

Health Psychology

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Online First Publication, November 12, 2012. doi: 10.1037/a0030372

CITATION

Vlaev, I., Seymour, B., Chater, N., Winston, J. S., Yoshida, W., Wright, N., Symmonds, M., & Dolan, R. (2012, November 12). Prices Need No Preferences: Social Trends Determine Decisions in Experimental Markets for Pain Relief. *Health Psychology*. Advance online publication. doi: 10.1037/a0030372

Prices Need No Preferences: Social Trends Determine Decisions in Experimental Markets for Pain Relief

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Objective: A standard view in health economics is that, although there is no market that determines the “prices” for health states, people can nonetheless associate health states with monetary values (or other scales, such as quality adjusted life year [QALYs] and disability adjusted life year [DALYs]). Such valuations can be used to shape health policy, and a major research challenge is to elicit such values from people; creating experimental “markets” for health states is a theoretically attractive way to address this. We explore the possibility that this framework may be fundamentally flawed—because there may not be any stable values to be revealed. Instead, perhaps people construct ad hoc values, influenced by contextual factors, such as the observed decisions of others. **Method:** The participants bid to buy relief from equally painful electrical shocks to the leg and arm in an experimental health market based on an interactive second-price auction. Thirty subjects were randomly assigned to two experimental conditions where the bids by “others” were manipulated to follow increasing or decreasing price trends for one, but not the other, pain. After the auction, a preference test asked the participants to choose which pain they prefer to experience for a longer duration. **Results:** Players remained indifferent between the two pain-types throughout the auction. However, their bids were differentially attracted toward what others bid for each pain, with overbidding during decreasing prices and underbidding during increasing prices. **Conclusion:** Health preferences are dissociated from market prices, which are strongly referenced to others’ choices. This suggests that the price of health care in a free-market has the capacity to become critically detached from people’s underlying preferences.

Keywords: preferences, pain, health markets, auction, decision making, social influence

The standard view in health policy is that people make consistent and rational decisions that maximize their health and welfare according to the information available; and in situations where people make suboptimal decisions, policies usually aim to increase the provision of information, having assumed a lack of it (e.g.,

campaigns on smoking-related health effects and sexually transmitted diseases; Webb & Sheeran, 2006). A central tenet of this view is that individuals can make accurate and stable judgments about the value of specific health states (Shafir & LeBoeuf, 2002); and such judgments should guide the process by which individuals can trade health against financial and other values, enabling everyday decisions that influence health; for example, whether to pay for gym membership or buy healthy food. This has assumed greater importance recently as health systems have become more responsive to patient choices about what kind of health care they want (Darzi, 2008).

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This work was supported by the Wellcome Trust (Ray Dolan Senior Investigator Award 098362/Z/12/Z). The Wellcome Trust Centre for Neuroimaging is supported by core funding from the Wellcome Trust 091593/Z/10/Z.

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A growing body of evidence in cognitive and social psychology and behavioral economics indicates that people are not only frequently irrational in their valuations and decisions (Kahneman & Tversky, 2000), but are also consistently and reliably so (Ariely, 2008). This evidence has also started to shape theorizing and research in health psychology (Loewenstein, 2005) and public and health economics (Loewenstein & Ubel, 2008). This has driven attempts to characterize a more veridical architecture of human decision-making (see Vlaev, Chater, Stewart, & Brown, 2011, for a review), not least because this might help shape new policies that help or “nudge” people to make better decisions in more sophisticated ways than the mere provision of information (Thaler &

Sunstein, 2008). This is important for health policy, because the tension between individual decision-making on the one hand, and the manner in which options are presented (i.e., the decision context), is an effervescent topic in modern politics (and political science). There is a persistent drive to shift health care decision-making from the State to the individual, reinforcing the need for a better understanding of how individuals use information in health care markets to make decisions (Camerer, Issacharoff, Loewenstein, O'Donoghue, & Rabin, 2003; Loewenstein, Brennan, & Volpp, 2007; Thaler & Sunstein, 2008).

An important observation from recent experiments in “behavioral health economics” is that people behave as if they make judgments about the financial value of pain in relative terms (relative to very recently experienced pains and also relative to the amount of money available on each trial), not in absolute terms (relative to the individual’s overall health or wealth; Vlaev, Seymour, Dolan, & Chater, 2009). This raises the possibility that in social situations, such as markets, the behavior of other people might also induce relative judgments generating “herd-like” market dynamics. Results from brain imaging studies provide evidence that both behavioral value judgments and neural representations are influenced by the judgments of others (Carp, Halenar, Quandt, Sklar, & Compton, 2009; Klucharev, Hytönen, Rijpkema, Smidts, & Fernández, 2008), by prices (Plassmann, O’Doherty, Shiv, & Rangel, 2008), and advice (Biele, Rieskamp, & Gonzalez, 2009). Most notably, neural responses correlate with a discrepancy between private and social valuations and predict the change in subsequent private judgments, suggesting an error-based learning account of value (Klucharev et al., 2008). Recent data on pain judgment reveal similar social effects—observing analgesic effect in other people induces substantial placebo analgesic responses in the recipients (Colloca & Benedetti, 2009).¹

In health markets, one persistent ambiguity, which we aim to address here, is exactly what aspects of decision-making are modulated by social information. One possibility is that the experience of pain, its *intrinsic value*, is modulated. Expectancy effects are well known in pain ratings, and both implicit (e.g., classical conditioning) and explicit (e.g., verbal directives) information is widely known to bias pain perception, manifest for instance in the placebo and nocebo effects (Wager et al., 2004). Furthermore, recent behavioral economic studies show that the placebo effect can be modulated by the perceived price of a placebo tablet, and notably prices are often perceived to be correlated with consumer demand (Waber, Shiv, Carmon, & Ariely, 2008). Another possibility, however, is that the pain pricing decision, or the *extrinsic (market) value*, is biased independently by social information. This could result in a dissociation between *health preferences* (how health states are intrinsically valued) and *market preferences* (how health states are extrinsically valued in terms of what people are willing to pay to avoid them).

This “dissociation” hypothesis is motivated by a recently proposed fundamental cognitive principle, termed *qualitative incommensurability*, which explains inconsistent judgments and trade-offs in perceptual and preferential decisions (see Vlaev, 2011). This principle postulates that people are unable to systematically compare qualitatively different options or outcomes on a single value or “utility” dimension—an assertion based on existing evidence that such comparisons are extremely difficult. This inability seems to reflect a basic property of human cognition that applies

right across psychology, from the basic psychophysics of sound perception right through to high-level cognitive processes in decision making. As a result, contextual effects should undermine human ability to stably trade-off between qualitatively different goods, such as pain and money. This is because price judgments will mostly be affected by other reference prices, while pain judgments will be predominantly affected by relative comparisons with other pains (see Vlaev, Chater, Stewart, & Brown, 2011, for evidence that choice depends directly on relative comparisons). This cognitive mechanism is likely to generate dissociation between health preferences and market preferences. The typical lack of previous experiences with ill-health states might make people especially prone to extrinsic or market influences, because this entails little experience with related prices that could help them make more consistent decisions.

Here we test this “dissociation” hypothesis. Our study paradigm was an experimental health market, in which individual valuation decisions were made in the context of observing the decisions made by other consumers in a second-price auction.² We use a second price auction because according to classical economic theory, rational decision makers should reveal their “true” preferences (Krishna, 2002). Specifically, the experiments tested the following two hypotheses:

Hypothesis 1: Information about other players’ price-bids to avoid pain will influence the participants’ extrinsic values (observable market preferences revealed by the price that they were willing to pay).

Hypothesis 2: Information about other players’ price-bids to avoid pain will not influence the participants’ intrinsic values (unobservable health preferences).

Method

Participants

Thirty participants (11 men and 19 women; mean age = 24.1 year, $SD = 4.61$) were recruited through the participant pool of University College London. They were randomly assigned to two experiments, so there were 15 subjects in 5 triads in each experiment. Each session lasted an average of 2 hours, and each participant was awarded a £5 show-up fee and up to £20 depending on their performance in the auction (mean income = £22.69, $SD = 2.02$). Volunteers provided

¹ An influence of social information on decision-making is well described in humans and other species. Ecological and experimental studies of decision-making and behavior in animals in simple tasks (such as where to forage for food) show influences from the number of other people behaving in a certain way, the consensus among them, their confidence, their pay-off and apparent affluence, and the costs of relying on social information (Hoppitt & Laland, 2008; Rendell et al., 2010; White & Galef, 1998, 2000).

² *Market* is a social institution or a place where goods and services can be sold and bought for money, and sometimes directly exchanged (market is also the process in which the prices of goods and services are established). *Experimental health market* is a laboratory market where the participants can buy relief from pain. *Auction* is a market process of buying and selling goods or services by offering them up for bid, taking bids, and then selling the item to the highest bidder who pays their bid; but in second-price auction the winning bidder pays the second highest bid rather than his or her own (in economics, an auction may refer to any mechanism for exchange).

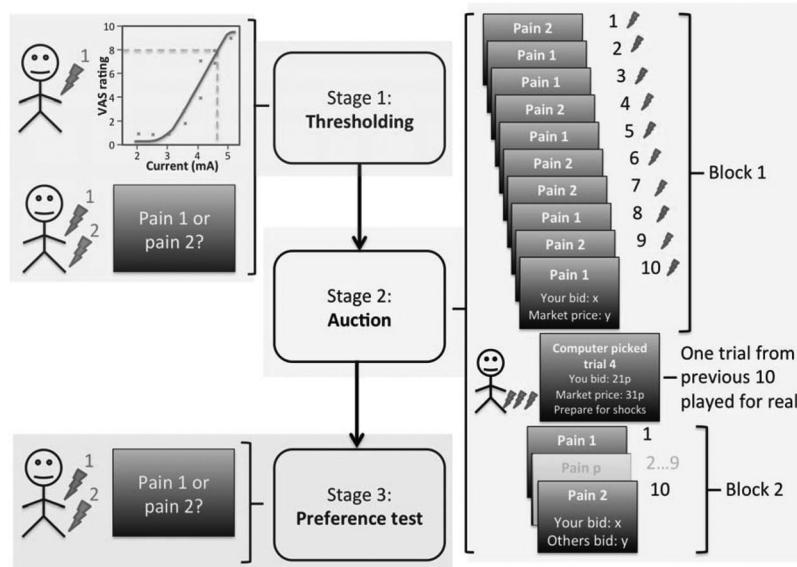


Figure 1. Sessions consisted of three consecutive stages (see the Methods section for more detail): (a) thresholding procedure ensuring that the leg and arm shocks are equally painful; (b) auction for pain relief consisting of 100 trials, in which participants made bids to avoid leg and arm shocks; and (c) preference test asking subjects to directly choose which pain they prefer to experience for a longer duration, which tested whether the two pains are still equally painful or preferred after the auction stage.

written informed consent, and the study was approved by the University College London Research Ethics Committee.

Procedure

Sessions consisted of three consecutive stages illustrated in [Figure 1](#): (a) thresholding procedure ensuring that the leg and arm shocks are equally painful; (b) auction for pain relief consisting of 100 trials, in which participants made bids to avoid leg and arm shocks; and (c) preference test asking subjects to directly choose which pain they prefer to experience for a longer duration, which tested whether the two pains are still equally painful/preferred after the auction stage (i.e., after they have seen different price trends/valuations for the two pains).

The shocks were delivered using a Digitimer DS7a electrical stimulator through silver chloride surface electrodes placed 2–4 cm apart on the dorsum of the left hand and on the distal lateral aspect of the left leg. Each shock consisted of a 1-s duration train of monophasic pulses of 10-ms duration at 10 Hz and was triggered by a TTL pulse delivered from the stimulus computers parallel port. Participants sat viewing a computer screen, and used two keys on the keyboard to submit their decisions.

Thresholding. The standard pain thresholding procedure controls for heterogeneity of skin resistance between participants and also allowed us to administer a range of potentially painful stimuli in an ethical manner. As in previous experiments ([Seymour et al., 2004](#)), shocks with step increases in amplitude were administered to one site (arm or leg), and participants provided a simple visual analogue scale rating of each shock on a scale from 0 (*not painful*) through 10 (*worst imaginable pain*). Mild intensities were initially used, and subsequently intensities of stimulation were increased until participants rated the sensation at the limit of tolerance. Such

a series of increments in shocks were administered to the first site three times to allow adaptation to initial anxiety about the shocks, and thereafter ratings proved more consistent.

When a maximum tolerated current was reached, we tested shock values rated as “8” to establish a stable current intensity corresponding to this value at the first site. “8” corresponds to a significantly aversive but not intolerable pain. Subsequently, we tested incremental stimulation at the other site, asking the participant after each shock whether they would prefer to receive stimulation at that intensity at that site or stimulation established to correspond to “8” at the other site. The stimulation at the original site was repeated with each trial. The intensity at the second site was increased until the participant’s preference for stimulation at the two sites reversed. This procedure was repeated a further two times. The order of sites (arm or leg) used for establishing thresholds was counterbalanced across participants and also counterbalanced with respect to which site was subject to the pricing manipulation (see below).

Auction. We designed an experimental market wherein participants could choose to pay money to avoid painful electrical stimuli, which is illustrated in [Figure 2](#). In a three-player “second price” auction, participants were asked to decide how much they were willing to pay/bid out of a £20 endowment, provided at the start of the experiment, to avoid 15 shocks ([Figure 2a](#)). An offer was marked on a number scale operated by two keys on the keyboard. There were 100 consecutive bids. There were two types of pain distinguished by location—arm pain and leg pain, relief from each being bought by bidding in pence. Fifty pain trials were allocated for the arm and 50 for the leg (pseudorandomly intermixed). Because only one-in-ten trials was played out “for real” —selected after each block of 10 bidding trials—with the

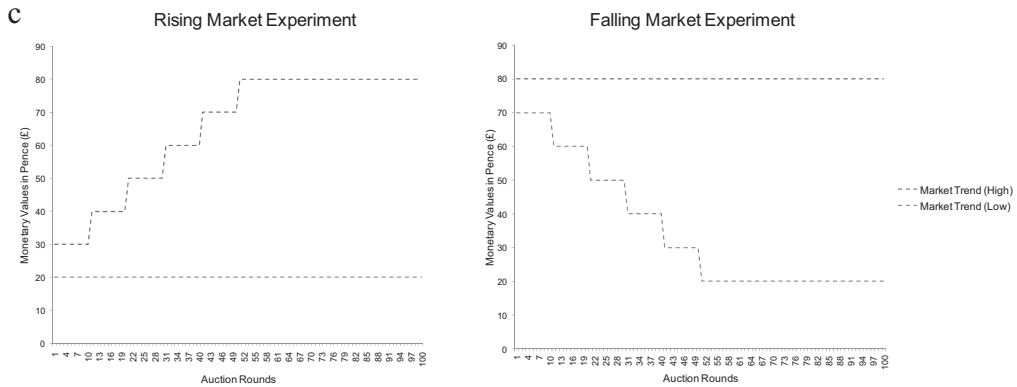
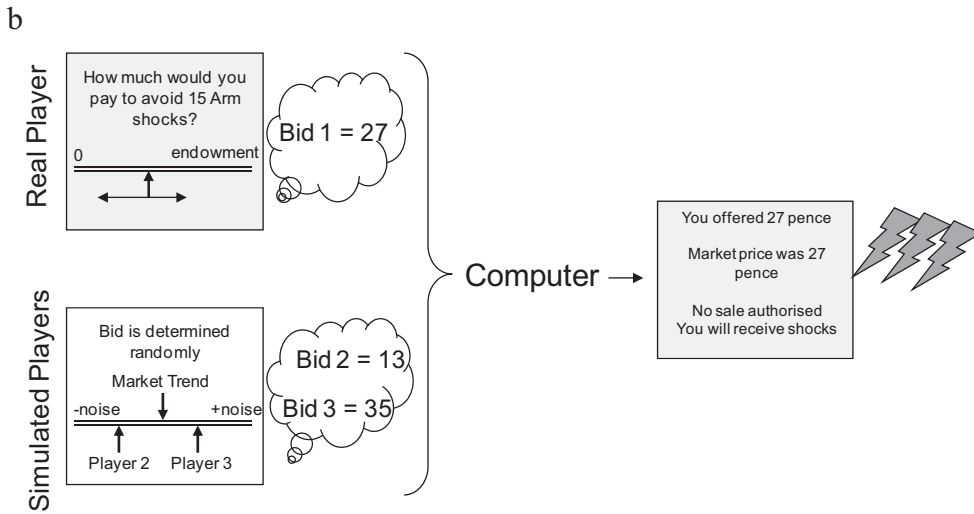
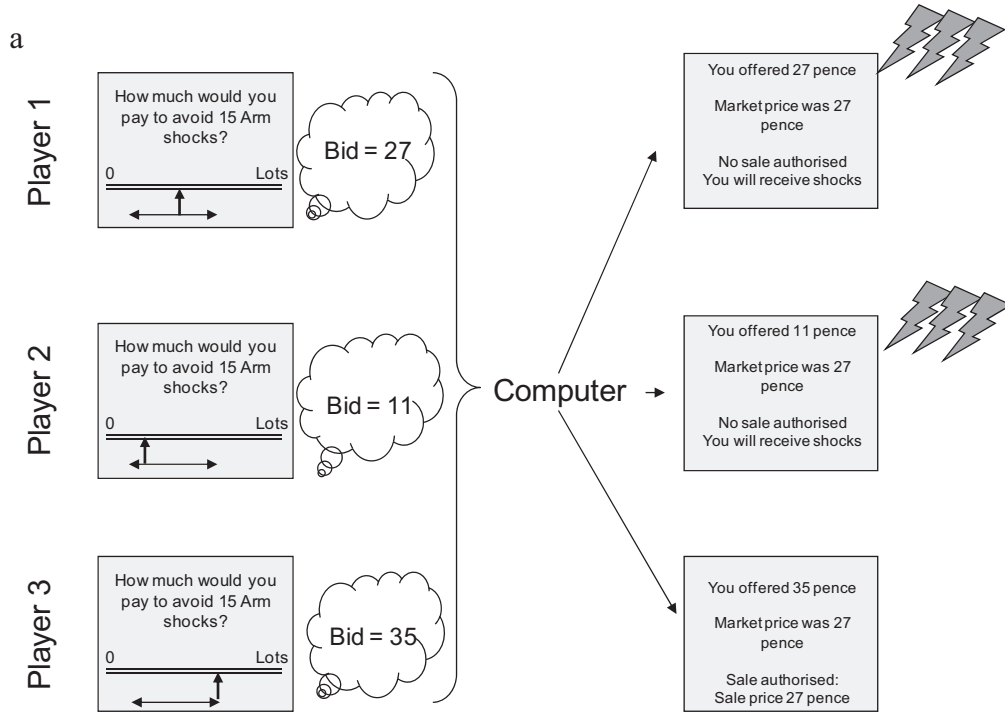


Figure 2 (opposite)

outcome of extended pain or no pain delivered, each player had on average £2 (200 pence) per round to spend, but the participants were allowed to bid any amount they wished up to the total amount left in the account. Participants were informed that their best interest is to treat all rounds as real, because any round can be played out. After bidding, each participant was informed of the median bid in the group: if the bid was below or equal to the median (i.e., the second price in the 3-players auction) then he or she would expect to experience the pain; if the bid was above the median they would buy relief at the median bid price (i.e., not the price they bid; Krishna, 2002).

We ensured that participants have fully understood the rules of the game; that is, the structure and reward contingencies of 2nd priced auction games, which is not an everyday market experience. This is essential because unless subjects understand the optimal strategy, they may mistakenly think that the optimal behavior involves bidding strategically. It was explained that a second-price auction is believed to be incentive-compatible: the best response is to bid one's true willingness to pay. This follows because winning (the highest bid) means the actual payment will be the second-highest bid, which is an uninformative random variable, so there is no incentive to bid more or less. The participants were trained and instructed with graphical slides, text, verbal and practice sessions; and we verbally examined their understanding of the design at several points during the session—before the study began, before each stage, and after the experiment.

Before the start of the auction, each participant experienced six electric shocks on the arm and six on the leg, alternating arm then leg, which provided the participant with a sample of experiences of the “commodity” traded in the auction (we used six shocks to match the number of shocks in the postauction pain preference test). As a consequence, they entered the pricing phase of the experiment with full information about the experience they are evaluating.

Unbeknown to the participants, the bids of the “other” players were artificially generated to follow a pattern, here referred to as the market trend, in two separate experiments with 15 participants each (Figures 2b and 2c). In the first experiment (5 men and 10 women; mean age = 24.1 year, $SD = 4.36$; mean income = £23.89, $SD = 1.15$), denoted the Rising Market Experiment,

participants observed stable low pricing for one pain type and increasing prices for the other pain type. In the second experiment (6 men and 9 women; mean age = 24.0 years, $SD = 5.00$; mean income = £21.48, $SD = 1.99$), denoted as Falling Market Experiment, participants encountered markets with stable high pricing for one pain and decreasing prices for the other. In each experiment, the two market trends, denoted as Low Pricing and High Pricing, were randomized with respect to arm pain and leg pain. The bids of the simulated players were randomly generated using uniform distributions with a mean market trend and variance equal to $\pm 50\%$ of the value of the mean (i.e., between 50% and 150% of its mean). In the rising-market experiment, the mean bids for the low price pain were fixed at 20 pence (p), while the average bids for the high price pain started at 30p and increased in 10p increments every 10 trials up reaching 80p after the first 50 trials, and remaining at 80p over the following 50 trials. In the falling-market experiment, this pattern was reversed with the average bids for high price pain were fixed at 80p, while the low price pain started at 70p and decreased to 20p over the first 50 trials, reaching an asymptote at 20p over the last 50 trials. If participants' bidding (their extrinsic values) follows those social trends (the social context) this result should support Hypothesis 1.

Finally, the money not spent on avoiding the electric shocks on each trial was kept in the participant's account and the total payment was based on the accumulated money over all trials.

Preference test. The auction was followed by six trials on which the participants were asked to make pairwise comparisons between the two pain types. On each trial, the participants experienced two shocks and then were asked to select which shock they preferred to experience for a longer duration (15 shocks). If participants' are equally likely to choose each pain (i.e., their intrinsic values are not affected by the social trends observed during the auction), then this result should support Hypothesis 2. At the end of this stage, one of the six choices was selected at random and each participant had to experience 15 shocks for real.

Statistical Analyses

Paired t tests were used to test the difference between bids for low-price pain and high-price pain in the rising-market and falling-

Figure 2 (opposite). Bidding for pain relief in a second price auction, which should encourage each participant to reveal his/her “true” preferences and bid however much he/she feels it is worth paying to avoid the pain. (a) The pain auction from the point of view of the participants. Before the auction began, the participants received 6 shocks to the arm and 6 to the leg to familiarize themselves with the pain “commodity”; then on each trial they were asked to bid for pain relief from 15 such shocks, and the second largest bid was deemed the market price. If a particular bid was greater than the market price, the bidder buys pain relief for that trial at the market price. If the player bids equal to or less than the market price, he/she does not buy pain relief for that trial and should receive the multiple shocks. This auction was repeated for 100 trials, but only 1-in-10 trials were played out for real. (b) The pain auction as it was actually implemented. Unbeknown to the participants, they were playing against simulated players whose bids were randomly generated using uniform distributions with a mean and variance equal to $\pm 50\%$ of the current value of the “market trend.” (c) Price manipulation in the fake auction. The participants were assigned to two “market trend” conditions. In the rising trends experiment, the “high price” pain rose incrementally for the first 50 trials then stabilized for the final 50 trials, while the “low price” pain remained constantly low. In the falling trends experiment, the “high price” pain remained constantly high, while the “low price” pain fell incrementally for the first 50 trials then stabilized for the final 50 trials. For each participant, arm and leg were randomly assigned to be “high price” or “low price” for the duration of the trials.

market experiment respectively; and also for the differences between the choice proportions in the postauction preference test. Unpaired t tests were used to test the difference between bids and the underlying “market trend” for high-price and low-price pain respectively. Pearson product–moment correlation was used to test the association of the bids and the “auction price” for high-price pain and low-price pain respectively. Univariate Analysis of Variance was used to test the differences in bids across market trends and experiments: within-subject main effect of market trend (low vs. high) and between-subjects main effect of market condition (rising vs. falling). Multiple regression analysis compared the three major factors explaining the variance in bids: (a) “market trend (target pain)” is the underlying current value of the simulated players’ bids; (b) “market trend (other pain)” is an interaction term between the current price trend of the pain that the agent is not valuing on the current trial and an indicator ($-1, +1$) of whether this pain is currently higher or lower in price (i.e., the coefficient indicates to what degree current bids are attracted toward the “other price,” irrespective of which pain is currently of higher value); and (c) “Last Bid” is the last bid made by the player for the target pain. A separate regression was run for each participant and one-sample t test procedure tested whether the mean of each variable’s coefficients—across all participants—differs from zero (see Gelman & Hill, 2007).

Results

In the rising-market experiment, the participants observed that other bidders increased their bids for one pain type and offered constantly low bids for the other pain type (see Figure 3). The results are presented in terms of low-price pain and high-price pain, because arm pain and leg pain were randomly assigned to these conditions across participants. Participants’ bids closely followed the market trend for the static low-price pain. Indifference predicts that the bidders should offer similar amounts for the two

pains; however, we found a significant increase in bids for the high-price pain, evident as a difference between the average bids: 40.2 pence for high-price pain and 20.8 pence for low-price pain, $t(14) = 4.0, p = .001$. The correlation between bids and the auction price was also significant for both the high-price pain ($r = .67, p < .001$) and low-price pain ($r = .61, p < .001$), which confirmed that the participants were responsive to the market trend. The bids significantly lagged behind the increasing price during the first 50 trials and thereafter, $t(14) = 4.5, p = .001$ —high price bids by participants were reduced by -25.2 pence on average relative to the market trend (65.4 pence); that is, the participants consistently underbid; while there was no difference between the bids and the market trend for the low-price pain, $t(14) = 1.2, p = .25$; that is, the low price bids were unaffected.

In the falling-market experiment, Figure 4 presents the opposite pattern—bidders gradually decreased their offers as the low-price pain decreased, while they kept offering constantly higher bids for the high-price pain—that is, the bidders closely tracked the market prices. Again, there was a significant difference between the average bids for the two pain types: 83.7 pence for the high-price pain and 57.0 pence for the low-price pain, $t(14) = 4.6, p < .001$. Here the correlation between bids and the auction price was significant for both the high-price pain ($r = .93, p < .001$) and low-price pain ($r = .24, p = .016$), again demonstrating that bids are driven by an underlying market trend. The participants followed the trend of the static high-price pain—where there was no significant difference between bids and trend, $t(14) = 0.40, p = .70$, but their bids still significantly lag behind the dynamic/decreasing pricing for the low-price pain throughout the session, $t(14) = 3.5, p = .004$ —low price bids by participants were increased by $+21.6$ pence on average relative to the market trend (35.4 pence). Thus, the participants consistently *overbid*, offering in excess of the amount required to beat the market price and avoid the pain.

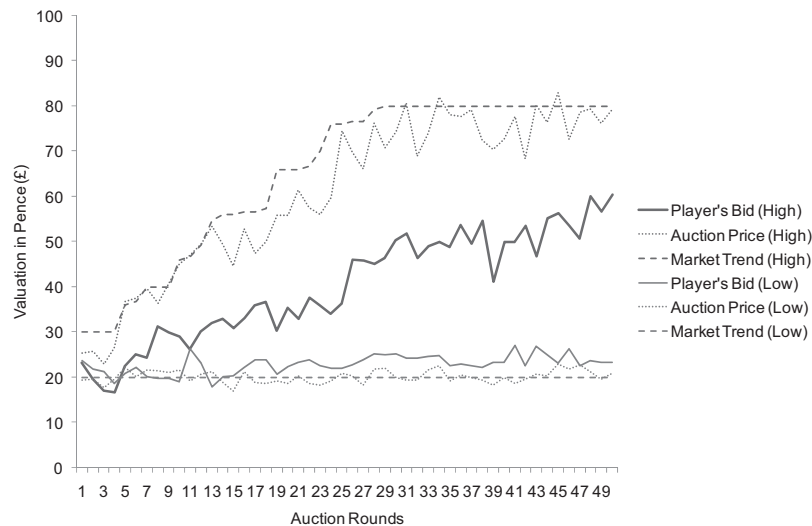


Figure 3. Mean price offers depending on social/pricing context in the Rising Market experiment. Data are the running averages (over a fixed window of ten trials) of bids plotted alongside the actual auction (second) price and the mean market trend (low vs. high) used to generate the bids of the other two players for each pain type (the actual bids are not plotted on this figure but closely follow this trend).

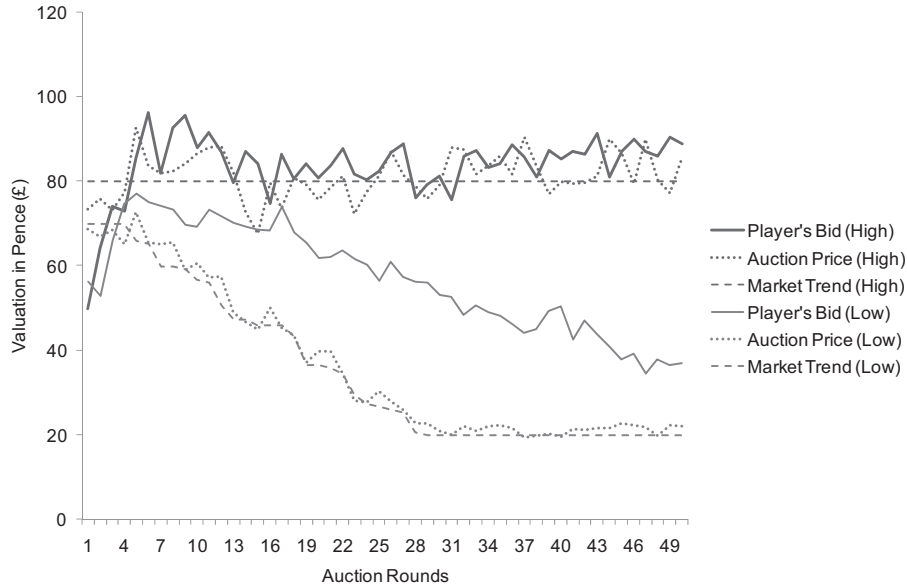


Figure 4. Mean price offers depending on social/pricing context in the Falling Market experiment. Data are the running averages (over a ten trials window) of bids plotted alongside the actual auction (second) price and the mean market trend (low vs. high) used to generate the bids of the other two players for each pain type (the actual bids are not plotted on this figure but closely follow this trend).

The differences across market trends and experiments are summarized in Figure 5. Strikingly, willingness-to-pay (in real monetary terms) between low-price pain in the rising-market experiment and high-price pain in the falling-market experiment is completely different—players offered four times more in the latter. There is also a significant within-subject main effect of market trend (low vs. high), $F(1, 28) = 36.4, p < .001 (\eta^2 = .57)$, and also a significant between-subjects main effect of market condition (rising vs. falling), $F(1, 28) = 22.0, p < .001 (\eta^2 = .44)$, because people offer more on average in the falling-market than in the

rising-market. And these differences are despite the fact that all pain types are equally preferred, as revealed by the postauction preference test. In the rising-market, the choice proportions of the low-price pain and high-price pain were 0.56 and 0.44, respectively, $t(14) = 0.6, p = .54$, while in the falling-market both choice proportions were exactly 0.50, $t(14) = 0.0, p = 1$. Thus, the participants revealed that their preferences for each pain type remained the same (i.e., equally aversive).

Table 1 presents the results from the regression analysis. Market trend (target pain) explained the greatest proportion of bids (in

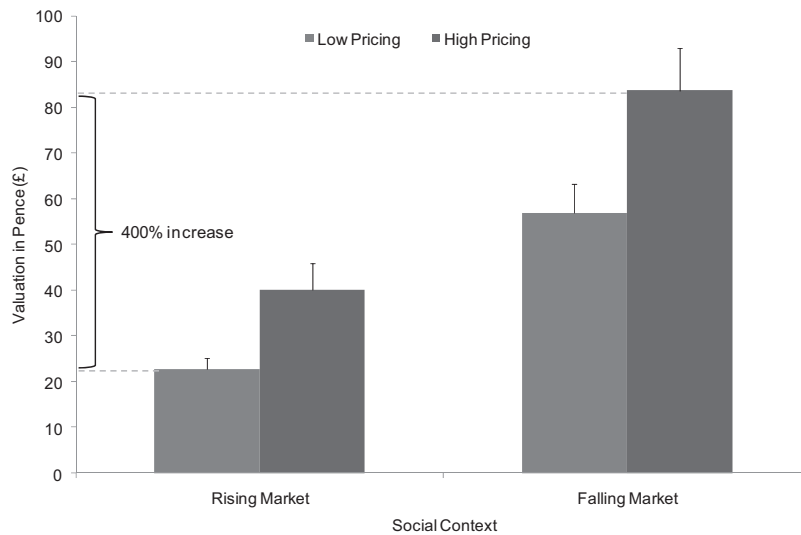


Figure 5. Summary of the results in the two experiments (or social contexts): rising market vs. falling market, plotted according to pricing condition (low vs. high) in each experiment/ context. Data are mean and SEs.

Table 1
Regression Analysis of the Factors That Explain the Variance in Bids (Valuation)

Rounds	Regression variables	Rising market experiment			Falling market experiment		
		Coefficient	<i>p</i>	<i>R</i> ² change	Coefficient	<i>p</i>	<i>R</i> ² change
1–100	Market trend (target pain)	.34	.000	.78	.50	.000	.86
	Market trend (other pain) ^a	−.06	.002	.08	−.08	.001	.07
	Last bid	.52	.000	.05	.55	.000	.03
	<i>R</i> ²			.91			.96
75–100	Market trend (target pain)	.62	.000	.85	.80	.000	.87
	Market trend (other pain) ^a	−.07	.118	.10	−.17	.001	.11
	Last bid	.13	.083	.00	.23	.031	.00
	<i>R</i> ²			.95			.98
1–100	Last bid = price (high pain)	.98	.504		−1.97	.320	
	Last bid = price (low pain)	.72	.512		−3.57	.189	
	Trial-price interaction	.06	.223		.01	.807	

Note. Separate regression was run for each participant and the table presents the averaged values of the variables. The *p* values indicate the significance of the one-sample *t*-test procedure testing whether the mean of each coefficient (across all participants) differs from zero.

^a Market trend (other pain) reflects the interaction of the current price trend of the other pain and an indicator of whether the other pain was the higher or lower in price in the experimental condition (i.e., this coefficient indicates that bids are being attracted towards the other price, irrespective of which pain is currently of higher value).

terms of *R*²). Market trend (other pain) had a significant additive power in explaining bids, potentially accounting for underbidding and overbidding phenomena when the market trend, and the auction price, were increasing or decreasing respectively. The negative value of this coefficient indicates that this factor pulls the bids in a direction opposite to the market trend of the target pain, sufficient to cause the underbidding/overbidding behavior especially if participants base their responses entirely on the observed social trends in the market. To confirm that underbidding/overbidding does not reflect a learning lag in tracking the market trend for the changing price, we ran a separate regression for the last 25 trials alone, which showed similar results across all variables (Table 1) and thus verifies that the coefficient for market trend (other pain) is negative even after the trend has stabilized. These results suggest that the participants may not define their preferences in terms of absolute money-pain trade-offs and also that they may not have stable preferences relative to the market price (e.g., preferring to keep the probability of receiving pain fixed). Last Bid also influenced the current bid, which may reflect assimilation (positive correlation) toward previous responses (Petzold, 1992) or habit (Fuhrer, 2000; Osborn, 1988)—well-documented psychophysical and economic phenomena. In summary, bidding is best explained by participants following other market agents, and not by stable underlying preferences.

We also tested whether the participants treat others' bids as useful information about how bad the pain really is, or how it should be priced compared with other goods. There is a large literature on rational conformity, "information cascades," and herding, which shows conditions under which prices could depend on information revealed by actions of others (Bikhchandani, Hirshleifer, & Welch, 1998). Two new variables for the high-pain and low-pain indicated whether the current pain follows a trial where the bid was equal or not equal to the market price. The effect of these variables was not significant (Table 1), which rejects the possibility that players perceive others' bids as having some information value. The effect of time (the interaction between trial number and market price) was also not significant, which suggests

that agents do not become less reliant on others for information as they gain more experience.

Discussion

The demand for pain relief is relative to what other consumers are willing to pay, even for other commodities (here, alternative pain reliefs). The results reveal deep contrasts between intrinsic and extrinsic values in pain markets—maker preferences are affected, and even reversed, by social observations, which occurs despite the subjective perception of the two pains remaining constantly equal and unaffected by the prices offered by others. These effects are unlikely to occur if market preferences reveal people's health preferences. Assuming that the participants understood the logic of the auction market, this casts doubt on the assumption that people make economic choices according to their true health values.³ This bears new lessons in behavioral health economics and verifies the commensurability principle (Vlaev, 2011).⁴

Similar behavioral results have been shown in experimental auctions when gamble pricing by others has an effect on the market price (Cox & Grether, 1996; Loomes, Starmer, & Sugden, 2003). This is the *shaping hypothesis* that market experience alters or "shapes" preferences, because values may be only partially formulated or imprecise, and responses are generated by heuristics that use market prices as cues. However, this mechanism is unlikely to drive the behavior here, as the health/

³ Note that this effect is different from much evidence that preferences about pain do not adhere to normative structures, as shown in work on the pain of colonoscopies and duration neglect (Kahneman, Wakker, & Sarin, 1997).

⁴ In addition to explaining inconsistent trade-offs in decision making, qualitative incommensurability between value scales could also explain other analogous dichotomies between intrinsic and extrinsic motivation (Deci, Koestner, & Ryan, 1999) and between "social markets" and "monetary markets" (Heyman & Ariely, 2004).

pain preferences remained unchanged before and after the auction.

The demonstration of socially determined relativity, especially for pain, is an important new result. Our previous work shows pain-based and income-based relativities in willingness-to-pay (Vlaev et al., 2009) and in motor control (Kurniawan et al., 2010), where the comparison values are other available options. However, this is very different from the present case where the comparison is with the “bids” of other people, which suggests that the “value” people attribute to avoiding an aversive state depends on their beliefs about the value that other people attribute to that state. Therefore, how individuals assess a health state might not be only based on personal experiences, but rather is determined socially. This “social relativity” phenomenon is relevant to health psychology, economics, and policy.

Implications

Misalignment between intrinsic and extrinsic valuations of health is an inherent part of any market-based health system, in which patients, as consumers, purchase health care to alleviate their symptoms. This leaves the patient open to the full force of advertising by commercial providers, who for example might try to suggest that a great many patients routinely purchase a treatment (at its current price), leading the patient to overvalue the treatment. Ill-health and health treatments are often those in which a patient has little experience with, so as such are especially susceptible to “coercive” marketing strategies.

Health policy in the United Kingdom, among other countries, is moving strongly in the direction of patient-based choice, both in terms of providers and products, and is increasingly privately (and not state) provided. Therefore, possible implications include ways to align (or realign) these valuations through policy. Given the potential vulnerability of patients to profit-driven health care provision, patients (typically the elderly and sick, and as such not best placed to critically appraise the cost-worthiness of a particular treatment) may need substantial support with their health choices, and the growing industry of patient-directed marketing may need special regulation. Also, if other studies confirm that social forces matter, then firms or governments can use this knowledge to affect prices or purchasing behavior. For example, this provides the opportunity for health policymakers to positively use “the market” to reduce prices and improve quality by legislation that openly publicizes patient experiences with providers and treatments. This is already being implemented with health care providers in the United Kingdom and United States, and this could be extended to individual treatments, when a sufficient threshold of feedback is reached (to avoid oversusceptibility to a small number of individual experiences).

The contribution to health psychology is theoretical as well as applied. Researchers study psychological factors in pain management and related psychological, physical, and biological functioning (Burns, 2000; Dixon, Keefe, Scipio, Perri, & Abernethy, 2007; Ward et al., 2008), and also factors mediating and moderating the experience of pain (Burns et al., 2008; Vowles, McCracken, & Eccleston, 2008). This study extends this theoretical understanding to factors affecting the economic behavior of patients—consumption of relief from (simulated)

health symptoms. The practical implications are the new opportunities and techniques (akin to social norms) to influence the economic behavior of patients in pain, for example motivating them to purchase medication (see Hanoch, Katsikopoulos, Gummerum, & Brass, 2007) or health insurance, especially because factors such as economic hardship and financial worry can influence experience of pain (Rios & Zautra, 2011; Rohling, Binder, & Langhinrichsen-Rohling, 1995). Our work also tackles psychological effects on outcomes related to health policy. Pain is a major public health issue, given the fact that the prevalence of clinically significant pain is approximately 20% in the general population, and the global annual cost of analgesics is around \$60 billion (Macfarlane, Jones, & McBeth, 2005; NFO World Group, 2007). If psychologists can better understand and influence the over- or underconsumption of analgesics, this could have an enormous impact on policy.

Limitations

A possible limitation of the current approach is the possibility that bidders might engage in some form of strategic bidding, rather than revealing their true preferences that a second price auction should elicit. This might involve basing bids on expectations of others’ bids, in which participants do not bid their willingness-to-pay, but merely bid lower if they think they can get away with it. To avoid this, our participants were extensively trained and instructed, which guarantees they understood the structure and reward contingencies of this auction. The validity of results from n th price auctions is also supported by a large literature in economics—such auctions are a longstanding and widely used method in allocating goods and institutional design (e.g., Cassidy, 1967). Note also that such strategic influences will be even more pronounced in traditional “first price” auctions (Goeree, Holt, & Pfaffrey, 2002), which characterize the majority of real market settings; and hence the observed effects might be more dramatic in the real health economy.⁵ Similarly, real consumers obtain information about prices and then make a yes/no purchase decision, without opportunity to adjust their payments depending on preferences, which could potentially make them even more influenced by their guesses and market prices. The second price auction is used in economics because it is supposed to avoid such problems.

Future Directions

Future research should provide more elaborate controls for participants’ assumptions about the other players’ understanding, about stochastic elements in their behavior, and the effective goal that drives their bidding behavior (e.g., strategic bidding, avoiding the shock; winning an auction per se; exploiting others). For example, participants could see information

⁵ There is large economic literature on price sensitivity demonstrating that people react and change their behavior in responses to price. However, this literature is not very relevant, and we can exclude it as a potential explanation, if price is random as in second (or n^{th}) price auction. The whole point of the second price auction is that it *should* make people reveal their true preference—which definitely will not be in other cases (e.g., first price auction), when people will clearly behave strategically.

about others' valuations, but in which they cannot react strategically to that information. Another possibility is to use verbal protocols to examine participants' intuitions and intentions (e.g., see Bechara, Damasio, Tranel, & Damasio, 1997; Maia & McClelland, 2004).

Also, our study population may not be wholly reflective of the demographics of the population most likely to consume health products in real environments. Other factors including age, educational background and previous health experience may influence susceptibility to price manipulations, which is something that could be addressed in field studies in real clinical populations (e.g., differently priced treatments might yield different purchasing patterns, or indeed differential experience). This is especially relevant in the current health policy climate which focuses on increasing choice and competition in health care markets. Susceptibility to valuation biases shaped by social context is likely to have substantial economic implications, if such psychological processes play an important role in real and dynamic health care markets.

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Received November 16, 2011

Revision received April 13, 2012

Accepted April 16, 2012 ■