW consumers, and in doing so, manage to elicit the perceived value of v. In addition to confirming the validity of Propositions 1 and 2, these experimental results also provide new insights into the impact of PWYW on the resulting prices and revenues. In the buffet lunch experiment (see Table 3), with a fixed price higher than the elicited value of v, consumers gain from the PWYW pricing scheme and purchase rate increases. Although the average consumer under-pays, revenue increases by 30%. In both the cinema and hot beverages experiments, fixed prices are lower than the elicited fair prices. Consistent with Proposition 2, sales are lower. However, while prices decrease in the cinema, they increase in the hot beverages experiment. As a result revenues decrease in the cinema and increase in the delicatessen (though these are not significant). As explained by the authors, customers may feel entitled to pay lower prices due to a perceived unfair increase in movie prices, which consequently reduces their image-sensitivity in the PWYW setting.[10] They also note that customers are not aware of the PWYW condition until they enter the cinema, and hence the decrease in sales may not be entirely driven by PWYW. On the other hand, both buffet lunch and hot beverages experiments were advertised outside the venues, which means that the pricing scheme itself may play a role in affecting sales numbers. Additionally, the buffet lunch experiment was advertised with fliers distributed in various locations which may further contribute to the higher sales figure.

When a pro-social element is added to the good, thus increasing its fair value, individual contribution has to increase to maintain self-image. Without any change to the consumption utility of the good, this shift serves to make a purchase less likely. This is consistent with the findings in Gneezy et al. (2012) (see Table 2), where people were less likely to buy a photo when told that half their PWYW payment would support a charity, and those who still made a purchase paid a much higher price. An increase in the fair value means that an individual has to pay more to keep the same level of self-image, so for some individuals it is better not to buy at all, rather than risk under-paying and

[10] Kim et al. (2009) use the term "fair price" differently: in the cinema study, the implied internal reference price (which we have assumed to be v in our model, i.e. €7.38) is higher than what the surveyed customers say is fair (less than €6 (p. 52)). This means that although they think they should pay €7.38, customers act selfishly towards the cinema and feel entitled to pay €4.87 on average. In our model's setting, this simply translates to a population of low image-sensitivity whose utility maximizing contribution lies below the reference fair price.

causing negative self-image. For these individuals, the pro-social element apparently does not add to the utility of the good, or at least not enough to compensate for the increase in contribution.

Ultimately, the feasibility of PWYW to a seller depends on the purchase decision and price paid by individuals, which in turn depend on the distribution of individual preferences in the economy. Assuming an economy consisting of individuals with uniformly distributed consumption utility and image sensitivity, our simulation illustrates the model's predictions, and also highlights the welfare consequences of PWYW. For sellers, PWYW is only beneficial when enough image-sensitive consumers buy the good. This condition is fulfilled when the good is of relatively low fair value. At high levels of fair value, fixed-pricing is preferred. For consumers, PWYW utility is higher when the fixed price is higher than the exogenous fair price. It also follows that in such situations, the PWYW total welfare is higher than the fixed-price welfare. If the seller is able to sell a good at a lower price, however, fixed-pricing is preferred over PWYW.

In situations where the seller enters a market with relatively low image-sensitivity or consumption utility, it would be unwise to adopt PWYW (for example, Terra Bite Lounge in Seattle switched back to a fixed-price scheme due to its location, frequented by a lot of teenagers with presumably low image-sensitivity or consumption utility).[11] The same precaution should also be taken if the seller anticipates image-insensitive customers to self-select into the market (see, for example, Gautier and Klaauw, 2012; León et al., 2012). The fact that many PWYW settings have appealed to consumers' pro-social preferences also alludes to the possibility of individuals having different image-sensitivity to different sellers, or that a charitable component, while raising the fair value of the good, also invokes an increase in the image-sensitivity of the individual (see, for example, Gravert, 2014). A charitable organization using PWYW to raise funds by selling burgers will arguably attract higher contributions than if a fast-food chain were to adopt PWYW for a day.

6. Conclusion

PWYW as a pricing mechanism has been implemented in a wide range of industries characterized by low marginal costs. Clearly, in the appropriate setting it can be a profitable strategy for sellers to adopt. Various field experiments have confirmed the fact that buyers do pay a positive amount, which previous literature has attributed to other-regarding social preferences. However, no existing model has been able to explain the other field experimental observations of higher average price and lower purchase rate when compared to fixed-price schemes.

We fill this gap by incorporating self-image into the buyer's utility function when considering a PWYW purchase. Individuals are either image-insensitive or image-sensitive, and make their purchase decision based on their heterogeneous consumption utility of the good. Consistent with field experimental findings, when the good's fixed price is sufficiently high, going to PWYW increases utility for both types of consumers, as a result increasing the purchase rate. Only if the good's fixed price is lower than its fair value threshold can PWYW result in a lower purchase rate. The propositions derived from our model can explain the higher average price and lower purchase rate in terms of the individual's self-image, as well as the persisting selfish behaviour of those free-riding or under-paying. Moreover, an increase in fair value can further lower the purchase rate, and in some situations increase the average price.

Under some simple assumptions, the simulation results indicate that the welfare-improving quality of PWYW is limited to a certain range of prices. For sellers, it is only beneficial at low fair values, while for consumers PWYW is only preferred to a high fixed price.

Finally, our model presents some interesting dimensions for future research. First, our analysis focuses purely on self-image. It may be fruitful to see what happens when a social dimension is added. Second, it is not always possible to exogenously come up with a fair price. Introducing uncertainty and endogeneity in the fair value can be an important avenue for further investigation. Additionally, although we have focused on the role of self-image in consumer behaviour, our model also provides a framework in studying investors' behaviour. Similar to consumers' financial decision-making, the role of self-image in investment decisions has been suggested in previous studies (Glac, 2009). However, we leave this for future research.

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Appendix A. Proofs

A.1. Proof of Observation 1

Proof. Consider individual i. At his optimal contribution level, $\frac{\partial f_i}{\partial c}(c_i^*, v) = 1$. Hence,

$$\frac{\partial f_i}{\partial c}(v, v) < 1 = \frac{\partial f_i}{\partial c}(c_i^*, v).$$

Due to the concavity of the self-image function with respect to c, it follows that $c_i^* < v$.

Similarly, at individual j's optimal contribution level, $\frac{\partial f_j}{\partial c}(c_j^*, v) = 1$. Hence,

$$\frac{\partial f_j}{\partial c}(c_j^*, v) = 1 \leq \frac{\partial f_j}{\partial c}(v, v).$$

Due to the concavity of the self-image function with respect to c, it follows that $v \leq c_j^*$. □

[11] See http://www.nytimes.com/2010/05/21/us/21free.html?_r=0. Accessed on 14-08-2014.

Table C.1
PWYW simulation results.

PWYW					
v	Price	Purchase rate	Profit	Utility	Total welfare
1	0.889	0.523	4 646	2 720	7 366
1.5	1.323	0.523	6 919	4 102	11 021
2	1.764	0.523	9 224	5 473	14 696
2.5	2.209	0.523	11 546	6 831	18 377
3	2.659	0.522	13 878	8 178	22 056
3.5	3.113	0.521	16 204	9 516	25 720
4	3.570	0.520	18 554	10 845	29 399
4.5	4.032	0.519	20 932	12 167	33 100
5	4.495	0.519	23 316	13 484	36 800
5.5	4.960	0.519	25 721	14 795	40 516
6	5.427	0.518	28 124	16 101	44 225
6.5	5.898	0.518	30 526	17 402	47 928
7	6.368	0.517	32 937	18 701	51 637
7.5	6.841	0.517	35 334	19 995	55 329
8	7.317	0.516	37 733	21 287	59 020
8.5	7.792	0.515	40 122	22 576	62 698
9	8.268	0.515	42 537	23 862	66 399
9.5	8.744	0.514	44 938	25 146	70 084
10	9.222	0.513	47 347	26 428	73 775

Table C.2
Low fixed price simulation results.

FP $p = v - 1$					
v	Price	Purchase rate	Profit	Utility	Total welfare
1	0	1.000	0	9 922	9 922
1.5	0.5	0.829	4 146	10 316	14 462
2	1	0.744	7 441	11 128	18 569
2.5	1.5	0.694	10 412	12 115	22 527
3	2	0.660	13 194	13 184	26 378
3.5	2.5	0.637	15 930	14 300	30 230
4	3	0.621	18 615	15 444	34 059
4.5	3.5	0.608	21 266	16 608	37 874
5	4	0.596	23 820	17 785	41 605
5.5	4.5	0.587	26 402	18 973	45 374
6	5	0.579	28 970	20 167	49 137
6.5	5.5	0.574	31 565	21 367	52 932
7	6	0.569	34 110	22 572	56 682
7.5	6.5	0.564	36 628	23 780	60 407
8	7	0.559	39 158	24 990	64 148
8.5	7.5	0.556	41 685	26 204	67 889
9	8	0.553	44 248	27 419	71 667
9.5	8.5	0.550	46 759	28 636	75 394
10	9	0.547	49 212	29 855	79 067

A.2. Proof of Proposition 1

Proof. Suppose individual i is presented with a fixed-price scheme, where the asking price is p. With $r = p$, his purchase utility is

$$U_i(p) = u_i(x) - p.$$

Assume now that the seller chooses to introduce PWYW. The new price paid by i is then equal to c_i^*, and his utility from making a purchase is

$$\begin{aligned} U_i(c_i^*) &= u_i(x) - c_i^* + f_i(c_i^*, v) \\ &\geq u_i(x) - v + f_i(v, v) \\ &= u_i(x) - v \\ &\geq u_i(x) - p \quad \forall p \geq v \\ &= U_i(p) \end{aligned}$$

where the first inequality follows from the optimality of c^*. Therefore, $U_i(c_i^*) \geq U_i(p)$, and PWYW yields a weakly higher utility than the fixed-price scheme at any price p greater than or equal to the fair price v. A non-buyer can be turned into a buyer under PWYW, hence weakly increasing the purchase rate. □

A.3. Proof of Proposition 2

Proof. The individual's purchase utility under a fixed-price scheme is

$$U_i(p) = u_i(x) - p.$$

Under PWYW, his utility from making a purchase is

$$U_i(c_i^*) = u_i(x) - c_i^* + f_i(c_i^*, v).$$

Table C.3
High fixed price simulation results.

FP $p = v + 1$					
v	Price	Purchase rate	Profit	Utility	Total welfare
1	2	0.000	0	0	0
1.5	2.5	0.161	4 025	421	4 446
2	3	0.245	7 353	1 237	8 590
2.5	3.5	0.291	10 185	2 216	12 401
3	4	0.327	13 064	3 277	16 341
3.5	4.5	0.352	15 836	4 388	20 223
4	5	0.369	18 465	5 530	23 995
4.5	5.5	0.383	21 065	6 691	27 756
5	6	0.395	23 688	7 866	31 554
5.5	6.5	0.403	26 176	9 052	35 227
6	7	0.411	28 777	10 244	39 021
6.5	7.5	0.417	31 245	11 443	42 688
7	8	0.424	33 928	12 646	46 574
7.5	8.5	0.428	36 406	13 854	50 260
8	9	0.433	38 979	15 065	54 044
8.5	9.5	0.436	41 411	16 278	57 688
9	10	0.438	43 840	17 493	61 333
9.5	10.5	0.441	46 284	18 709	64 993
10	11	0.443	48 752	19 926	68 678

If $p \leq c_i^* - f_i(c_i^*, v)$, $U_i(c_i^*) \leq U_i(p)$ and his utility is weakly lower under PWYW. A buyer can be turned into a non-buyer, thus weakly decreasing the purchase rate.

$c_i^* - f_i(c_i^*, v) \leq v \ \forall i$ follows from the optimality of c^*. □

A.4. Proof of Proposition 3

Proof. Writing the optimal level of contribution c^* as a function of v, the individual's utility from purchasing the good is

$$U_i(c^*(v)) = u_i(x) - c^*(v) + f_i(c^*(v), v).$$

Taking the partial derivative with respect to v,

$$\begin{aligned}\frac{\partial U(c^*(v))}{\partial v} &= -\frac{dc^*(v)}{dv} + \left(\frac{\partial f}{\partial c^*} \cdot \frac{dc^*(v)}{dv} + \frac{\partial f}{\partial v}\right) \\ &= \frac{\partial f}{\partial v} < 0\end{aligned}$$

following the assumption that $f_r < 0$, and where the second equality follows from the first-order-condition. A buyer can be turned into a non-buyer, thus weakly decreasing the purchase rate. □

Appendix B. Analytical results

Using the assumptions made in Section 4, at the optimal contribution level c_i^*, the individual's PWYW utility is

$$U_i(c_i^*) = u_i(x) - v + \frac{(1-\mu_i)^2}{2\mu_i}.$$

The relative strength of effects of fair price or self-image depends on the image-sensitivity of individuals μ_i and fair price v. For a given individual, the self-image effect dominates the price effect if

$$\frac{(1-\mu_i)^2}{2\mu_i} > v.$$

Intuitively, this requires an individual to be highly image-sensitive or the fair price to be low.

In particular, recall that

$$u_i(x) \sim U(0, 2v)$$
$$\mu_i \sim U\left(\frac{1}{1+v}, 1 + \frac{v}{1+v}\right).$$

Assuming v is exogenous, the two distributions are independent and have the joint density

$$g(u_i(x), \mu_i) = \frac{v+1}{4v^2}$$

in the relevant domain.

The purchase rate under PWYW is $\Pr(U_i(c_i^*) \geq 0)$, which can be expressed as

$$\begin{aligned}&\Pr(U_i(c_i^*) \geq 0) \\ &= 1 - \Pr\left(u_i(x) < v - \frac{(1-\mu_i)^2}{2\mu_i}\right) \\ &= 1 - \int_{\frac{1}{1+v}}^{1+\frac{v}{1+v}} \int_0^{v-\frac{(1-\mu_i)^2}{2\mu_i}} g(u_i(x), \mu_i)\, \mathrm{d}u_i(x) \mathrm{d}\mu_i \\ &= 1 - \left(\frac{v+1}{4v^2}\right)\left(\frac{2v^2+v}{v+1} - \frac{1}{2}\ln(2v+1)\right) \\ &= \frac{2v-1}{4v} + \frac{v+1}{4v^2} \cdot \ln(2v+1)^{1/2}\end{aligned}$$

which converges to 0.5 rather quickly from above (see Fig. 1). In particular, the maximum value of 0.5260 is obtained at $v = 1.7383$.

On the other hand, with fixed-pricing utility is

$$U_i(p) = u_i(x) - p$$

and the purchase rate is

$$\begin{aligned}\Pr(U_i(p) \geq 0) &= 1 - \Pr(u_i(x) < p) \\ &= 1 - \frac{p}{2v}.\end{aligned}$$

This purchase rate is at most 0.5, and hence less than the PWYW purchase rate, when $p \geq v$ as per Proposition 1. However, if $p < v$, the purchase rate is greater than 0.5, and as soon as $p < 0.948v$, this purchase rate will be greater than that under PWYW.

Appendix C. Numerical results

See Tables C.1–C.3.

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Paper II

Pay-What-You-Want in Competition

1 Introduction

Pay-What-You-Want (PWYW) is a pricing scheme in which a good is up for sale and the consumer, should he decide to buy, chooses the price to pay for it. Despite the standard prediction of consumer free-riding, PWYW has in fact become increasingly popular in recent years, arguably due to the extensive media coverage after the success of Radiohead's album "In Rainbows".[1] Many other business have followed the example of Radiohead: in the period between March 2014 to April 2015, there were 113 instances of PWYW cited in news and academic articles, the majority of which are still currently operating (see Table 1 in the Appendix for a complete list). In recent years PWYW has also gained much attention in the academic literature, with publication in journals such as Science (Gneezy et al., 2010), Proceedings of the National Academy of Sciences (PNAS) (Gneezy et al., 2012) and Management Science (Schmidt et al., 2014) (see Greiff and Egbert (2016) for a survey of the literature).

The popularity of PWYW raises two questions. Firstly, how such a pricing scheme can exist: why do sellers adopt PWYW despite the possibility of getting no revenue, and accordingly, why do consumers pay a positive amount without having to

[1] In 2007, the band Radiohead released their album "In Rainbows" using PWYW. Hundreds of thousands of fans chose to pay a positive amount for the album, and the band in fact profited from this pricing format, making more money than from digital downloads of all their other studio albums combined (see `http://musically.com/2008/10/15/exclusive-warner-chappell-reveals-radioheads-in-rainbows-pot-of-gold/`, accessed 28-July-2016).

do so? Although numerous studies have attributed the success of PWYW to consumers' non-selfish behaviours, heterogeneity in preferences means that PWYW is prone to an adverse selection problem: selfish consumers self-select into the PWYW seller's market and free-ride, causing the seller to make a loss. Second, the empirical examples of PWYW (listed in Appendix A) show a distinct cluster of sellers operating in the food, music and online retail industries (such as games and softwares) – industries characterised by imperfect competition against fixed-price competitors, selling non-resalable goods of low marginal cost, with some level of product differentiation. If indeed PWYW has the potential to generate more profits than fixed-pricing, why have these competitors, and sellers in other industries, stuck to fixed-pricing? No matter which view is taken, be it the standard prediction that consumers free-ride and that PWYW would be unsuccessful, or that consumers are sufficiently pro-social that PWYW would be profitable, it is puzzling that the spread of PWYW in the market has so far can only be described as partial.

This paper aims to address the above questions in an industrial organisation framework of competing pricing strategies. Previous studies of PWYW focus primarily on the role of consumer preferences, such as altruism, social norms and self-signalling (see, for example, Kim et al. (2009), Gneezy et al. (2012), or Greiff and Egbert (2016) for an extensive survey of the PWYW literature) to motivate above zero payments. With the exception of Chen et al. (2009) and Chao et al. (2014) which are discussed below, existing theoretical models typically assume a monopolist seller (Isaac et al., 2015; Chao et al., 2015; Kahsay and Samahita, 2015; Mak et al., 2015). Our analysis differs in that we focus on the seller characteristics that are likely to favour PWYW under different market structures, including monopoly and price competition. Sellers' entry into the market and their choice of pricing schemes are modelled in a sequential setting, with and without product differentiation. Our model generates equilibrium predictions which account for the partial spread of PWYW in the market, whereby either both sellers choose fixed-pricing or at most one seller chooses PWYW and competes against a fixed-price seller.

In prior work, the success of PWYW has been attributed to preferences for fairness, self-signalling and social norms. In contrast, our model shows that even when consumers have social preferences, this is not enough to induce a seller to adopt a voluntary pricing scheme such as PWYW. The emergence of PWYW as an equilibrium strategy also requires certain market and product characteristics. However, when these conditions are fulfilled, PWYW is a simple and cheap strategy that a

second mover can adopt to escape the Bertrand trap. This serves as a theoretical basis for the later entry of PWYW into the market, in addition to the argument that PWYW is a recent phenomenon chosen as a marketing strategy for its novelty. We confirm the model's predictions using the existing examples of PWYW in the market. The parameters that are predicted to sustain the choice of PWYW by a seller include a low marginal cost for the good, a high level (or not too high, in the case of product differentiation) of surplus-sharing, a low proportion of free-riders and an intermediate range of product differentiation – which are in line with the empirical examples of PWYW. We also contribute a welfare analysis of equilibrium outcomes with and without PWYW, which explains why PWYW may not be the optimal pricing scheme in the market. Our results have far-reaching implications given the popular use of PWYW as a serious alternative to piracy in industries such as music and online games (El Harbi et al., 2014).

The need to study PWYW in competition has been recognised by Greiff and Egbert (2016) who identify gaps in the surveyed literature regarding what conditions are required for PWYW to be feasible for high cost goods, and how PWYW fares in the long-run. While most of the existing literature has focused on short-term experiments, the few empirical studies that have followed PWYW sellers over the long run concern low cost goods and find that in general, though PWYW brings in more customers, the average prices paid decrease over time (Riener and Traxler, 2012; Schons et al., 2014). Greiff and Egbert (2016, p. 20) postulate that "over longer time spans, the success of PWYW pricing will depend on the availability of substitutes and, therefore, on market structure." The same sentiment is echoed in Natter and Kaufmann (2015), who identify the demand for more knowledge on the effect of competition on PWYW's effectiveness. The lack of research on PWYW's feasibility in competition with other sellers is a clear gap in the literature that has so far only been addressed theoretically in Chen et al. (2009) and Chao et al. (2014), and experimentally in Schmidt et al. (2014) and Krämer et al. (2015). In the rest of this section we will explore these studies in more detail and in comparison to our current paper.

Chao et al. (2014) study a duopoly where sellers simultaneously compete in price, with the option of adopting PWYW. A key difference from the current paper is the modelling of consumer preference: under PWYW, consumers are assumed to experience guilt whenever their payment is less than an internal reference price, which is determined partly by their valuation of the good and an external anchor. We show that the same market segmentation, in which high valuation consumers

prefer to pay a fixed price rather than face the moral obligation of paying a higher price under PWYW, is achieved using a simpler and more tractable assumption of surplus-sharing. We obtain similar equilibrium outcomes, either both sellers choose fixed-pricing and earn zero (the Bertrand outcome), or one seller uses fixed-pricing and the other uses PWYW, with both sellers earning positive profits if consumers are sufficiently guilt-averse and costs are sufficiently low. Additionally, while Chao et al. (2014) model homogeneous good competition, the simplicity of our model allows for the analysis of PWYW under product differentiation.

Chen et al. (2009) is another closely related paper which considers PWYW under monopoly and horizontal product differentiation. While there are similarities in the modelling of consumer preference and the resulting profitability under monopoly, we have different predictions regarding competition. This is due to the different way in which consumer behaviour, and hence PWYW price, is modelled. In Chen et al. (2009), consumer surplus is defined according to the 'next best option', with the equilibrium finding that either both sellers choose PWYW, or both sellers choose fixed-pricing. In our model, as will be made clear in Sections 3 and 4, we assume that PWYW payment is not reduced by the transport cost, and (similar to Chao et al. (2014)) that high valuation customers will choose fixed-pricing to avoid the social obligation of sharing their high consumer surplus under PWYW. This mirrors the findings in various laboratory and field experiments such as Kim et al. (2009), Gneezy et al. (2012) and Schmidt et al. (2014) where a significant proportion of consumers prefer fixed-pricing to PWYW. Consequently, our model produces an equilibrium in which PWYW competes against fixed-pricing, given certain conditions.

While both Chao et al. (2014) and Chen et al. (2009) provide seminal equilibrium analyses of simultaneous oligopoly competition with PWYW, neither of them presents a theoretical mechanism explaining the phenomenon often observed in real life, the entry of PWYW into fixed-price dominated markets. Our paper contributes the first complete and tractable model of firm behaviour that not only incorporates product differentiation, but also accounts for the later entry of real world PWYW sellers and their partial spread in the market. Using a simple surplus-sharing mechanism similar to Chen et al. (2009), we replicate the equilibrium results of Chao et al. (2014) under homogeneous competition and additionally generalize the results under product differentiation. In both cases, a competing seller only chooses PWYW facing a fixed-price seller if there is a sufficiently high level of surplus-sharing, otherwise the Bertrand result obtains. In

particular, our unique sequential setting provides insights into the dynamics of sellers' strategies. A first mover will always choose fixed-pricing, while the second mover will only choose PWYW given the favourable conditions. This equilibrium outcome is empirically consistent with the majority of PWYW examples, where the PWYW seller typically enters a market with an existing fixed-price competitor.

The only laboratory experiments so far that have tested the feasibility of PWYW under competition are Schmidt et al. (2014) and Krämer et al. (2015). In contrast to our prediction of a separating equilibrium, given buyers are sufficiently altruistic Schmidt et al. (2014) predict that both sellers use PWYW (Prediction 3). When there is one PWYW seller facing a fixed-price seller, PWYW will achieve maximum market penetration (Prediction 2). However, the authors concede that this may not hold if buyers still opt for fixed-pricing due to, for example, self-image concerns, and this is indeed what they find with around 20% of buyers still choosing fixed-pricing despite the presence of PWYW. Consequently, the authors find that given the choice, 85% of sellers also prefer to set a fixed price. However if buyers are not sufficiently altruistic, both papers predict an equilibrium where both sellers choose fixed-pricing. Krämer et al. (2015) compare the performance of PWYW in competition with a fixed-price seller. The authors predict and show that PWYW captures almost the whole market, in contrast to our prediction and the real world examples where a substantial proportion of buyers prefer a fixed price to PWYW. This difference is explained by the assumption that PWYW provides an additional benefit to the seller (through the buzz or word-or-mouth advertising generated), meaning that buyers do not feel bad about accepting a PWYW offer. This assumption will hold in situations where the buzz or media coverage of PWYW is sufficiently large.

The rest of this paper will be structured as follows: we develop the model in Section 2, starting with the monopoly case followed by competition in Section 3. Product differentiation is introduced in Section 4, while Section 5 presents a welfare analysis. Section 6 ties all the results together with the existing empirical examples of PWYW, and Section 7 concludes. All proofs are provided in the Appendix.

2 Model

While the literature on PWYW consumers' social preferences is extensive, a rich model of consumer behaviour capturing all the aspects previously mentioned, such

as guilt, fairness and reciprocity, will unnecessarily complicate the model. This paper has a different goal and focuses instead on seller behaviour. From the point of view of the seller it is sufficient to observe and take as given that consumers are either free-riders or fair (who may pay more the higher their valuation for the good, as empirically shown in Schmidt et al. (2014) and Krämer et al. (2015), or instead opt out for any of the motivations above). This can be captured in a simple linear model of a consumer who maximises his net surplus, as done in, for example, Greiff et al. (2014), Chen et al. (2009), Cui et al. (2007), and in standard industrial organisation models of consumer preferences such as Economides (1986) and Perloff and Salop (1985).[2]

Each consumer is assumed to have unit demand. For simplicity, consumer i's total utility from purchasing the good at price p is assumed linear according to the following:

$$U_i = u_i - p.$$

u_i is the good's consumption utility, or alternatively, i's willingness to pay for the good. It is assumed to be uniformly distributed between zero and k times the good's constant marginal cost $c > 0$, which is public knowledge, so that $u_i \sim U(0, kc)$. k is a scaling term which varies with the support of the consumption utility distribution, to capture the fact that some goods may be valued by consumers more than their marginal cost.[3] Moreover, $k > 1$ so that production of the good is efficient. The population size is normalised to 1, and the utility of no purchase is zero. We assume there is no fixed cost of production, and the seller sells no other type of good.[4]

When the seller lets the consumer pay what he wants (PWYW), this triggers different reactions in consumers given heterogeneous fairness concerns. Assume a proportion θ, $0 < \theta \leq 1$, are free-riders, who would always take the good for

[2]In a later version of Chen et al. (2013) obtained directly from the authors, a component for inequity-aversion is added to the utility function. Chao et al. (2014) also use a guilt-aversion component to model consumer preference. For the purpose of tractability in our analysis of varying market structures, we have opted to use the simpler surplus-sharing mechanism described here.

[3]For goods with extremely low marginal cost c, high consumption utility is captured by a high value of k. Alternatively, replacing the upper bound of the consumption utility distribution with $kc + \epsilon$, $\epsilon > 0$, produces qualitatively similar results. This also captures the case of goods with zero marginal cost, where ϵ then acts as a positive fixed cost.

[4]While in some instances PWYW may be used as a promotional tool to help cross-sell a complementary product by the same seller, for tractability we have assumed that only one product is offered by the seller.

free.[5] Previous studies have consistently found that a proportion of the population of individuals free-ride unconditionally, and that this behaviour type is stable (Kurzban and Houser, 2005; Fischbacher et al., 2001). Hence, it is reasonable to assume that θ is an exogenous market parameter,[6] which can vary by country or industry. Cross-country variations in free-riding behaviour have been found in Kocher et al. (2008). It is also plausible to consider goods with charity component to attract fewer free-riders compared to other goods.

The remaining $1 - \theta$ consumers, however, are fair: they will pay at least c and therefore will not purchase the good if their consumption utility u_i is less than c. They will even split the surplus $u_i - c$ out of reciprocity for the seller having chosen a PWYW scheme, or any of the previously mentioned social preferences.[7] Let λ be the proportion of surplus shared with sellers, $0 < \lambda \leq 1$.[8] This parameter represents the strength of social preferences in the economy, and can also be interpreted as an exogenous social norm – typically assumed to be 0.5 in an equal sharing rule, but in a richer and more generous economy the norm may be to give more and vice versa (see, for example, Gächter and Herrmann (2009) who find cross-cultural variations in reciprocity).[9]

The fair consumer's PWYW payment is therefore defined to be[10]

$$p_i = c + \lambda(u_i - c).$$

Observe that since λ and c are assumed exogenous, PWYW payment is deterministic. This means that given the seller offers PWYW, social norms dictate that consumers pay p_i. Substituting this payment into the utility function then gives

[5]The analysis for $\theta = 0$ is straightforward and is left to the reader.

[6]Assuming consumers endogenously choose whether to free-ride or be fair towards the seller does not change our qualitative results. This analysis is provided as a robustness check in Appendix C.1.

[7]See also the literature on gift exchange, for example Fehr et al. (1998) where sellers offer high quality and consumers reciprocate by paying prices which are substantially higher than the sellers' reservation prices.

[8]$\lambda = 0$ is simply the case of fixed-pricing at cost.

[9]Assuming λ is heterogeneous has qualitatively similar results. The analysis is provided as a robustness check in Appendix C.2.

[10]PWYW revenue from fair consumers can therefore be interpreted as that from a two-part tariff, where the surplus-sharing component defines the entry fee and c is the price paid per unit good. To this extent, our analysis in this paper is therefore related to the literature on non-linear pricing.

the consumer's PWYW utility:[11]

$$U_i = u_i - c - \lambda(u_i - c).$$

Again, we stress that social norms dictate that fair consumers do not buy the good if $u_i < c$.

2.1 Monopoly

Under fixed-pricing (FP), a monopolist's profit can be expressed as

$$\pi_{FP} = \int_p^{kc} \frac{1}{kc}(p-c)du = (p-c)\left(1 - \frac{p}{kc}\right)$$

using the familiar $(p-c)q$ notation. Performing the usual profit maximisation calculation, we have optimal price, quantity and profit as follows:

$$p_{FP} = \frac{c(k+1)}{2} \qquad q_{FP} = \frac{k-1}{2k} \qquad \pi_{FP} = \frac{c(k-1)^2}{4k}.$$

Under PWYW, a monopolist's profit can be expressed as

$$\begin{aligned}\pi_{PWYW} &= \theta \int_0^{kc} \frac{1}{kc}(-c)du + (1-\theta)\int_c^{kc} \frac{1}{kc}(c + \lambda(u-c) - c)du \\ &= \frac{(1-\theta)\lambda c(k-1)^2}{2k} - \theta c.\end{aligned}$$

Hence,

Proposition 1. *The monopolist will choose PWYW if and only if*

$$\lambda > \hat{\lambda} = \frac{(k-1)^2 + 4\theta k}{2(1-\theta)(k-1)^2},$$

which increases with θ and decreases with k.

[11] This particular choice of reduced-form utility, despite its simple structure and extensive use in the literature cited above, may seem arbitrary and deserve more motivation. Note that this utility function can be derived from, for example, the inequity aversion model of Fehr and Schmidt (1999). If the fair consumer simply compensates the PWYW seller by paying c, he will get a surplus of $u_i - c$ while the seller will get a profit of zero. Advantageous inequity aversion will result in a utility reduction of $\lambda(u_i - c)$, which under PWYW will instead be shared with the seller.

Not surprisingly, the condition for PWYW to be chosen over FP is that λ, the level of surplus shared, is high enough, or θ, the proportion of free-riders, is low enough – which are supported by the findings in Chen et al. (2009). Additionally, if k, the scaling term corresponding to the support of u_i, is high enough, many fair consumers will have a sufficiently high valuation for the good and thus make a correspondingly high PWYW payment. Thus, PWYW achieves endogenous price discrimination which is more profitable than a fixed-price monopoly. This is illustrated in Figure 1. When the proportion of free-riders is high, PWYW profit is negative. As λ increases and θ decreases such that

$$\lambda > \frac{2\theta k}{(1-\theta)(k-1)^2},$$

PWYW profit becomes positive, but still less than fixed-price profit. Only when λ exceeds the threshold $\hat{\lambda}$ above will PWYW yield higher profit than fixed-pricing. As k increases, the λ-intercepts of these boundaries stay the same but the curves stretch to the right, increasing PWYW profit.

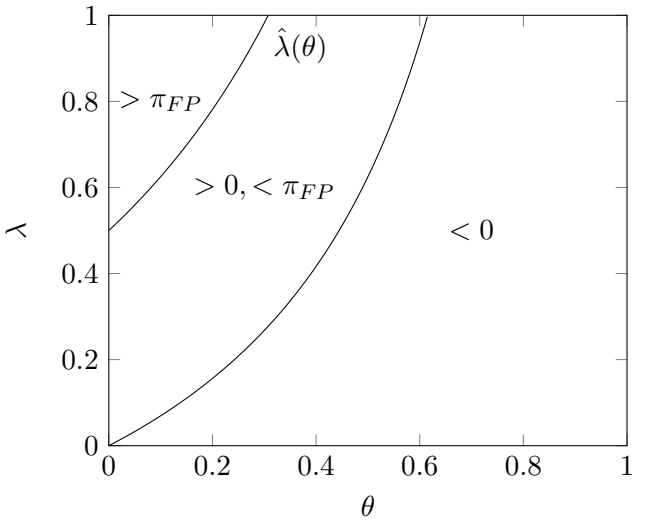


Figure 1: Profit regions for PWYW monopolist, $k = 5$

To illustrate why PWYW is rarely chosen by a monopolist, consider Fehr and Schmidt (1999, Table III) who estimate the proportion of individuals experiencing zero disutility from advantageous inequality to be around 0.3. Using this estimate for the number of free-riders θ suggests that for the seller to choose PWYW over

FP, even when λ is very close to 1, requires the good to be valued more than twice its cost on average ($k/2 > 2.40$). As the average level of surplus-sharing decreases, the average valuation needs to increase. In a typical economy with a $\lambda = 0.5$ norm, PWYW profit will never exceed fixed-price profit.

3 Competition

Suppose now that there are two competing sellers selling the same product, and they can choose their preferred pricing schemes. Assume the product precludes resale.[12] In stage 1, Seller A chooses either FP or PWYW. In stage 2, Seller B enters and chooses either FP or PWYW. In stage 3, any seller that chooses FP now chooses his price. If there are two FP sellers, the choice of price occurs simultaneously.

The sequentiality in entry closely models what we see in practice, whereby PWYW has commonly entered a market previously dominated by fixed-price sellers. It takes into account frictions such as menu costs, marketing expenses and customer self-selection which are costly and time-consuming, thus preventing sellers from quickly adopting an alternative pricing scheme, at least in the short- to medium-run. This means that the second seller is able to observe what the first seller does and choose a strategy with prior knowledge of the competitor's choice of pricing scheme.[13] Given two FP sellers, however, the simultaneity in price competition captures the repeated interaction through the flexibility in prices which sellers can adjust dynamically, once FP is chosen.[14]

The full representation of the game and the resulting end nodes, as derived below, are shown in Figure 2. All decisions are common knowledge.

At the end of Stage 3, the consumers make their purchase decisions. When both sellers choose PWYW, consumers randomise such that each seller gets half the market and shares the monopolist PWYW profit. When both sellers choose FP, consumers go to the seller with the lower price or randomise if prices are the same.

[12] With resale, a FP competitor or free-riding consumer can drive out the PWYW seller by buying a sufficiently large amount of the good at zero cost to resell them at a positive price.

[13] Assuming simultaneity has qualitatively similar results. The analysis is provided as a robustness check in Appendix C.3.

[14] Letting sellers choose prices sequentially corresponds to a situation in which prices, once set, are fixed. An analysis is provided in Appendix C.4 with similar results. Additionally, a second mover advantage may induce the incumbent to choose PWYW given an intermediate range of λ.

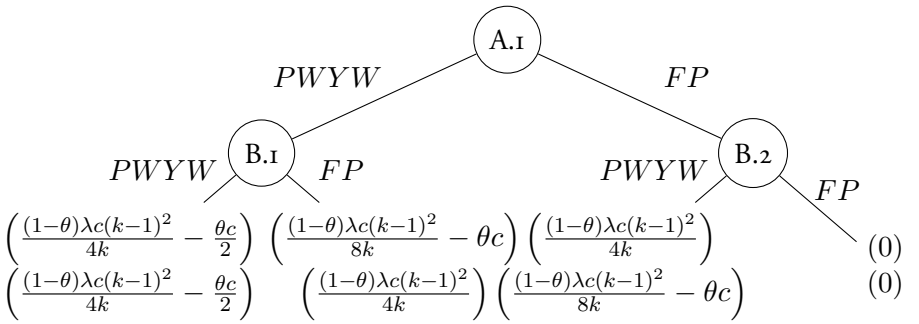


Figure 2: Competition between two sellers

Hence we assume that the usual Bertrand result applies where both sellers set $p = c$ and make zero profit.

When there is one PWYW seller and one FP seller, the free-riders will always take the good from the PWYW seller, while the fair consumers will go to the seller at which he will pay the lower price, be it the fixed price p or his PWYW price p_i. Going to the PWYW seller means that they are obliged, through fairness norms, to pay p_i. Consumers with high consumption utility may consequently prefer to go to the FP seller and pay a lower fixed price.

At first sight, this choice may seem inconsistent with the fair buyer's motivation to pay a positive price under PWYW. However, it can be argued that when choosing pricing schemes, buyers (who know they will be obliged by social norms to pay a higher price for higher consumption utility under PWYW) simply choose what would in the end give them a higher surplus, and only conditional on choosing PWYW does the fairness mechanism *appear to* kick in. A similar market segmentation is also seen in Chao et al. (2014) where fair consumers with high valuation have higher reference prices, and hence experience higher guilt cost for paying less under PWYW. The assumption that (even fair) consumers choose the seller at which they can pay a lower price is crucial to capture the preference for fixed-pricing seen in empirical examples. PWYW involves a certain degree of uncertainty regarding the correct behaviour (Park et al., 2016) and some consumers may seek to avoid this moral deliberation and obligation (Schmidt et al., 2014). This is also demonstrated in the experiments by Gneezy et al. (2012) and Kim et al. (2009) where fewer people buy a good when it is offered under PWYW than when there is a

fixed price.[15]

Define

$$u_p = c + \frac{p - c}{\lambda}$$

to be the consumption utility at which a fair consumer is indifferent between paying p_i, his PWYW payment, and the fixed price p. Therefore, when $c \leq u_i < u_p$, he prefers to go to the PWYW seller, when $u_i = u_p$ he is indifferent, and beyond u_p he is better off purchasing at the fixed price than sharing his consumer surplus with the PWYW seller. This is illustrated in Figure 3.

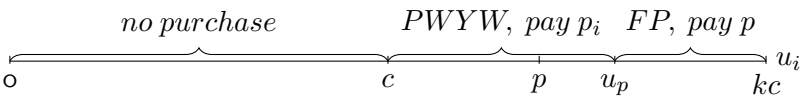


Figure 3: Fair consumer's action when PWYW and fixed-pricing both exist

Clearly the fixed-price seller chooses the profit-maximising price p taking into account that this price will determine demand for both himself and his competitor. He will no longer get all the consumers with valuation greater than p since the θ free-riders go to the PWYW seller. Out of the fair consumers, he will only get those with $u_i \geq u_p$ (see Figure 3). Hence the fixed-price seller will not set $p \geq c(\lambda k - \lambda + 1)$, as $u_p \geq kc$ and he would then get no customer. He will also not set $p \leq c$, as this will yield zero or negative profit. Therefore his fixed price will lie in $(c, c(\lambda k - \lambda + 1))$, and his profit can be expressed as[16]

$$\pi_{FP} = \frac{1 - \theta}{kc} \int_{u_p}^{kc} (p - c) du.$$

The profit maximising-price is thus

$$p^* = c\left(1 + \frac{\lambda(k-1)}{2}\right)$$

[15]Commonly suggested alternatives, such as letting PWYW consumers pay the competitor's fixed price less epsilon, or share a proportion of surplus defined as the competitor's fixed price less marginal cost, will not capture the choice of a subset of consumers who prefer to pay a fixed price. As per Schmidt et al. (2014, pp. 1222-1223), "some customers may opt for a [FP] seller because they are happy to buy the product for a low posted price, but they would feel 'cheap' if they paid this low price voluntarily."

[16]The set $(c, c(\lambda k - \lambda + 1))$ is non-empty since $\lambda > 0$ and $k > 1$.

and $u_p = c(k+1)/2$. Hence,

$$\pi_{FP} = (1-\theta)\frac{\lambda c(k-1)^2}{4k}, \qquad \pi_{PWYW} = (1-\theta)\frac{\lambda c(k-1)^2}{8k} - \theta c.$$

The resulting profit for each seller is shown in Figure 2. To describe the equilibrium results, define the following:

Definition 1. *In a separating equilibrium, one seller chooses PWYW and the other FP.*

Definition 2. *In a pooling equilibrium, both sellers choose the same pricing scheme, either PWYW or FP. Specifically, in the FP-pooling equilibrium, both sellers choose FP. In the PWYW-pooling equilibrium, both sellers choose PWYW.*

The equilibrium outcomes will now be summarised in Proposition 2, and illustrated in Figure 4.

Proposition 2. *Given*

$$\lambda^* = \frac{8\theta k}{(1-\theta)(k-1)^2},$$

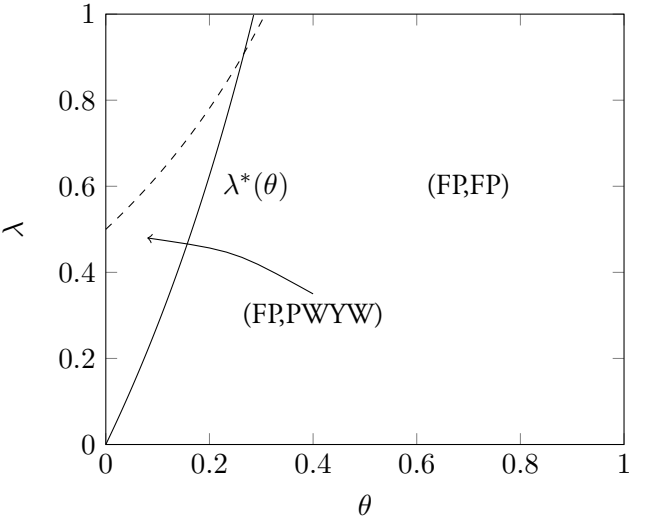
which increases with θ and decreases with k, when two competing sellers choose pricing schemes sequentially and then enter into a simultaneous price competition, the subgame perfect equilibrium is either separating or FP-pooling. Specifically,

i if $\lambda > \lambda^*$, Seller A chooses FP, and Seller B chooses PWYW,

ii if $\lambda < \lambda^*$, Seller A chooses FP, and Seller B chooses FP,

iii if $\lambda = \lambda^*$, Seller A chooses FP, and Seller B randomises between PWYW and FP.

In equilibrium, either both sellers compete in a Bertrand price competition and earn zero profit, or if there is sufficiently high surplus-sharing in the market one seller will use PWYW against a FP competitor. All pure strategy equilibria are unique. Our results are similar to Chao et al. (2014), where consumers are assumed to be guilt-averse and sellers compete in a simultaneous setting. In our sequential setting, we see that PWYW can be used as a strategy by the second mover to avoid Bertrand competition. Seller B choosing FP will lead to zero profit for both sellers. As long as λ is sufficiently high or θ is sufficiently low, there is positive residual



Dashed line represents the corresponding monopolist threshold $\hat{\lambda}$ above which PWYW is chosen.

Figure 4: Subgame perfect Nash equilibria, $k = 5$

PWYW profit and Seller B will choose PWYW, with Seller A reaping the majority of the market profit. This is anticipated by Seller A, and therefore as a first mover he always chooses FP. Only when the PWYW profit becomes negative does Seller B prefer the Bertrand competition.

Note that λ^* decreases as k, and hence the support of u_i, increases. As the good becomes more valuable to consumers, choosing PWYW becomes more profitable for Seller B as his residual profit (when Seller A has chosen FP) increases. Setting $\theta = 0.3$ (Fehr and Schmidt, 1999), the average valuation of the good needs to be at least 2.62 times its cost for PWYW to be chosen by the second mover, even when λ is very close to 1 which is not often seen in practice. When $\lambda = 1/2$, the average valuation needs to be even higher (4.37) which may be less realistic. On the other hand, we see that for low values of θ it is possible to sustain a PWYW seller in competition for lower values of λ compared to the monopoly situation.[17] This is due to the opportunity cost of adopting FP: as a monopolist, choosing FP leads to

[17]This relationship is reversed if $\theta > (k-1)^2/12k$ and $k < 13.93$. In this region it is more difficult for PWYW to survive competition, as the lower proportion of fair buyers contributes even lower profit due to the presence of the FP competitor. However, as can also be seen in Figure 4, the existence of this case also requires $\lambda \approx 1$ which is less common.

positive profit, while the Bertrand competition profit is zero. Hence the switching point to FP occurs at a higher value of λ as a monopolist than in competition.

Our equilibrium results under homogeneous competition differ from those in Chen et al. (2009) where setting transport cost equal to zero yields the PWYW-pooling equilibrium. The difference stems from their assumption of no free-riders, which is relaxed here, and the way that fair consumers choose their seller when both PWYW and FP are available. In Chen et al. (2009), surplus is defined according to the 'next best option': given the FP seller's price p, the fair consumer's PWYW payment is $c + \lambda(p - c)$, which is always less than p if $\lambda < 1$. This means that all consumers will buy from the PWYW seller, and consequently there is no equilibrium with PWYW competing against FP. This contrasts with our definition of surplus-sharing and our assumption of heterogeneous consumption utility, giving rise to fair consumers who do not buy at all, those who buy from the PWYW seller, and those who go to the FP seller to pay a fixed price, thus yielding the separating equilibrium.

It might appear that our results are simply driven by the zero profit feature of the Bertrand model, that given PWYW is sufficiently profitable it would naturally be chosen as an alternative to fixed-pricing. While this explains the choice of the second mover at node B.2 in Figure 2, we argue that the equilibrium path at node B.1, and hence A.1, is not necessarily obvious. Given a first mover choosing PWYW, our model predicts that the second mover would reap more profit using a fixed price. This relies on our assumption that consumers with high valuation would rather pay a fixed price than face the moral obligation of paying a higher price under PWYW, in contrast to other predictions such as Schmidt et al. (2014) where full market penetration under PWYW leads to the PWYW-pooling equilibrium.

In summary, no pooling equilibrium exists where both sellers choose PWYW. Instead, PWYW is used as a strategy by the second mover to avoid Bertrand competition. Consequently, this makes PWYW a simple and cheap alternative to other costly marketing strategies such as differentiating products or introducing switching costs. For the first mover, the 'threat' of a competitor choosing PWYW is likewise beneficial in preventing the Bertrand equilibrium of zero profit.

4 Product Differentiation

Many PWYW examples can be found in markets with differentiated products, such as food, music and softwares (see the list of PWYW examples in Table 1 in the Appendix). While adopting PWYW seems to be more profitable for imperfect substitutes than homogeneous goods (we do not see a PWYW telecommunication company, for example), the adoption of PWYW does not quite reach the other extreme: products which are highly differentiated through exclusive brand names are still sold predominantly at fixed prices. In this section, we study a model of PWYW competition with horizontal product differentiation which can explain this finding.

Consumers are uniformly distributed along a Hotelling linear city of length 1. We continue to assume unit demand. For simplicity, and as commonly assumed in models of horizontal product differentiation including Hotelling (1929), consumption yields constant surplus $v = E(u) = kc/2$ as firms are assumed to be risk-neutral. This is a considerable simplification from the homogeneous product model with heterogeneous consumption utility studied in previous sections, however it facilitates the analysis to generate tractable results under product differentiation.

Consumers also pay a transportation cost $t > 0$, such that a consumer located at $x \in [0, 1]$ incurs disutility tx if he purchases from Seller L located at 0, and $t(1 - x)$ from Seller R located at 1. Both sellers have the same profit and cost structures as before, with constant marginal cost c. We assume also that v, and hence k, is sufficiently large such that the market is fully covered: all consumers will purchase a unit in equilibrium.[18]

Sellers choose their pricing scheme sequentially and prices are set at the end (simultaneously, if both sellers choose FP).[19] With both sellers choosing FP, the equilibrium outcome is simple to calculate: both sellers set $p_L = p_R = c + t$ and get half the market with profits $\pi_L = \pi_R = t/2$.[20] This result is intuitive: the

[18] It is straightforward to derive the required conditions: $k > 2 + 3t/c$ when $\lambda \in (0, 2/3]$, and $k > 2 + t/(c - c\lambda)$ otherwise.

[19] The corresponding analysis for sequential price setting is provided in Appendix C.4. With positive transport cost, despite the second mover advantage it is still preferable for the first mover to choose FP, resulting in a FP-pooling equilibrium.

[20] A consumer will be indifferent to purchasing at either seller if his utility from purchasing at Seller L, $U = v - p_L - tx$, equals the utility from purchasing at Seller R: $U = v - p_R - t(1 - x)$.

higher the degree of differentiation, the higher the sellers are able to charge in mark-up over the cost of the good, while in the limit as $t \to 0$ we get the Bertrand equilibrium again.

Suppose now that both sellers adopt PWYW. When the consumer buys from a PWYW seller, his PWYW payment continues to be defined by the surplus-sharing mechanism as per Section 2: $p_i = c + \lambda(v - c)$. Note that we have assumed the surplus-sharing component is derived from the consumer's total surplus from the good, not counting any reduction from transport cost. Transport cost moderates product differentiation insofar as it determines the consumer's choice of sellers, without creating heterogeneity in PWYW payment. We argue that this is a realistic representation of a fair consumer who has to consume a good slightly different from his first choice, but upon arriving at the seller, in keeping with social norms pays according to the good's pure consumption utility, without penalising the seller for the extent of product differentiation.[21]

For clarity in the analysis, assume no free-riders.[22] The consumer's utility from buying at Seller L is $U = v - tx - (c + \lambda(v - c))$, while from Seller R his utility is $U = v - t(1 - x) - (c + \lambda(v - c))$. As the payment for the good is identical at both sellers, the indifferent consumer is located at $x = 1/2$ and each seller gets half the market with $\pi_L = \pi_R = \lambda(v - c)/2$. This is independent of the transport cost: when the consumer pays what he wants, his payment is deterministic. Consequently each seller always gets half the PWYW market profit regardless of the degree of product differentiation.

Suppose now that Seller L adopts PWYW and Seller R adopts FP. The indifferent

His location is thus $x = (p_R - p_L + t)/(2t)$. Hence, from maximising $\pi_L = (p_L - c)x$ with respect to p_L and by symmetry, we get $p_L = p_R = c + t$ and $x = 1/2$.

[21] While this is mainly done for tractability, another plausible interpretation of the model is a setting whereby a product, while sufficiently differentiated, has a commonly understood fair value. For example, a Radiohead album is a differentiated product with a relatively well-known fair price: almost all consumers have arguably experienced buying a music album. Combined with adherence to social norms, consumers therefore have a relatively narrow estimate of what they should pay for it in a PWYW setting. While in reality those who prefer not to pay this fair value can simply abstain from buying, we have assumed in the model that the market is covered. Consequently the transport cost t merely determines the consumers' choice of sellers, and once this choice is made, p_i is paid. Another realistic interpretation is that given the two sellers' products are not perfect substitutes, a consumer may want to help keep his preferred seller in the market by paying the fair price p_i rather than discounting it by his transport cost.

[22] The analysis with free-riders, which does not change the qualitative equilibrium results, is presented in Appendix C.5.

consumer is now located at $x = (t+p_R-c-\lambda(v-c))/(2t)$. It is straightforward to derive the profit maximising price of Seller R:

$$p_R = c + \frac{t + \lambda(v-c)}{2}$$

which implies

$$x = \frac{3}{4} - \frac{\lambda(v-c)}{4t}$$

and profits are

$$\pi_L = \frac{3\lambda(v-c)}{4} - \frac{\lambda^2(v-c)^2}{4t} \qquad \pi_R = \frac{(t+\lambda(v-c))^2}{8t}.$$

For simplicity, assume that when the seller is indifferent between PWYW and FP he will choose FP.[23] The equilibrium results are stated in the following proposition:

Proposition 3. *When two competing sellers of differentiated products choose pricing schemes sequentially and then enter into a simultaneous price competition, the subgame perfect equilibrium is either separating or FP-pooling. Specifically,*

i if

$$\frac{2t}{(k-2)c} < \lambda < \frac{4t}{(k-2)c},$$

the first mover chooses FP and the second mover chooses PWYW,

ii otherwise, both sellers choose FP.

All pure strategy equilibria are unique. As the first mover always chooses fixed-pricing, when the surplus-sharing norm is low PWYW is attractive to consumers but yields low profit to the seller. However, an extremely high surplus-sharing norm makes PWYW highly profitable per unit of the good, but demand is low since many customers would prefer purchasing at the (lower) fixed price. This is because the location of the indifferent consumer, x, decreases with λ as the

[23] Abstracting from this assumption, in the special case where $\lambda = \frac{4t}{(k-2)c}$, both (FP,FP) and (FP,PWYW) are equilibrium outcomes. When $\lambda = \frac{2t}{(k-2)c}$, profits for all sellers at all end nodes equal $t/2$ and all of (FP,FP), (FP,PWYW), (PWYW,FP), (PWYW,PWYW) are equilibrium outcomes.

price paid to the PWYW seller increases more than the fixed price. Therefore it is in the intermediate region of λ that a seller would choose PWYW against a FP competitor.

As seen above, variations in k, c and t affect not only the upper and lower thresholds of λ, but also the range of values for which PWYW obtains. Given the market is fully covered as per Footnote 18, this set is non-empty. As consumer valuation k increases, the bounds for λ decrease and the range narrows: on the one hand, PWYW becomes more attainable for lower values of surplus-sharing, but when surplus-sharing is high PWYW is less appealing for consumers as the amount paid to the PWYW seller increases. The effect of marginal cost c is similar: both upper and lower thresholds of λ are decreasing in c. For low values of λ, as c increases the higher valuation for the good increases PWYW profit and results in the second mover choosing PWYW. However, when λ is high, the higher PWYW payment results in lower demand making fixed-pricing more profitable. The range also narrows, meaning that there are fewer values of λ for which PWYW obtains as marginal cost increases.

The effect of varying the degree of product differentiation, as captured by the transportation cost t, follows from the proposition above:

Corollary 1. *Given* $\lambda \geq \frac{4t}{(k-2)c}$*, as* t *increases to* $t' \in \left(\frac{\lambda(k-2)c}{4}, \frac{\lambda(k-2)c)}{2}\right)$ *the FP-pooling equilibrium becomes separating.*

At low levels of product differentiation, demand for the PWYW seller is low. Consider the limiting case with homogeneous products: as $t \to 0$, the FP competitor can simply set $p = c + \lambda(v - c) - \epsilon$ and capture all consumers. Therefore, an increase in t serves to guarantee that some consumers will go to the PWYW seller as the location of the indifferent consumer x moves closer to the FP seller. Observe that the range given in Proposition 3 increases with t. However this increase in quantity becomes smaller as t increases, with an upper bound at $3/4$, the limit of the location of the indifferent consumer when $t \to \infty$.

Note that the above increase in demand will only convince a FP second mover to switch to PWYW when the level of surplus-sharing norm is above the threshold given in Proposition 3 (where FP was chosen due to low demand). When the level of surplus-sharing is low such that PWYW results in high demand but is not sufficiently profitable, yet another increase in demand from product differentiation

will not induce the FP seller to switch to PWYW as the amount paid by each consumer is still too low to overtake the profit increase as a FP seller.

It is worth discussing the key differences between this model and that in Chen et al. (2009). We have assumed here that the transport cost is not included in the surplus-sharing calculation: once the consumer 'arrives' at the PWYW seller, he considers his surplus to be the pure consumption utility less the cost of the good. In Chen et al. (2009), the consumer utility from purchasing at the PWYW seller is defined to be $U = v - tx - (c + \lambda(v - tx - c))$. When the consumer has the choice of PWYW and FP sellers, his surplus is defined to be $p_t - c$, in line with the 'next best option' where p_t is the (fixed) price at which he is indifferent between buying from either seller. As a result, the location of the indifferent consumer and hence demand is independent of λ, the surplus-sharing parameter. The FP profit is lower compared to that derived here, giving rise to a PWYW-pooling equilibrium whenever λ exceeds a threshold value which is increasing in transport cost, or a FP-pooling equilibrium otherwise. While the FP-pooling equilibrium is consistent with the results obtained here, as seen in the empirical examples it is rare to see a market dominated by PWYW. Moreover, we find that the relationship between surplus-sharing, transport cost and the likelihood of PWYW in equilibrium is also not as straightforward as Chen et al. (2009) suggest: while a higher level of surplus-sharing makes PWYW more profitable for the second mover, given our assumptions above this is only true up to a point, beyond which higher surplus-sharing will drive away customers to the fixed-price competitor. Similarly, given a sufficiently high surplus-sharing norm, as the level of product differentiation increases, PWYW is more profitable for the second mover up to a point, beyond which FP would be preferred.

5 Welfare

In this section, we discuss the welfare implications of the various types of market structure taking into consideration the surplus of the consumers. We show that when PWYW arises in equilibrium, it may result in lower welfare for buyers.

Facing a monopolist seller, free-riders are always better off under PWYW than fixed-pricing, while for the fair consumers PWYW is preferred only if 'not too much' surplus is shared. With a norm of high surplus-sharing, fixed-pricing will be preferred. Overall, buyers will prefer PWYW if the level of surplus-sharing λ is

less than some threshold value $\bar{\lambda}$. Since the monopolist seller only prefers PWYW if λ exceeds $\hat{\lambda}$ as given in Proposition 1, it follows that:

Proposition 4. *In an economy with a monopolist seller, PWYW will only be preferred by both the seller and buyers if*

$$\theta \leq \frac{(k-1)^2}{4}$$

and $\hat{\lambda} \leq \lambda \leq \bar{\lambda}$*, where*

$$\hat{\lambda} = \frac{(k-1)^2 + 4\theta k}{2(1-\theta)(k-1)^2} \quad \textit{and} \quad \bar{\lambda} = \frac{(k-1)^2(3-4\theta) + 4k^2\theta}{4(1-\theta)(k-1)^2}.$$

A low proportion of free-riders θ is a necessary condition for PWYW to be preferred by both seller and buyers. Free-riders who have a low valuation for the good ($u_i < c$) and yet take it for free, incurring a cost c to the seller, is a major contributor to dead-weight loss. With $\theta = 0.3$ (Fehr and Schmidt, 1999), PWYW being preferred by both seller and buyers requires that $k > 2.095$, or that the good is on average valued at 1.05 times its cost. This requirement ought to be fulfilled by most monopolist goods such as petrol or medicine, however the prevailing surplus-sharing parameter in the market may be too low for the seller. This results in FP being the preferred pricing scheme of the monopolist seller as explained in Section 2.

Under competition, while there is no PWYW-pooling equilibrium, one of the sellers may choose PWYW if the surplus-sharing norm λ exceeds the threshold λ^* (the north-west region in Figure 4). This avoids the Bertrand competition where both sellers set a price $p = c$ and get zero profit, where moreover all surplus accrues to buyers. Although the free-riders will prefer an equilibrium in which one seller offers PWYW, clearly the fair buyers prefer the FP-pooling equilibrium where they pay a fixed price of c, to the separating equilibrium where they either share their surplus or pay a higher fixed price. Hence, the separating equilibrium will only be preferred if the proportion of free-riders is sufficiently high. However there is no compatible region in the $\lambda\theta$-plane in which the separating equilibrium is preferred by both sellers and buyers:

Proposition 5. *In an economy with two competing sellers selling a homogeneous product, whenever the separating equilibrium obtains, it will never be preferred by all buyers.*

When products are differentiated as per the setting in Section 4, assuming all consumers are fair and have constant valuation of the good at $v = kc/2$, they will prefer the separating equilibrium if the size of the surplus shared is sufficiently low. Specifically, when $\lambda \leq \frac{2t}{(k-2)c}$, both sellers' prices in the separating equilibrium are weakly lower than in the FP-pooling equilibrium. The indifferent consumer is now located to the right of $x = 0.5$. While some customers will pay more in transport cost to travel to the PWYW seller, the loss is made up by the savings made by those who still go to the closest seller and are now paying a lower price. However this is outside of the region in which PWYW is chosen by the seller as given in Proposition 3.

Proposition 6. *In an economy with two competing sellers selling a differentiated product, whenever the separating equilibrium obtains, it will never be preferred by all buyers.*

The adoption of PWYW by a seller in competition means that buyers are dictated by social norms to share a proportion λ of their surplus. Our analysis suggests that this is a move which is welfare-decreasing for buyers, who consequently should lobby against the use of such pricing schemes. Given a strong social norm to share a proportion of their surplus consumers may be better off under traditional fixed-pricing schemes.[24]

6 Discussion and Empirical Observations

This paper studies the profitability of PWYW relative to fixed-pricing both as a monopolist and in competition, which has so far received little attention in the literature. In this section, the results from the analysis will be discussed in relation to the empirical examples of PWYW which are compiled in Table 1 in the Appendix.[25] These examples come from previous academic literature and following Google news alerts for "pay-what-you-want" from March 2014 to April 2015. While the list is not exhaustive and is skewed towards instances which generate a lot of publicity, it does offer some limited insight into the types of businesses

[24]A similar argument may be made about consumers who complain about tipping and declare a preference for having an all-inclusive price.

[25]Refer to Appendix A for an explanation of how each example is classified according to its market and product characteristics.

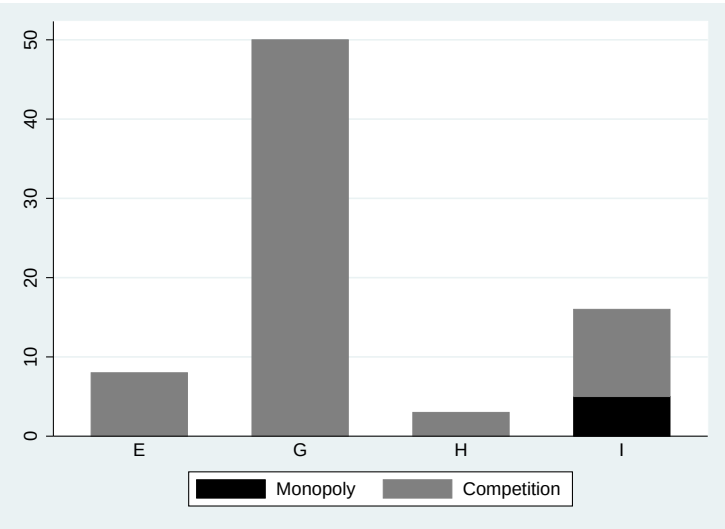
that use PWYW. This also means that the proportion of sellers that are reported to have used PWYW for a limited time or have since discontinued PWYW at 32% is possibly understated, as a new seller opening a PWYW store would arguably generate more publicity. We therefore focus on the 77 current PWYW sellers in the discussion that follows.

One obvious caveat is that the PWYW examples used in this discussion do not necessarily conform to the representative seller assumed in our analysis. We have made many simplifying assumptions to generate a tractable model. For example, we assume that any PWYW seller only sells one type of good, has zero fixed cost and positive marginal cost. In reality, many PWYW sellers have used PWYW only for some good as a tool to up- or cross-sell another fixed-priced good, or only used PWYW temporarily. There may be a fixed cost of production while marginal cost may indeed be zero.[26] We have also assumed that once a pricing scheme is chosen, it is fixed (though prices are allowed to adjust in case of fixed-pricing), while in reality some firms have started off with fixed-pricing and switched to PWYW and vice versa despite the barrier of marketing and menu costs. Clearly, some assumptions are a closer match to reality than others. Nevertheless, to the extent that our assumptions hold in reality, our model could be regarded as a starting point for explaining real life behaviour. We would thus like to emphasise that the use of empirical examples in this discussion section is merely for descriptive and illustrative purposes, that is, we do not conduct any statistical test to derive our conclusions.

Figure 5 shows the distribution of current PWYW sellers across the various industries. The majority of PWYW businesses can be found in the retail sector (SIC Division G): in the food industry or selling digital products online. A significant number of sellers are in the service industry (Division I), including hotels and tourist attractions. The vast majority of sellers operate in a competitive environment. As shown in Figure 4, even for low levels of free-riding, a PWYW monopolist requires a higher level of surplus-sharing norm in the market relative to competition. Not surprisingly, empirical examples of PWYW monopolists are limited to the few football clubs or tourist attractions in our sample.

As a way to increase the level of surplus-sharing in the market, many successful PWYW ventures have appealed to consumers' generosity, for example by explicitly

[26]These deviations can be addressed by replacing the upper bound of the consumption utility distribution with $kc + \epsilon$, $\epsilon > 0$ as described in Footnote 3.



Number of current PWYW examples by SIC Division and market structure. Examples come from Table 1. SIC Divisions: "E" Transportation, Communications, Electric, Gas, And Sanitary Services, "G" Retail Trade, "H" Finance, Insurance, And Real Estate, "I" Services.

Figure 5: Market structure of current PWYW sellers

stating that proceeds will be donated to charity (such as done by 14% of sellers). The success of Humble Bundle, the online game company which has consistently used PWYW, has been attributed precisely to its charity component.[27] In the behavioural literature, a charity component has the effect of increasing the perceived value of the good (Gneezy et al., 2012; Kahsay and Samahita, 2015) while at the same time increasing the image-sensitivity of the buyer (Gravert, 2014). One would then expect less free-riding and underpayment to occur as they result in self-image loss in the consumer. Consequently, the threshold level for surplus-sharing decreases. This is captured in our model more simply by assuming that the charity component attracts a higher level of surplus-sharing by consumers. When the norm of surplus-sharing is high enough, in the competitive equilibrium a PWYW seller co-exists alongside a fixed-price seller. In particular, the first mover can avoid Bertrand competition by choosing a fixed price and ensuring that the second mover finds PWYW more profitable. This is seen in the trend of PWYW sellers' entry into markets dominated by fixed-pricing, where they choose

[27] See `http://www.techdirt.com/blog/entrepreneurs/articles/20100716/17423610253.shtml`, accessed 28-July-2016.

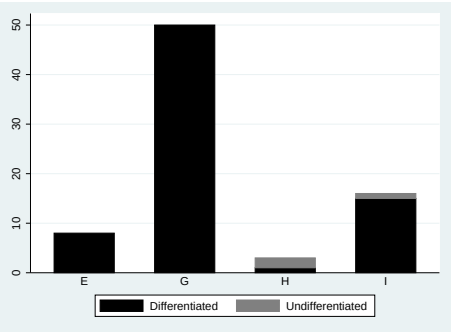
PWYW to avoid fierce competition and have instead appealed to the generosity of consumers. Correspondingly, a proportion of consumers do pay positive and high prices despite not having to do so (Kim et al., 2009; Riener and Traxler, 2012; Gneezy et al., 2012; Kim et al., 2014). For example, the company Activehours lets customers access their pay before payday, essentially borrowing money with PWYW interest. It has recently entered a homogeneous, fixed-price market, and has instead chosen to let customers pay what they want in an effort to gain their trust and appeal to their generosity.[28] Using PWYW is desirable both as a point of difference and to avoid the tough Bertrand-like competition in the market for lending. Furthermore, we do not see a market dominated by PWYW sellers competing against each other, consistent with the equilibrium predictions of Propositions 2 and 3. This signifies the strategic role played by firms' choice regarding prices.

Our model also predicts the profitability of PWYW given a sufficiently high level of product differentiation. This is indeed what we see in Figure 6a, which confirms that the vast majority of PWYW sellers differentiate themselves either through geography or product characteristics as per Corollary 1. Figure 6b shows many PWYW sellers in different industries operating from a physical store, thus allowing for geographical product differentiation. Moreover, the lower social distance generated by the personal nature of the transaction can serve to encourage a higher surplus-sharing norm, thus benefiting PWYW relative to an anonymous online transaction (Hoffman et al., 1996; Kim et al., 2014; Regner and Riener, 2013).[29] As predicted in Corollary 1, when combined with high surplus-sharing, product differentiation makes PWYW increasingly profitable as the upper threshold value of surplus-sharing λ increases. However, there also exist a significant number of PWYW sellers operating online, where the lack of geographical differentiation is compensated by the low or zero marginal cost of digital products.[30] Proposition

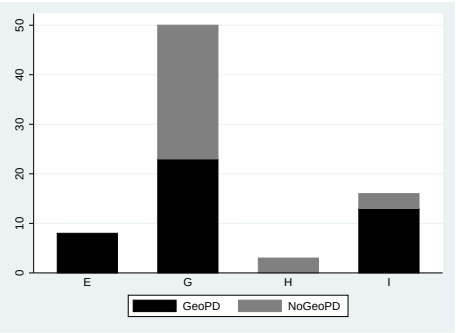
[28]See `http://www.mobilebeyond.net/activehours-ceo-says-employees-owed-2t/`, accessed 28-July-2016.

[29]However, Gneezy et al. (2012) find that anonymity increases average payments, appealing to the crowding-out and self-image explanations. When a transaction is monitored by the seller, an intrinsically motivated buyer may feel that his payment is made out of obligation, not fairness, crowding out its self-signalling value. Our model accommodates both possibilities using the surplus-sharing parameter, which can increase or decrease with anonymity depending on the presence or absence of intrinsic motivation in the buyer.

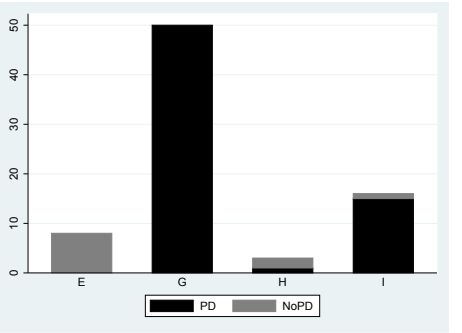
[30]Given our classification in Appendix A, the partition of sellers into those with and without geographical product differentiation exactly corresponds to the partition of sellers into those with and without marginal cost, with the exception of theatres, movie shows, art galleries, tourist attrac-



(a) Differentiation in either geographical or product characteristics



(b) Geographical product differentiation



(c) Differentiation in product characteristics

Number of current PWYW examples by SIC Division and product differentiation. Examples come from Table 1. SIC Divisions: "E" Transportation, Communications, Electric, Gas, And Sanitary Services, "G" Retail Trade, "H" Finance, Insurance, And Real Estate, "I" Services.

Figure 6: Product differentiation of current PWYW sellers

3 predicts that as cost increases, the lower threshold value for generosity increases and it becomes more difficult for the separating PWYW and FP equilibrium to obtain.[31][32] Not surprisingly, PWYW sellers of digital products, such as Humble

tions and football games. These 21 sellers offer products that are geographically differentiated but incur no marginal cost.

[31]The upper threshold also increases, meaning that an extremely high surplus-sharing norm, though unlikely, will drive fewer consumers away as the high cost justifies the high PWYW payment.

[32]For homogeneous goods analysed in Section 3, a high value of marginal cost c correspondingly makes a high value of k unreasonable, due to consumers' budget constraints. As the threshold value of surplus-sharing λ, which must be exceeded for PWYW to be chosen, is decreasing in k, a low marginal cost also indirectly makes PWYW more attainable.

Bundle and Storybundle, have operated successfully online. On the other hand, higher marginal cost items are less able to sustain the PWYW pricing model. This is seen in the examples of several hotels, such as Ibis, who have adopted PWYW for a period of time and then gone back to fixed-pricing. A low marginal cost is a standard requirement for a seller to be able to sustain PWYW (Chen et al., 2009; Kim et al., 2014; Krämer et al., 2015; Chao et al., 2015).

When it comes to differentiation in product characteristics, it is clear that the majority of sellers in the retail and service industries do differentiate their products as shown in Figure 6c. The combination of product differentiation and high surplus-sharing is often achieved through various marketing strategies to promote the success of PWYW, for example by artist Amanda Palmer. She offers a differentiated product and directly appealed to fans to pay more, hence endogenously increasing the level of surplus-sharing.[33] Additionally, cafes or restaurants such as Seva Cafe attract generous consumers by advertising their charity connections. Given a sufficiently high surplus-sharing norm, PWYW is chosen by the second mover to avoid Bertrand competition with the FP incumbent (Proposition 3). An example of such entry behaviour is Kish restaurant (recounted in Kim et al. (2010)). As a new entrant in Frankfurt's restaurant market, the owner decided to adopt PWYW on their lunch menu as it was found to be more profitable than fixed-pricing. This is not an isolated incident, as can be seen in the entry of many PWYW sellers into predominantly fixed-price markets in Table 1.

In most other markets where sellers face consumers with low generosity or when there is a high number of free-riders in the economy, it is not possible to sustain even one PWYW firm in equilibrium. This is what we see in instances such as the restaurant Five Loaves and Two Fish in China which discontinued PWYW after only a few months, having suffered big losses with 20% of customers eating for free.[34] Consistent with our assumption of an exogenous surplus-sharing norm, the trend of successes and failures above has been attributed to cultural factors where PWYW does well in countries with high taxes and strong social welfare systems.[35] Using trust as a proxy, we find a 44% correlation between a coun-

[33]See the transcript of Amanda Palmer's TED talk "The Art of Asking" (2013): `http://www.ted.com/talks/amanda_palmer_the_art_of_asking/transcript`, accessed 28-July-2016.

[34]See `http://www.bbc.com/capital/story/20140120-a-recipe-for-disaster`, accessed 28-July-2016.

[35]Ibid.

try's measure of trust and the presence of PWYW there ($p < 0.01$).[36] PWYW garners a lot of enthusiasm and publicity in the beginning, but in reality may be tough to sustain in the long term if customers have low levels of surplus-sharing. While data on PWYW duration is not freely available, we observe that many other businesses have only chosen to experiment with PWYW through temporary promotions without committing to permanent use. This is consistent with previous studies of PWYW which find that average prices decline over time (Riener and Traxler, 2012; Schons et al., 2014).

Finally, we also note the low possibility of resale of PWYW goods. As shown in Table 1 and noted in Greiff and Egbert (2016), a large percentage of PWYW sellers sell experience goods with negligible marginal cost, such as theatre shows and tourist attractions, which have a low resale possibility. Goods with higher marginal costs, such as food and drinks, are often served directly to consumers which prevents a competitor from buying a large volume and reselling it at profit. Goods that technically allow resale are limited to digital products such as music and software, however in this case resale may not be legal.

7 Conclusion

This paper aims to explain the mixed popularity of PWYW pricing schemes in different sectors. Many PWYW examples can be found in monopolistically competitive markets with some level of product differentiation, but few PWYW examples exist in perfect competition or as monopolists. While previous PWYW literature has studied consumers' social preferences and their behaviour when facing a PWYW seller, we focus on the seller's choice between fixed-pricing and PWYW pricing schemes while still retaining the social preference of consumers in a surplus-sharing mechanism. Sellers' strategies are studied in various types of markets where entry occurs sequentially, to capture the commonly later entry of a PWYW seller into a fixed-price dominated market. We show that the profitability of PWYW, and hence its popularity, depends not only on the preferences of consumers but also on the market structure, product characteristics and sellers' strategies. There is no equilibrium in which PWYW dominates the market. Given

[36]Trust measure data comes from the World Values Survey Wave 6 (2010-2014) and the European Values Study Wave 4 (2008) question: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" A country's trust level is calculated using the proportion of responders answering "Most people can be trusted."

a sufficiently high level of surplus-sharing and product differentiation, PWYW can be chosen by the second mover as a simple strategy to avoid Bertrand competition. While the problem of adverse selection persists, in which PWYW attracts the free-riders and fair consumers with low valuation, in some cases this is still more profitable than entering into a price competition with the incumbent. If the level of surplus-sharing is too low, fixed-pricing dominates. These results are consistent with well-known empirical examples of PWYW. Welfare analysis shows that although PWYW is preferred by free-riders, fair consumers with high consumption utility will prefer paying a fixed price. As a result, the presence of a PWYW seller may reduce consumer surplus, thus contributing to its limited popularity.

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Appendices

A PWYW Examples

In Table 1 a summary of anecdotal evidence of PWYW is provided, based on media coverage (current as at 15 April 2015).[37] These are the most popular sellers found by following news alerts for "pay-what-you-want" since March 2014 and using examples commonly quoted in previous academic literature.

Each business has been listed by company name, per country (in case of multiple locations). Each listing is categorised according to the *Standard Industry Classification (SIC) Division*, which broadly describes its industry, and *Major Group*, which further categorises the seller according to the type of product sold.[38] Under *Competition*, a seller is classified as operating in Competition, except for football clubs, museums and other tourist attractions. These have been classified as Monopolists, where we have defined the market level to be the seller's city of operation. A business has *Geographical Product Differentiation* if it has a physical location, in contrast to online sellers. *Differentiation in Product Characteristic* refers to whether the product sold has a close substitute. While this is a coarse way to capture product differentiation, no established measure currently exists. Products that are classified as undifferentiated and have close substitutes include ridesharing, loan interest, money transfer service and a tax software. A product is classified as having no *Marginal Cost* if it is sold online or falls under one of the following categories: theatres, movie shows, art galleries, tourist attractions, and football games. A product is *Resalable* if it is not an experience good, which also excludes food and drinks, ridesharing, hotel stays, and tourist attractions. This leaves all online commodities such as softwares, music and games in the (perhaps not legally) resalable category.

[37] The owner of One World Cafe, one of the most popularly cited examples of PWYW, has now turned to consulting other business owners and encouraging the use of PWYW in a large number of other restaurants. These are excluded from the table, since they focus specifically on religious or community aspects. The full list can be found on `http://www.oneworldeverybodyeats.org/other-community-cafes/`, accessed 28-July-2016.

[38] See `https://www.osha.gov/pls/imis/sic_manual.html`, accessed 28-July-2016.

Name	Product	City	Country	SIC Division[a]	SIC Major Group[a]	Competition	Geo PD[b]	PDc	MC[d]	Resale[e]
Current										
8k	Marketing	online	all	I	73	x		x	x	
Activehours	Loan Interest	online	US	H	61	x			x	x
Amanda Palmer	Music	online	all	G	59	x		x		x
American Museum of Natural History	Tourism	New York	US	I	84		x	x		
Annalakshmi	Food/Drink	Singapore	Singapore	G	58	x	x	x	x	
Antholojam	Games	online	all	G	59	x		x		x
Asher Fulero	Music	online	all	G	59	x		x		x
Aspirationf	Investment Management	online	US	H	62	x		x	x	
Available Light Theater	Theatre	Columbus	US	I	79	x	x	x		
Bond360	Movies	online	all	G	59	x		x		x
Cafe Liebling	Food/Drink	Munich	Germany	G	58	x	x	x	x	
Coeurage	Theatre	Los Angeles	US	I	79	x	x	x		
Dallas Theater	Theatre	Dallas	US	I	79	x	x	x		
Das Park Hotel	Hotel	Essen	Germany	I	70	x	x	x	x	
Das Park Hotel	Hotel	Linz	Austria	I	70	x	x	x	x	

[a]Standard Industry Classification.
[b]Geographical product differentiation.
cDifferentiation in product characteristics.
[d]Marginal cost.
[e]Resale possibility.
fExplicit charity component.

David Cross	Movies	multiple	Canada	I	78	x	x	x		
David Cross	Movies	multiple	US	I	78	x	x	x		
De Culinaire Werkplaats	Food/Drink	Amsterdam	The Netherlands	G	58	x	x	x	x	
De Peper	Food/Drink	Amsterdam	The Netherlands	G	58	x	x	x	x	
Der Gewurz Laden	Food/Drink	Munich	Germany	G	58	x	x	x	x	
Fika Londonf	Food/Drink	London	UK	G	58	x	x	x	x	
Foco Cafe	Food/Drink	Fort Collins	US	G	58	x	x	x	x	
Giffing Tool	Software	online	all	G	59	x		x		x
Godel's Knot	Music	online	all	G	59	x		x		x
Humble Bundlef	Games	online	all	G	59	x		x		x
Infinite Skillsf	Computer Training	online	all	I	82	x		x		x
Inverness Football Club	Sports	Inverness	UK	I	79		x	x		
Jeff Bridgesf	Music	online	all	G	59	x		x		x
Jeff Rosenstock	Music	online	all	G	59	x		x		x
Kish (lunch)	Food/Drink	Frankfurt	Germany	G	58	x	x	x	x	
Lentil As Anything	Food/Drink	multiple	Australia	G	58	x	x	x	x	
Lost Constellation	Games	online	all	G	59	x		x		x
Lost Type	Software	online	all	G	59	x		x		x
Morningside Cafe	Food/Drink	London	UK	G	58	x	x	x	x	
Mosaic Coffee House	Food/Drink	Seattle	US	G	58	x	x	x	x	
Moshpit Tragedy Records	Music	online	all	G	59	x		x		x
Motto	Food/Drink	Beirut	Lebanon	G	58	x	x	x	x	
Mustard Seed Cafe	Food/Drink	El Paso	US	G	58	x	x	x	x	
National Aquarium	Tourism	Baltimore	US	I	84		x	x		
Noah Eli Gordon	Books	online	all	G	59	x		x		x
Noisetrade	Music and Books	online	all	G	59	x		x		x
Okay?	Games	online	all	G	59	x		x		x
One Working Musician	Music	online	all	G	59	x		x		x

Openbooks	Books	online	all	G	59	x		x		x
Panelsyndicate	Comics	online	all	G	59	x		x		x
Panera Cares	Food/Drink	multiple	US	G	58	x	x	x	x	
Patriot	Music	online	all	G	59	x		x		x
Perks of Life	Food/Drink	Eagle	US	G	58	x	x	x	x	
Radical.fmf	Music	online	all	G	59	x		x		x
SAME Cafe	Food/Drink	Denver	US	G	58	x	x	x	x	
Seva Cafef	Food/Drink	Ahmedabad	India	G	58	x	x	x	x	
Shear Dimensions	Hairdresser	Olathe	US	I	72	x	x	x	x	
Simpletax	Tax Software	online	Canada	I	72	x				x
Soul Kitchen	Food/Drink	Red Bank	US	G	58	x	x	x	x	
Spor	Music	online	all	G	59	x		x		x
St James Town Cafe	Food/Drink	Toronto	Canada	G	58	x	x	x	x	
Stan's Studio	Food/Drink	Glasgow	UK	G	58	x	x	x	x	
Storybundlef	Books	online	all	G	59	x		x		x
The Good Packf	Music	online	all	G	59	x		x		x
The Metropolitan Museum of Art	Tourism	New York	US	I	84		x	x		
The Museum of the Coastal Bend	Tourism	Victoria	US	I	84		x	x		
The Real Junk Food Project	Food/Drink	multiple	UK	G	58	x	x	x	x	
The Saltaire Canteenf	Food/Drink	Bradford	UK	G	58	x	x	x	x	
Third Eye Games	Games	online	all	G	59	x		x		x
Thom Yorke	Music	online	all	G	59	x		x		x
Topshelf Records	Music	online	all	G	59	x		x		x
Vortex Music Magazinef	Magazines	online	all	G	59	x		x		x
Wiener Deewan	Food/Drink	Vienna	Austria	G	58	x	x	x	x	
Wundercar	Ridesharing	multiple	Germany	E	47	x	x		x	
Wundercar	Ridesharing	Dublin	Ireland	E	47	x	x		x	
Wundercar	Ridesharing	Budapest	Hungary	E	47	x	x		x	

Wundercar	Ridesharing	Warsaw	Poland	E	47	x	x		x	
Wundercar	Ridesharing	Prague	Czech Republic	E	47	x	x		x	
Wundercar	Ridesharing	Copenhagen	Denmark	E	47	x	x		x	
Wundercar	Ridesharing	Helsinki	Finland	E	47	x	x		x	
Wundercar	Ridesharing	Istanbul	Turkey	E	47	x	x		x	
Xendpay	Money Transfer	online	all	H	60	x				
Discontinued										
Alfreton Town	Sports	Alfreton	UK	I	79		x	x		
Barnstaple Town	Sports	Barnstaple	UK	I	79		x	x		
Bath Cityf	Sports	Bath	UK	I	79		x	x		
Bitcoin Magazine	Magazines	online	all	G	59	x		x		x
Cards Against Humanity	Games	online	all	G	59	x		x		x
Cringletie House	Hotel	Edinburgh	UK	I	70	x	x	x	x	
Five Loaves and Two Fish	Food/Drink	Fuzhou	China	G	58	x	x	x	x	
Frome Town Football Club	Sports	Frome	UK	I	79		x	x		
Grant Kirkhope	Music	online	all	G	59	x		x		x
Ibis	Hotel	Singapore	Singapore	I	70	x	x	x	x	
Ibis	Hotel	New Delhi	India	I	70	x	x	x	x	
Jane Siberry	Music	online	all	G	59	x		x		x
Lincoln City	Sports	Lincoln	UK	I	79		x	x		
Lyft	Ridesharing	Chicago	US	E	47	x	x		x	
MacGameStoref	Games	online	all	G	59	x		x		x
Magnatune	Music	online	all	G	59	x		x		x
McPixel	Games	online	all	G	59	x		x		x
Munster Zoo	Tourism	Munster	Germany	I	84		x	x		
Pay As You Please	Food/Drink	Killarney	Ireland	G	58	x	x	x	x	

Payez Ce Que Vous Voulez Hotels	Hotel	Paris	France	I	70	x	x	x	x	
Propellerhead	Software	online	all	G	59	x		x		x
Proun	Games	online	all	G	59	x		x		x
Randall Theatre	Theatre	Medford	US	I	79	x	x	x		
Rushden & Diamonds	Sports	Wellingborough	UK	I	79		x	x		
Santorini Grill	Food/Drink	New York	US	G	58	x	x	x	x	
Serafina	Food/Drink	Dubai	UAE	G	58	x	x	x	x	
Sidecar	Ridesharing	multiple	US	E	47	x	x		x	
Stephen King	Books	online	all	G	59	x		x		x
Steve Hofstetter	Comedy	online	all	G	59	x		x		x
Terra Bite Lounge	Food/Drink	Seattle	US	G	58	x	x	x	x	
The Theater Project	Theatre	Brunswick	US	I	79	x	x	x		
The San Diego Symphony	Orchestra	San Diego	US	I	79	x	x	x		
Trent Reznor	Music	online	all	G	59	x		x		x
Urban Canine	Pet Grooming	Chicago	US	A	7	x	x	x	x	
Vincents Art Workshopf	Artwork	Wellington	New Zealand	I	84	x	x	x		
World of Goo	Games	online	all	G	59	x		x		x

Table 1: PWYW examples.

B Proofs

B.1 Proposition 1

$$\pi_{PWYW} = \frac{(1-\theta)\lambda c(k-1)^2}{2k} - \theta c > \frac{c(k-1)^2}{4k} = \pi_{FP}$$

implies

$$\lambda > \frac{(k-1)^2 + 4\theta k}{2(1-\theta)(k-1)^2} = \hat{\lambda}.$$

For existence of PWYW in equilibrium, it is easy to show that the set $\hat{\lambda} < 1$ is non-empty. It is also straightforward to derive the following:

$$\frac{d\hat{\lambda}}{d\theta} = \frac{(k+1)^2}{2(1-\theta)^2(k-1)^2} > 0 \qquad \frac{d\hat{\lambda}}{dk} = -\frac{2\theta(k+1)}{(1-\theta)(k-1)^3} < 0.$$

B.2 Proposition 2

From Figure 2, when Seller A has chosen FP, at B.2 Seller B will only choose PWYW if $\frac{(1-\theta)\lambda c(k-1)^2}{8k} - \theta c > 0$, or $\lambda > \frac{8\theta k}{(1-\theta)(k-1)^2} = \lambda^*$. If Seller A chose PWYW, Seller B will always choose FP at B.1. Hence, given λ, it is straightforward to derive the equilibrium actions for both sellers, which are summarised in Proposition 2. For existence of PWYW in equilibrium, it is easy to show that the set $\lambda^* < 1$ is non-empty. It is also straightforward to derive the following:

$$\frac{d\lambda^*}{d\theta} = \frac{8k}{(1-\theta)^2(k-1)^2} > 0 \qquad \frac{d\lambda^*}{dk} = -\frac{8\theta(k^2+k-1)}{(1-\theta)(k-1)^4} < 0.$$

B.3 Proposition 3

Suppose the first mover A has chosen PWYW. The second mover B will always choose FP since

$$\pi_B(PWYW, PWYW) = \frac{\lambda(v-c)}{2} \leq \frac{(t+\lambda(v-c))^2}{8t} = \pi_B(PWYW, FP).$$

On the other hand, if the first mover has chosen FP, the second mover will choose PWYW if

$$\pi_B(FP, PWYW) = \frac{3\lambda(v-c)}{4} - \frac{\lambda^2(v-c)^2}{4t} > \frac{t}{2} = \pi_B(FP, FP)$$

which will be the case if $\lambda \in \left(\frac{t}{v-c}, \frac{2t}{v-c}\right)$.

Given the second mover's strategy above, the first mover will always choose FP since

$$\pi_A(FP, PWYW) = \frac{(t+\lambda(v-c))^2}{8t} >$$
$$\frac{3\lambda(v-c)}{4} - \frac{\lambda^2(v-c)^2}{4t} = \pi_A(PWYW, FP)$$

in the range $\lambda \in \left(\frac{t}{v-c}, \frac{2t}{v-c}\right)$ and

$$\pi_A(FP, FP) = \frac{t}{2} \geq \frac{3\lambda(v-c)}{4} - \frac{\lambda^2(v-c)^2}{4t} = \pi_A(PWYW, FP)$$

otherwise.

Substituting $v = kc/2$ into the bounds of $\lambda \in \left(\frac{t}{v-c}, \frac{2t}{v-c}\right)$ yields the resulting inequality in Proposition 3:

$$\frac{2t}{(k-2)c} < \lambda < \frac{4t}{(k-2)c}.$$

For existence of PWYW in equilibrium, note that given $t > 0$ and the restrictions on k in Footnote 18, the range above is non-empty.

B.4 Proposition 4

When the monopolist chooses FP, consumer surplus CS of consumers who buy at price $p = \frac{c(k+1)}{2}$ is:

$$CS_{FP} = \frac{1}{kc}\int_p^{kc}(u-p)du\Big|_{p=\frac{c(k+1)}{2}} = \frac{c(k-1)^2}{8k}.$$

Under PWYW, consumer surplus consists of the free-riders' surplus plus the surplus of fair buyers whose consumption utility exceeds c:

$$\begin{aligned} CS_{PWYW} &= \frac{\theta}{kc}\int_{p}^{kc}(u-p)du\Big|_{p=0} + \frac{1-\theta}{kc}\int_{c}^{kc}(u-c-\lambda(u-c))\,du \\ &= \frac{\theta kc}{2} + \frac{(1-\theta)c(k-1)^2(1-\lambda)}{2k}. \end{aligned}$$

Hence $CS_{PWYW,FP} > CS_{FP,FP}$ if and only if

$$\lambda < \bar{\lambda} = \frac{(k-1)^2(3-4\theta)+4k^2\theta}{4(1-\theta)(k-1)^2}.$$

For PWYW to be weakly preferred by both buyers and seller, there must be some values of λ such that $\hat{\lambda} \leq \lambda \leq \bar{\lambda}$. This requires that

$$\bar{\lambda} = \frac{(k-1)^2(3-4\theta)+4k^2\theta}{4(1-\theta)(k-1)^2} \geq \frac{(k-1)^2+4\theta k}{2(1-\theta)(k-1)^2} = \hat{\lambda},$$

that is,

$$\theta \leq \frac{(k-1)^2}{4}.$$

B.5 Proposition 5

It is straightforward to calculate consumer surplus in both the Bertrand FP-pooling equilibrium and the separating equilibrium. In the Bertrand equilibrium (FP,FP), total consumer surplus is:

$$CS_{(FP,FP)} = \frac{c(k-1)^2}{2k}.$$

In the separating equilibrium, the total consumer welfare of the free-riders, the fair buyers with low u_i buying from the PWYW seller, and the fair buyers with high u_i buying from the FP seller can be expressed as

$$CS_{(FP,PWYW)} = \frac{\theta kc}{2} + \frac{(1-\theta)(4-3\lambda)c(k-1)^2}{8k}.$$

Hence $CS_{PWYW} > CS_{FP}$ if and only if

$$\lambda < \lambda^c = \frac{4\theta(2k-1)}{3(k-1)^2(1-\theta)}.$$

Since $\lambda^c < \lambda^*$ (as given in Proposition 2), it follows that whenever the separating equilibrium obtains, $\lambda \geq \lambda^* > \lambda^c$ and the consumers prefer the pooling equilibrium.

B.6 Proposition 6

In the FP-pooling equilibrium, consumer surplus is

$$CS_{(FP,FP)} = v - c - \frac{5t}{4}.$$

In the separating equilibrium, consumer surplus is

$$CS_{(PWYW,FP)} = v - c + \frac{\lambda^2(v-c)^2 - 14\lambda(v-c)t - 7t^2}{16t}.$$

This is always less than $CS_{(FP,FP)}$ above unless

$$\lambda \leq \frac{t}{v-c} \text{ or } \lambda \geq \frac{13t}{v-c}.$$

We consider only the first region, since restricting the location of the indifferent consumer to $x \geq 0$ results in $\lambda \leq \frac{3t}{v-c}$. Hence, when the separating equilibrium obtains at $\frac{t}{v-c} < \lambda < \frac{2t}{v-c}$, consumers are never better off.

C Robustness Checks

C.1 Endogenous consumer choice

Suppose that each consumer maximises his utility by choosing whether or not to free-ride, in contrast with the model presented in Section 2 where his type (free-rider or fair) is determined exogenously. We show here that the qualitative results obtained in Propositions 1 and 2 are unchanged. To do so, we introduce a social or moral penalty for free-riding. For example, in this analysis we use the function $U_i = (1-\lambda)(1-\frac{1}{r})u_i$, $r > 1$, for the free-rider's utility: his consumption utility of the good is now discounted by a factor $(1-\lambda)$ to match the fair consumers' marginal utility, and further by the factor $(1-\frac{1}{r})$ to account for the penalty. The higher r is, the lower the social penalty, and hence the higher the free-rider's residual utility.

Hence, facing a PWYW seller, the typical consumer will choose to free-ride up until $u_i = rc$, at which point he is better off paying a fair price $c + \lambda(u_i - c)$.[39] The consumer's utility when he is a free-rider, fair consumer, or chooses to pay a fixed price under competition is illustrated in Figure 7.

With the above consumer preference, the PWYW monopolist profit is now

$$\begin{aligned}\pi_{PWYW} =& \frac{1}{kc}\int_0^{rc}\frac{1}{kc}(-c)du + \frac{1}{kc}\int_{rc}^{kc}\lambda(u-c)du \\ =& -\frac{rc}{k} + \frac{\lambda c(k-r)(k+r-2)}{2k}\end{aligned}$$

which will be greater than the monopolist FP profit only if

$$\lambda > \frac{(k-1)^2+4r}{2(k-r)(k+r-2)}.$$

That is, when the level of surplus-sharing is sufficiently high as per Proposition 1.

We now turn to the competition setting described in Section 3. When both sellers choose PWYW, they split the monopolist PWYW profit and each earns

$$\pi_A = \pi_B = -\frac{rc}{2k} + \frac{\lambda c(k-r)(k+r-2)}{4k}.$$

[39] Note that other free-rider utility functions can be substituted here, as long as the indifferent consumer has consumption utility $u_i = rc$. An example is where the free-rider is penalised by the amount $u_i - (1-\lambda)c(r-1)$, such that his utility is constant at $U_i = (1-\lambda)c(r-1)$.

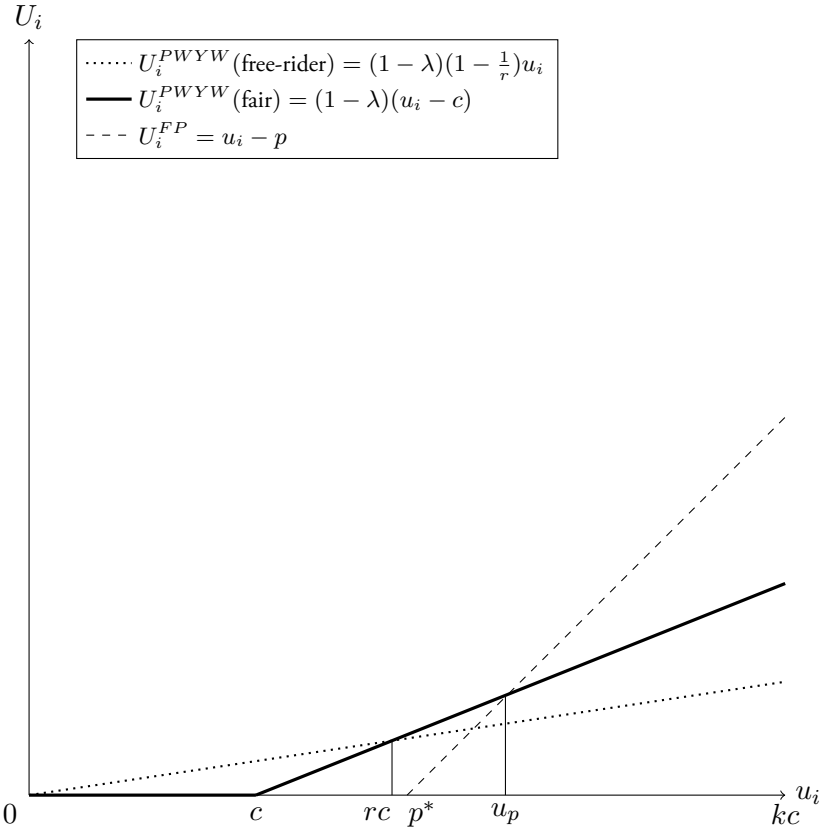

Figure 7: Consumer utility functions, λ=0.6

When both choose FP, each seller earns zero profit under Bertrand competition. When one seller chooses PWYW and the other FP, the FP seller captures all consumers with $u_i \geq u_p$ as given in Section 3, while the PWYW seller captures those with $u_i < u_p$, some of whom will free-ride ($u_i < rc$). For the existence of fair consumers who choose the PWYW seller, we impose the restriction $r < \frac{k+1}{2}$. The FP seller's profit-maximising price is identical to that given in Section 3:

$$p^* = c\left(1 + \frac{\lambda(k-1)}{2}\right)$$

and his profit is

$$\pi_{FP} = \frac{\lambda c(k-1)^2}{4k}.$$

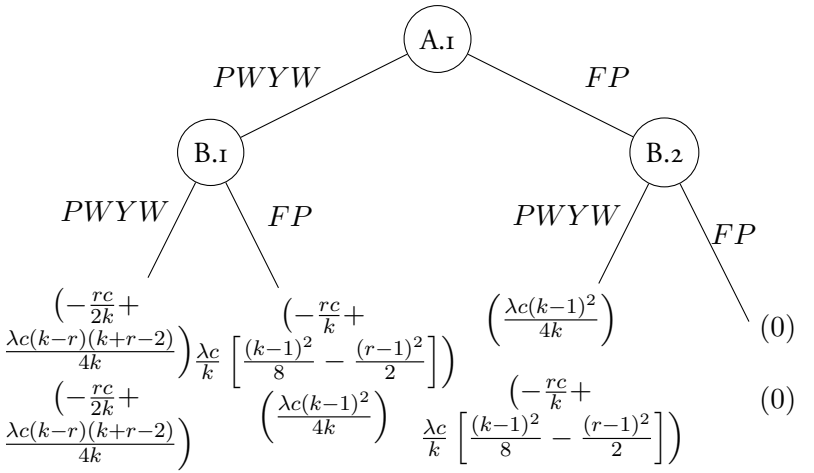

Figure 8: Competition between two sellers, endogenous consumer choice

The PWYW seller's profit is thus

$$\begin{aligned}\pi_{PWYW} =& \frac{1}{kc}\int_0^{rc}(-c)du + \frac{1}{kc}\int_{rc}^{u_p}\lambda(u-c)du \\ =& -\frac{rc}{k}+\frac{\lambda}{kc}\left[\frac{(p-c)^2}{2\lambda^2}-\frac{c^2(r-1)^2}{2}\right] \\ =& -\frac{rc}{k}+\frac{\lambda c}{k}\left[\frac{(k-1)^2}{8}-\frac{(r-1)^2}{2}\right].\end{aligned}$$

The sellers' profits at the various end nodes are summarised in Figure 8.

When the first mover has chosen PWYW, it is straightforward to show that the second mover will always choose FP:

$$-\frac{rc}{2k}+\frac{\lambda c(k-r)(k+r-2)}{4k} < \frac{\lambda c(k-1)^2}{4k}.$$

On the other hand, when the first mover has chosen FP, the second mover will choose PWYW only if the PWYW profit exceeds zero, that is if

$$\lambda > \frac{8r}{(k-1)^2-4(r-1)^2}.$$

Consequently, the first mover will always choose FP in the first stage, as per the result stated in Proposition 2.

C.2 Heterogeneous surplus-sharing

Suppose that consumers share their surplus according to the following PWYW price:

$$p_i = \lambda_i u_i.$$

λ_i represents each consumer's individual surplus-sharing proportion, which depends on his own degree of social preferences. His PWYW price increases the more he cares about social preferences and the higher his consumption utility from the good. Assume that λ_i is independent and identically distributed according to some continuous distribution with expected value λ. While we drop the free-riding parameter θ, the presence of free-riders is captured in this new model by assuming the presence of consumers with $\lambda_i = 0$. As the proportion of such consumers increases, the expected value of the surplus-sharing parameter λ naturally decreases.

The PWYW monopolist's expected profit is thus given by

$$\mathbf{E}\pi_{PWYW} = \mathbf{E}\int_0^{kc} \frac{1}{kc}(\lambda_i u_i - c)du = \frac{\lambda kc}{2} - c$$

which, similar to Proposition 1, is only greater than the monopolist FP profit when

$$\lambda > \frac{(k+1)^2}{2k^2}.$$

Under the homogeneous goods competition setting in Section 3, at the end node when both sellers choose PWYW each earns half the monopolist profit above. When one seller chooses PWYW and the other FP, given λ_i, the buyer will choose PWYW whenever $u_i < u_p$ and FP when $u_i > u_p$ where

$$u_p = \frac{p}{\lambda_i}.$$

The FP seller's expected demand is thus positive as long as $\mathbf{E}u_p > kc$. Given his profit-maximising price of

$$p = \frac{\lambda kc + c}{2},$$

positive expected demand translates to the condition that $\lambda > 1/k$ which we assume will be satisfied for the rest of the analysis.[40] Accordingly, the FP seller's expected profit is

$$\mathbf{E}\pi_{FP} = \frac{c(\lambda k - 1)^2}{4\lambda k}$$

and his competitor earns

$$\mathbf{E}\pi_{PWYW} = \frac{c(\lambda k + 1)(\lambda k - 3)}{8\lambda k}.$$

It is straightforward to derive the subgame perfect Nash equilibrium, which is identical to Proposition 2 except for the fact that the threshold value is $\lambda^* = 3/k$.

Suppose now that we have the differentiated goods setting as per Section 4 where again $v = kc/2$. With two PWYW sellers in the market, each seller gets half the monopolist PWYW expected profit of $(\lambda v - c)/2$. When Seller L on the left chooses PWYW and Seller R chooses FP, the indifferent consumer is now located at $x = (t + p_R - \lambda_i v)/(2t)$. Consequently, Seller R sets $p = (t + c + \lambda v)/2$ and each seller earns

$$\mathbf{E}\pi_{FP} = \frac{(t + \lambda v - c)^2}{8t} \qquad \mathbf{E}\pi_{PWYW} = \frac{3(\lambda v - c)}{4} - \frac{(\lambda v - c)^2}{4t}.$$

Assuming the indifferent seller chooses FP then yields the same result as Proposition 3, but with threshold values

$$\frac{t + c}{v} < \lambda < \frac{2t + c}{v}$$

for the separating equilibrium to obtain.

C.3 Simultaneous choice of pricing schemes

Suppose that each seller's action space consists of a price and the PWYW pricing scheme. This means that the two sellers choose their pricing schemes simultaneously, and the choice of FP implies choosing the actual fixed price. The pay-off matrix is presented below:

[40] If $\lambda \leq 1/k$, demand for the FP seller is zero, resulting in $\mathbf{E}\pi_{FP} = 0$. The PWYW seller captures the whole market and gets the PWYW monopolist expected profit, which in this case is ≤ 0. The resulting subgame perfect equilibrium is thus FP-pooling.

		Seller B	
		$PWYW$	FP
Seller A	$PWYW$	(α, α)	(β, γ)
	FP	(γ, β)	$(0, 0)$

where

$$\alpha = \frac{(1-\theta)\lambda c(k-1)^2}{4k} - \frac{\theta c}{2}$$

$$\beta = \frac{(1-\theta)\lambda c(k-1)^2}{8k} - \theta c$$

$$\gamma = \frac{(1-\theta)\lambda c(k-1)^2}{4k}.$$

It is easy to see that $\alpha < \gamma$ whenever there are free-riders in the economy. If $\lambda > \lambda^*$, as defined in Proposition 2, we have $\beta > 0$ and the game becomes structurally similar to the hawk-dove game, with the two separating equilibria of (FP,PWYW) and (PWYW,FP). There is additionally a mixed-strategy Nash equilibrium where each seller randomises between PWYW and FP. If $\lambda < \lambda^*$, $\beta < 0$ and thus the FP-pooling equilibrium obtains. If $\lambda = \lambda^*$, $\beta = 0$ and there are three resulting pure strategy Nash equilibria: the FP-pooling equilibrium, and two separating equilibria (FP,PWYW) and (PWYW,FP).

Under product differentiation, the pay-off matrix becomes:

		Seller B	
		$PWYW$	FP
Seller A	$PWYW$	(α, α)	(β, γ)
	FP	(γ, β)	(δ, δ)

where

$$\alpha = \frac{\lambda(v-c)}{2}$$

$$\beta = \frac{3\lambda(v-c)}{4} - \frac{\lambda^2(v-c)^2}{4t}$$

$$\gamma = \frac{(t+\lambda(v-c))^2}{8t}$$

$$\delta = \frac{t}{2}.$$

We have $\alpha \leq \gamma$, with equality at $\lambda = \frac{2t}{(k-2)c}$. As long as $\frac{2t}{(k-2)c} < \lambda < \frac{4t}{(k-2)c}$, the range given in Proposition 3, we also have $\beta > \delta$ resulting in two separating equilibria of (PWYW,FP) and (FP,PWYW). There is additionally a mixed-strategy Nash equilibrium where each seller randomises between PWYW and FP. If $\lambda < \frac{2t}{(k-2)c}$ or $\lambda > \frac{4t}{(k-2)c}$, $\beta < \delta$ and thus the FP-pooling equilibrium obtains. If $\lambda = \frac{4t}{(k-2)c}$, $\beta = \delta$ and there are three resulting pure strategy Nash equilibria: the FP-pooling equilibrium, and two separating equilibria (PWYW,FP) and (FP,PWYW). Only when $\lambda = \frac{2t}{(k-2)c}$ will $\alpha = \beta = \gamma = \delta = t/2$, and all of (FP,FP), (FP,PWYW), (PWYW,FP), (PWYW,PWYW) are possible equilibrium outcomes corresponding to the results stated in Footnote 23.

C.4 Sequential choice of prices

Suppose that competing sellers choose their prices sequentially. In stage 1, Seller A chooses either FP or PWYW. If FP is chosen, in stage 2 he sets his price. In stage 3, Seller B chooses either FP or PWYW, and if FP is chosen in stage 4 he sets a price. All decisions are common knowledge. This setting models situations whereby a PWYW seller enters a market dominated by a FP seller, whose price stays constant after the competitor's entry. The full representation of the sequential game and the resulting end nodes is shown in Figure 9. At the end of the game, the consumers make their purchase decisions as previously described in Section 3 for homogeneous goods and Section 4 for differentiated goods.

Homogeneous goods

While there is no equilibrium in which both sellers choose PWYW, the pricing scheme is however used as an alternative to avoid Bertrand competition for either first or second mover, depending on the level of surplus-sharing. The full equilibrium outcomes are described in the following proposition:

Proposition 7. *When two competing sellers choose both pricing schemes and prices sequentially, the subgame perfect equilibrium is either separating or FP-pooling. Specifically,*

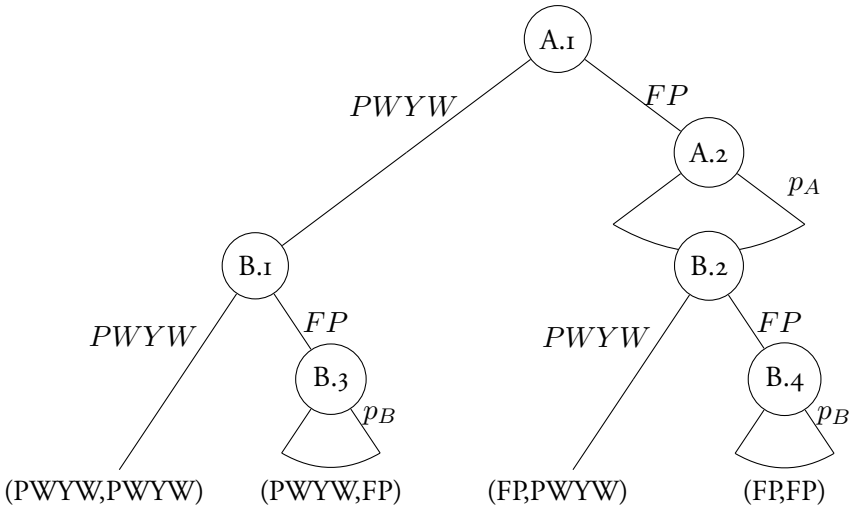

Figure 9: Competition between two sellers, sequential price setting

i if $\lambda > \hat{\lambda}$*, Seller A chooses FP, and Seller B chooses PWYW,*

ii if $\lambda \leq \hat{\lambda}$*,*

- *if* $\lambda > \lambda^*$*, Seller A chooses PWYW, and Seller B chooses FP,*
- *if* $\lambda < \lambda^*$*, Seller A chooses FP, and Seller B chooses FP,*
- *if* $\lambda = \lambda^*$*, Seller A randomises between PWYW and FP, and Seller B chooses FP,*

where $\hat{\lambda}$ *and* λ^* *are as previously given in Sections 2 and 3.*

Proof. The game tree is solved by backward induction starting at node B.4. When both sellers choose FP, the best response strategy of Seller B is defined by:

$$p_B = \begin{cases} \dfrac{c(k+1)}{2} & \text{if } p_A > \dfrac{c(k+1)}{2} \implies \pi_A = 0, \pi_B = \dfrac{c(k-1)^2}{4k} \\ p_A - \epsilon & \text{if } c < p_A \leq \dfrac{c(k+1)}{2} \implies \pi_A = 0, \pi_B \approx \dfrac{(kc - p_A)(p_A - c)}{kc} \\ c & \text{if } p_A \leq c \implies \pi_A \leq 0, \pi_B = 0. \end{cases}$$

In all three cases, $\pi_A \leq 0$. Therefore at node A.2 Seller A will choose p_A that gives him positive profit, which is only the case if Seller B chooses PWYW.

If Seller A competes against PWYW, it is clear that setting $p_A \geq c(\lambda k - \lambda + 1)$, $u_A \geq kc$ and Seller A will not get any sales. He will also not set $p_A \leq c$, as this will yield zero or negative profit. These regions are therefore excluded from Seller A's strategy space in A.2, and his fixed price will instead lie in $(c, c(\lambda k - \lambda + 1))$. In this range of p_A, Seller B's PWYW profit can be expressed as:

$$\begin{aligned}\pi_B &= \frac{1-\theta}{kc}\int_c^{c+\frac{p_A-c}{\lambda}} \lambda(u-c)du - \theta c \\ &= \frac{1-\theta}{2\lambda ck}(p_A - c)^2 - \theta c.\end{aligned}$$

When $\lambda \leq 1/2$, Seller B's profit under PWYW is always less than that under FP.[41] When $\lambda > 1/2$, Seller B's PWYW profit will be greater than his FP profit if

$$\hat{p}_A = c\left[1 + \sqrt{\frac{\lambda(k-1)^2 + 4\theta\lambda k}{2(1-\theta)}}\right] < p_A.$$

For $\hat{p}_A < c(\lambda k - \lambda + 1)$, a necessary condition is

$$\lambda > \hat{\lambda} = \frac{(k-1)^2 + 4\theta k}{2(1-\theta)(k-1)^2} > \frac{1}{2}.$$

In this case,

$$\pi_A = \frac{1-\theta}{kc}(p_A - c)\left(kc - c - \frac{p_A - c}{\lambda}\right)$$

is decreasing in the domain $p_A \in (\hat{p}_A, c(\lambda k - \lambda + 1))$. Hence, at A.2 Seller A sets

$$p_A = \hat{p}_A + \epsilon.$$

At B.3, given Seller A has chosen PWYW, the optimal fixed price for Seller B also lies in $(c, c(\lambda k - \lambda + 1))$.

$$\pi_B = \frac{1-\theta}{kc}(p_B - c)\left(kc - c - \frac{p_B - c}{\lambda}\right)$$

[41] To see this, note that π_B under FP and PWYW are both increasing in the domain $(c, c(\lambda k - \lambda + 1))$. The former is concave, the latter convex. Evaluating π_B under both FP and PWYW at the endpoints $p_A = c$ and $p_A = c(\lambda k - \lambda + 1)$ shows that the PWYW profit lies below the FP profit and the result follows.

is maximised at

$$p_B = \frac{\lambda c(k-1)}{2} + c,$$

giving

$$\pi_B = \frac{(1-\theta)\lambda c(k-1)^2}{4k} \qquad \pi_A = \frac{(1-\theta)\lambda c(k-1)^2}{8k} - \theta c.$$

At B.1, if B chooses PWYW both sellers split the profits and each gets

$$\pi_A = \pi_B = \frac{(1-\theta)\lambda c(k-1)^2}{4k} - \frac{\theta c}{2}.$$

Clearly, with $\theta > 0$ Seller B will choose FP at B.1.

At A.1, given $\lambda \leq \hat{\lambda}$, Seller A choosing FP always results in his competitor also choosing FP. Hence, no matter what fixed price Seller A sets, he always ends up with zero profit. He therefore chooses PWYW and earns

$$\pi_A = \frac{(1-\theta)\lambda c(k-1)^2}{8k} - \theta c$$

which will be positive as along as

$$\lambda > \lambda^* = \frac{8\theta k}{(1-\theta)(k-1)^2}.$$

When $\lambda > \hat{\lambda}$, Seller A can get positive profit when he chooses FP:

$$\pi_A \approx \frac{1-\theta}{kc}(\hat{p}_A - c)\left(kc - c - \frac{\hat{p}_A - c}{\lambda}\right).$$

This is always greater than his PWYW profit.[42] Hence Seller A will choose FP as long as $\lambda > \hat{\lambda}$.

Therefore, the subgame perfect equilibrium outcomes are as summarised in Proposition 7. □

[42] To see this, set $\lambda = 1$ and $\theta = 0$. At this best case scenario, PWYW profit still lies below FP profit.

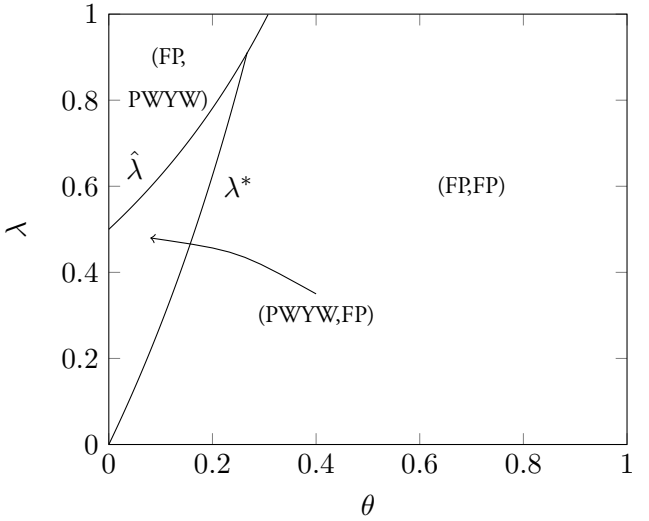

Figure 10: Subgame perfect Nash equilibria, $k = 5$

These regions are shown in Figure 10. When consumers share a sufficiently high proportion of surplus ($\hat{\lambda}$), Seller A can afford to set a fixed price and ensure that PWYW will be sufficiently profitable for Seller B. Otherwise, Seller B will always choose fixed-pricing, creating a Bertrand competition and capturing all profit. To avoid the Bertrand trap, if λ is at least equal to λ^* (or the number of free-riders is low), Seller A should choose PWYW: even though Seller B will still choose FP, there is still positive residual profit for the PWYW seller. All pure strategy equilibria are unique except the case where both sellers choose FP. In this case, Seller A will get zero profit regardless of what price is chosen, as it will be undercut by Seller B who will get a positive profit.

Product differentiation

As per Section 4, we continue to assume no free-riders and exogenous consumption utility $v = kc/2$. Without loss of generality, we assume that Seller R located at 1 is the first mover. Again, when a seller is indifferent between PWYW and FP he is assumed to choose FP.[43] When products are differentiated and prices are

[43]Abstracting from this assumption, in the special case where $\lambda = \frac{5t}{2c(k-2)}$, both (FP,FP) and (FP,PWYW) are equilibrium outcomes. Additionally, if $\lambda = \frac{3t}{(k-2)c}$, both (PWYW,FP) and (FP,FP)

chosen sequentially, in equilibrium no seller will choose PWYW:

Proposition 8. *When two competing sellers of differentiated products choose both pricing schemes and prices sequentially, the subgame perfect equilibrium is FP-pooling.*

Proof. Consider the end node where both sellers choose FP. Given p_R, Seller L's optimal strategy is to set ${p_L}^*(p_R) = \frac{p_R+t+c}{2}$. Consequently, profits for both sellers as a function of p_R are:

$$\pi_L = \frac{(p_R + t - c)^2}{8t} \qquad \pi_R = \left(\frac{3t - p_R + c}{4t}\right)(p_R - c).$$

Suppose, given p_R, that Seller L decides to offer PWYW instead at node B.2. Profits for both sellers as a function of p_R are:

$$\pi_L = \lambda(v - c)\left(\frac{t + p_R - c - \lambda(v - c)}{2t}\right)$$

$$\pi_R = \left(\frac{t - p_R + c + \lambda(v - c)}{2t}\right)(p_R - c).$$

It is straightforward to show that π_L is always weakly greater under FP than PWYW for any value of p_R. Hence, the second mover Seller L will always choose FP at B.2. Consequently, whenever Seller R chooses FP at A.1, he is guaranteed a profit of $\pi_R = \left(\frac{t-p_R+c+\lambda(v-c)}{2t}\right)(p_R - c)$. Maximising profit with respect to p_R, the optimal price is $p_R^* = 3t/2 + c$ and $\pi_R^* = 9t/16$.

If Seller R instead chooses PWYW at A.1, the resulting outcomes are as described in the simultaneous pricing case of Section 4 (see the proof of Proposition 3). The second mover will always find it more profitable to choose FP, as a result profit for the first mover is

$$\pi_R = \lambda(v - c)\left(\frac{3}{4} - \frac{\lambda(v - c)}{4t}\right).$$

This is always less than or equal to $9t/16$, and as a result the first mover Seller R will always choose FP. □

are equilibrium outcomes.

Given the first mover's set price, it is always optimal for the second mover to choose FP and undercut the first mover. In particular, in the (FP,FP) end node the first mover sets $p_R = c + 3t/2$, while the second mover sets $p_L = c + 5t/4$. On the other hand, when the first mover chooses PWYW, the second mover will find it more profitable to undercut the PWYW 'price' and set a fixed price. As a result, the first mover is better off choosing FP and setting a sufficiently high price such that any residual demand still yields a higher profit.

C.5 Product differentiation with free-riders

Consider the setting of Section 4, however we now assume that the proportion of free-riders $\theta > 0$. When both firms choose FP, profits are unaffected by free-riders:

$$\pi_i = \frac{t}{2}.$$

When both firms choose PWYW, they are both negatively affected by free-riders:

$$\pi_i = \frac{(1-\theta)\lambda(v-c) - \theta c}{2}.$$

When Seller L chooses PWYW and Seller R FP, the indifferent fair consumer is still located at $x = (t + p_R - c - \lambda(v-c))/(2t)$ but the free-rider will be closer to Seller R as more of them will pay the transport cost to take the good for free: $x = (t + p_R)/(2t)$. With this demand structure, the profit-maximising FP seller now optimally sets

$$p_R = \frac{t + c + (1-\theta)(c + \lambda(v-c))}{2}$$

which is lower than in the case of no free-riders, to attract some of the free-riders as well. Hence the location of both indifferent fair consumer and free-riders decrease (or become closer to the PWYW seller) as θ increases. Profits are

$$\begin{aligned}\pi_L =& (1-\theta)\lambda(v-c)\left(\frac{3t + c - (1+\theta)(c + \lambda(v-c))}{4t}\right) \\ &- \theta c\left(\frac{3t + c + (1-\theta)(c + \lambda(v-c))}{4t}\right)\end{aligned}$$

while

$$\pi_R = \frac{(t - c + (1 - \theta)(c + \lambda(v - c))^2}{8t}$$

both of which are decreasing in θ.

The equilibrium analysis follows as per the proof of Proposition 3. Suppose the first mover A has chosen PWYW. The second mover B will always choose FP since

$$\pi_B(PWYW, PWYW) < \pi_B(PWYW, FP).$$

On the other hand, if the first mover has chosen FP, the second mover will choose PWYW if

$$\pi_B(FP, PWYW) > \pi_B(FP, FP).$$

The above inequality is less likely to hold compared to the case of no free-riders, as the left hand side is decreasing in θ while the right hand side is independent of θ.

Given the second mover's strategy above, the first mover will always choose FP since

$$\pi_A(FP, PWYW) > \pi_A(PWYW, FP)$$

given $\pi_B(FP, PWYW) > \pi_B(FP, FP)$ holds.[44] Otherwise,

$$\pi_A(FP, FP) > \pi_A(PWYW, FP)$$

as the same inequality holds for Seller B.

[44]To prove this, set $\theta = 0$. At this best case scenario, the PWYW profit is still lower than the FP profit.

Paper III

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Venting and gossiping in conflicts: Verbal expression in ultimatum games

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ABSTRACT

Conflicts often lead to expression of emotion to unrelated parties. We study non-instrumental verbal expression in binary ultimatum games, where receivers can comment either privately or to a third-party audience prior to accepting or rejecting the offer. The potential for gossip is sufficient to induce image concerns in senders, resulting in fairer offers in the audience treatment. Consequently, despite insignificant effect on receivers' behaviour, the possibility of verbal expression to an audience is found to increase co-operation and hence welfare. There is demand for verbal expression even when it is unobserved or not triggered by negative stimulus.

1. Introduction

Many negotiations or bargaining situations break down due to diverging self-interests, resulting in non-cooperation and in many cases the socially sub-optimal outcome. Often this leads to the need to communicate disappointment, disapproval or other negative emotions to parties with no part in the conflict. For example, customers turn to social media to complain about companies who provide bad service, clients pay large amounts of money to talk to a therapist about conflicts in personal relationships, and yet others use the more traditional form of verbal expression in a private diary. All the above behaviours can be considered non-instrumental as they take place ex-post: the conflict has already occurred and there is no way to affect outcomes. To the extent that these actions involve monetary or effort costs, they are clearly irrational according to standard economic theory which predicts that a rational agent should be indifferent to non-instrumental communication. What then can explain this demand for expression? Does it have any effect on future bargaining outcomes?

In this paper we focus on non-instrumental *verbal* expression, which allows subjects to communicate both emotion and potentially other information to unrelated parties (in contrast to simple ratings of outcomes).[1] We study whether and how the opportunity for verbal expression, in particular when triggered by a negative stimulus, works to increase co-operation – defined as acceptance of offers in a binary ultimatum game (Güth et al., 2001) in three treatments. Besides the standard *control* treatment (C), in the *private* treatment (P) we allow the receiver to comment privately on the sender's offer, while in the *audience* treatment (A) the comment is seen by the experimenter. Our results indicate that the mere possibility for verbal expression to an audience does result in higher rates of co-operation and hence welfare by inducing the senders to choose the fair offer more often. Consequently, verbal expression is found to have no significant effect on the rejection rate of the fewer unfair offers. Our second contribution is the finding that there is indeed a demand for verbal expression even when it is not directed to the sender or any audience at all.

Our study is related to the literature on communication in bargaining which has shown that the possibility to express emotion to the counter-party improves co-operation (Xiao and Houser, 2005; Güth and Levati, 2007; Chen and Kamei, 2014; Koukoumelis and Levati, 2014). Three reasons are proposed: that people sim-

[1] While the existing economic literature on verbal expression has focused on emotions, we do not exclude the possibility that verbal expression may be used to communicate other information.

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ply feel better after explicitly displaying emotion, that it gives one the opportunity to deny the implied inferiority from receiving (and subsequently accepting) a low offer, or that sending a disapproving message acts as a substitute for punishment (Xiao and Houser, 2005). Correspondingly, Ellingsen and Johannesson (2008) and Xiao and Houser (2009) show in dictator game experiments that dictators do anticipate negative feedback, behaving more altruistically when receivers have the chance to write a message.[2]

In practice, however, there might be formal or informal constraints such that individuals consider it to be impossible or undesirable to directly communicate to the counter-party. For example, in trials and workplace bargaining, negotiations are conducted by lawyers or representatives from the union and employer, and the actual parties concerned are prohibited from making contact with each other. Conflicts in personal relationships can result in ostracism or the silent treatment where communication comes to a halt. In these types of situations it is important to establish which of the different mechanisms are in play. If feedback is used as a substitute for punishment, then clearly it would have no effect on co-operation when the possibility to send a negative message no longer exists. However, negative feedback to an unrelated party presents an opportunity for gossip, which may still substitute for punishment. Alternatively, verbal expression can be used as a way to vent emotion or justify acceptance of a low offer. Are these channels sufficient to increase co-operation? Does the presence of an audience matter? Our experiment is designed to answer these questions by removing the counter-party as an audience, and instead let receivers direct their verbal expression to an experimenter audience or no one at all.

The expression of negative emotions has been given some attention in the psychological literature, finding conflicting effects (Bushman, 2002; Niederhoffer and Pennebaker, 2009). According to catharsis theory, expressing emotion relieves the pressure built up by anger (or other negative emotions), thus decreasing future aggression. The positive effects of expressing emotion, for example through writing, have been published in studies such as Pennebaker and Beall (1986) and Niederhoffer and Pennebaker (2009). This has also been attributed to the inhibition theory (Pennebaker, 1989), which argues that humans have a natural tendency to express emotion and repressing this urge by activating the behavioural inhibition system requires energy. Writing about one's emotion will therefore reduce the effort required for inhibition, which consequently makes the receiver feel better and more likely to be co-operative. However, both theories have received weak support (see Littrell, 1998 for a review), with studies finding not only that venting anger does not reduce aggression, it may even make people more aggressive (Lohr et al., 2007; Bushman, 2002; Morrow and Nolen-Hoeksema, 1990; Geen and Quanty, 1977). This finding is attributed to cognitive neoassociation theory (Bushman, 2002). Venting anger, for example through verbal expression, primes aggressive thoughts and thus keeps the angry emotions active in one's memory, and hence increases the likelihood of subsequent aggressive responses.

At the same time, expressing emotion also allows the receiver to rationalise his situation. A low offer can be seen as an attack on his self-image, and rejection is one way to signal to oneself that one is not a weakling (Tirole, 2002). However, denying this inferiority by verbal justification is a cheaper substitute for rejection, and in this case the possibility for verbal expression should be expected to increase co-operation. Ong et al. (2013) indeed find that responders who voice to a third party are more willing to accept a lower offer in an ultimatum game. Hence, the overall effect of verbal expression is unclear.

If the combined channels of self-justification, catharsis and lower inhibition are sufficient to induce more co-operative behaviour by receivers, then private verbal expression is sufficient, and is a cheap way, to increase co-operation as receivers are less likely to reject a given offer. However, given the findings supporting cognitive neoassociation theory above, the pure effect of private verbal expression without an audience is unclear. To the best of our knowledge, ours is the first economic experiment designed to study the pure effect of verbal expression in private.

Does the presence of an audience matter? If anything, it will work through the channel of justification and strengthen its positive effect. The literature on voice indeed shows that people value the chance to state their opinions to an audience (Ong et al., 2012; 2013). If it is important for receivers to be able to voice their opinion or emotion to an audience and have it heard, then verbal expression will only work when a third party is present and not when simply venting in private. Verbal expression to an audience additionally provides the opportunity for gossip about the selfish senders. To the extent that the possibility of gossip triggers reputational concerns in senders who offer a low amount, this may also be seen by receivers as a substitute for punishment and hence reduce rejection of unfair offers.

The role of gossip as a discipline mechanism has been well-established in experimental work such as the dictator game in Piazza and Bering (2008), where dictators' concerns about being identified and gossiped about increase the amount allocated to the receiver, and even when reputation should not matter (Beersma and Van Kleef, 2011; Boero et al., 2009). Such concern for social image has been attributed to a cognitive response to situations where others can observe and judge (Ellingsen and Johannesson, 2008).[3] Hence, although senders will not anticipate punishment through negative feedback, the potential for (even non-instrumental) gossip by receivers in third-party verbal expression can likewise promote altruistic behaviour.

As a second research question, we seek to explore the determinants of verbal expression. Despite the standard economic prediction that individuals should be indifferent to non-instrumental communication, several studies show that expressing emotional events in words, as commonly done privately in personal diaries or to a therapist, improves well-being (Littrell, 1998; Niederhoffer and Pennebaker, 2009) and that individuals are even willing to pay for it (Ong et al., 2013; Grosskopf and Lopez-Vargas, 2014; Barton and Rodet, 2015). Grosskopf and Lopez-Vargas (2014) also show that responders' demand for expressing emotion increases with the stimulus (amount of money taken in a power-to-take game).

The link between self-esteem and emotion expression is briefly hinted at in Xiao and Houser (2005). A low offer in the ultimatum game triggers feelings of inferiority, and rejecting it can be motivated by a desire to maintain the self-image that one is not a "weakling" (Tirole, 2002). However, verbal expression allows receivers to deny this inferiority and justify an acceptance decision (Xiao and Houser, 2005). Similarly, Ong et al. (2013) argue that expressing an opinion acts as a self-signalling device which can substitute for the more costly alternative of offer rejection. Con-

[2] Other studies of ex-ante communication in the lab similarly find that it increases giving when receivers write a message (Mohlin and Johannesson, 2008; Andreoni and Rao, 2011). This is reversed, however, when messages come from senders: communication is used as a tool for persuasion in increasing the earnings of senders both as a result of higher acceptance rates and lower offers (Andreoni and Rao, 2011; Andersson et al., 2010). Our study differs in that verbal expression occurs ex-post after receivers see the amount offered by the senders, to capture its non-instrumentality and remove the potential effect that a reduction in social distance has on senders' decisions.

[3] Alternatively, one can hypothesise that subjects are still conscious of the dynamic reputational mechanism of gossip even in the laboratory, as modelled by Kandori (1992) whereby community enforcement of informal sanctions can sustain co-operative behaviour in one-shot transactions.

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Table 1
Demographic characteristics of subjects.

	NYU	LU	*p*-value	All
Male	39%	59%	0.000	50%
Local	53%	40%	0.005	46%
Econ	17%	39%	0.000	29%
Median age	21	23	0.000	22
Total	232	276		508

Notes: *p*-values for differences in Male, Local and Econ are computed using two-group proportion test. *p*-value for difference in Median age is computed using Wilcoxon rank-sum test.

sequently, the authors find that expressing voice results in higher self-image as proxied by receivers' offer expectations. These suggest that verbal expression will be favoured by low self-esteem individuals, who are more likely to have unstable self-conceptions and thus to assume a threat to their self-image (Rosenberg, 1965, p. 152). However, there is a lack of conclusive evidence, with the psychology literature finding that lower self-esteem is typically associated with high oral communication apprehension (McCroskey et al., 1977). Our study contributes to this literature by employing the Rosenberg self-esteem measure (Rosenberg, 1965) and investigating its relationship with the demand for verbal expression.

The paper will be structured as follows: Section 2 describes the experiment and the hypotheses to be tested. Results are presented and discussed in Section 3, and Section 4 concludes.

2. Experiment

2.1. Design

We conducted sessions at the Center for Experimental Social Science (CESS) laboratory at New York University (NYU) from 28 January to 11 February 2015 (15 sessions, n=232), and at Lund University School of Economics and Management (LU) from 3 to 12 October 2016 (17 sessions, n=276), yielding 254 pairs of observations. A summary of demographic characteristics is provided in Table 1. The samples have significant differences: subjects at LU are older and consist of more males, international students and economics majors. While economics students are expected to behave more selfishly (Frank et al., 1993), we do not expect any monotonic bias in this dimension or any of the other differences to affect our comparison of the effect of verbal expression across treatments or groups, and have subsequently pooled the sample for the analysis.

We use the ultimatum game in our experiment as a simple way to illustrate a situation in which both parties have diverging self-interests, and to study how they react to the possibility of verbal expression. Our use of the direct-response method distinguishes this study from the existing literature such as Ong et al. (2012), Chen and Kamei (2014) and Güth and Levati (2007). Since the observation of interest is a low offer from the sender, it would be more economical to use the strategy method to elicit receivers' decisions prior to seeing their actual offers. However, the negative stimulus in the form of a low offer is made more salient in the direct-response method, and the possibility for verbal expression may well lose its impact when repeated in the strategy method. Moreover, when emotions are involved, it is not possible to ignore the fact that the strategy method, where receivers make decisions in a "cold" state, results in lower punishment rates compared to the direct-response method where decisions are made in the "hot" state.[4] To ensure that we obtain enough observations with the direct-response method, we use a binary ultimatum game. One choice should be such that it is sufficiently unfair to the receiver, triggering verbal expression, but not too unfair that the sender expects rejection of that offer with a high probability. Hence, out of a $20 pie, we will use the unfair (17,3) and fair (9,11) choices as per Güth et al. (2001) where the first number refers to the sender's share.[5] The same relative pay-offs are used in the Swedish sessions: out of 200 SEK, the sender earns 170 SEK from the unfair option and 90 SEK from the fair option, and the rest goes to the receiver.[6]

We conduct three treatments of the binary ultimatum game. In the *control* treatment (C), there is no possibility for verbal expression. In the first-party *private* treatment (P), receivers can vent by commenting privately. In the third-party *audience* treatment (A), the comment is observed by the experimenter, thus also allowing for the possibility of gossip. These treatments are further described below. The experiment was programmed using z-Tree (Fischbacher, 2007). At the start of each session, subjects arrived at the lab and were randomly assigned to seats. Instructions were read aloud by the experimenter, and thereafter the treatment was started.[7] At the conclusion of the experiment, subjects completed a demographic survey which also contained questions aimed at eliciting a self-esteem measure (Rosenberg, 1965).[8] Each session lasted approximately 30 minutes and subjects earned 5 USD or 50 SEK in show-up fee.

2.1.1. Control treatment (C)

This treatment consists of the standard binary ultimatum game. The sender chooses to offer the fair amount (3 USD or 30 SEK) or the unfair amount (11 USD or 110 SEK), which is then observed by the receiver. To control for the delay effect (Grimm and Mengel, 2011; Bolle et al., 2014), we show receivers a 2-minute countdown on the screen, after which they make the decision to accept or reject.[9]

2.1.2. Private treatment (P)

In treatment P, immediately after seeing the proposed offer and before making their accept/reject decision, receivers are asked whether they would like to comment on the offer and choose from two buttons: "yes" or "no". If they click "yes", they are presented with a text box in which they can type whatever they like, with no restriction, within two minutes. If they click "no", they are shown a two-minute countdown on the screen. Whether they choose to comment or not will be known to the experimenter, however the content of the comment will only be known to the receiver herself. Neither the choice to comment nor the content of the comment will be known to the sender. This is common knowledge and stated in the instructions read aloud at the start of the experiment,

[4] This has been demonstrated in the ultimatum game study in Güth et al. (2001): the authors find significant differences in punishment behaviour across treatments when using the direct-response method, however no differences are found when the strategy method is used. See also Brandts and Charness (2011) for other motivations to use the direct-response instead of the strategy method.

[5] Comparing the two options, Güth et al. (2001) find that twice as many senders chose the unfair option, hence potentially giving us enough receivers with strong needs for verbal expression. Around half of these unfair offers were accepted, convincing us that sufficiently many senders will expect to get an acceptance.

[6] 1 USD is roughly equivalent to 8.7 SEK at the time of the experiment. While there is a slight difference in pay-offs when converted to USD, we have chosen to keep the same absolute numbers for ease of comparison.

[7] Experiment instructions for NYU are included in Appendix A. Experiment instructions for LU are the same, except for USD amounts that are changed to SEK and payment methods which allow for bank transfers.

[8] The full list of survey questions is included in Appendix B.

[9] The opportunity for verbal expression, even if not taken, presents a delay for the receiver before making the decision to accept or reject the offer. According to Grimm and Mengel (2011), delaying acceptance decisions by around ten minutes can increase the acceptance of low offers significantly from less than 20% up to 80%. We therefore include a delay in our control treatment to separate the effect of pure verbal expression from that of the delay.

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where the privacy of comments is also emphasised. After the two minutes, the receiver decides to accept or reject the offer, and the pay-offs are implemented.

Although this design might cause a concern for experimental demand effect, in particular that subjects feel nudged to type something given that the alternative is to spend two minutes waiting, this should in theory not affect our comparison with the verbal expression in treatment A. On the other hand, our interpretation that the possibility for verbal expression may have an effect on behaviour naturally relies on this nudge by definition.[10]

2.1.3. Audience treatment (A)

Treatment A is identical to treatment P, with the only difference being that the content of the comment is "known" to the experimenter. Neither the choice to comment nor the content of the comment will be known to the sender. This is common knowledge and stated in the instructions read aloud at the start of the experiment.

Subjects may have different interpretations of "known", namely that comments are simply read, that comments could be scrutinised for a rationale behind the decision to accept or reject, or even that comments may be acted upon by the experimenter, for example by affecting the likelihood of certain subjects participating in future sessions, thus bringing up concerns about the role of the experimenter as an authority figure. The use of an experimenter as an audience is however not novel (see, for example, Ong et al., 2012 and Kurzban et al., 2007). As is common procedure in the lab, subjects are anonymous and it should be well understood that the experimenter does not influence future participation in response to a comment. Regarding the other two possible interpretations, we do not distinguish between the two channels and thus simply observe the effect of having an audience "know" the content of the verbal expression. This is not too far from reality: one might express an opinion on social media or to friends but it is not a given that the audience will scrutinise it to find explanation for future actions.

2.2. Hypotheses

We anticipate two channels through which the possibility of verbal expression, by writing a comment, can increase co-operation. The first is the reputational concerns of senders who may want to avoid being the subject of receivers' gossip to the audience. Third-party verbal expression makes social approval or disapproval more salient through the knowledge that someone else is observing the sender's behaviour. This is expected to result in higher offers in the audience treatment, but not in the private treatment where there are no image concerns about being the subject of gossip.

Hypothesis 1a. Senders' average offer in treatment A is greater than that in treatment C or treatment P.

Hypothesis 1b. Senders' average offer in treatment P is not significantly different from that in treatment C.

The second channel through which the possibility of verbal expression to an audience may increase co-operation is its effect on receivers. To the extent that senders' concerns about being gossiped about is considered a punishment, this may substitute for and hence reduce rejection of unfair offers. Moreover, receivers may also value having their opinions heard, as it allows them to justify their acceptance decision to an audience. Without an audience, however, we do not expect that rejection rate is significantly different in treatment P compared to the control.

[10] See Xiao and Houser (2005), Grosskopf and Lopez-Vargas (2014), Koukoumelis and Levati (2014), Güth and Levati (2007) where emotion expression is also optional.

Table 2
Number of senders choosing fair and unfair offers.

	Treatment C		Treatment P		Treatment A	
	n	%	*n*	%	*n*	%
Fair offer	41	48	48	56	53	64
Unfair offer	45	52	37	44	30	36
Total	86		85		83	

Hypothesis 2a. Receivers' rejection rate of unfair offers in treatment A is less than that in treatment C or treatment P.

Hypothesis 2b. Receivers' rejection rate of unfair offers in treatment P is not significantly different from that in treatment C.

Combining the hypothesised behaviours of senders and receivers above, we expect that co-operation, and hence earnings, will be higher when an audience is present compared to the situation in which comments are not allowed or unobserved.

Hypothesis 3a. Average earnings in treatment A are greater than those in treatment C or treatment P.

Hypothesis 3b. Average earnings in treatment P are not significantly different from those in treatment C.

Finally, given the lack of conclusive evidence on the link between self-esteem and the demand for verbal expression, we adopt the following null hypothesis:

Hypothesis 4. Self-esteem has no effect on the choice to comment.

3. Results

We first present the results on the effect of verbal expression on senders' offers, receivers' rejection rates and earnings. This is followed by results on the decision to comment.

3.1. Effect of verbal expression

We start our analysis with senders' behaviour. From Table 2, we see that over half (52%) of the senders decide on the unfair allocation in the control treatment. This number decreases when receivers are offered the chance to vent privately, and even more so when the receivers are provided with an audience to their comments. The data provides some support for Hypothesis 1a that image concerns drive senders to be more generous when there exists the opportunity for gossip, despite no threat of future interaction with the receiver or the experimenter. More senders offer the fair allocation in treatment A compared to treatment C (χ^2-test, $p = 0.034$), or treatments P and C combined ($p = 0.075$), although the difference between treatments P and A is not significant ($p = 0.328$). Without an audience in front of whom image is sought, senders do not offer significantly different amounts in treatment P compared to the control treatment, as per Hypothesis 1b ($p = 0.250$). This audience effect is robust even when controlling for demographic characteristics and experiment location, as shown in Table 3 below. The possibility of having their action reported to a third-party increases the likelihood of the sender choosing the fair offer by over 18%. Senders at NYU are also less likely to choose the fair offer than at LU.

The finding that senders are more generous when there is a possibility of gossip, while supported by previous literature such as Piazza and Bering (2008), is contrary to what a rational sender would do if they expect that receivers become more lenient. This suggests that the mere potential for gossip is more powerful than predicted by standard economic theory. In particular, the context in which the offended party can communicate matters: when receivers have the possibility to report to a third party, senders seek to avoid the potential shame and become more cautious in comparison to situations where any possible bad reputation is only

Table 3
Marginal effects on sender's choice of fair offer, logistic regression results.

	(1)	(2)
Treatment P	0.086	0.118
	(0.074)	(0.077)
Treatment A	0.159**	0.187**
	(0.073)	(0.074)
Donate		−0.099
		(0.071)
Redistribution		0.062
		(0.042)
Age		−0.001
		(0.006)
Male		−0.005
		(0.068)
Local		0.003
		(0.066)
Econ		−0.106
		(0.072)
NYU		−0.164**
		(0.071)
Observations	254	254
LR χ^2 p-value	0.104	0.151

Notes: Standard errors in parentheses, $^{**}p < 0.05$.

kept between the two parties, or considered a part of bargaining (see, for example, Xiao and Houser, 2005 who find senders do not send more when receivers can express emotion).

We now turn to the receivers' decisions. As expected, barring one observation in treatment C, all fair offers are accepted.[11] Receivers' responses to unfair offers are summarised in Table 4. Due to senders' increased generosity, there are fewer remaining unfair offers in treatments P and A. We see that the proportion rejected increases when receivers are given the opportunity for private verbal emotion, but not significantly (18/45 to 18/37, $p = 0.432$). As predicted, the rate of rejection is lower when an audience is present (9/30), though the difference is also insignificant compared to treatment P ($p = 0.122$) or treatment C ($p = 0.377$). The choice to comment also has no significant effect on the rejection of unfair offers in any treatment (treatment P $p = 0.236$, treatment A $p = 0.338$, treatments P and A $p = 0.655$).

We can therefore not reject the null hypotheses that the opportunity for verbal expression, both in private or to an audience, has no effect on receivers' behaviour. This suggests that the previously established role of emotion expression in increasing co-operation in receivers, as reported in Xiao and Houser (2005), is mainly due to the possibility to punish through negative feedback. When this is absent, as is the case here, any increase in co-operation when an audience is present is mainly driven by the increased generosity of senders who want to avoid being the subject of gossip.

What is the overall effect of verbal expression on co-operation? Table 5 shows the number of accepted offers in each treatment. We see that the combination of higher generosity by senders and lower rejection rate of unfair offers by receivers, although insignificant, indeed result in higher overall co-operation in treatment A. The proportion of offers accepted is higher when an audience is present relative to the control ($p = 0.049$) or treatment P ($p = 0.068$), while the mere possibility of verbal expression has no effect on the proportion of accepted offers in treatment P compared to treatment C ($p = 0.884$). Table 6 shows the regressions of offer acceptance over treatment dummies.[12] The results show again that the presence of an audience is significant in increasing the rate of co-operation by 11%, while the mere possibility to comment in private has a negligible effect. Overall co-operation is lower at NYU given the higher rates of senders choosing unfair offers, though this is not significant.

The increase in co-operation in treatment A naturally translates to higher average earnings, as shown in Table 7. As predicted in Hypothesis 3a, the possibility for verbal expression to an audience results in significantly higher average dollar earnings in treatment A compared to treatment C in the NYU sample (two-sided t-test, $p = 0.030$) though not treatment P ($p = 0.140$), while, as per Hypothesis 3b, venting in private is not sufficient: earnings in treatment P are not significantly different from treatment C ($p = 0.438$). The differences in earnings are however less pronounced in LU (C v P $p = 0.721$, P v A $p = 0.260$, C v A $p = 0.462$).

3.2. Demand for verbal expression and self-esteem

The data on receivers' choice to comment presented in Table 8 reveal some unexpected results. Over half of receivers choose to comment in treatment P despite the absence of an audience, and the proportion is not significantly different from treatment A (χ^2-test, $p = 0.981$). Moreover, the choice to comment is significantly higher for receivers of fair offers, in contrast to the expectation that verbal expression is triggered by negative stimuli ($p = 0.033$). Both positive and negative stimuli trigger the desire for verbal expression.

The content of receivers' comments provides some insights about their motivations for verbal expression. While comments in treatment P are not observed by the experimenter, comments from treatment A are included in Appendix C. Fair offers trigger expressions of gratitude or explanations for the subsequent decision to accept.[13] The latter is also true for almost all unfair offers which are subsequently accepted, at first glance supporting the explanation proposed by Xiao and Houser (2005): justifying acceptance of unfair offers is a way to refute the inferiority implied by the low offer, and is cheaper than rejection. If verbal expression is indeed used as a method to refute the threat to self-image, this should be more commonly chosen by those with low self-esteem as these individuals are more likely than high self-esteem individuals to have unstable self-conceptions and assume a threat to self-image (Rosenberg, 1965, p. 152). We next explore if self-esteem is indeed a predictor of verbal expression.

Table 9 shows the results from logistic regressions of the likelihood of verbal expression against various predictors. From columns (1)–(3), getting a fair offer increases the choice of commenting by over 20%, which seems to be motivated by gratitude or the desire to rationalise the sender's choice for receivers expecting the economically rational low offer. Those with past experience of charitable donations and preferring redistribution are also more likely to choose to comment, as opposed to the self-interested economic agent who sees no point in verbal expression. However, the presence of an audience does not significantly affect the likelihood to comment. Moreover, commenting behaviour appears to be heterogeneous across the two sample groups as seen in the highly significant coefficients of NYU: subjects at the American university are 67% more likely to comment than those in Sweden, and for

[11] This one rejection is suspected to be a mistake and does not affect our results.

[12] While treatment effects come from two channels, senders' fair offers and receivers' acceptance of unfair offers, we have chosen to combine them in these regressions and only use treatment dummies as explanatory variables. We drop senders' choice of fair offers from the regressions as almost all fair offers are accepted. Furthermore, the individual treatment effects on the acceptance of unfair offers by receivers are weak (as discussed earlier) and separate regressions yield only marginally significant effects.

[13] It may appear that receivers were expressing gratitude to senders and that they misunderstood that comments are not observed by senders. One possible explanation is that receivers were apparently expecting a low offer, and upon seeing the fair offer immediately felt an impulse to express gratitude, despite the audience being the experimenter.

Table 4
Number of receivers choosing to accept or reject unfair offers and their choice to comment.

	Treatment C	Treatment P			Treatment A		
		Comment	Not comment	Total	Comment	Not comment	Total
Accept	27	10	9	19	10	11	21
Reject	18	6	12	18	6	3	9
Total	45	16	21	37	16	14	30

Table 5
Number of offers accepted and rejected.

	Treatment C		Treatment P		Treatment A	
	n	%	*n*	%	*n*	%
Acceptance	67	78	67	79	74	89
Rejection	19	22	18	21	9	11
Total	86		85		83	

Table 6
Marginal effects on offer acceptance, logistic regression results.

	(1)	(2)
Treatment 1	0.011	0.004
	(0.053)	(0.053)
Treatment 2	0.114**	0.107**
	(0.051)	(0.051)
NYU	−0.026	−0.030
	(0.048)	(0.048)
Observations	254	253
LR χ^2 *p*-value	0.170	0.190

Notes: Column (1) includes the whole sample, column (2) excludes the observation of a fair offer that was rejected. Standard errors in parentheses, $^{**}p < 0.05$.

Table 7
Average earnings of senders and receivers in local currency.

	Treatment C	Treatment P	Treatment A	Average
NYU (USD)				
Sender	8.71	9.55	10.58	9.71
Receiver	5.48	6.17	7.56	6.50
Average	7.10	7.86	9.07	8.10
LU (SEK)				
Sender	99.82	82.33	94.75	92.90
Receiver	63.82	75.81	80.25	72.32
Average	81.82	79.07	87.50	82.61

Table 8
Number of receivers choosing to comment or not comment.

	Treatment P			Treatment A		
	Fair	Unfair	Total	Fair	Unfair	Total
Comment	33	16	49	32	16	48
Not comment	15	21	36	21	14	35
Total	48	37	85	53	30	83

this group the choice to comment appears to be motivated by low self-esteem.[14] From columns (4)–(6) we can derive that a one standard deviation decrease (5.88) in the Rosenberg self-esteem measure from its mean (21.36) increases the likelihood of the receiver commenting by approximately 16%. This is robust to the audience effect, the amount received, and any social preference or demographic indicators, though we also see that males have a higher likelihood of verbal expression. The evidence here is in line with the explanation proposed in Ong et al. (2013) whereby individuals choose to voice their opinion to protect their unstable self-image. In contrast, the effect of getting a fair offer is more apparent in the LU sample, as are the positive effects of Donate and Redistribution. The effect of self-esteem is, on the contrary, positive though insignificant.

The average self-esteem scores of receivers, split into various groups, are summarised in Table 10. Comparing the average level of self-esteem between the receivers who comment and those who do not, regardless of rejection decision, we find that the choice to comment is not associated with lower self-esteem, confirming Hypothesis 4 (20.80 vs 21.61, two-sided *t*-test, $p = 0.355$). This is true both for those receiving a fair offer (20.74 vs 21.11, $p = 0.754$) and those receiving an unfair offer (20.94 vs 22.11, $p = 0.367$). Self-esteem is also not significantly different between fair and unfair offers (Control $p = 0.436$, Comment $p = 0.861$, Not comment $p = 0.481$).

However, we also find that self-esteem is higher in the control group than treatment groups (C v P $p = 0.074$, P v A $p = 0.164$, C v A $p = 0.001$). Self-esteem is elicited at the end of the experiment, and while the Rosenberg self-esteem measure is commonly adopted to measure consistent and long-lasting global traits (Robins et al., 2001), the significant difference between the control and treatment groups despite the random assignment suggests that participants' reports on self-esteem may have been affected by the setup of the game. Given that the proportion of receivers receiving fair offers is higher in the treatment groups, it is curious that these receivers should report lower self-esteem. We do not have an explanation for this result and leave further investigation to future research.

In summary, despite the significant and negative effect of self-esteem on commenting in the NYU sub-sample, we find no conclusive evidence that self-esteem predicts verbal expression.

4. Concluding remarks

This paper investigates the effect of verbal expression in achieving bargaining solutions in conflicts. In many situations people choose to communicate ex-post to parties that are outside the conflict, rendering verbal expression effectively non-instrumental. Previous literature has focused either on verbal expression directed to the counter-party, which does not allow us to disentangle the various channels through which communication may increase cooperation, or pre-play verbal expression to a third party, combined with the strategy method. Our study makes several distinctions from the existing literature: verbal expression is allowed in private or to a third party to remove the possibility to punish through negative feedback, and it is implemented post-play with the direct-response method to increase the salience of the conflict that has occurred. We experiment with a binary ultimatum game where receivers can comment privately on the senders' offers prior to making an acceptance/rejection decision (treatment P), and where the comment is observed by the experimenter (treatment A).

The possibility of verbal expression to an audience is found to increase economic welfare, which is mainly driven by senders behaving more fairly. Consequently there are fewer observations of unfair offers which does not allow us to reject the null hypothesis regarding the effect of verbal expression on rejection. Our study

[14] We exclude the possibility that self-esteem is the main driver of lower rejection as there is zero correlation between self-esteem and rejection in treatment C in the NYU sample.

Table 9
Marginal effects on receiver's choice to comment, logistic regression results.

	All			NYU			LU		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fair offer	0.214*	0.215*	0.255**	0.088	0.099	0.092	0.201*	0.201*	0.278**
	(0.117)	(0.117)	(0.126)	(0.113)	(0.115)	(0.125)	(0.113)	(0.114)	(0.132)
Treatment A		−0.063	−0.130		−0.319	−0.348		0.170	0.035
		(0.329)	(0.344)		(0.440)	(0.450)		(0.412)	(0.448)
Self-esteem	0.016	0.015	0.014	−0.027**	−0.035**	−0.031*	0.014	0.019	0.018
	(0.011)	(0.013)	(0.013)	(0.011)	(0.017)	(0.018)	(0.010)	(0.013)	(0.014)
Treatment A*Self-esteem		0.002	0.003		0.014	0.015		−0.010	−0.007
		(0.015)	(0.016)		(0.022)	(0.024)		(0.020)	(0.020)
Donate			0.209**			0.096			0.223
			(0.096)			(0.141)			(0.146)
Redistribution			0.121**			0.034			0.170**
			(0.055)			(0.080)			(0.072)
Age			0.030			0.002			0.051**
			(0.019)			(0.021)			(0.024)
Male			0.158*			0.229*			0.106
			(0.084)			(0.121)			(0.118)
Local			−0.035			0.009			0.010
			(0.090)			(0.128)			(0.131)
Econ			−0.071			−0.042			−0.111
			(0.108)			(0.208)			(0.114)
NYU	0.672***	0.679***	0.681***						
	(0.192)	(0.190)	(0.218)						
NYU*Fair offer	−0.130	−0.127	−0.157						
	(0.165)	(0.166)	(0.179)						
NYU*Self-esteem	−0.042***	−0.043***	−0.039**						
	(0.015)	(0.015)	(0.016)						
Observations	168	168	168	85	85	85	83	83	83
LR χ^2 p-value	0.003	0.011	0.001	0.019	0.077	0.212	0.073	0.236	0.009

Notes: Self-esteem indicates the Rosenberg self-esteem measure (Rosenberg, 1965), ranging from 0 to 30. *Donate* is a dummy variable which equals 1 if the subject has donated either money or time to charities or non-profit organisations in the past 12 months. *Redistribution* is defined as the average of scores from the responses to the statements: (i) "Hard work does not bring success, it is more a matter of luck and connections" and (ii) "The government should take more responsibility to ensure that everyone is provided for" where 1 is strongly disagree and 5 is strongly agree. Standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 10
Average self-esteem scores of receivers, number of observations in parentheses.

	Fair offer	Unfair offer	Average
Comment	20.74 (65)	20.94 (32)	20.80 (97)
Not comment	21.11 (36)	22.11 (35)	21.61 (71)
Control	22.85 (41)	23.36 (45)	23.12 (86)
Average	21.44 (142)	22.28 (112)	21.81 (254)

extends the literature on communication in bargaining to settings in which one side can vent privately or communicate to a third party. We show that the role of verbal expression in increasing co-operation in previous literature is mainly driven by the possibility to give negative feedback to the counter-party, rather than the pure effect of verbal expression itself. Further, we provide some support that the threat of gossip, even if it has no material effect, is enough to induce subjects to behave more fairly.

Although verbal expression itself plays an insignificant role in reducing rejection rates, we find that there is demand for verbal expression even if it is not observed by the opponent or any third party. We find no conclusive evidence that this choice to comment is motivated by self-esteem. This suggests that the role of verbal expression in increasing the co-operation of receivers provoked by low offers is less crucial than its potential in increasing the generosity of senders. Finally, this study shows the combined importance of voice and the presence of an audience in increasing welfare and motivates the use of third-party intermediaries in economic exchanges.

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Appendix A. Experiment instructions

A1. General instructions

You are about to participate in an experiment in decision-making. Before we start, please make sure your phones are turned off or on silent, and put away all personal belongings.

In today's experiment you will be paired with one other person to form a group. You will not know the identity of the other person but it could be anyone in this room. All interactions between the two of you will be through the computer terminals.

Please DO NOT talk or communicate with other participants during the session. If you have any question, raise your hand and we will approach you to answer it.

Today's session will last approximately 45 minutes. At the end of the session you will complete a questionnaire and receive your payment. This payment consists of a **show-up fee of $5** and your **experiment earning**. Your experiment earning depends on your own decision as well as the decision of the other person in your

group. You will be paid with cash privately at the end of the session.

We will now read through the details of the experiment together. These will also appear on your screen as you reach the relevant stage of the experiment, however please feel free to look at the paper instruction anytime for reference.

Are there any questions at this point?

A2. Treatment C

In your group, one of you will be randomly chosen to be the SENDER, and the other person will be the RECEIVER.

Stage 1: The SENDER will receive an endowment of $20. The SENDER will have to decide between the following two allocations:

- Keep $17 and offer $3 to the RECEIVER
- Keep $9 and offer $11 to the RECEIVER

Stage 2: The RECEIVER will see what the offer from the SENDER is. This Stage will be left after 2 minutes. The remaining waiting time is shown in the countdown on the top right corner of the computer screen.

Stage 3: The RECEIVER will then make a decision whether he/she would like to accept this offer OR whether he/she would like to reject it.

- If the RECEIVER accepts the offer, then the experiment earning is the allocation chosen by the SENDER.
- However if the RECEIVER rejects the offer then the experiment earning is $0 for both SENDER and RECEIVER.

Once all participants are done making the decisions, you will see a questionnaire. We request you to please fill out the questionnaire as best as possible. Please wait quietly while we pay each participant.

A3. Treatment P

In your group, one of you will be randomly chosen to be the SENDER, and the other person will be the RECEIVER.

Stage 1: The SENDER will receive an endowment of $20. The SENDER will have to decide between the following two allocations:

- Keep $17 and offer $3 to the RECEIVER
- Keep $9 and offer $11 to the RECEIVER

Stage 2: The RECEIVER will see what the offer from the SENDER is. The RECEIVER will then choose whether to comment on the offer or not, and will be given 2 minutes to enter his/her comment in a text box that will be displayed on the screen. Whether the RECEIVER chooses to type a comment or not, this Stage will be left after 2 minutes. The remaining waiting time is shown in the countdown on the top right corner of the computer screen. **There is no restriction as to what you can write. The content of your comment is private, however your choice whether or not to comment will be known to the experimenter. Neither the content nor the choice to comment will be known to the SENDER.**

Stage 3: The RECEIVER will then make a decision whether he/she would like to accept this offer OR whether he/she would like to reject it.

- If the RECEIVER accepts the offer, then the experiment earning is the allocation chosen by the SENDER.
- However if the RECEIVER rejects the offer then the experiment earning is $0 for both SENDER and RECEIVER.

Once all participants are done making the decisions, you will see a questionnaire. We request you to please fill out the questionnaire as best as possible. Please wait quietly while we pay each participant.

A4. Treatment A

In your group, one of you will be randomly chosen to be the SENDER, and the other person will be the RECEIVER.

Stage 1: The SENDER will receive an endowment of $20. The SENDER will have to decide between the following two allocations:

- Keep $17 and offer $3 to the RECEIVER
- Keep $9 and offer $11 to the RECEIVER

Stage 2: The RECEIVER will see what the offer from the SENDER is. The RECEIVER will then choose whether to comment on the offer or not, and will be given 2 minutes to enter his/her comment in a text box that will be displayed on the screen. Whether the RECEIVER chooses to type a comment or not, this Stage will be left after 2 minutes. The remaining waiting time is shown in the countdown on the top right corner of the computer screen. **There is no restriction as to what you can write. Your choice whether or not to comment AND the content of your comment will be known to the experimenter. However, neither the content nor the choice to comment will be known to the SENDER.**

Stage 3: The RECEIVER will then make a decision whether he/she would like to accept this offer OR whether he/she would like to reject it.

- If the RECEIVER accepts the offer, then the experiment earning is the allocation chosen by the SENDER.
- However if the RECEIVER rejects the offer then the experiment earning is $0 for both SENDER and RECEIVER.

Once all participants are done making the decisions, you will see a questionnaire. We request you to please fill out the questionnaire as best as possible. Please wait quietly while we pay each participant.

Appendix B. Post-experiment survey

1. What is your age (in years)?
2. What is your gender?
   (a) Female
   (b) Male
3. What is your nationality?
4. What is your major?
   (a) Mathematics
   (b) Computer Science
   (c) Physics or Chemistry
   (d) Economics
   (e) Humanities
   (f) Foreign Language
   (g) Other
5. Which year are you in of your program?
   (a) Freshman
   (b) Sophomore
   (c) Junior
   (d) Senior
   (e) Masters Program
   (f) PhD Program
   (g) Other
6. Please enter your GPA in the box below. If you do not have a GPA yet or you do not know your GPA, please enter −1.
7. What was the highest level of education your father (or male guardian) completed?
   (a) Less than high school
   (b) High school or equivalent
   (c) Vocational or trade school
   (d) College or university
   (e) Don't know

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8. What was the highest level of education your mother (or female guardian) completed?
   (a) Less than high school
   (b) High school or equivalent
   (c) Vocational or trade school
   (d) College or university
   (e) Don't know
9. What is your employment status?
   (a) Working over 40 hours/week
   (b) Working over 20 but less than or equal to 40 hours/week
   (c) Working less than or equal to 20 hours/week
10. How much on average is your weekly discretionary spending? This consists of personal consumption such as food, entertainment, clothes etcetera EXCLUDING university fees and housing expenses.
   (a) $\leq$ \$50
   (b) $>$ \$50 and $\leq$ \$100
   (c) $>$ \$100 and $\leq$ \$150
   (d) $>$ \$150 and $\leq$ \$200
   (e) $>$ \$200
11. In the past twelve months, have you donated money to or done volunteer work for charities or other non-profit organisations?
   (a) I donated the following dollar amount:
   (b) I donated the following number of hours:
12. On a scale from 1 to 4, where 1 is STRONGLY DISAGREE, 2 is DISAGREE, 3 is AGREE and 4 is STRONGLY AGREE, please indicate the extent to which you agree with the following statements.
   (a) I feel that I'm a person of worth, at least on an equal plane with others.
   (b) I feel that I have a number of good qualities.
   (c) All in all, I am inclined to feel that I am a failure.
   (d) I am able to do things as well as most other people.
   (e) I feel I do not have much to be proud of.
   (f) I take a positive attitude toward myself.
   (g) On the whole, I am satisfied with myself.
   (h) I wish I could have more respect for myself.
   (i) I certainly feel useless at times.
   (j) At times I think I am no good at all.
13. Below is a list of statements dealing with your general feelings about society. On a scale from 1 to 5, where 1 is STRONGLY DISAGREE, 2 is DISAGREE, 3 is NEUTRAL, 4 is AGREE and 5 is STRONGLY AGREE, please indicate the extent to which you agree with the following statements.
   (a) Hard work does not bring success, it is more a matter of luck and connections.
   (b) The government should take more responsibility to ensure that everyone is provided for.
14. (Only for receivers receiving an offer of 11) Imagine that your SENDER chose (17,3) instead of (9,11). This means that you received an offer of 3 instead of 11.
   Treatment C
   Would you have chosen to Accept or Reject the offer?
   (a) Accept
   (b) Reject
   Treatment P
   Would you have chosen to comment on the offer, knowing that the experimenter would know whether or not you chose to comment, but not the content of your comment?
   (a) Yes
   (b) No
   Would you then have chosen to Accept or Reject the offer?
   (a) Accept
   (b) Reject
   Treatment A
   Would you have chosen to comment on the offer, knowing that the experimenter would know both whether or not you chose to comment, as well as the content of your comment?
   (a) Yes
   (b) No
   Would you then have chosen to Accept or Reject the offer?
   (a) Accept
   (b) Reject

Appendix C. Content of receivers' comments

Refer to Table C1.

Supplementary material

Supplementary material associated with this paper can be found, in the online version, at 10.1016/j.socec.2016.12.003.

Table C1
Content of receivers' comments in treatment A, unedited.

Offer	Comment	Decision
NYU		
11	good choice. would not have accepted only 3dollars.	Accept
11	thanks	Accept
11	thank you!	Accept
11	i love you	Accept
11	I was flattered that the sender offered to send \$11 instead of choosing to keep \$17. If I were given the other offer, I would n't have accepted so that neither of us would have gotten the money.	Accept
11	I think the offer stands good as i am given prirority and earning more!	Accept
11	It was generous of the sender.	Accept
11	The offer was in my favor. I felt the sender was purposefully ensuring their own gain. While offering 17 would have been more selfish, I could have decided to take the deal, rather than receive nothing. However, because three dollars would be insubstantial, I would have a high likelihood of rejecting that offer. In a sense, the sender would then lose that 17dollars, and I would only lose 3.	Accept
11	I was suprised by the offer. Was it randomly decided that some people get \$11 even if the sender chose a different outcome.	Accept
11	good choice	Accept
11	Very fair!	Accept
11	I am surprised that the sender did n't send \$3 because I would have accepted as long as there was a gain.	Accept
11	Wait... I have n't seen the offer yet. Was it on the last page?	Accept
11	yay!	Accept
11	thanks	Accept
3	Not cool bud	Accept
3	it 's risky to only offer me 3 because he/she could lose out on 17 if i reject since obviously it 's not a fair offer. it 's sort of a decision of 3dollars vs pride	Accept

(*continued on next page*)

Table C1 (*continued*)

Offer	Comment	Decision
3	Well logically the receiver has no choice but to accept the offer if he/she wants to make more than the show-up fee for the experiment. The sender could be nice and try to share the endowment more equally, but does not benefit as much if he/she keeps the 17$. Logically the receiver should accept the offer regardless because both people are better off gaining the extra money, but if the receiver is ruthless and does n't want the sender to benefit more than he/she benefits, then they wo n't accept.	Accept
3	It 's a practical choice. I would have done the same if I am the sender.	Accept
3	It 's like a prisoner's dillema... I know it can be tough for the sender... but the receive will choose to accept anyway because this is the best choice.	Accept
3	I figured this would happen, due to an anonymous person's greed. However, I could easily reject the offer out of spite, and I think that was a bad decision for the sender to amke, not knowing my character. I would have sent the 11 if I were the sender, just making sure that I myself would receive something. Dumb move.	Accept
3	I have no incentive to accept this as it is a menial amount above the show-up fee of $5. As such, to make this more equitable for both parties, I will reject the offer so we both get $5.	Reject
LU[a]		
110	I was surprised to get offered 110.	Accept
110	I m generally satisfy with the allocation, if the sender choose to keep 170, i will definitely reject the offer	Accept
110	For me it was clear that I will accept the offer if I receive 110kr. If the person had offered me 30kr I would not accept it because I 'd rather have 0 earnings of the experiment than giving a selfish person 170kr. I would also react like the sender did.	Accept
110	I will choose to accept the offer, obviously. However, if the person would have sent me 30kr I would have rejected it because of 1) it 's greedy to take 170kr and give 30kr 2) if I were the sender I would have sent 110kr.	Accept
110	If I reject the offer then according to the information presented, both me and sender will gaining 0kr. Hence I decided to accept the offer for mutual benefit.	Accept
110	as a receiver, i think 110kr is the best choice for me. even sender gives me only 30kr, i will choose to accept it.	Accept
110	I 'm happy. It seems like I have a generous opponent/partner. Or he just wants to make sure I do not reject his offer.	Accept
110	It seems they really want me to accept. Is it a loss-loss for them? I will choose accept, as I cannot see myself loosing anything.	Accept
110	:D Nice offer thanks! it 's like a game theory :D	Accept
110	I think the offer sent by the sender is the best possible outcome for both the sender and receiver combined, since I (the receiver) will definitely accept this offer if 110kr, which is the maximum possible allocation for me. I think it is the most rationale decision and eliminates any sort of dilemma (such as prisoner's dilemma) or anything like that.	Accept
110	if the sender would have offered me 30kr I would have refused the offer, otherwise I would have accepted the allocation because is more fair. That 's why I accepted the offer of 110kr	Accept
110	Good offer, I would n't accept 30kr	Accept
110	The sender does not want to take any risk. I would not have done the same. You have to take risk in order to suceess and win.	Accept
110	Wondering if this was a choice out of character or the "safe" choice due to the low possibilty to get any money when chosen otherwise. However, I 'd done the same no matter of Stage 3.	Accept
30	He or she is smart	Accept
30	Would have done the same, therefore expected that.	Accept
30	Cheapskate! I would have sent the higher amount. But my desire to maximize the benefit to myself outweighs my vengeance... .	Accept
30	I wish I was the sender, because every sender will choose the best offer for himself!	Accept
30	I cant accept small amount of money because the Sender will keep sending me low amounts	Reject
30	I will reject this offer because the sender has the position of power and has used it solely for their own benefit. I disagree with their purely profit making choice and I am not desperate enough that 30kr is enough to convince me that they should not learn the consequences of greed.	Reject
30	honestly i am very compelled to simply ruin it for the sender. 30kr is nt a lot of money and it would nt make that much of a difference to me.	Reject

[a] Five receivers did not finish typing in the allocated 2 minutes and their comments were consequently not saved by the experiment program. Three received fair offers, which were accepted, and two received unfair offers, which were rejected.

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Paper IV

Curating Social Image: Experimental Evidence on the Value of Actions and Selfies

with Håkan J. Holm

1 Introduction

New technology has dramatically changed the way people curate their social image. Founded in 2004, popular social networking site Facebook has expanded in a period that coincides with the entry of smartphones into the market, most notably the iPhone in 2007. People started carrying a smartphone wherever they went, giving unprecedented access to social media, and with the release of Apple's front-facing camera in 2010 iPhone users began taking pictures of themselves. By 2015, 1.2 billion "selfies" were taken yearly in the UK alone (Ofcom, 2015).[1]

People's pre-occupation with social media and their online image has potentially large economic consequences. Social media consumes an increasing share of people's leisure time and one in three Americans admit to using social media during

[1] "Selfie" was chosen as the Oxford Dictionaries Word of the Year in 2013. It is defined as "a photograph that one has taken of oneself, typically one taken with a smartphone or webcam and uploaded to a social media website".

work time to take a mental break (Pew Research Center, 2016). Using a conservative estimate of 20 minutes daily Facebook activity, the economic loss of active Facebook usage to employers is nearly a trillion USD, an economic impact that is difficult to ignore.[2] The economic impact on leisure time activities is probably much larger but is more difficult to estimate. In recent years, a new industry has flourished which monetizes people's desire to maintain their online reputation. For example, some websites re-post official arrest mugshots and then charge a high fee for those wanting to remove them, while other businesses (often run by the same owner as the websites) offer mugshot removal as part of a reputation management service.[3] Furthermore, the billions of selfies taken yearly have spawned a market in accessories and create a great potential as a marketing tool.[4] Remarkably, little has been done in the existing economic literature to understand the new digital environment where social image is produced.

A large part of social media interaction is shaped by how people edit and then decide what to upload to their profile to be viewed by others, as dictated by the image they want to project. If indeed people selectively edit their image before publishing, and are willing to pay to remove undesirable information, economic theory would suggest that this process reflects how people value different pieces of information. We conduct a framed field experiment with student subjects designed to capture how image concerns affect people's valuation. Subjects play the public good game (henceforth PG), and are subsequently asked to state their reservation prices for publishing different sets of information on a public webpage using the Becker-DeGroot-Marschak (BDM) mechanism. Each set consists of their name and the fact that they participated in an economic experiment, with various combinations of their PG contribution and their selfie (for a random subset of subjects who are asked to take a selfie prior to the PG). Subjects are thus able to adjust their reputation and level of visibility ex-post. To the best of our understanding this sequential design and the selfie-taking under experimental control

[2] `http://www.businessinsider.com/how-much-time-do-people-spend-on-facebook-per-day-2016-4?r=US&IR=T&IR=T` and `http://www.cnbc.com/2016/02/04/facebook-turns-12--trillions-in-time-wasted.html`, both accessed 10 August 2016.

[3] `http://www.nytimes.com/2013/10/06/business/mugged-by-a-mug-shot-online.html`, accessed 31 October 2016.

[4] `http://www.bloomberg.com/news/articles/2014-12-31/selfie-sticks-rule-holiday-season-as-musthave-accessory` and `http://www.forbes.com/sites/cherylsnappconner/2015/07/17/why-selfies-should-be-part-of-your-marketing-plan-and-9-new-photo-apps/#43327fdd4bbf`, both accessed 5 August 2016.

make our study unique in comparison to previous experiments on social image and the associated audience effect. As will be shown later this design allows us to test if recently developed theoretical mechanisms about image concerns (Bénabou and Tirole, 2006) can help us predict behavior in a controlled environment that has more similarities to modern social media interaction than previous studies.

Selfies and information about socially sensitive acts (such as PG contributions) are two important "input" components of people's social image.[5] From a theoretical perspective we argue that the selfie can be thought of as an instrument to impact the "visibility" of a social signal, and information about socially sensitive acts can be viewed as the "moral" content of the signal. Information that enhances reputation such as a high PG contribution should, according to Bénabou and Tirole (2006), lead to a higher willingness to publish and lower bids, and vice versa. The addition of the selfie is hypothesized to amplify these effects. Assuming that valuations are additive and not too negatively correlated, which we think are reasonable for our sample, then we can also make the (less obvious) prediction that image concerns will increase the variation in prices demanded when PG contribution or selfie is added to the publication. We also think that social media habits, the rating of the selfie, and other personal characteristics may affect a subject's willingness to publish their information.

Our contributions are the following. We are able to elicit subjects' valuations for publishing potentially sensitive information sets, as reflected in the BDM bids, and isolate the premium demanded for various components of social image. We show that these can to a large extent be explained by theory of social reputation. The price demanded for publishing information containing PG contribution is negatively correlated with PG contribution itself. Not surprisingly, the more subjects free-ride the more unwilling they are to publish their contribution, especially with a selfie. The premium demanded for adding PG contribution to the publication, net of individual privacy concern, is similarly found to increase as PG contribution decreases. These are in line with the theoretical predictions although both effects are not consistently highly significant. The effect of adding a selfie to the publication of PG contribution is a highly significant increase in the price demanded, and

[5]One might argue that a selfie is just like any other photo portraying a person, but what distinguishes a selfie from other types of photographs taken of the same subject is the control retained by the subject. The selfie signifies a sense of human agency (Senft and Baym, 2015), and this consequentially allows more freedom for personality expression. Qiu et al. (2015), e.g., found that people express their personality differently in the context of selfies than they do in other types of photos, and propose that this difference is due to impression management of social media users.

this premium is strongly negatively correlated with PG contribution. This shows that when information is more visible with a selfie, subjects are more motivated to hide lower PG contribution, even if the subject is already identifiable through her name. All these findings are consistent with predictions from the model by Bénabou and Tirole (2006), where the visibility of behavior increases the reputational impact, and further provide empirical evidence that people are prepared to take costly actions to filter public information about themselves. We are also able to confirm the less obvious prediction that the variance of bids increases when PG contribution or selfie is added, showing the presence and heterogeneity of image concerns in individuals.

Our novel design also allows us to explore some questions that we believe are new but where the theoretical predictions are less clear. One question to further explore is the cause of the "selfie effect". As noted previously, adding a selfie affects the distribution of BDM bids. This raises the question of whether this is caused by the selfie as such (e.g., through concerns about physical appearance) or if it is information about PG contribution that gets much more sensitive in combination with a selfie. To investigate this we also study the premium for adding PG contribution information with and without a selfie. We find that both the premium for PG contribution information and its variance drop when a selfie is included which suggests that concerns for the selfie itself (e.g., the visual physical appearance) crowd out social image concerns for behavior. Put simply, when looks enter social behavior becomes less important.

We can also study how selfie-taking per se affects behavior, in particular cooperation. Our finding is that taking a selfie does in fact have a negative impact on cooperation. However, the prevalence of this effect depends on how often subjects take selfies. Whereas taking a selfie does not have any significant negative impact among the subjects in general, there is a strong negative effect among subjects who take a selfie at least monthly or weekly. This is in line with the behavioral addiction hypothesis, which suggests that among frequent selfie-takers, taking a selfie triggers psychological mechanisms that crowd out other concerns, including social ones.

The outline of the paper is as follows. We start by generating our main hypotheses in a theory section and then describe the experimental design in section 3. We present our main results in section 4. In section 5 we motivate our exploratory questions and present the results we get. The paper ends with concluding remarks

in section 6.

2 Theory and Hypotheses

2.1 Social-signaling through socially sensitive actions

We suspect that our valuation of publicity depends on whether or not it enhances our reputation. In the experiment, valuation of publicity will be elicited as BDM bids for the experimenter's right to publish the subject's name and participation information. We next add information about the subject's contribution in the PG, which is assumed to be socially sensitive as it may either enhance or damage reputation.

Our investigation about the subjects' willingness to publish specified information sets about themselves and their behavior, with or without a selfie, is related to previous research on audience effects and social image.[6] People want to be seen as not only prosocial, but also as having low concerns for material incentives (Bénabou and Tirole, 2006). This gives rise to the "audience effect", whereby the existence of or an increase in the size of an audience leads to an increase in prosocial behavior, and fairness norms (Bernheim, 1994; Andreoni and Bernheim, 2009).[7][8] Experimental evidence of image-seeking in the presence of an audience can be seen in e.g. Andreoni and Petrie (2004), where subjects contribute more in a PG when their contribution and photo are displayed to other group members. Subjects are also found to state a higher willingness to pay for a Fairtrade product when choices

[6]There is a set of studies on the valuation of privacy, which is somewhat related to the present paper. The results in these studies are mixed and demonstrate that there is overall a high level of heterogeneity in privacy valuation (Acquisti and Grossklags, 2005; Beresford et al., 2012; Acquisti et al., 2013; Benndorf and Normann, 2014; Schudy and Utikal, 2015). However, these studies are somewhat peripheral to ours since they investigate general concerns and absolute valuations of privacy, while we are studying changes in privacy valuation when the set of published information is varied, by including selfies and/or cooperative behavior in the lab, which according to theory is sensitive for a subject's social image.

[7]It can also be pointed out that an "increase" in the audience can increase the possibility of reciprocation in a repeated game setting.

[8]Alternatively, the potential presence of an audience may also lead individuals to constrain their behavior. This phenomenon, coined the "chilling effect", has been established not only in online social media interaction (Marwick and Boyd, 2011), but it also extends offline where subjects normalize their behavior anticipating that their actions may be published online (Marder et al., 2016).

are made in public than private (Friedrichsen and Engelmann, 2014; Teyssier et al., 2015). Additionally, making subjects publicly count their PG contribution significantly increases cooperation (Rege and Telle, 2004).[9]

All the above studies are based on comparisons of behavior given that subjects are fully aware of their degree of anonymity prior to making their choices. Such a design makes sense to study the impact of between-subject treatment effects of, e.g., social pressure. However, increasing publicity ex-ante makes it difficult to parse out agents' image concerns from their intrinsic prosociality. In our study, we employ a sequential design where subjects have the possibility to ex-post adjust their degree of anonymity after they have chosen their PG contribution, thus capturing an important aspect of modern social media interactions while making the dissonance between different motivations more prominent. Historically the degree of anonymity has been determined by the physical context a subject is acting in, which has been difficult to affect, whether it is at a populous city square, on an abandoned dirt track, or in a given lab setting. Subjects can thus automatically adjust their behavior in the different contexts according to the reputational concerns and personal gains. In contrast, today people have a relatively large freedom to decide what actions and contexts that they share with others on social media. This possibility gives rise to a more prominent dissonance concerning the action taken and the image the person wants others (and probably also herself) to see, leading to an internal conflict which has been recognized by prominent psychologists (Festinger, 1962; Higgins, 1987) and which the subject tries to resolve in different ways (e.g., by denial, justification and/or change of beliefs). In our experiment, the subject first plays the PG without knowing about the possibility of publishing her contribution, thus minimizing image concern and leaving a "wiggle room" with respect to her social reputation (Dana et al., 2007). We then induce dissonance by surprising the subject with the opportunity to publish information about her behavior.[10] The only way to resolve this dissonance and at the same time maintain her reputation is by choosing to remain anonymous, at the expense of experimental earnings. The sequential design therefore allows for within-subject elicitations of

[9]More explicit identification of group members, for example by asking subjects in the same group to stand up and look at each other, not surprisingly increases cooperative behavior (Frey and Bohnet, 1997; Bohnet and Frey, 1999) by lowering social distance (Hoffman et al., 1996).

[10]The ex-post determination of anonymity is also employed in the design of a tax evasion experiment by Casal and Mittone (2015), however subjects are aware from the start that they will have the possibility to pay to remain anonymous and consequently adjust their behavior accordingly. The authors find that allowing subjects to buy anonymity increases dishonest behavior.

social image valuation: the BDM bid may be regarded as an indicator of the individual subject's unwillingness to openly confess (their PG contribution) under varying degrees of visibility.

To see how the above factors combined form our experimental predictions, it is instructive to use Bénabou and Tirole's (2006) (henceforth BT) simplest model of social signaling.[11] We provide the intuition for our hypotheses here, while theoretical motivations for the predictions can be found in the Appendix. In this model subjects are assumed to choose a level of contribution to a public good to maximize the following utility:

$$U(a, y) = (v_a + v_y y)a - C(a) + R(a, y)$$

where

$$R(a, y) = x\left[\gamma_a E(v_a|a, y) - \gamma_y E(v_y|a, y)\right].$$

Here, v_a and v_y are the subject's intrinsic valuations of contributing to a public good a and of material reward ya respectively, $C(a)$ is the utility cost of contributing to the public good and $R(a, y)$ is the so called reputation function which depends on x, the visibility of the PG contribution. In our PG setting, contributing a attracts a reward of ya in the same currency, and hence $R(a, y)$ can be expressed as an increasing function of a, the contributed amount.[12]

The effect of adding PG contribution to the published information will thus depend on the reputation function, which could either be positive or negative depending on how much the subject contributed, and thus whether she wants to promote or hide it. From the start subjects might have minor reputational concern for having their name and participation information published, all the more so when a selfie is included, due to many factors like social media aversion, if the selfie is one that is deemed attractive by the subject or not, or other general privacy concerns. This means that they may state bids greater than zero even without the contribution information. Those who contributed a lot and want to signal this would decrease their bids when contribution information is included while those who want to hide low contributions would increase their bids when contribution information is included. This means that it is not possible to know the direction of the bids when contribution information is added. However, assuming that

[11] Many of the hypotheses where we refer to BT can also be generated from theories on beliefs about future reciprocation. However, we use BT for its relative simplicity in a static setting and its focus on image effects.

[12] See Appendix for details.

the valuations for publishing name and PG contribution are additive and not too negatively correlated, what we should expect is an increase in the variance from the addition of contribution information, which would point to the presence of a reputational term in the subject's utility function.

Secondly, at the individual level, since people want to appear prosocial and not greedy we expect a negative correlation between the contribution and the bid for publishing contribution information. Additionally, the bids with contribution information minus that without contribution information (denoted by contribution information premium, henceforth CIP), is expected to increase as PG contribution decreases. This can be thought of as the valuation of publishing reputationally sensitive information net of individual privacy concerns.[13] As a consequence, we get the following hypothesis:

Hypothesis 1a. *The variance of bids increases when contribution information is included.*

Hypothesis 1b. *There is a negative correlation between bids for publishing contribution information and PG contributions.*

Hypothesis 1c. *CIP is decreasing with PG contribution.*

2.2 The visibility of information

Our next hypothesis can be considered to be the mirror image of the previous one. We evaluate the impact of adding a selfie given that sensitive information is already publicly available. Note that, if information is published, the subjects are already identifiable since names are always included in all sets of information, however the addition of the selfie increases the visibility of the information by making it easier to identify subjects.

Turning back to the BT model, adding a selfie boils down to increasing the salience or visibility parameter (x) in the reputation function, and the effect will thus

[13]Hypothesis 1c would be identical to Hypothesis 1b in the case where subjects do not display a disutility for publishing name (and selfie). If that is the case, the subject would bid zero for publishing name (and selfie), and her CIP would therefore equal her bid for publishing the same information plus the PG contribution. From an empirical point of view people do value privacy and subjects indeed display a positive reservation price for publishing name (and selfie).

be to amplify the reputational gain or loss depending on the subject's PG contribution. For some subjects who have contributed sufficiently much in the PG with low privacy concerns, their BDM bid would be zero, which is the lowest possible bid in our design.[14] A selfie would not change the zero bid since it would only increase the reputational value of this information. However, since subjects were not aware that the decisions made in the PG could be made public, contribution decisions were made without taking into account reputational concerns and are likely to be lower than if subjects knew these would be public information. We can thus expect that some subjects would prefer to hide this information since it has a reputational cost to them. These subjects would make positive bids, and since the selfie will increase the visibility of their PG contribution, these bids would increase when published with a selfie. Thus, we expect that bids will be higher with a selfie than without.[15] The same mechanism that is expected to push up the average bid will also generate a larger variation in the bids when a selfie is included in the information than if not, assuming that the valuation for publishing name and PG contribution and the valuation for publishing the selfie are additive and not too negatively correlated. Additionally, the increase in bids, that is the difference in valuation between the subject's BDM bid with selfie and the bid without the selfie (which we term the selfie premium) should be higher the lower the PG contribution.

Hypothesis 2a. *A selfie will increase the bid for publishing contribution information.*

Hypothesis 2b. *A selfie will increase the variance of bids.*

Hypothesis 2c. *Selfie premium is decreasing with PG contribution.*

2.3 Other factors

When we test the robustness of our results in regressions we also control for other factors that may affect the BDM bids. Some subjects may have privacy concerns

[14] In theory the subjects might be willing to pay to publish such information (which would imply negative BDM bids), but for practical reasons we excluded negative bids in our experimental design.

[15] If we assume that some subjects are concerned about privacy, and consequently bid positive for contribution information without the selfie even after a high PG contribution, adding a selfie has the same effect as for subjects who have made a low PG contribution: the same privacy concern will lead them to increase the valuation of the information with the selfie.

which affect their use of social media and in turn their willingness to publish information about themselves on the web. We therefore control for factors such as how narcissistic they are (according to the Narcissistic Personality Inventory, Ames et al. (2006)), how often they take selfies, how they rate the attractiveness of their selfies in the experiment and how active they are on various social media platforms. We categorize social media platforms according to whether they are visual (Facebook and Instagram) or text-based (Twitter), since the former is typically used for the sharing of selfies to the public but not the latter. Furthermore, the BDM elicitation method can be difficult to grasp (Cason and Plott, 2014) and lack of understanding may cause noisy behavior and thereby bias elicitations (Andersson et al., 2016). We therefore control for cognitive reflection (Frederick, 2005). A low score might bias BDM bids upward given that the profit-maximizing dominant strategy is to bid zero.

Additionally, we control for the standard demographic variables of age, gender, nationality and major. Aversion to publishing information on the web, and hence BDM bids, are expected to be higher for older students who are less familiar with social media, though given our student sample the majority should have had previous social media experience. While different factors may affect how males and females use social media (Correa et al., 2010), we have no ex-ante prediction regarding how BDM bids are affected by gender, major or nationality.

3 Experiment

We will here describe the general design and then detail the content of the sessions.

3.1 Design

Our experimental design is aimed at investigating valuations for the publication of various potentially sensitive information sets both within and between subjects. We therefore adopt the design strategy as summarized in Table 1. The underlying structure of each session consists of a PG, followed by three BDM rounds: BDM1, BDM2 and BDM3. BDM1 and BDM2 elicit subjects' reservation prices for the publication of various combinations of name, selfie, participation and contribution information as will be explained below. BDM3 elicits subjects' reservation

prices for the publication of BDM1 and the information it contains.[16]

Table 1: Structure of experimental treatments.

T1	T2	T3/Control
Questionnaire	Questionnaire	Questionnaire
Take selfie	Take selfie	
PG	PG	PG
Risk elicitation	Risk elicitation	Risk elicitation
BDM1 for *NS*	BDM1 for *NCS*	BDM1 for *NC*
BDM2 for *NCS*	BDM2 for *NC*	BDM2 for *N*
BDM3 for BDM1 bid	BDM3 for BDM1 bid	BDM3 for BDM1 bid
Post-experiment survey	Post-experiment survey	Post-experiment survey
Earnings announced	Earnings announced	Earnings announced

Notes: The letters in the BDM elicitations refer to which information set is to be published if the bid is accepted. *N* - name of the subject. *C* - contribution in PG. *S* - selfie.

Apart from the contents of BDM1 and BDM2, the treatments differ in whether or not subjects take selfies before the PG and, if they do, when they are then asked to rate their selfies. In Treatment 1 (T1), subjects take a selfie, play the PG, rate the selfie, and then proceed to the BDM stages. In T2, subjects take a selfie, rate it, and then play the PG followed by the BDM stages. The order of PG and selfie rating is varied to control for the effect of having rated the selfies, though no order effect is expected.[17] In the control treatment (T3), subjects play the PG followed by the BDM stages without taking or rating selfies. This design also allows us to obtain a clean treatment effect of selfie-taking by comparing PG contributions in T3 with those from T1 and T2 combined, which is one of our exploratory questions to be discussed in section 5.

In the PG stage, subjects are divided into pairs and given an endowment of 135 SEK (Swedish crowns) each.[18] To avoid an obvious 50-50 sharing norm, each subject can only contribute from the following amounts to a group project with the other member: 0, 15, 30, 45, 60, 75, 90, 105, 120, 135, and keep any remaining amount. The total contribution from both group members is then multiplied by 1.4 and

[16]This is done to check for evidence of more sophisticated reasoning by subjects, which is not found in the data. The analysis is detailed in the Appendix.

[17]Given that subjects take a selfie, PG contribution is not affected by having rated the selfie (Wilcoxon-Mann-Whitney (WMW) test p=0.75, n=163), nor by the rating itself (Pearson correlation coefficient 0.03, p=0.70).

[18]135 SEK is roughly equivalent to 15 USD at the time of the experiment.

split evenly. The PG is followed by a risk elicitation task (Gneezy and Potters, 1997), where subjects are given the same endowment of 135 SEK and can invest from the above amounts in a risky project which pays three times the amount invested or zero, each with a probability of 0.5. This is done to control for risk attitude and its effect on PG contribution.

The information published, for which bids are elicited in BDM1 and BDM2, can be classified into four types: *N – Name, NC – Name and Contribution in PG, NS – Name and Selfie, and NCS – Name, Contribution in PG and Selfie.* In *N*, subjects are asked to state the minimum price they have to be paid for their name and participation information to be published on our researcher's webpage. Specifically, the webpage would display the following sentence: "[Subject's full name] took part in an experiment on decision-making." In *NC*, the published sentence states: "[Subject's full name] took part in an experiment on decision-making. He/She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. [Subject's full name] decided to contribute [subject's PG contribution] to this group project." *NS* and *NCS* are identical to *N* and *NC* respectively, the only difference being that the selfie taken earlier is included with the corresponding published sentence.[19] In the control treatment, subjects bid first for *NC* followed by *N*, thus yielding the (within-subject) CIP without selfie. CIP with selfie is obtained in T1, where subjects first bid for *NS* and then *NCS*. In T2, subjects bid for *NCS* followed by *NC*, thus yielding the selfie premium. The order of bids in the control is reversed in T1 to allow for between-subject comparison with T2.

Finally, we summarize how we plan to conduct hypotheses tests using the experimental design in Table 2. It should be noted that some of the between-subject comparisons of the BDM elicitations can be affected by the previous tasks. For instance in Hypothesis 1, comparing BDM1 in T1 vs T2 is relatively unproblematic since the subjects have been exposed to the same tasks before they do BDM1, but this is not true for the comparison of BDM1 in T3 vs T2 since T2 subjects have taken a selfie, which is not the case for T3 subjects. To provide additional evidence we therefore also (whenever it is possible) provide within-subject tests. In these tests all subjects have been exposed to the same "history" of tasks, but it can never be excluded that the effects are due to this specific history or that the

[19] In the Appendix we provide examples of information that was published on the researcher's webpage.

order of the elicitations may matter. However, when both between-subject and within-subject comparisons point in the same direction and are significant, we can be rather confident that there is a treatment effect. This will also be tested using Fisher's method, as will be detailed further below.

Table 2: Summary of hypotheses tests in experimental design.

Hypothesis	Between-subject Comparison	Within-subject Comparison
1. Contribution information	BDM1 in T1 vs T2 BDM2 in T3 vs T2	BDM1 vs BDM2 in T1 BDM2 vs BDM1 in T3 Correlations
2. Visibility (impact of selfie)	BDM1 in T3 vs T2 BDM2 in T2 vs T1	BDM2 vs BDM1 in T2 Correlation

3.2 Sessions

The experiment was conducted in a computer room at the Lund University School of Economics and Management (LUSEM) during the period 3-12 November 2015 and programmed using z-Tree (Fischbacher, 2007). Participants were recruited through e-mail from the pool of students taking courses at LUSEM and using posters displayed throughout the school. In total we ran 14 sessions with 233 subjects.[20] Each session lasted approximately 75 minutes and subjects earned 50 SEK in show-up fee. Additionally, subjects earned on average 235 SEK in experimental earnings. The total hourly experimental pay was 228 SEK, which is more than this group would earn on a regular job in Sweden.

Upon arriving at the lab, subjects are randomly assigned to seats and asked to put their phone on silent and flight mode, face down on the side of the table. Instructions are read and subjects then complete a brief demographic survey followed by the Rosenberg (1965) self-esteem questionnaire.[21]

In T1 and T2, subjects are next asked to take a selfie using the camera on their mobile phone and ensure the image is saved. The only requirement for the selfie is that it contains the subject's face but no part of any other individual. The subjects

[20]One subject had difficulty understanding the instructions and was not used to taking a selfie. We have therefore excluded this observation from the data.

[21]Instructions can be found in the Appendix.

who did not have a camera phone were allowed to borrow the experimenter's phone to take the selfie.[22] In T2, this is followed by the rating stage: subjects are asked to rate how attractive their selfies are and how they expect others to rate them, both on a scale from 1 to 7. In T1, the rating stage comes after the PG stage.

At the start of each of the BDM stages, subjects are informed that they have the opportunity to sell the right to publish some information about themselves, and what information would be displayed should they choose to sell this right. The information would be published on our researcher's webpage for a period of two months, starting three weeks after the experiment concludes. Subjects are told that the webpage was historically viewed by approximately 40 people per month, but that there is no guarantee that this number would stay the same after their information is published.[23] They are also informed that this information may be used for future research purposes and appear in research papers or presentations about this experiment, but apart from these the information will be used for no other purpose.

The subjects are asked to name the minimum price, between 0 and 201 SEK, at which they are willing to sell the right to publish their information. The actual price is determined individually by a random draw of the computer which can take any value between 0 and 200. If the randomly drawn price is less than the bid, no information is published and no money is earned in this stage. If the randomly drawn price is greater than or equal to the bid, the right to publish the information is sold and subjects are paid the amount as determined by the random draw. They are asked to show a photo ID at the end of the experiment, and if the selfie is sold, to e-mail the selfie to the experimenter. Contribution information and BDM1 prices, if sold, are displayed on the last screen on the subject's computer to be copied by the experimenter.

Throughout the BDM stages we emphasize that subjects have no obligation to sell the right to publish their information, and they are given instructions on how to ensure their information is never published.[24]

[22]Of the 163 students in T1 and T2, 10 did not have a camera phone.

[23]This particular outlet was chosen to fix beliefs and to retain control over the publication process. It can be noted that this publication means relatively "low exposure". Consequently, the different treatment effects on bids are probably underestimated compared to other standard modes of publication, e.g. on a Facebook profile page.

[24]Subjects are informed that if they are unwilling to have any information published they should bid 201.

To familiarize subjects with the BDM procedure, we include an example in the instructions read aloud at the start of the stage and show that it is optimal for them to state their true valuation. It was also pointed out that if they do not mind that their information is published, they will maximize their pay-off by bidding 0. Prior to the actual BDM elicitation, subjects complete two questions and are given feedback on their answers to ensure they understand how the transaction works. This is followed by a simulation round where they can practice selling their information in a hypothetical transaction. While the BDM procedure is a popular method for eliciting valuation in an incentive compatible way, it has come under criticism for subjects' failure in recognizing the relevant game form (Cason and Plott, 2014). The extensive explanation of the procedure given in the instructions, the practice questions and simulation round are aimed at addressing this criticism. Moreover, as also pointed out in Friedrichsen and Engelmann (2014), any monotonic bias in the true valuation will not affect our analysis of BDM premia or comparison across treatments or groups.

After the last BDM stage, subjects complete a second questionnaire containing a brief cognitive reflection test, social media and prosocial habits, the Big 5 Inventory, the Narcissistic Personality Inventory (NPI) (Ames et al., 2006) and control questions about if they had learned from someone about the content of the experiment.[25] Finally, total earnings are displayed. For each session, two stages are randomly chosen for payment and implementation: the first paid stage is chosen out of the PG and the following risk elicitation task, and the second paid stage is chosen out of the three BDM stages.

4 Results

Of the 233 total participants, 65% are male and 66% Swedish. 50% are majoring in Economics, and the average age is 24. Summary statistics of the key variables elicited in the experiment are presented in Table 3.

Our results section is structured as follows. We start with the valuation of socially sensitive information about PG contributions (H1) and then move on to the impact of visibility through the selfie (H2). We conduct two-sided non-parametric

[25]Only 2 subjects claimed to have had some knowledge about the experiment before participating in the experiment (other than the information stated in the recruitment e-mail). The behavior of these subjects did not differ in any notable way from the other subjects.

Table 3: Summary statistics.

	N	Mean	SD	Min	Max
Treatment 1					
PG contribution	77	44.22	45.06	0	135
Risky investment	77	76.56	39.58	0	135
BDM1 for *NS*	77	58.95	69.62	0	201
BDM2 for *NCS*	77	68.43	76.12	0	201
Treatment 2					
PG contribution	86	43.43	46.76	0	135
Risky investment	86	78.14	39.33	0	135
BDM1 for *NCS*	86	64.63	72.19	0	201
BDM2 for *NC*	86	38.63	59.45	0	201
Treatment 3					
PG contribution	70	51.00	49.68	0	135
Risky investment	70	83.57	42.08	0	135
BDM1 for *NC*	70	46.91	67.69	0	201
BDM2 for *N*	70	22.69	51.73	0	201

tests for significant difference within and between subjects as described in Table 2. We also conduct regression analyses to check the robustness of our results. While we expect our results to go in the direction predicted by the hypotheses above, given that we run multiple tests for some hypotheses we cannot characterize our results in a simple binary way. For hypotheses with a single test, whenever our result is in the expected direction with at least 5% significance, we can conclude that the hypothesis is confirmed. It is weakly confirmed if the result is significant at the 10% level. For hypotheses with multiple tests (H1a, H1b, H2a, H2b), we combine the p-values using Fisher's method. Given that we cannot exclude dependence in our sample, the combined p-values should thus be interpreted with care.[26] As a pre-caution we adopt stricter significance thresholds: we consider the hypothesis confirmed if the combined p-value is less than 1%, and weakly confirmed if the combined p-value is less than 5%. A summary of test results is presented in Table 4.

[26]While there are corrections that address the dependence in samples, such as Brown's method or Kost's method, these rely on knowing the form of the covariance matrix of the underlying test statistics (Brown, 1975; Kost and McDermott, 2002).

Table 4: Summary of test results.

Hypothesis	Between-subject Comparison	Within-subject Comparison	Fisher's Method	Conclusion
H1a	+(+) (T1 vs T2) +(+)** (T3 vs T2)	+(+) (T1) +(+)*** (T3)	***	C
H1b		-(-) (correl, *NC*) -(-)** (correl, *NCS*)	**	W
H1c		-(-)* (correl)		W
H2a	+(+)* (T3 vs T2) +(+)** (T2 vs T1)	+(+)**	***	C
H2b	+(+) (T3 vs T2) +(+)*** (T2 vs T1)	+(+)***	***	C
H2c		-(-)** (correl)		C

Notes: +/- indicates direction of two-sided test result or correlation, expected direction in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. "C" indicates the hypothesis is confirmed and "W" weakly confirmed.

4.1 Social-signaling through PG contribution

As seen in Table 3 above, the standard deviation of BDM bids in T1 is higher for *NCS* (76) than for *NS* (70). Similarly, in T3, standard deviation for BDM bids is higher for *NC* (68) than *N* (52). The higher variance points to the presence of reputational concerns in the subject's utility function when contribution information is published alongside her name. As summarized in Table 4, however, the difference is only significant in a Levene test in T3 (p=0.00) and not in T1 (p=0.14). When we turn to between-subject tests, we obtain similar results. The difference in BDM1 standard deviation, which corresponds to *NCS* in T2 (72) and *NS* in T1 (70), is not statistically significant (p=0.25). The difference in BDM2 standard deviation, which corresponds to *NC* in T2 (59) and *N* in T3 (52), is statistically significant (p=0.05). Despite the fact that the differences are not consistently significant, in particular only without a selfie, an application of Fisher's method yields a combined p-value of 0.001, overall confirming Hypothesis 1a regarding increased heterogeneity of bids with contribution information.

The data also provides support for Hypothesis 1b in that higher PG contributions

are associated with lower bids for the publication of contribution information, significantly so when a selfie accompanies it. The Pearson coefficients of correlation between the variables are -0.17 for *NCS* (p=0.03, n=163) and -0.09 for *NC* (p=0.25, n=156). The combined p-value under Fisher's method is 0.041, weakly confirming Hypothesis 1b. We also run linear regressions with control variables which may be expected to influence the subject's valuation for the right to publish her name and selfie.[27] As columns (1-2) of Table 5 show, an increase in PG contribution does result in a higher willingness to publish that information as indicated by the negative effect on bid, though it is only significant when a selfie is included.[28] It is also worth noting that subjects who actively use Facebook and Instagram, which are visual-based social media platforms often used for sharing photos, have a higher willingness to publish their information on the web, while frequent users of Twitter, which is text-based, show a lower willingness to publish the same information. Swedish subjects also appear to be more willing to publish their selfies with contribution information than non-Swedish subjects. The subjects' rating of their own selfies surprisingly does not have a significant effect on bids.[29] Consistent with our expectation, low cognitive ability biases bids upwards.

[27]All post regression estimates of Variance Inflation Factors (VIF) do not exceed 1.26, which is less than the rule of thumb threshold value of 10 thus showing no evidence of multicollinearity (Chatterjee and Hadi, 2015).

[28]The negative effect of PG contribution on the bid is robust to tobit specification (see Appendix).

[29]Ratings from objective strangers, for the subset of 47 selfies that are sold to the experimenter, are not more strongly correlated to *NCS* bids. This elicitation is described in the Appendix.

Table 5: OLS regressions of *NC* and *NCS* bids and CIP.

	(1) *NC* T2+T3	(2) *NCS* T1+T2	(3) CIP T1+T3
PG contribution	-0.13	-0.29**	-0.24**
	(0.11)	(0.12)	(0.11)
T1			-24.29**
			(10.72)
PG contribution * T1			0.18
			(0.16)
T2	-5.35	1.90	
	(10.45)	(11.39)	
NPI	8.33	-14.31	-0.68
	(26.72)	(30.99)	(21.54)
Visual SM	-8.04*	-14.12***	-0.65
	(4.31)	(5.06)	(3.40)
Text SM	4.70	20.27***	4.18
	(7.30)	(7.52)	(5.88)
Selfie frequency	-6.38	-4.35	-0.86
	(5.29)	(5.56)	(3.50)
Rating		-4.35	
		(4.44)	
CRT	-10.64**	-15.12**	-2.24
	(5.37)	(5.88)	(3.54)
Age	0.15	0.05	-0.66
	(1.27)	(1.40)	(1.29)
Male	-18.19	-2.67	-9.18
	(11.57)	(12.92)	(8.41)
Swedish	-12.28	-24.78**	-3.27
	(11.20)	(11.65)	(8.23)
Econ	8.36	4.08	-7.41
	(10.31)	(11.38)	(7.66)
Constant	129.51***	192.52***	67.18
	(45.93)	(53.68)	(41.56)
Observations	156	163	147
Adjusted R-squared	0.03	0.13	0.01

Notes: "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is "very unattractive" and 7 is "very attractive". "CRT" is the number of correct responses to three Cognitive Reflection Test questions. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

As predicted in Hypothesis 1c, CIP also decreases when PG contribution increases. The Pearson correlation coefficient is -0.15 (p=0.08, n=147), and this negative correlation is also confirmed by the linear regression in column (3) of Table 5. A 1 SEK increase in PG contribution reduces the CIP by around 0.24 SEK. It is worth noting that when the subject has taken a selfie and that selfie is published along with the PG contribution, the CIP is also lower by approximately 24 SEK, ceteris paribus. This point will be explored further in section 5. Overall, our results provide partial support for Hypothesis 1: the bid premium resulting from publishing contribution information, and the bid itself (with a selfie), are negatively correlated with PG contribution, while the variance of bids increases with the addition of contribution information.

4.2 Increased visibility

Table 3 also shows that the treatment effect of publishing a selfie along with name and contribution information is to increase the subject's bid. In T3, the average bid for BDM1 is 47 while adding the selfie in T2 raises it to 65 (WMW test p=0.06, n=156). Similarly, in T2 the average bid for BDM2 is 39, while the corresponding average bid with the selfie in T1 is 68 (p=0.01, n=163). This difference is also seen within T2, where removing the selfie in BDM2 lowers the average bid from 65 to 39 (p=0.02). As summarized in Table 4, overall the results confirm Hypothesis 2a concerning the negative effect of increased visibility on subjects' willingness to publish their contribution information, with a combined p-value of 0.001. This is also evident in the linear regressions shown in Table 6. In columns (1-2), the coefficients of "Selfie included" indicate that adding a selfie raises the bid by approximately 20 SEK.[30] We note again that active users of Facebook and Instagram, visual-based social media platforms, are more willing to publish their information while the opposite is the case for Twitter. Swedish subjects also have a marginally higher willingness to publish their information. Low cognitive ability is again associated with an upward bias in bids.

[30]The positive effect of selfie publication on the bid is robust to tobit specification (see Appendix).

Table 6: OLS regression results.

	(1) BDM1 T2+T3	(2) BDM2 T1+T2	(3) Selfie premium T2
PG contribution	-0.29**	-0.13	-0.28**
	(0.12)	(0.12)	(0.14)
Selfie included	19.98*	24.36**	
	(11.30)	(10.80)	
NPI	-18.91	8.29	-34.46
	(28.89)	(29.37)	(33.52)
Visual SM	-12.51***	-9.77**	-5.88
	(4.66)	(4.80)	(5.51)
Text SM	12.43	12.86*	10.77
	(7.90)	(7.13)	(8.25)
Selfie frequency	-6.39	-4.24	-1.58
	(5.72)	(5.27)	(7.23)
Rating		-1.68	-3.51
		(4.21)	(5.16)
CRT	-10.35*	-14.50**	-0.61
	(5.80)	(5.57)	(7.32)
Age	-0.61	0.76	-0.65
	(1.37)	(1.33)	(1.37)
Male	-13.98	-6.02	5.20
	(12.51)	(12.24)	(15.14)
Swedish	-18.01	-20.38*	-5.65
	(12.11)	(11.03)	(13.11)
Econ	9.84	3.65	5.74
	(11.14)	(10.78)	(12.74)
Constant	174.33***	113.17**	95.68
	(49.66)	(52.73)	(58.30)
Observations	156	163	86
Adjusted R-squared	0.09	0.11	0.03

Notes: "Selfie included" is a dummy variable equal to 1 for bids for *NS* or *NCS*, or 0 for bids for *N* or *NC*. In column (1), a "Selfie included" value of 1(0) corresponds to being in T2(T3). In column (2), a value of 1(0) corresponds to T1(T2). "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is "very unattractive" and 7 is "very attractive". "CRT" is the number of correct responses to three Cognitive Reflection Test questions. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

We should also according to Hypothesis 2b expect a higher variance when a selfie is added to the publication of contribution information, and as Table 3 shows this is again the case. The standard deviation of BDM1 for *NC* in T3 is 68, which increases to 72 for *NCS* in T2, though a Levene test shows that this difference is not significant (p=0.15). For BDM2, the standard deviation for *NC* in T2 is 59 which increases to 76 for *NCS* when a selfie is included in T1. This difference is significant (p=0.00). Similarly, within T2 removing the selfie decreases the standard deviation from 72 in BDM1 to 59 in BDM2 (p=0.00). Applying Fisher's method yields a highly significant combined p-value (0.000). The higher variance when a selfie is added points to the stronger signaling motive for subjects, causing those who would like to prevent the publication of their information to bid higher while those who are not concerned bid lower. Given that the lower bound for bids is zero, the effect is stronger for the former group of subjects, which naturally translates to a higher average bid as discussed in the previous paragraph.

Looking next at the selfie premium we find results that confirm Hypothesis 2c. In T2, as PG contribution increases, subjects attach lower premium to increased visibility. The Pearson correlation coefficient is -0.25 (p=0.02, n=86). This negative relationship is also supported by linear regression results in column (3) of Table 6: the coefficient for PG contribution is negative and significant at the 5% level. Overall, our results confirm that publishing a selfie increases bids and this increase is driven by low PG contribution.

5 Exploratory Questions

In this section we will explore further some of the mechanisms behind the subjects' valuations of their signals. More specifically, we are interested in how subjects' social image concern is affected by the inclusion of a selfie in the signal. Furthermore, we will explore whether taking a selfie affects subjects' inclination to cooperate. In contrast to our previous analysis, here we will mainly motivate our questions by previous empirical research and not by a theoretical model.

5.1 Crowding-out of social image concerns

When we compare the CIP demanded by subjects in T1 (with a selfie) and in T3 (without a selfie), one prediction would be that the PG contribution information

would have a larger effect on subjects' willingness to publish when it is also more visible with the selfie. However, if subjects already demand a high price for publishing their name and selfie, for example if they are concerned about their physical appearance, the addition of PG contribution may not lead to a substantial increase in bids.

Indeed, and analogous to the Narcissus myth, concerns for physical appearance have been found to dominate other concerns, as they reflect a narcissistic personality trait (Davis et al., 2001; Vazire et al., 2008).[31] This means that at the moment subjects make their bids for publishing PG contribution, having their selfies also published may accentuate concerns about physical appearance which can push aside potential reputational concerns arising from the information about previous contribution in the PG. CIP with a selfie would thus be less than that without the selfie. If such crowding-out effect is strong enough one should also expect that the variance of the CIP with a selfie will be lower than the variance without a selfie, as subjects become less concerned about hiding or publishing their contribution resulting in lower heterogeneity in CIP.[32]

Results on crowding-out

From our results, we find that the average CIP in T1 with the selfie is 9.48, which is lower than 24.23 in T3 without the selfie. This difference is marginally significant (WMW test p=0.06, n=147) and thus consistent with the crowding-out explanation. When we consider the variance, a stronger result in the expected direction is obtained: the standard deviation of CIP with the selfie is 36, compared to 51 without the selfie. A Levene test shows that this difference is also significant (p=0.00). When contribution information is published along with a selfie, subjects become less concerned about hiding or publicizing their contribution and consequently there is less heterogeneity in CIP. These results are also confirmed in the OLS regression of CIP in column (3) of Table 5, where the treatment effect

[31] Insofar as one believes that mythology provides insights to our psyche, it can be noted that Narcissus fell in love with his own image to the extent that he committed suicide. His obsession with his own image entirely crowded out other concerns.

[32] $\mathrm{Var}[X+Y] < \mathrm{Var}[X]$ as long as $2\,\mathrm{Cov}[X,Y]+\mathrm{Var}[Y] < 0$, that is, $\mathrm{Cov}[X,Y] < 0$ and its absolute value is sufficiently high. In our setting, X and Y represent the CIP and the valuation of the selfie respectively. The above condition is therefore satisfied given a strong crowding-out effect, as a higher concern for physical appearance is associated with a lower concern for social image, as measured by the CIP demanded.

of including a selfie in T1 is a significant decrease of the CIP by 24 SEK, thus indicating that social image concerns are crowded out by concerns about physical appearance.[33]

More generally, adding contribution information does not change bids when a selfie is included. BDM1 and BDM2 are not significantly different in T1 (59 vs 68, p=0.60). In T3, however, average bid for *NC* with contribution information is 47, which is higher than that for *N* at 23 (p=0.04). Another evidence of the crowding-out effect is found in the correlation of CIP with PG contribution. In T1, this value is -0.05 (p=0.66), which is insignificant. In T3 when the selfie is removed, the correlation is much stronger and significant at -0.24 (p=0.046). Hence PG contribution affects CIP only without the selfie. Taken together with the evidence for Hypotheses 1a and 1c, that the standard deviations of bids with and without contribution information are only statistically different without a selfie and that the CIP is lower when a selfie is included, this provides further evidence that the inclusion of the selfie dampens the CIP.

One might argue that the effect of selfie on CIP is merely due to the order effect: in T1 PG contribution information is added in BDM2, while in T3 it is removed. While T2 does not provide within-subject data on CIP to confirm or disconfirm any order effect, it does provide a way to show that the more general result in the previous paragraph holds: that while adding contribution information increases bids, this increase is lower and the significance disappears when the published information is accompanied by a selfie. We do this by comparing the BDM bids between treatments, with and without selfies. Average BDM1 in T1 for *NS* is 59, but adding PG contribution information in T2 only results in a slight increase to 65 for *NCS* (p=0.86, n=163). The average BDM2 in T3 for *N* is 23 and adding contribution information in T2 raises the average BDM2 bid to 39 for *NC*. The difference is significant (p=0.02, n=156). Overall, while we cannot completely discount order effect, we have provided further evidence why such an effect unlikely explains our crowding-out result.

5.2 Selfie-taking and cooperation

The impact of taking a selfie on cooperation is not obvious a priori. Research based on priming, self-signaling and behavioral addiction suggests opposing mechanisms

[33]The results are robust to excluding bids at the maximum value (see Appendix).

that may be triggered by the taking of a selfie.

Evidence suggests that subtle observation cues, in particular a picture of "watching eyes", trigger people to instinctively take reputation into account when making choices, resulting in increased prosociality (Haley and Fessler, 2005; Bateson et al., 2006; Ernest-Jones et al., 2011; Ekström, 2012). One can thus expect that in a selfie, when the subject is directly facing an image of herself for a brief moment, she may also react to the eye cues in a similar way.

Taking a selfie is also a way to capture an image of oneself at the present moment, to be preserved for future viewing either by oneself or to show to others. This can thus serve as a prime for the subject to present the best version of herself, leading to increased prosociality in the immediate future. Related to this, taking a selfie also increases the salience of the present moment. If subjects anticipate that the memory of this moment, and hence the subsequent action immediately following it, would last for longer, self-signaling motive would thus also lead to increased prosociality (Bénabou and Tirole, 2006, p. 1657).[34]

It is important to take into account that selfies are usually taken for the purpose of sharing by uploading to a social media website, where the emphasis on self-presentation may drive individuals to focus on their physical appearance. Consequently, selfie-taking has been associated with narcissistic personality traits and a self-centered mindset (Sorokowski et al., 2015; Weiser, 2015; Fox and Rooney, 2015) which can trigger behavior that seeks benefits for the self at a cost to others (Campbell et al., 2005). This concern about self-presentation and physical appearance may well crowd out other concerns, including concern for others, as described in the previous section. Altogether, these findings suggest that taking a selfie has no obvious effect on PG contribution.

On the other hand, frequent selfie-taking can also be considered to be a type of behavioral addiction. According to Grant et al. (2010), "addicts" can be characterized by their sensation-seeking behavior, to the extent that they succumb to

[34]van der Weele and von Siemens (2014) provide a direct test of this by asking subjects to wear a bracelet as a reminder of their donation in the experiment. No self-signaling effect is found in this setting. Other evidence of self-signaling is seen in situations where individuals avoid full information, under which their actions would unambiguously signal their type. See, e.g., Dana et al. (2006), Dana et al. (2007) and Grossman and van der Weele (2016). In Tonin and Vlassopoulos (2013), subjects opt out from a positive donation, indicating that the decision to give was motivated by self-signaling – which, once satiated, allows the individual to reverse her decision.

the temptation to perform acts that are harmful to themselves or others.[35] Several behavioral addictions have been shown to share the same emotional and neural processes as substance abuse (ibid.).[36] Given this, it is likely that addicted people are more triggered by a stimulus related to the addiction than non-addicted people and also that this stimulus crowds out other concerns more in the former group. Hence, by the same logic as seeing a slot machine makes a compulsive gambler less concerned about other things than the immediate gratification from placing a gamble, in the case of selfie-taking, asking addicts to take a selfie in the experiment can serve as a stimulant that triggers self-interest, crowding out other social or reputational concerns.

The addiction mechanism above suggests that for frequent selfie-takers, the self-centric aspect of selfie-taking (Weiser, 2015; Fox and Rooney, 2015) will be magnified while other aspects will become routine and have smaller effects. They will arguably become desensitized to the self-image motive arising from subtle eye cues or the prime to present the best version of themselves. Consequently, addicts who are exposed to the selfie treatment are expected to display less cooperative behavior in the subsequent PG compared to addicts who do not experience the stimulus.

Results on selfie-taking and cooperation

We present the average PG contribution across treatment groups, for various frequencies of selfie-taking, in Table 7. The mean contribution for the whole group (i.e., Treatments 1 and 2) who took a selfie before the PG was 44 and it was 51 for the group (T3) who did not, which may suggest that taking a selfie has a negative impact on cooperation. There is however no statistically significant difference between the two samples in a WMW test ($p=0.32$, $n=233$), which means that we cannot reject that the positive and negative effects of selfie-taking roughly counteract each other. When we look at the frequent selfie producers who we hypo-

[35]We refer again to the mythological example of Narcissus. A long list of reported injuries and even deaths in connection with selfie-taking especially among young people breathe life into this old myth (for a list and media sources see `http://en.wikipedia.org/wiki/List_of_selfie-related_injuries_and_deaths`, accessed 21-April-2016).

[36]In the last version of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013) accepted by the American Psychiatric Association, compulsive gambling received official status as a behavioral addiction disorder with a specific diagnosis code, while several other compulsive behaviors received a more general diagnosis ("Behavioral Addiction, Not Otherwise Specified").

thesize to be affected by taking a selfie, we do in fact find substantial differences.[37] Among the subjects who take a selfie at least once a week the corresponding means are 32 and 62, respectively. This difference is statistically significant (p=0.01, n=55), which supports the behavioral addiction mechanism. Similarly, in the group who take selfies at least monthly, taking a selfie in the experiment is followed by a lower mean PG contribution of 34 compared to 53 without the selfie (p=0.02, n=108). Note the surprisingly large effects among the weekly and monthly selfie-takers, taking a selfie reduces PG contributions by 48% and 37% respectively. Moreover, this result likely underestimates the future effect of selfie-taking in the population, given the popularity of selfies among the younger generation who take selfies more often than our sample group.[38]

Table 7: Average PG contribution across treatment groups.

	Selfie	No selfie
All	43.80 (163)	51.00 (70)
Take selfies at least weekly	31.92 (39)	61.88 (16)
Take selfies at least monthly	33.65 (78)	53.00 (30)

Notes: "Selfie" refers to T1 and T2, "No selfie" refers to T3. Number of observations in parentheses.

To investigate if these results are robust if we take into account potential confounds, we run linear regressions where we have included several control variables, which include demographic variables as well as the amount invested in the risk elicitation task as a control for risk attitude.[39] In the unrestricted sample (column 1 of Table 8), taking a selfie has no significant effect. However, for those who take selfies at least once a week (column 2) or even once a month (column 3), taking a

[37]The proportions of frequent selfie-takers in the selfie-taking group (T1 and T2) and the control group (T3) are not significantly different. Weekly selfie-takers make up 24% of the treatment group and 23% of the control group (χ^2-test, p=0.86), while monthly selfie-takers make up 48% of the treatment group and 43% of the control group (p=0.48).

[38]In our sample where age ranges from 19 to 51, the proportion of subjects who take selfies at least once a month is 46%. According to Ofcom (2015), the proportion of monthly selfie-takers increases as we look at younger generations: 9% for age group 45-54, 24% for 35-44, 33% for 25-34 and 55% for 16-24.

[39]The results are robust to ordered logit specification (see Appendix).

selfie significantly reduces PG contributions.[40][41]

Table 8: OLS regressions of PG contribution.

	(1) PG contribution	(2) PG contribution	(3) PG contribution
Take selfie	-6.25	-34.99**	-18.22**
	(6.63)	(13.62)	(8.82)
Risk investment	0.33***	0.24*	0.29**
	(0.08)	(0.14)	(0.11)
Age	1.20	0.17	-0.35
	(0.78)	(2.29)	(1.51)
Male	-11.14*	2.47	-5.87
	(6.70)	(12.13)	(8.53)
Swedish	-11.42*	6.76	-11.22
	(6.49)	(12.69)	(8.43)
Econ	-3.11	-3.45	2.66
	(6.11)	(11.55)	(7.85)
Constant	11.54	38.70	47.22
	(21.61)	(54.13)	(37.30)
Observations	233	55	108
Adjusted R-squared	0.07	0.07	0.06

Notes: Column (1): the whole sample, column (2): subjects who take selfies at least weekly, and column (3): subjects who take selfies at least monthly. "Take selfie" is a dummy variable equal to 1 for subjects in T1 or T2. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

6 Concluding Remarks

In this paper we design a framed field experiment to study if recent economic theory can predict social-signaling behavior in the new environment offered by

[40]Comparing frequent selfie-takers and the remaining population along other characteristics, they tend to be younger, have higher self-esteem, more active on social media and rate their selfies higher. Age is already controlled for. However controlling for any of the other variables does not change the qualitative effect of selfie-taking on cooperation. Results are provided in the Appendix.

[41]We are primarily interested in whether taking a selfie lowers PG contribution for frequent selfie-takers, which is why we have performed regressions on subsamples. A regression with interaction terms instead tests if the effect of taking a selfie differs between frequent and non-frequent selfie-takers.

social media. Our design is novel in that it combines field aspects such as the large freedom individuals have to choose what to share in social media in retrospect (that is, after they have taken certain actions) and real publication of information about subjects on the internet with incentivized decisions under laboratory control. Previous studies on e.g. audience effects are based on between-subject treatment comparisons of behavior under varying degrees of anonymity, which are determined exogenously for subjects before actions are taken. In our sequential design, subjects play the PG, and are then surprised with multiple rounds of BDM elicitations to ex-post reveal their willingness to publish their name with various sets of information about their PG contribution or selfie. We believe that this difference is important not only because the sequential design more closely captures modern social media interaction, but also because it is more likely to create dissonance within the subjects, which is expected to affect the subjects' valuation of the information they share with others.

In the experiment we manipulate the information subjects can share concerning socially sensitive acts (PG contributions) and visibility (the selfie), which according to theory are crucial ingredients for creating social image. We find that the price demanded by subjects for "confessing" their PG contribution increases the more they free-ride. Although the direction of this effect is consistent with predictions, the effect is (somewhat surprisingly) not consistently statistically significant. The results concerning the hypothesized effect of increased visibility are statistically strong and consistent with theory in all parts. Thus, increased visibility through the publication of the selfie also makes subjects less willing to publish their information, as indicated by higher BDM bids. Furthermore, the premium a subject demands for publishing her selfie is negatively correlated with the subject's degree of cooperation. We are also able to confirm less obvious theoretical predictions about increases in the variance of valuations due to the addition of socially sensitive information (i.e., PG contributions) or increased visibility (i.e., the selfie) pointing to the heterogeneous strength of reputational concerns among subjects. The overall conclusion from these results is that theory about social image concerns can indeed guide our understanding of how subjects value the information they signal in an environment designed to reflect social media interaction. Furthermore, our study is the first to establish the extent of the chilling effect in the lab and these findings provide new empirical evidence that people are prepared to take costly actions to "filter" sensitive behavioral information about themselves (in retrospect) before it is published on the web. One obvious implication of this is that the virtual "reality" we get about other people is most likely skewed in a

"softened" direction.

In light of recent technological developments which have made tracking and information dissemination increasingly cheap, the conformity arising from the desire to maintain social image may potentially have further consequences. Aggregate behavior becomes less informative about individuals' true preferences, which creates a problem for information aggregation (Jann and Schottmüller, 2016) and motivating new research into the optimal level of privacy in a fast-changing society (Ali and Bénabou, 2016).

We also explore some interesting empirically open questions where theory does not provide any clear predictions. One finding is that concerns about physical appearance (as reflected by the selfie) appear to crowd out reputational concerns for cooperative behavior, as evidenced by the lower average premium and lower variance of the premium for PG contribution information when published with a selfie. This indicates that in people's minds different dimensions of their social image compete which determine how concerned they are that certain pieces of information reach others. An interpretation of this finding is that our thinking about how we look may make us less concerned about how we behave. This may have implications for contexts in which socially sensitive actions are linked to visible physical appearance. For example, a charity may try to increase donation by publishing the name and photo of a donor in their newsletter. However, this may result in the donor being more concerned about her physical appearance than the donation itself. If this effect is large enough, the addition of the photo may cancel out any increase in donation that adding only name can bring.

Our second exploratory question concerns the effect of selfie-taking on cooperative behavior. We find that frequent selfie-taking is an activity which may be not completely harmless. There is a strong negative impact on cooperation for frequent selfie-takers, although not for other subjects. Hence, for the majority this popular activity is merely a modern way of communicating personal visual images that saves text and has no consequence on cooperative behavior. At the same time, for the minority who take selfies often this activity can lead to uncooperativeness. This suggests the possibility of an addiction mechanism affecting frequent selfie-takers but not others. While our result in this respect is surprisingly strong we want to stress the exploratory nature of this question and that this finding needs to be complemented by results from additional studies (possibly using other subject pools and designs) before bold conclusions are drawn. One important issue

for future research is how selfie-taking affects cooperative behavior over time. Our study demonstrates an effect on cooperation approximately 15 minutes after the selfie is taken. Hence, it is possible that the taking of a selfie only has an effect for a short period of time on the "addicted" selfie-takers, and that they are just as cooperative as other people as long as they are not "disturbed" by the selfie activity.

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Appendices

A Theoretical Predictions

A.1 Social-signaling through PG contribution

In the baseline scenario, *N*, we elicit subjects' reservation prices for publishing their name and the fact that they participated in an economic experiment. BDM bids for *N* therefore reflect their disutility of publishing their name and participation information, which could be due to factors such as privacy concerns. Let this bid, and hence disutility, be b_N.

We next add information about their PG contribution to study how subjects' valuation for the publication changes when such socially sensitive information is made public. BDM bids for *NC* thus reflect both the disutility of publishing name and participation information, b_N, but also any disutility in reputational loss arising from the publication of the PG contribution, b_C, which has a non-trivial value according to theory on social reputation as will be explained below. For simplicity, we have assumed these are additive: $b_{NC} = b_N + b_C$.

To compare bids for *N* and *NC*, note that

$$\mathrm{Var}[b_{NC}] = \mathrm{Var}[b_N + b_C] = \mathrm{Var}[b_N] + \mathrm{Var}[b_C] + 2\,\mathrm{Cov}[b_N, b_C] > \mathrm{Var}[b_N]$$

as long as b_N and b_C are not too negatively correlated. We have no reason to expect negative correlation between privacy concern for publishing name and participation and publishing PG contribution, if anything they should be positively correlated. Hence, given that subjects are heterogeneous in their reputational concerns, we have

Hypothesis 1a. *The variance of bids increases when contribution information is included.*

To evaluate b_C, the reputational loss from publishing PG contribution, first recall the BT model where

$$\begin{aligned} U(a, y) &= (v_a + v_y y)a - C(a) + R(a, y) \\ &= (v_a + v_y y)a - \frac{ka^2}{2} + x\left[\gamma_a E(v_a|a, y) - \gamma_y E(v_y|a, y)\right]. \end{aligned}$$

Here, v_a and v_y are the subject's intrinsic valuations of contributing to a public good a and of material reward ya respectively, $C(a)$ is the utility cost of contributing to the public good and $R(a, y)$ is the so-called reputation function.[42] Additionally,

$$E(v_a|a, y) = \bar{v}_a + \rho(y)[ka - \bar{v}_a - \bar{v}_y y - \bar{r}(a, y)]$$
$$E(v_y|a, y) = \bar{v}_y + \chi(y)[ka - \bar{v}_a - \bar{v}_y y - \bar{r}(a, y)]$$
$$\rho = \frac{\sigma_a^2 + y\sigma_{ay}}{\sigma_a^2 + 2y\sigma_{ay} + y^2\sigma_y^2}$$
$$y\chi = 1 - \rho.$$

In the experiment, contributing a unit of a corresponds to a monetary decrease of a, which is absorbed by the cost term, and an income of $0.7a$ from the group project so that $y = 0.7$. Our setting is identical to the case of sponsor matching (see Footnote 10 in BT) where contributors are rewarded in the same (monetary) currency, generating $v_a = v_y$ and $\gamma_y = 0$, such that $\sigma_a^2 = \sigma_y^2$, $\sigma_{ay} = 1$, and hence $\rho > 0$. Additionally, PG contribution is made prior to taking publication into account, so that $\bar{r}(a, y) = 0$ in the above signal extraction problem. Hence R can be written as an increasing function of a:

$$R(a) = \bar{\mu}_a \bar{v}_a + \mu(ka - 1.7\bar{v}_a)$$

where

$$\mu \coloneqq \bar{\mu}_a \rho = x\bar{\gamma}_a \rho = \frac{R_a}{k}.$$

Note that $\mu > 0$ if contribution is visible ($x > 0$), since agents are assumed to care about appearing prosocial ($\bar{\gamma}_a > 0$, fixed across agents). μ thus corresponds to the scaled marginal reputational return for contributing a.

According to Proposition 1 of BT, the optimal contribution for each agent is

$$a^* = \frac{v_a + v_y y}{k} + \mu.$$

Note first that without reputational concern the optimal contribution is

$$\hat{a} = \frac{v_a + v_y y}{k} < a^*.$$

[42] The cost function $C(a)$ is assumed to be convex such that the utility for income, represented as $-C(a)$, is concave. The quadratic functional form is chosen so that the reputation vector $E(\boldsymbol{v}|a)$ is differentiable in a. See Footnotes 10 and 17 in BT.

That is, in the PG subjects contribute less than what they would have if they knew their contribution would be made public.

The utility of the subject of contributing $\hat{a}$ prior to knowing that this contribution would be made public is

$$U(\hat{a})|_{x=0} = (v_a + v_y y)\hat{a} - \frac{k a^2}{2}$$

while after realizing the publication

$$U(\hat{a}) = (v_a + v_y y)\hat{a} - \frac{k\hat{a}^2}{2} + R(\hat{a}) = U(\hat{a})|_{x=0} + R(\hat{a}).$$

b_C, defined to be the reputational loss from making PG contribution public, thus corresponds to the difference between the above utilities, that is $b_C = -R(\hat{a})$. This has a positive variance and can be either positive or negative depending on the chosen PG contribution $\hat{a}$.[43] Those who have contributed sufficiently will find that R is positive and thus decrease their bid, while those who have not contributed a sufficient amount will incur a reputational cost and thus increase their bid. Hence, ex-ante it is not possible to predict the sign of $b_{NC} - b_N$.

Turning to the correlation of bids with PG contribution, note that

$$b_{NC} = b_N + b_C = b_N - R(\hat{a}).$$

Since we do not expect that b_N, the disutility of publishing name and participation, is correlated with PG contribution, therefore it follows that $\frac{db_{NC}}{da} = -R_a = -k\mu < 0$ and hence the following prediction:

Hypothesis 1b. *There is a negative correlation between bids for publishing contribution information and PG contributions.*

Finally, we exclude individual privacy concern to arrive at the $CIP = b_{NC} - b_N = b_C = -R(\hat{a})$ and that $\frac{dCIP}{da} = -R_a = -k\mu < 0$, yielding the closely related prediction:

Hypothesis 1c. *CIP is decreasing with PG contribution.*

The corresponding analysis can be made when studying the change in bids going from *NS* to *NCS*.

[43] In particular, there is a unique and common threshold $a_0 = \frac{\bar{v}_a(1.7\rho - 1)}{\rho k}$, such that $R(a_0) = 0$, beyond which making contribution public is reputationally enhancing and below which it is reputationally damaging.

A.2 Increased visibility

We can next compare bids in *NC* and *NCS*. Recall that bids in *NC* can be expressed as $b_{NC} = b_N + b_C$, where $b_C = -R(\hat{a})$. Bids in *NCS* can similarly be expressed as $b_{NCS} = b_N + b_S + b_C$, the disutility of publishing name and participation, plus the disutility of publishing the selfie (for example, due to privacy concerns or if subjects are concerned about the attractiveness of the selfie), plus the reputational cost of publishing PG contribution where $b_C = -R'(\hat{a})$, the reputational term evaluated at the higher visibility x'. The addition of the selfie thus results in a selfie premium consisting of b_S, the additional disutility from having a selfie published, plus the extra reputational cost $(-R'(\hat{a}) - (-R(\hat{a})))$. To evaluate the sign of this extra cost, express

$$R(\hat{a}) = x[\bar{\gamma}_a \bar{v}_a + 1.7\bar{\gamma}_a \rho(v_a - \bar{v}_a)]$$

and note that x has the first-order effect of amplifying the reputational gain or loss of making contribution public. Whenever $R(\hat{a}) < 0$, $R_x < 0$: for those who are hurt by the publication of PG contribution, increasing the visibility by adding a selfie results in an increase in reputational cost $(R(\hat{a}) - R'(\hat{a}) > 0)$. If $R(\hat{a}) > 0$, $R_x > 0$: for those with a positive reputation for contributing a high amount, increasing the visibility will increase the reputational gain even more. However, if these subjects state a positive reservation price for *NC* ($b_{NC} = b_N + b_C > 0$), this implies a positive individual privacy concern ($b_N > 0$) which should lead to a disutility from having their selfie published ($b_S > 0$). Hence, unless the subject has made a sufficiently high PG contribution and very much wants the selfie to be published, the increase in visibility is expected to lower R or contribute further to privacy concern and hence result in a higher bid.

Hypothesis 2a. *A selfie will increase the bid for publishing contribution information.*

Turning next to variation in bids, note that

$$\begin{aligned}\mathrm{Var}[b_{NCS}] &= \mathrm{Var}[b_N + b_S + b_C] \\ &= \mathrm{Var}[b_N + b_S] + \mathrm{Var}[b_C] + 2\,\mathrm{Cov}[b_N + b_S, b_C] \\ &> \mathrm{Var}[b_N + b_S].\end{aligned}$$

as long as $b_N + b_S$ and b_C are not too negatively correlated. We again have no reason to expect negative correlation between the disutility of publishing name and selfie and publishing PG contribution. Hence we have

Hypothesis 2b. *A selfie will increase the variance of bids.*

Finally, it is straightforward to show that the selfie premium is decreasing as contribution increases since $\frac{d}{da}(b_S + R(a) - R'(a)) = R_a - R'_a = k\mu - k\mu' < 0$ whenever $\mu' > \mu$ and hence $x' > x$.

Hypothesis 2c. *Selfie premium is decreasing with PG contribution.*

B Experiment Instructions

(Instructions for T1 are provided below. Instructions for T2 and T3 can be derived from these.)

You are about to participate in an experiment on decision-making. Before we start, please make sure your phones are on silent and on flight mode, and put away all personal belongings.

This experiment consists of two questionnaires and five stages. You will start the experiment with Questionnaire 1, which is followed by each of the five stages. In Stage 1, you will interact with another randomly chosen participant. In the remaining Stages, you will be making decisions on your own. You will conclude the experiment with Questionnaire 2.

The experiment will take place through your computer terminals. Please do not talk or try to communicate with other participants during the session. If you have any question, please raise your hand and the experimenter will approach you to answer it. You have also been provided with a pen and paper which you are free to use, for example to aid with calculations.

Today's session will last up to 1.5 hours. After the session you will receive your experimental payment. This payment consists of a **participation fee of 50kr** plus your **experiment earnings**. Your experiment earnings will depend on your own decisions, on the decision of another participant, and on chance. It is therefore important to think about each of your decisions carefully.

After Questionnaire 1 and prior to each of the five stages, the computer program will pause. During this time you will receive instructions for the next stage.

You are free to withdraw your participation at any time during the experiment, but if you choose to do so you will not receive any payment.

Are there any questions at this point?

We will now start the experiment with Questionnaire 1. Please answer the questions on your computer screen to the best of your ability.

At this time we ask you to take a self-picture ("selfie") using the camera on your mobile phone and save the image (this simply means: make sure it is not deleted). The selfie image should contain your face, such as that in a passport photo, but it should not contain any part of another individual in the room. There is no other requirement and you are free to make whatever facial expression you choose.

Please do NOT use your mobile phone for any other purpose. Once you are done taking the selfie, please put down your mobile phone face down at the side of your table.

If you do not have a mobile phone with a camera function, please raise your hand and we will lend one to you for use during the experiment.

You are about to begin with Stage 1. Out of Stage 1 and Stage 2, only one will be implemented and used for payment. Which stage is chosen will be determined by a random draw at the end of the experiment, and this chosen stage will be applied to all participants in this session.

Stage 1

In this stage, each participant will be randomly matched with another participant in this room to form a group of 2. All participants are provided with the same instructions.

At the start of Stage 1, you will be given a sum of 135kr, called your endowment. Your task is to decide how to use your endowment. You have to decide how much of the 135kr you want to contribute to a group project and how much to keep for yourself. You can choose to contribute from the following amounts: 0, 15, 30, 45, 60, 75, 90, 105, 120, 135.

After all group members have made their decisions, your experiment earnings from Stage 1 will be calculated. The earnings consist of 2 parts:

i The amount you kept for yourself.

ii The income from the group project, which equals 0.7 x the total contribution of both group members.

The earnings of each group member are calculated the same way, meaning that each group member receives the same income from the project. Suppose the sum of the contributions of all group members is 180kr. In this case each member of the group receives an income from the project of 0.7*180=126kr. If the total contribution to the project is 15kr, then each member of the group receives an income of 0.7*15=10.5kr from the project. All decimals will be rounded **up** to the next whole number.

When considering how much you should contribute, consider the following. Each 1kr that you do not contribute to the project adds 1kr to your income. Supposing that you contribute this 1kr to the project instead, then the total group contribution would rise by 1kr. Your income from the project would rise by 0.7*1=0.7kr. However the income of the other group member would also rise by 0.7kr, so that

the total income of the group from the project would rise by 1.4kr. Your contribution to the project therefore also raises the income of the other group member. On the other hand you also earn an income for each 1kr contributed by the other group member to the project. For each 1kr contributed by the other member you earn 0.7*1=0.7kr.

You will have five practice rounds to ensure you understand how pay-offs are calculated. Next, you will move on to the actual round where you will be asked to choose the amount you wish to contribute to the project. Please press the Continue button when you have finished. You will find out whether or not this stage is chosen for payment, and hence your earnings from this stage, at the end of the experiment.

In summary, if this stage is chosen for payment your earnings in SEK in Stage 1 are: (135 - your contribution to the project) + 0.7*(total contributions to the project).

Stage 2

From this stage onward, you will be making decisions on your own and are no longer part of a group.

At the start of Stage 2, you will again be given an endowment of 135kr. Your task is to decide how to use your endowment. You have to decide how much of the 135kr you want to invest in a risky project. Any remaining amount NOT invested will go towards your experiment earnings. You can choose to invest from the following amounts: 0, 15, 30, 45, 60, 75, 90, 105, 120, 135.

After you have made your decision, your experiment earnings from Stage 2 will be calculated. The earnings consist of 2 parts:

i The amount NOT invested in the risky project.

ii The income from the risky project, which equals 3 x the amount you invested with a probability of 0.5, or 0 (zero) with a probability of 0.5. Each participant's outcome will be determined individually by a random draw of the computer.

Suppose you choose to invest 60kr. Then your income from the risky project equals 180kr with a probability of 0.5, or 0 with a probability of 0.5. This means that your total earnings from this stage, including the remaining 75kr you kept, equals 255kr with a probability of 0.5 or 75kr with a probability of 0.5.

Suppose on the other hand that you choose to invest 0kr. Then your income from the project is zero and your total earnings from this stage are simply 135kr.

You will be asked to choose the amount you wish to invest in the risky project. Please press the Continue button when you have finished. You will find out whether or not this stage is chosen for payment, and hence your earnings from this stage, at the end of the experiment.

In summary, if this stage is chosen for payment your earnings in SEK in Stage 2 are: (135 - your investment in the risky project) + 3*(your investment in the risky project) with probability 0.5, or (135 - your investment in the risky project) with probability 0.5.

The next three stages concern your valuation of the right to publish some information about you. Only one of these stages will be implemented and used for payment. Which stage is chosen will be determined by a random draw at the end of the experiment, and this chosen stage will be applied to all participants in this session.

Stage 3

You have the opportunity to sell the right to publish your name and the selfie you took earlier on our researcher's webpage, with information about your participation in this experiment. Specifically, the webpage would display **your selfie with the following text: "[Your name] took part in an experiment on decision-making."** No other information, including your selfie ratings, will be displayed. Historically, this webpage was viewed by around 40 people per month, but there is no guarantee that this number would stay the same after your information is published. If it is published, your information will be displayed on the webpage during the period Dec 2015 - Jan 2016.

It is important for you to understand that you have no obligation to sell the right to publish your information, and we will give you instructions below on how you can ensure that your information will not be published.

If you are willing to sell the right to publish your information, the transaction works as follows. **You will be asked to name the minimum price in kr, P_1, at which you are willing to sell the right to publish the information above. That is, P_1 is your reservation price. The actual price will be determined individually by a random draw of the computer which is completely independent of P_1.** This randomly drawn price can take any value between 0 and 200kr.

If the random draw is lower than P_1, none of your information will be published and you will not receive any money in this stage.

If the random draw is higher than or equal to P_1, you will be required to e-mail your image to us and show a photo ID at the end of this session and we will pay you the price as determined by the random draw. Your name, image and participation information will be published on the webpage. This information may also be used for future research purposes and appear in research papers and/or presentations about this experiment, but apart from these your information will be used for NO

other purpose.

Please note that it does not make sense to enter P_1 exceeding your true valuation. By doing so you may lose money. If your valuation of the right to publish your information is for example 10kr, you should enter 10 as P_1. If the random draw decides that we pay a price of 40kr, you will receive 40kr even if the P_1 amount you entered was only 10kr. However, if you had entered 50 as P_1 your information will not be published and you will not receive any money at all in this stage. In particular, note that we will never pay a price more than 200kr. Note also, if you do not mind that the information about you is published, you maximize your expected pay-off by setting P_1 equal to 0, since then the probability that you sell the right is 1.

If you are not willing to sell the right to publish your information, you should enter the amount 201 as P_1. Since the computer will only draw numbers between 0 and 200, we will never draw a price that is higher than or equal to 201 and as a result we will never publish your information. This also means that you will not earn any money in this stage.

Your decision is final and no renegotiation would take place.

You will have three practice rounds to ensure you understand how pay-offs are calculated. These consist of two practice questions followed by a simulation round, where you will have the chance to familiarize yourself with a hypothetical transaction. The randomly drawn price is hypothetical and will not affect your earnings, and no right to publish any information will actually be bought or sold.

When you have finished the simulation round, you will continue with an actual transaction. This time, the randomly drawn price will determine whether or not you sell the right to publish your information as per the instructions above.

In summary, if this stage is chosen for payment your earnings in SEK in Stage 3 are: The price randomly drawn by the computer if it exceeds P_1, OR zero otherwise.

Stage 4

This time, you have the opportunity to sell the right to publish your name and the selfie you took earlier on our researcher's webpage, with information about your contribution to the group project in Stage 1 of this experiment. Specifically, the webpage would display **your selfie with the following text: "[Your name] took part in an experiment on decision-making. He/She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. [Your name] decided to contribute** [X] **to this group project.** No other information, including your selfie ratings, will be displayed. If it is published, your information will be displayed on the webpage during the period Dec 2015 - Jan 2016.

It is important for you to understand that you have no obligation to sell the right to publish your information, and we will give you instructions below on how you can ensure that your information will not be published.

If you are willing to sell the right to publish your information, the transaction works as follows. **You will be asked to name the minimum price in kr, P_2, at which you are willing to sell the right to publish the information above. That is, P_2 is your reservation price. The actual price will be determined individually by a random draw of the computer which is completely independent of P_2.** This randomly drawn price can take any value between 0 and 200kr.

If the random draw is lower than P_2, none of your information will be published and you will not receive any money in this stage.

If the random draw is higher than or equal to P_2, you will be required to e-mail your image to us and show a photo ID at the end of this session and we will pay you the price as determined by the random draw. Your name, image and contribution information will be published on the webpage. This information may also be used for future research purposes and appear in research papers and/or presentations about this experiment, but apart from these your information will be used for NO other purpose.

Please note again that it does not make sense to enter P_2 exceeding your true valuation by the same reasoning as in Stage 3.

If you are not willing to sell the right to publish your information, you should enter the amount 201 as P_2. Since the computer will only draw numbers between 0 and 200, we will never draw a price that is higher than or equal to 201 and as a result we will never publish your information. This also means that you will not earn any money in this stage.

Your decision is final and no renegotiation would take place.

In the next screen, you will face an actual transaction. The randomly drawn price will determine whether or not you sell the right to publish your information as per the instructions above.

In summary, if this stage is chosen for payment your earnings in SEK in Stage 4 are: The price randomly drawn by the computer if it exceeds P_2, OR zero otherwise.

Stage 5

In this stage, we are interested in knowing your valuation of the right to publish the information from the transaction conducted in Stage 3 earlier. Specifically, how much would you have to be paid for us to publish P_1, your reservation price, or the fact that you chose not to sell the right to publish your information?

You have the opportunity to sell the right to publish the above information on the previously mentioned researcher's webpage. Specifically, the webpage would display the following text:"**[Your name] took part in an experiment on decision-making. He/she was willing to publish his/her name and selfie with information about his/her participation in this experiment for a minimum price of [your P_1] OR he/she was not willing to publish his/her name and selfie with information about his/her participation in this experiment.**" No other information, including your selfie ratings, will be displayed. If it is published, your information will be displayed on the webpage during the period Dec 2015 - Jan 2016.

It is important for you to understand that you have no obligation to sell the right to publish your information, and we will give you instructions below on how you can ensure that your information will not be published.

If you are willing to sell the right to publish your information, the transaction works as follows. **You will be asked to name the minimum price in kr, P_3, at which you are willing to sell the right to publish the information above. That is, P_3 is your reservation price. The actual price will be determined individually by a random draw of the computer which is completely independent of P_3.** This randomly drawn price can take any value between 0 and 200kr.

If the random draw is lower than P_3, none of your information will be published and you will not receive any money in this stage.

If the random draw is higher than or equal to P_3, you will be required to show a photo ID at the end of this session and we will pay you the price as determined by the random draw. Your name and P_1 information (or the fact that you were not willing to publish your information in Stage 3) will be published on the webpage. This information may also be used for future research purposes and appear in research papers and/or presentations about this experiment, but apart from these your information will be used for NO other purpose.

Please note again that it does not make sense to enter P_3 exceeding your true valuation by the same reasoning as in Stage 3.

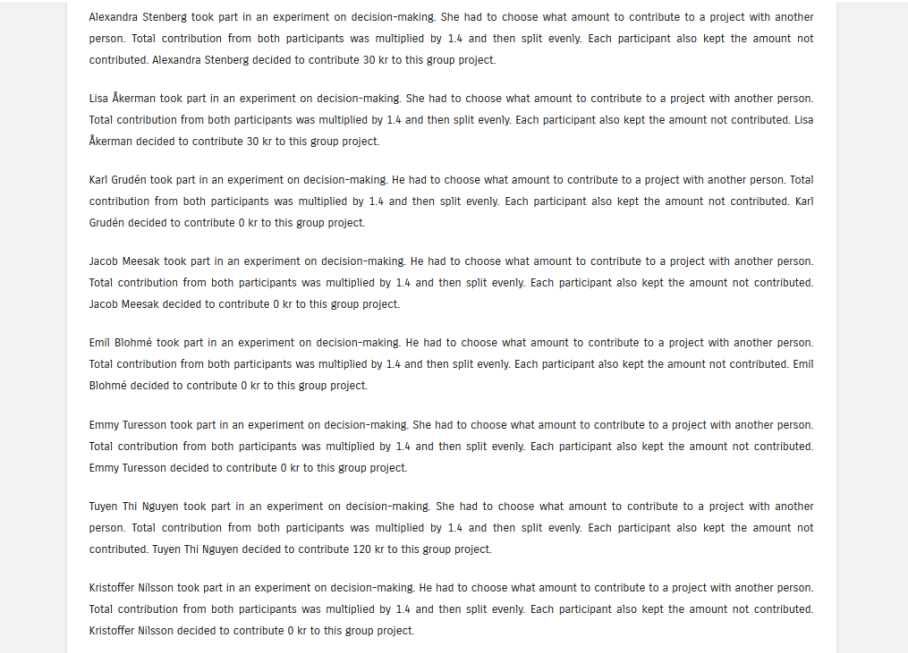
If you are not willing to sell the right to publish your information, you should enter the amount 201 as P_3. Since the computer will only draw numbers between 0 and 200, we will never draw a price that is higher than or equal to 201 and as a result we will never publish your information. This also means that you will not earn any money in this stage.

Your decision is final and no renegotiation would take place.

In the next screen, you will face an actual transaction. The randomly drawn price will determine whether or not you sell the right to publish your information as per the instructions above.

In summary, if this stage is chosen for payment your earnings in SEK in Stage 5 are: The price randomly drawn by the computer if it exceeds P_3, OR zero otherwise.

C Screenshots



Alexandra Stenberg took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Alexandra Stenberg decided to contribute 30 kr to this group project.

Lisa Åkerman took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Lisa Åkerman decided to contribute 30 kr to this group project.

Karl Grudén took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Karl Grudén decided to contribute 0 kr to this group project.

Jacob Meesak took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Jacob Meesak decided to contribute 0 kr to this group project.

Emil Blohmé took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Emil Blohmé decided to contribute 0 kr to this group project.

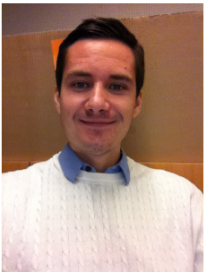
Emmy Turesson took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Emmy Turesson decided to contribute 0 kr to this group project.

Tuyen Thi Nguyen took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Tuyen Thi Nguyen decided to contribute 120 kr to this group project.

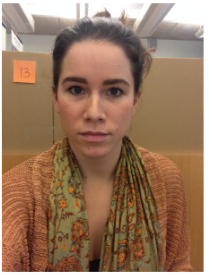
Kristoffer Nilsson took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Kristoffer Nilsson decided to contribute 0 kr to this group project.

Figure 1: Published information on researcher webpage

Mattias Lundin took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Mattias Lundin decided to contribute 15 kr to this group project.



Joel Persson took part in an experiment on decision-making. He had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Joel Persson decided to contribute 0 kr to this group project.



Marta Radinovic Lukic took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Marta Radinovic Lukic decided to contribute 15 kr to this group project.

Libo Liu took part in an experiment on decision-making. She had to choose what amount to contribute to a project with another person. Total contribution from both participants was multiplied by 1.4 and then split evenly. Each participant also kept the amount not contributed. Libo Liu decided to contribute 45 kr to this group project.

Figure 2: Published information with selfie on researcher webpage

D Robustness Checks

D.1 Hypothesis 1

We test the robustness of our results regarding the relationship between PG contribution and bids for its publication. First we show in Table 9 and Table 10 the correlations among control variables which are expected to affect the subject's valuation for the right to publish her name and selfie (used in the regressions of Table 5 and Table 6). While selfie frequency has a relatively high correlation with Visual SM, post-regression estimates of VIF shows no evidence of multicollinearity, as indicated in Footnote 27.

Table 9: Correlation matrix of selected predictors of *NC*.

	NPI	Visual SM	Text SM	Selfie frequency
NPI	1			
Visual SM	0.09	1		
Text SM	-0.05	0.11	1	
Selfie frequency	-0.01	0.47***	0.22***	1

Notes: "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about the daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Our dependent variables *NC* and *NCS* are bids elicited in the BDM mechanism which can only take values between 0 and 201. This means that subjects who might have been extremely unwilling to publish their information, and who therefore may have a reservation price higher than 201, had to bid 201. Similarly, subjects who are extremely willing to publish their information to the point where they would have been willing to pay for it had no choice but to state a bid of zero rather than a negative number. We therefore run tobit regressions on the BDM bids to test the robustness of our results. As shown in Table 11, PG contribution still has a negative effect on bids, though again the effect is only significant when a selfie is included. The coefficient of PG contribution in the tobit regressions has a higher absolute value than in the OLS regressions presented in Table 5 columns (1-2), suggesting that the true effect of PG contribution on the uncensored reservation

Table 10: Correlation matrix of selected predictors of *NCS*.

	NPI	Visual SM	Text SM	Selfie frequency	Rating
NPI	1				
Visual SM	0.17**	1			
Text SM	-0.04	0.12	1		
Selfie frequency	0.16**	0.37***	0.21***	1	
Rating	0.22***	0.05	0.03	0.19**	1

Notes: "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about the daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is very unattractive and 7 is very attractive. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

price is higher than previously shown.

D.2 Hypothesis 2

Our results for Hypothesis 2a are also based on linear regressions with censored BDM bids as the dependent variable. Using tobit specification as shown in Table 12 does not change the sign nor significance of the selfie's effect on bids. Publishing PG contribution with a selfie increases the subject's bid. Again, the coefficients in the tobit regressions are greater in absolute value than those in the linear regressions shown in Table 6 columns (1-2), indicating that the true effect of adding a selfie on a subject's unwillingness to publish their contribution information is higher than previously shown.

D.3 Crowding-out of social image concerns

We next check the robustness of the crowding-out effect to take into account the bounds for bids. There may be a concern that bids for *NS* are already higher than *N* due to the presence of the selfie, and hence when *C* is added, there is less room for *NS* bids to increase. The CIP with selfie (*NCS* minus *NS*) will therefore be lower than the CIP without selfie (*NC* minus *N*), not because the selfie crowds out

the concern for *C* but rather because of the bid limits imposed in the experiment. As Table 13 shows, removing subjects who bid 201 in either BDM stage in T1 (12 subjects) and T3 (6 subjects) leaves 65 subjects in T1 and 64 subjects in T3. In this subsample, the results still hold: both average CIP and its standard deviation are lower with the selfie than without.

We next regress *withcont* (pooling *NCS* and *NC*) on the treatment dummy T1, controlling for *nocont* (pooling *NS* and *N*) and other variables. We see in Table 14 that T1 is still significant: the bids for publishing information is lower by 13 SEK if a selfie is included, even after controlling for the *nocont* bids and PG contribution.

D.4 Selfie-taking and cooperation

While PG contribution is a ratio variable, in the experiment subjects could only choose from ten different values to avoid the obvious 50-50 division between the amount to keep and the amount to contribute to the group project. We show in Table 15 that the conclusions we draw regarding the effect of selfie-taking on cooperation are robust to ordered logit specification of the regressions. Taking a selfie has no effect on PG contribution for the whole sample in column (1). However when we restrict the sample to subjects who take selfies at least once a week (column 2) or even once a month (column 3), taking a selfie in the experiment has a negative and significant effect on PG contribution. This can be seen in the negative coefficient for "Take selfie" in columns (2-3): taking a selfie reduces the subject's log-odds of choosing a higher level of PG contribution.

The effect of selfie-taking on PG contribution is also robust to including other variables that are significantly different between frequent selfie-takers and the rest, i.e. self-esteem and social media activities, as presented in Table 16. The effect is marginal in the group of weekly selfie-takers (p=0.0504), for whom Twitter activity also significantly reduces PG contribution. Neither self-esteem nor activity on Facebook and Instagram significantly affects PG contribution.

Table 11: Tobit regressions of *NC* and *NCS* bids.

	(1) *NC* T2+T3	(2) *NCS* T1+T2
PG contribution	-0.27	-0.46**
	(0.18)	(0.19)
T2	-1.43	-1.01
	(17.39)	(17.13)
NPI	23.15	-5.23
	(43.95)	(46.92)
Visual SM	-12.05*	-21.48***
	(6.99)	(7.68)
Text SM	9.93	31.00***
	(11.84)	(11.14)
Selfie frequency	-9.97	-10.00
	(8.86)	(8.48)
Rating		-5.87
		(6.67)
CRT	-10.88	-20.90**
	(8.94)	(8.82)
Age	-1.64	-0.42
	(2.15)	(2.08)
Male	-39.18**	-14.98
	(19.11)	(19.27)
Swedish	-20.98	-40.69**
	(18.44)	(17.54)
Econ	11.05	-2.07
	(16.99)	(17.10)
Constant	185.41**	268.80***
	(75.73)	(80.24)
Observations	156	163

Notes: "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is "very unattractive" and 7 is "very attractive". "CRT" is the number of correct responses to three Cognitive Reflection Test questions. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 12: Tobit regressions of BDM1 and BDM2 bids.

	(1) BDM1 T2+T3	(2) BDM2 T1+T2
PG contribution	-0.51***	-0.23
	(0.19)	(0.19)
Selfie included	36.12**	38.61**
	(18.03)	(16.94)
NPI	-24.83	33.14
	(45.38)	(46.35)
Visual SM	-17.44**	-16.25**
	(7.25)	(7.57)
Text SM	15.09	25.86**
	(12.15)	(11.05)
Selfie frequency	-10.80	-8.67
	(9.05)	(8.44)
Rating		-3.64
		(6.57)
CRT	-11.26	-20.37**
	(9.21)	(8.70)
Age	-1.64	-0.32
	(2.13)	(2.11)
Male	-34.65*	-18.19
	(19.69)	(19.03)
Swedish	-23.34	-39.04**
	(18.97)	(17.37)
Econ	16.80	-5.22
	(17.53)	(16.91)
Constant	227.43***	176.38**
	(77.15)	(82.55)
Observations	156	163

Notes: "Selfie included" is a dummy variable equal to 1 for bids for *NS* or *NCS*, or 0 for bids for *N* or *NC*. In column (1), a "Selfie included" value of 1(0) corresponds to being in T2(T3). In column (2), a value of 1(0) corresponds to T1(T2). "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is "very unattractive" and 7 is "very attractive". "CRT" is the number of correct responses to three Cognitive Reflection Test questions. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 13: CIP data excluding maximum bidders.

	T1 (with Selfie)	T3 (without Selfie)	P-value
	N=65	N=64	
Average CIP	3.46	19.31	0.0539
St Dev of CIP	20.61	43.56	0.0000

Table 14: OLS regression of *NCS* and *NC* pooled.

	(1) withcont
nocont	0.85***
	(0.07)
PG contribution	-0.06
	(0.07)
T1	-12.60**
	(6.33)
NPI	3.15
	(17.07)
Visual SM	-4.43
	(2.80)
Text SM	4.93
	(4.80)
CRT	-3.84
	(2.98)
Age	-0.41
	(1.10)
Male	-13.51*
	(6.91)
Swedish	-9.90
	(6.71)
Econ	2.38
	(6.28)
Constant	67.89*
	(34.50)
Observations	129
Adjusted R-squared	0.59

Notes: "withcont" is *NCS* and *NC* pooled. "nocont" is *NS* and *N* pooled. "NPI" is the subject's score in the Narcissistic Personality Inventory (NPI-16) (Ames et al., 2006), ranging from 0-1. "Visual SM" is the sum of scores from the responses to questions about daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. "Selfie frequency" is the subject's frequency of selfie-taking, where: 1 is "Never", 2 is "Less than 1 time per month", 3 is "1-3 times per month", 4 is "1-6 times per week", and 5 is "Once or more per day". "Rating" is the subject's rating of their own selfie on a scale from 1-7, where 1 is "very unattractive" and 7 is "very attractive". "CRT" is the number of correct responses to three Cognitive Reflection Test questions. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 15: Ordered logit regressions of PG contribution.

	(1) PG contribution	(2) PG contribution	(3) PG contribution
Take selfie	-0.21	-1.53**	-0.76*
	(0.26)	(0.63)	(0.40)
Risk investment	0.01***	0.01	0.01*
	(0.00)	(0.01)	(0.01)
Age	0.04	-0.01	-0.02
	(0.03)	(0.11)	(0.07)
Male	-0.51*	-0.01	-0.44
	(0.26)	(0.55)	(0.38)
Swedish	-0.48*	0.32	-0.64*
	(0.26)	(0.58)	(0.38)
Econ	-0.11	-0.25	0.04
	(0.24)	(0.52)	(0.35)
Constant cut1	0.35	-1.07	-1.46
	(0.89)	(2.53)	(1.73)
Constant cut2	0.56	-0.99	-1.30
	(0.89)	(2.53)	(1.73)
Constant cut3	0.99	-0.57	-0.66
	(0.89)	(2.52)	(1.72)
Constant cut4	1.39	-0.04	0.04
	(0.89)	(2.51)	(1.71)
Constant cut5	1.81**	0.62	0.45
	(0.89)	(2.51)	(1.71)
Constant cut6	2.16**	1.21	0.90
	(0.89)	(2.53)	(1.72)
Constant cut7	2.58***	1.93	1.43
	(0.90)	(2.57)	(1.73)
Constant cut8	2.79***	2.19	1.66
	(0.91)	(2.59)	(1.74)
Constant cut9	3.11***		1.79
	(0.92)		(1.74)
Observations	233	55	108

Notes: Column (1): the whole sample, column (2): subjects who take selfies at least weekly, and column (3): subjects who take selfies at least monthly. "Take selfie" is a dummy variable equal to 1 for subjects in T1 or T2. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 16: OLS regressions of PG contribution with other individual characteristics.

	(1) PG contribution	(2) PG contribution	(3) PG contribution
Take selfie	-6.57	-28.04*	-17.96**
	(6.66)	(13.95)	(8.95)
Risk investment	0.31***	0.23	0.27**
	(0.08)	(0.14)	(0.12)
Age	1.13	-0.31	-0.34
	(0.80)	(2.27)	(1.53)
Male	-10.62	2.01	-3.58
	(6.96)	(12.52)	(8.94)
Swedish	-10.37	11.06	-9.30
	(6.61)	(12.85)	(8.67)
Econ	-3.24	-4.11	2.55
	(6.13)	(11.44)	(7.94)
SE	0.24	-1.41	0.24
	(0.61)	(1.26)	(0.89)
Visual SM	-1.34	3.31	1.87
	(2.49)	(5.44)	(3.49)
Text SM	-4.02	-14.02**	-5.09
	(4.29)	(6.92)	(5.16)
Constant	20.40	81.93	38.18
	(29.67)	(73.09)	(48.66)
Observations	233	55	108
Adjusted R-squared	0.06	0.10	0.05

Notes: Column (1): the whole sample, column (2): subjects who take selfies at least weekly, and column (3): subjects who take selfies at least monthly. "Take selfie" is a dummy variable equal to 1 for subjects in T1 or T2. "SE" is the subject's Rosenberg self-esteem score (Rosenberg, 1965), ranging from 0-30. "Visual SM" is the sum of scores from the responses to questions about the daily usage of Facebook and Instagram, where: 1 is "I do not have an account here", 2 is "Less than 30 minutes", 3 is "30 minutes - 1 hour" and 4 is "More than 1 hour". "Text SM" is the corresponding score for daily usage of Twitter. Standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

E Higher-level Reasoning by Subjects

In a more exploratory part of the experiment, we also investigate if people are prepared to pay to conceal more sophisticated information sets. BT provide some intuition for an agent who is eager to engage in a prosocial action but does not want to appear to be reputation seeking. When publicly offered a material reward, this agent will accept it and risk appearing to be motivated by the reward rather than turn it down, since "doing so could lead the audience to question an agent's motivation along another dimension: is he genuinely disinterested, or merely concerned about appearances?" because "good deeds that are too obvious may backfire" (p. 1669). While this can be considered relatively high-level reasoning to expect from our data, we investigate whether or not such sophisticated behavior can be traced in the sample we have by eliciting bids for the publication of the subject's previous bid. According to Hypothesis 1, bids for the publication of contribution information are informative about the subject's PG contribution: a subject who contributed a high amount in the PG should be willing to publish this information for a low minimum price. However, if this low bid is made public, the audience may interpret this as signaling the fact that the subject wants to show-off her high PG contribution. Consequently, she may now wish to conceal the first bid by bidding high to prevent its publication, generating what we term the "show-off premium", defined as the bid for the publication of the first bid minus the first bid. We do not rule out that a high second bid may also follow a high first bid for subjects that want to hide a low PG contribution, that is, a low show-off premium for low contributors or even other high contributors who care less about being seen as seeking publicity. However, if the first bid contains no contribution information, bidding low may simply signal a lack of privacy concern which should rationally then be followed by a similarly low second bid. Hence there is no reason for the bid to increase when no contribution information is published. Taking into account other (privacy) reasons for which people may want to conceal a low or high first bid, the show-off premium with contribution information should be higher than that without contribution information. However, bidding for the publication of bids can be difficult to grasp conceptually and given the similarity in the two BDM tasks we could also expect that subjects state similar values for both bids, which would weaken our results. Nevertheless, we cannot a priori rule out the presence of higher-level thinking in subjects and present the following hypothesis:

Hypothesis 3. *The show-off premium when the first bid contains contribution inform-*

ation is higher than that when the first bid contains no contribution information.

Implementation

BDM3 elicits bids for the publication of BDM1 bids, accompanied by a sentence explaining what information BDM1 contains. For example, in T3 BDM1 elicits bids for publishing *NC*: the subject's name and PG contribution. Hence in BDM3 the published sentence reads: "[Subject's full name] took part in an experiment on decision-making. He/she was willing to publish his/her name with information about his/her contribution to a group project in this experiment for a minimum price of [subject's BDM1 bid]" OR "[Subject's full name] took part in an experiment on decision-making. He/she was not willing to publish his/her name with information about his/her contribution to a group project in this experiment." in the relevant case.

Result

Hypothesis 3 tests for the prevalence of higher-level thinking within a subject who does not want to appear to be reputation-seeking, which would take the form of a higher show-off premium, defined as BDM3-BDM1, whenever BDM1 contains contribution information (T2+T3 vs T1). However, our data suggests the opposite: the show-off premium is higher in T1 than in T2 and T3 combined (-3 vs -10, WMW test p=0.08, n=233). The average BDM3 bids are in fact lower than BDM1 bids in all treatments, though the difference is not significant (WMW tests in T1, T2 and T3 yield p=0.65, 0.14 and 0.88 respectively). To conclude, no evidence of such sophisticated reasoning is seen in our data. Instead, bids in BDM3 appear to be negatively correlated with cognitive skills (Pearson correlation coefficient -0.22, p=0.001, n=233).[44] This is not surprising given that the profit-maximizing dominant strategy is to bid zero. Although subjects should be more practiced in the BDM mechanism by the time they reach BDM3, bidding for the publication of bids can be difficult to grasp conceptually. The strong relationship with low cognitive skills shows that there is a lot of noise in this data and results on BDM3 should thus be interpreted with caution.

[44]While this argument can also be true for BDM1 and BDM2, the negative relationship between bids and CRT is strongest for BDM3 (Pearson correlation coefficients for BDM1 and BDM2 are -0.11, p=0.09, and -0.20, p=0.003 respectively).

F Strangers' Rating and Expectation of the Selfies

The finding that *Rating* is not a significant factor affecting subjects' willingness to publish their selfies (as shown in Table 5 and Table 6) is worth investigating. Are subjects pooling in the middle of the attractiveness scale, creating too little variation in ratings? Given that 73% of subjects give their selfies a rating of 3, 4, or 5, this seems to be a plausible explanation.

We conduct an additional elicitation consisting of two surveys aimed at i) getting an objective stranger's rating of the published selfies and ii) eliciting a stranger's expectation of the selfie subject's contribution based on a viewing of the selfie image. The latter allows us to explore the extent to which the halo effect (Thorndike, 1920) is present in our sample of selfies. To perform an elaborate test of how strangers' ratings affect the subjects' willingness to publish their selfies, the ideal would be to let strangers rate all subjects' selfies. However, since only 47 selfie images were sold, we can only use these in this part which reduces the statistical power and introduces issues of selection into this investigation. Despite this we think these ratings are worth exploring and complement our previous findings. The two surveys therefore use the 47 selfie images that have been sold to the experimenter, all of which originate in T1, consisting of 66% male, 68% Swedish, with average age 24.

Implementation

The surveys were conducted online on 15 December 2016 using the Amazon Mechanical Turk platform and programed using Qualtrics. The MTurk workers are individuals from various countries, primarily US and India, who have previously signed up to do Human Intelligence Tasks (HITs) on the MTurk platform.[45] At the start of each survey, workers view a handwritten sentence which they are then asked to transcribe, this control question is included to control for computer bots. Full instructions are presented below.

[45] See `http://www.mturk-tracker.com/`, accessed 19 December 2016.

F.1 Survey 1: Rating Selfies

In this survey, workers are presented with a random order of the 47 selfies, each of which requires them to rate the attractiveness of the selfie on a scale between 1 to 7. This is followed by questions about social media use (as asked in the original experiment) and demographics. In total 59 workers participated. The average age is 33, and 60% are male. Indians are the largest nationality group making up 49%, while Americans make up 27%.[46] The average worker takes 7.42 minutes to complete the task.

One selfie is drawn at random for payment. Based on all the ratings provided by all workers for this particular selfie, we calculate the average rating, rounded to the nearest whole number. The worker is paid $6 if her rating matches the average rating, and $1 is deducted for each point her rating deviates from the average. Workers also receive a fixed fee of $0.10 for participating in the survey. Workers earn on average $5.00 in total. The average earning per hour is thus $40.42, which is much more than an MTurk worker earns on a typical task.

Results

For each selfie, the average rating of the 59 MTurk workers is calculated. These ratings have a correlation coefficient of 0.18 with the subjects' own self ratings, though this correlation is not significant. The MTurk workers' ratings are somewhat correlated with how the selfie subjects expect others to rate them (0.27, p=0.062). One would expect that the correlation between objective strangers' ratings and *NCS* bids are stronger (more negative) than the subject's own rating (-0.04, p=0.570), but this is not the case. There is little correlation between strangers' ratings and *NCS* bids (0.08, p=0.608), and using these objective ratings in the OLS regression for *NCS* bids as per Table 5 does not change the insignificance of the rating coefficient. The sample size is however much smaller, and all 47 selfies are generated in T1 which means that we cannot make comparison across treatments. In summary, for our subsample of 47 subjects with published selfies, it appears that the attractiveness of the selfie is indeed an insignificant predictor of subjects' willingness to publish the selfie.

[46] When asked for nationality, several workers state their race instead, such as Black American. These have been classified as US nationals.

F.2 Survey 2: Expected Contribution

In this survey, a new group of workers are presented with brief information about the PG which is framed as a group project. They then view a random order of the 47 selfies, each of which requires them to state how much they expect the person in the selfie would contribute to the group project out of the original amounts (0, 15, 30, 45, 60, 75, 90, 105, 120, 135). The survey ends with questions about demographics. In total 60 workers participated. The average age is 33, and 42% are male. Americans make up 60% of the worker pool. The average worker takes 6.60 minutes to complete the task.

One selfie is drawn at random for payment, and each worker's expected contribution is compared with the selfie subject's actual contribution. The worker is paid $9 if her stated expected contribution matches the actual contribution, and $1 is deducted for each 15-unit point her stated expected contribution deviates from the actual contribution. Workers also receive a fixed fee of $0.10 for participating in the survey. Workers earn on average $5.40 in total. The average earning per hour is thus $49.10, which is much more than an MTurk worker earns on a typical task.

Results

For each selfie, the average expected contribution of the 60 MTurk workers is calculated. Comparing the rating given to each selfie (by the first group of workers in Survey 1 above) with the selfie subject's expected contribution (stated by the second group of workers in Survey 2), there is a clear pattern: the MTurk workers (falsely) expect that more attractive people are higher contributors, with a correlation between rating and expected contribution of 0.45 (p=0.001). While there is positive correlation between expected and actual contribution (0.14), this is not significant (p=0.342). Our finding lends support to the halo effect, a cognitive bias in which attractiveness in a particular trait is assumed to carry over to another trait (Thorndike, 1920). Similar to Andreoni and Petrie (2008), selfie subjects that are judged more attractive are also expected to be more cooperative in the group project. In fact, there is a negative though insignificant correlation between attractiveness (as judged by workers in Survey 1) and actual contribution (0.-14, p=0.346).

F.3 Instructions

Survey 1

This HIT consists of 47 questions, each of which requires you to **rate the attractiveness of a selfie on a scale from 1 to 7,** where 1 is very unattractive and 7 is very attractive. All workers will face the same set of 47 selfies, but the order is randomized for each worker. The HIT will end with a short questionnaire.

Payment

This HIT will take about 15 minutes. After the HIT is completed you will receive your payment. This payment consists of **a fixed HIT payment of $0.10** plus **your bonus earnings.** Your bonus earnings will depend on your own decisions and on the decisions of the other workers. It is therefore important to think about each of your decisions carefully. The calculation of the bonus earnings is explained in the following paragraphs.

After the HIT expires, we will randomly pick a selfie to be used for payment. Based on all the ratings provided by all workers for this particular selfie, we will calculate the average rating, rounded to the nearest whole number. We will pay you **$6** if your rating matches the average rating, and deduct **$1** for each point your rating deviates from the average.

For example, if you rate the randomly chosen selfie to be a 5 on the scale of attractiveness, and the average rating stated by all workers (including yours) is 2.3 (which is rounded to 2), your deviation is 5-2=3 and therefore your payment will be 6-3=$3.

This means that the maximum possible earnings is $6, while the minimum possible earnings is $0, on top of the fixed HIT payment of $0.10.

Survey 2

This HIT consists of 47 questions, each of which requires you to **view a selfie image and state how much you expect the person in the selfie (the subject) would contribute to a group project.**

The Group Project

The selfie subject had to choose what amount (out of 0, 15, 30, 45, 60, 75, 90, 105, 120, 135) to contribute to a group project with another subject. Total contribution from both subjects was multiplied by 1.4 and then split evenly. Each subject also kept the amount not contributed.

Each subject would therefore earn more the more the other subject contributed and the less the subject him/herself contributed to the group project. Hence, a fully selfish subject should contribute nothing (that is 0) to the group project and a fully cooperative subject should contribute everything (that is 135).

In summary, we are asking you to guess the degree to which each selfie subject would cooperate when cooperation is costly.

The HIT will end with a short questionnaire. This HIT will take about 15 minutes in total.

Payment

After the HIT is completed you will receive your payment. This payment consists of **a fixed HIT payment of $0.10** plus **your bonus earnings.** Your bonus earnings will depend on your decisions. It is therefore important to think about each of your decisions carefully. The calculation of the bonus earnings is explained in the following paragraphs.

After the HIT expires, we will randomly pick a selfie to be used for payment. We will check from our previous data how much the person in the selfie *actually* contributed to his/her group project. This group project was part of an experiment that took place in the past. We will pay you **$9** if your stated expected contribution matches the actual contribution, and deduct **$1** for each 15-unit point your stated expected contribution deviates from the actual contribution.

For example, if you expect that the randomly chosen person contributes 120, and he/she in fact contributed 45, your deviation is 120-45=75 and therefore your payment is deducted by 75/15=5 and you will therefore earn 9-5=$4.

This means that the maximum possible earnings is $9, while the minimum possible earnings is $0, on top of the fixed HIT payment of $0.10.

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