Willingness to Pay, Willingness to Accept and "Smooth vs Kinked" Utility of Wealth Functions: An Empirical Test of a Theoretical Debate

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No 2010/06

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Abstract

We obtain 'Willingness to Accept/Willingness to Pay' (WTA/WTP) ratios for two health complaints, preceded by a WTA-WTP learning experiment utilising an incentive compatible disclosure method. We find that while, not surprisingly, there is some variation in WTA and WTP responses for more substantial health effects across the sample, it is nonetheless the case that as the severity of the health effect is reduced, so the WTP/WTP ratio converges across the sample and tends to unity, in accordance with theory. On the basis of this evidence, we find no compelling evidence to reject the neoclassical assumption of 'smooth' utility of wealth functions which underlies standard Value of a Prevented (Statistical) Fatality (VPF) analysis.

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1.   Introduction

The possibility of a significant disparity between an individual's willingness to pay (WTP) for a small increase in his/her allocation of a particular good and the corresponding willingness to accept (WTA) for a reduction of the same magnitude has been the focus of an ongoing debate in the literature – see, for example, Kahneman and Tversky (1979), Kahneman et al (1990), Haneman (1991), Shogren et al (1994) or Sugden (1999). Thus, while standard economic theory predicts that, at least for small variations in the allocation of a good or service, WTP and WTA should differ only to a very minor extent, there is a substantial body of evidence indicating large discrepancies.

Nonetheless, some have argued – and indeed have provided empirical evidence in support of the claim (see Shogren et al (1994), Bateman et al (1997) or Plott and Zeiler (2005)) – that if individuals are given sufficient time to reflect carefully on the issue, or by using an "incentive-compatible" elicitation device then WTP and WTA responses will tend to converge, at least in the case of "everyday goods" such as chocolates, ball-point pens or coffee mugs. However, when one turns to more complex goods such as health and safety, even when individuals are given the time and opportunity to consider their responses in a careful and well-informed manner, the evidence still points towards WTA figures that exceed their WTP counterparts by several multiples – see, for example, Guria et al (2005).

There would appear to be three broadly plausible explanations for the observed discrepancy between WTP and WTA responses in the health and safety context. The first possibility is that, as suggested by Kahneman, Tversky and others, underlying preferences may not conform to the standard neoclassical assumption of smooth and continuous substitutability between goods and may instead display "kinks" reflecting the fact that gains from a "status quo" are treated in a fundamentally different way from losses. This has potentially very serious implications for the so-called "willingness to pay" (WTP) approach to the valuation of health and safety – which is now widely used in public sector allocative and regulatory decision making in the USA, UK and several other countries. Of most concern is that this would mean that the marginal rates of substitution of wealth for the risk of death, injury or illness that are taken to underpin many of the valuation concepts used in the health and safety field – see, for example, Jones-Lee (1976) or Viscusi (1978) – would simply be *undefined.* As a result, methods such as those proposed by Carthy *et al*. (1999) would, to all intents and purposes, collapse.

By contrast, a second possiible explanation for the disparity is entirely consistent with neoclassical theory and relies on the diminishing marginal utility of wealth and the existence of budget constraints. Put simply, if an individual regards a potential health effect as being non-trivial, then with sufficient curvature in the individual's utility of wealth function it is quite possible that his/her WTP and WTA responses for a given variation in the level of the health effect could differ to a substantial degree.

The third possible explanation for the WTA/WTA disparity in the health and safety context is somewhat more prosaic and relies on the fact that for the vast majority of transactions carried out by members of the public, by far the most common are those in which people make an "off-the-cuff" decision as to whether or not they will pay the "posted" price for a particular good. Far less common are situations where a consumer ponders at length the maximum would s/he pay rather than go without the product or the minimum s/he would accept to sell something. Indeed, arguably a more likely scenario is to wonder about the least s/he can get away with paying or the maximum s/he can obtain for the item being sold. We are particularly struck by Plott and Zeiler's (2005) observation that, implicitly, researchers aim to avoid subject misconceptions about the elicitation procedures, but do little, if anything, to define or quantify possible misconceptions within a study. We conjecture that because of the natural psychology of the task with its associated strategic incentive, there is a reasonable possibility that at least some of the 'excessive' discrepancy noted in the literature is caused by peoples' 'misinterpretation' of what is actually meant by 'minimum WTA' and/or 'maximum WTP', particularly, given the one-shot, non-reflective nature of most empirical estimation exercises. Indeed, even if they are given the opportunity to revise their answers at the end of the exercise, respondents in a WTP/WTA study or choice experiment have nowhere near the flexibility and chance for reflection that is typically involved in a real-life purchase or sale. For example, failure to sell your home or the realisation that you have paid too much for a coat can almost always be followed up in reality by reducing your asking price for the house or returning your coat to the shop where you bought it.

In this paper we test the first explanation, controlling for the other two. We control for the second explanation by choosing two sufficiently 'trivial' health complaints and control for the third by teaching respondents, prior to the health valuation questions, what is meant by economists by a minimum (maximum) WTA (WTP) and the potential consequences of over or under bidding. This is achieved using an incentivised, incentive-compatible selling and buying task, invoking the idea of 'spillover effects' (Cherry et al 2003)) whereby lessons

leaned in such an environment can be carried over to a subsequent hypothetical valuation task.

This will allow for a more robust test as to whether there is a strong case to reject the neoclassical assumption of "smooth" preferences and well-defined marginal rates of substitution. If the discrepancy persists, this points to the possibility of a discontinuity in the utility of wealth function at current wealth i.e. the 'kinked' preferences of the first explanation (discussed in more detail in Section 2 below). If however, WTA and WTP responses are much closer together with the ratio approaching unity as the severity diminishes, then we would suggest that this be taken as evidence that it would be premature to accept the assumption of an undefined MRS for injury and wealth, at least until further empirical evidence is provided to the contrary.

In the next section, we outline the conceptual debate regarding the nature of underlying preferences and elicited WTA/WTP ratios. Section 3 outlines the empirical methods while Section 4 describes our results. Based on the elicited WTA/WTP ratios, our study finds no strong evidence to refute the underlying theoretical assumptions of continuous and differentiable utility (of wealth) functions. Section 5 offers some further discussion and observations.

2. WTP and WTA in the valuation of health and safety

Consider a safety improvement that will afford each member of a large group of n individuals a reduction of $\frac{1}{n}$ in the risk of death during the forthcoming period. The expected number of fatalities during the period will therefore be reduced by precisely one and the safety improvement is therefore described as preventing one "statistical fatality". Under the WTP approach the value of the safety improvement would be taken to be the aggregate, (possibly with distributional weights applied), of each affected person's willingness to pay for his or her (small) reduction in risk. This is naturally referred to as the "Value of Preventing One Statistical Fatality" (VPF) or as the "Value of Statistical Life" (VSL). In the case of non-fatal injuries or health impairments, WTP-based values are defined in a similar way. In turn, it is a well-established result (see, for example, Jones-Lee (1976) or Viscusi (1978)) that under this definition, the value of preventing a statistical fatality or injury will be given by the (possibly weighted) average of individual marginal rates of substitution (MRS) of wealth for the risk of death or the injury/health impairment concerned.

However, all of this presupposes that the relevant marginal rates of substitution are well-defined. More specifically, under Expected Utility Theory an individual's MRS of wealth for risk of a particular severity of injury (or health impairment) is given by the utility loss that the individual would experience as a result of suffering the injury, divided by his/her expected marginal utility of wealth (again, see Jones-Lee (1976) or Viscusi (1978). Thus, for example, consider an injury of sufficiently limited severity that the prospect of suffering the injury would leave the individual's marginal utility of wealth unaffected. The graph of the individual's utility of wealth function conditional on suffering the injury, I(w), would then be effectively "parallel" to the graph of the corresponding function conditional on normal health, U(w), that is I(w) would be given by:

$$I(w) = U(w) - \kappa, \kappa > 0 \tag{1}$$

Under conventional assumptions, for a financially risk-averse individual the situation would then be depicted in Figure 1, where $\bar{w}$ denotes the individual's current level of wealth.
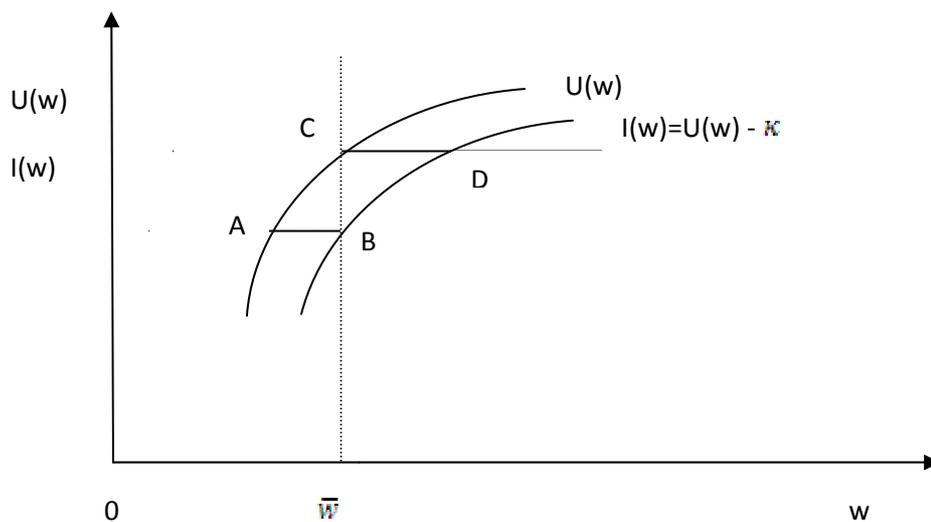

Figure 1

In this case the individual's MRS of wealth for risk of sustaining the injury is therefore given by:

$$MRS = \frac{U(\bar{w}) - I(\bar{w})}{U'(\bar{w})} \tag{2}$$

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$$= \frac{\kappa}{U'(\overline{w})} \qquad (3)$$

where $U'(\overline{w})$ denotes the first derivative of U(w) evaluated at $\overline{w}$, i.e. the marginal utility of wealth at $\overline{w}$.

In addition, as argued by Carthy *et a*l. (1998) the MRS of wealth for risk of suffering the injury as given by equation (3) can be expressed as a weighted average of the maximum amount that the individual would be willing to pay to avoid the certainty of suffering the injury (WTP) and the minimum sum that he or she would be willing to accept as compensation for suffering the injury (WTA). In terms of Figure 1, these amounts are given by *WTP=AB* and *WTA=CD*. Amongst other things, this result provides a means by which an individual's MRS for a particular severity of injury can be estimated on the basis of answers to questions concerning the certainty of suffering the injury, thereby avoiding the necessity to confront the respondent with the conceptually somewhat demanding task of trading-off wealth against small variations in risk.

But now suppose that rather than being "smooth" (i.e. continuous and differentiable) at $\overline{w}$, the utility functions U(w) and I(w) are in fact "kinked" with the right derivatives at $\overline{w}$ being significantly smaller than the left derivatives, as is assumed to be the case under Prospect Theory and Reference-Dependent Theory (see, for example, Kahneman and Tversky (1979) or Tversky and Kahneman (1991)). The MRS of wealth for risk would then be essentially *undefined* at $\overline{w}$ and as argued in Jones-Lee (1989), it would be necessary to distinguish between the WTP-based value of preventing a statistical injury for risk *reductions* (based on the left derivatives of U(w) and I(w)) and a "willingness to accept compensation" (WTA)-based value for *increases* in risk (based on the right derivatives). Assuming that the individual concerned was financially risk-averse for both increases and decreases in wealth, then for a relatively minor injury the situation would be as shown in Figure 2 where the graph of I(w) is again essentially "parallel" to the graph of U(w) in the sense reflected in equation (1) that is: $I(w) = U(w) - \kappa, \kappa > 0$.
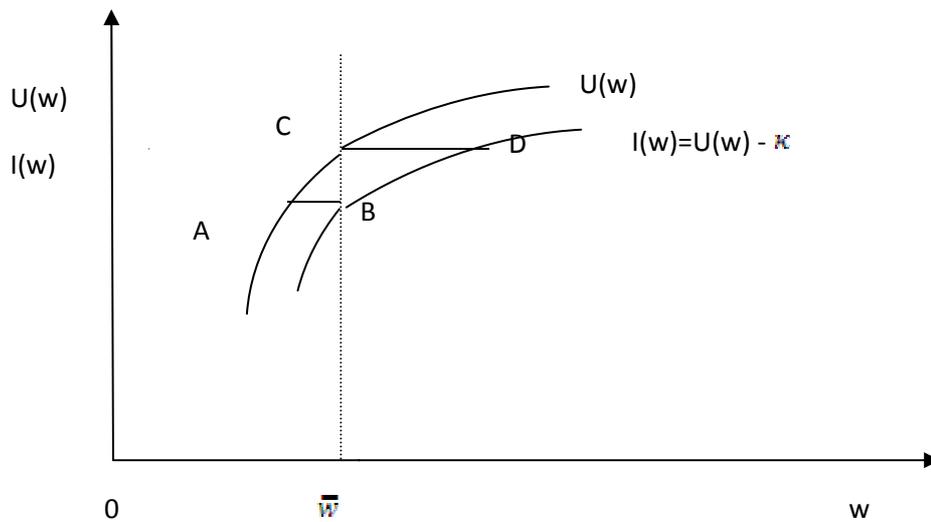
Figure 2

The fundamental and vitally important question that then arises is how one could, in practice, establish whether individual preferences concerning safety and health effects are more appropriately reflected by the "smooth" utility of wealth functions depicted in Figure 1 or by the "kinked" versions shown in Figure 2 (or, indeed, by some other "kinked" form). The simplest answer would appear to be by determining the individual's WTP and WTA for the certainty of suffering the injury and then establishing the way in which the ratio $\frac{WTA}{WTP}$ behaves as the severity of the injury is reduced i.e. in terms of equation (1), as $\kappa \to 0$.

Thus, consider first the "smooth" case shown in Figure 1. As already noted, the WTP and WTA amounts would then be given, respectively, by *AB* and *CD*. Furthermore, it will necessarily be the case that:

$$\frac{\kappa}{AB} > U'(\overline{w}) > \frac{\kappa}{CD} \tag{4}$$

from which it follows immediately that

$$CD > \frac{U'(\overline{w})}{\kappa} > AB \tag{5}$$

that is, WTA will necessarily exceed WTP. In addition, it is clear from Figure 1 that the ratio

$\frac{WTA}{WTP} \left(= \frac{CD}{AB}\right)$ will (i) be an increasing function of k (i.e. as the severity of the injury increases) and (ii) will tend to unity as k tends to zero[2].

By contrast, in the "kinked" case depicted in Figure 2, while the ratio $\frac{WTA}{WTP}$ would again exceed unity and would also be an increasing function of k, the kink would necessarily entail that $\lim_{k \to 0} \frac{AB}{CD} = \frac{U'(\overline{w})^-}{U'(\overline{w})^+}$ where $U'(\overline{w})^-$ and $U'(\overline{w})^+$ denote the left and right derivatives respectively of $U(w)$ at $w = \overline{w}$ so that with the kink taking the form depicted in Figure 2, it would be necessarily be the case that the $\frac{WTA}{WTP}$ ratio would tend to a figure *greater than* unity as the severity of the injury decreased.

But this does not exhaust all of the possibilities in the kinked case. Thus, for example, in Kahneman and Tversky (1979) it is argued that for the typical individual, while U(w) will indeed be concave for $w > \overline{w}$, it will by contrast be convex for $w < \overline{w}$ (i.e. to the left of the kink), though again the kink will entail that $U'(\overline{w})^- > U'(\overline{w})^+$. If we again assume $I(w) = U(w) - \kappa, \kappa > 0$ then the situation will be as depicted as in Figure 3.

In this case it will again necessarily follow that for κ small we will have $WTA > WTP$ and also that $\lim_{\kappa \to 0} \frac{WTA}{WTPCD} > 1$. However, the $\frac{WTA}{WTP}$ ratio will not necessarily be a monotonically increasing function of κ and could, for example, follow an initially increasing but eventually decreasing path or indeed, with U(w) sufficiently convex for $w < \overline{w}$, might even be monotonically decreasing.

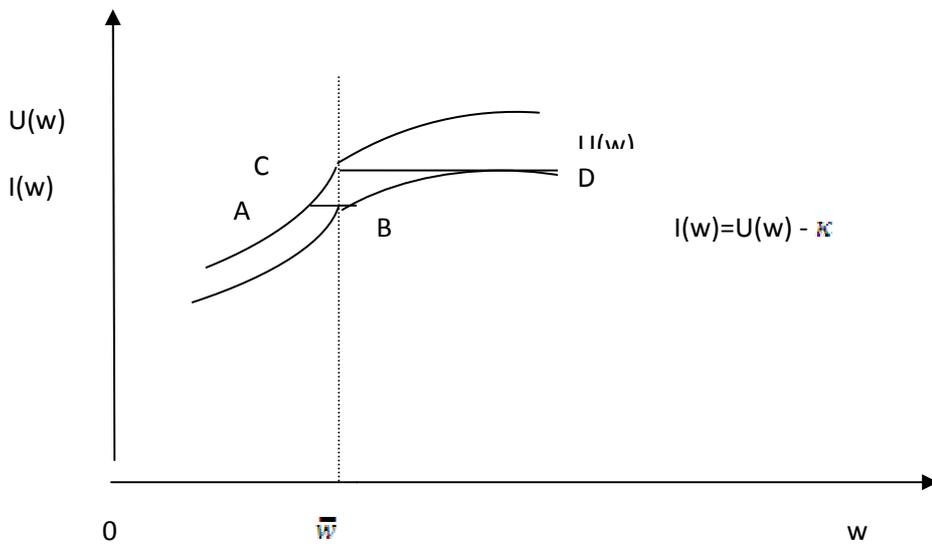[2] These results can be formally demonstrated using Taylor's Theorem.

Figure 3

A further possible version of the kinked case that also deserves mention is that in which the utility functions U(w) and I(w) are, at least locally, linear in the neighbourhood of the kink. Assuming that, as before, the graphs of I(w) and U(w) are "parallel", the situation will then be as shown in Figure 4.
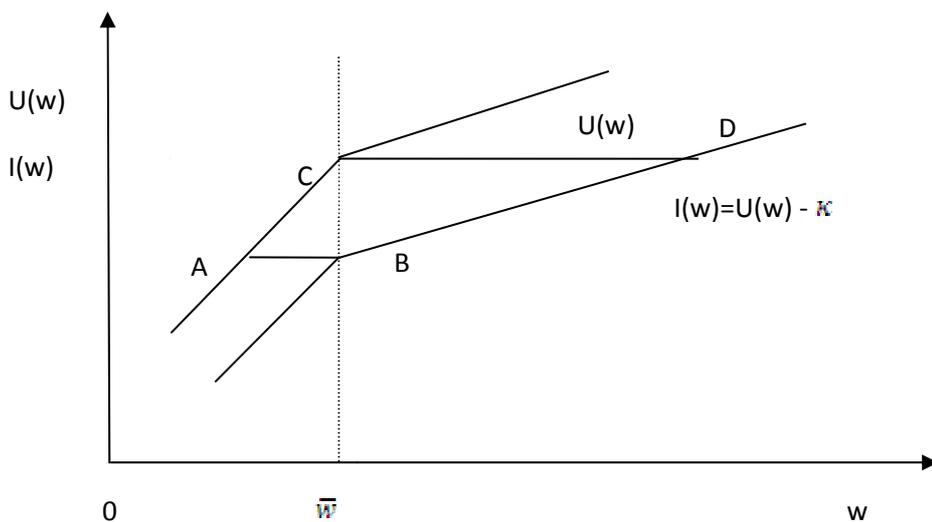

Figure 4

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In this case the WTP/WTA ratio will again exceed unity, but will necessarily remain constant.

In light of all this, it is clear that the unique distinction between the "smooth" and the "kinked" cases is that while in the former the $\frac{WTA}{WTP}$ ratio will necessarily tend to unity as the severity of the injury decreases, in the latter the ratio will tend to a figure greater than unity. It is also clear that the way in which the $\frac{WTA}{WTP}$ ratio varies as the severity of the injury is increased will also give some indication of the general form of the utility of wealth functions U(w) and I(w).

3. Methods

Testing the above theory requires the elicitation of optimal WTA and WTP. At a minimum, this means that respondents are familiar with these measures and have at least an intuitive understanding of the possible of consequences of offering anything other than their minimum WTA and maximum WTA. The two main objectives of our study protocol are thus to 1) provide respondents with the opportunity to acquire this knowledge and 2) to elicit individual-based WTA/WTP ratios for health states to carry forward into an analysis at an individual level to establish how the WTP/WTA ratio changes over different severities of an illness - in this case, measured by duration of symptoms - to provide evidence in favour or against the assumption of "smooth" preferences within standard theory, bearing in mind that rejection of the hypothesis of 'smooth' preferences does not confirm the presence of 'kinked' preferences. This particular measure of severity may at first appear strange, arguably at odds with the intuition that severity should (exclusively) reflect the nature of the symptom. This is debateable, and we find no convincing conceptual reason to suppose that people view there months of suffering as an equivalent disutility to, for example, one months suffering. More pragmatically, to test the theory requires a measure of objective severity that unambiguously increases or decreases. Duration clearly complies with this criteria, while individual perceptions of suffering are more difficult to assess

In what follows, we outline the main content of the protocol[3], which was backed up and supplemented by use of visual aids, aide memoirs and question-and-answer sessions to check for (mis)understanding and help respondents retain the key features of the elicitation method.

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[3] Full protocol and materials available on request.

The protocol consists of two different sections – WTA and WTP – which are further divided into an introductory discussion, a learning experiment, incentivised by the opportunity of entering a draw for a prize of £10[4], and a series of hypothetical valuations questions concerning a stomach complaint and laryngitis. It became clear very early on in the piloting that respondents found the concept (and associated explanations) of minimum WTA much harder than those associated with WTP. A decision was therefore taken to elicit WTA first for all respondents, rather than split the sample, to minimise the impact of fatigue effects on these responses. Simply put, the trade-off was one of uncertain order effects versus certain fatigue effects. However, within the hypothetical valuation questions we did split the sample – 50% answered stomach followed by laryngitis while the other 50% encountered them in reverse order. Duration was also switched i.e. one week/one month/three months and three months/one month/one week within both of the health problems. The protocol was developed, tested and refined on approximately 40 respondents prior to implementation in order to help improve, as much as possible, respondents' understanding of our instructions and explanations.

Introductory session

As mentioned, the first part of both the WTA and WTP sections provided the opportunity for an intuitive introduction to these concepts. In the case of WTA the example of selling a flat at an auction was used to introduce the idea of a 'reserve price' (in other words, minimum WTA) and the possible pitfalls if a person asks for too much (greater than this minimum) or too little (less than the this minimum). The auction rules explained in this example mirrored the rules that would be in operation in both the subsequent learning experiment and the health state valuation questions. This was reinforced by a hypothetical exercise in which they had to state the minimum they would sell a teddy for (a real teddy that they were temporarily given "ownership" of) in which they were pitted against another bidder who had offered an unknown, sealed bid. Once again, this mirrored the procedures to be used in the experiment and valuation sections (see below).

A similar set of tasks were devised for the WTP section, again mirroring the rules and mechanisms that they would encounter in the learning experiment and WTP valuation questions. In this case, participants were asked to (hypothetically) consider how much they would pay for a box of luxury chocolates in the knowledge that a bid had unknown bid had

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[4] Resulting in an expected value which ranged, dependant upon group size, from £1.00 to £0.42

been placed by a rival would-be purchaser. As in the WTA section, participant's responses were used as the basis for a summary explanation of why, given the mechanism, it was always best to state one's maximum WTA. Respondents were also given a memory jogger (handout) summarising the key points.

Respondents also recorded their answers in the response book, to gain familiarity with the layout that would be used in later questions.

Learning experiment

The learning experiment was based on the Plott and Zeiler (2005) mechanism which has been shown to generate theoretically predicted results (no discrepancy) in the context of lottery tickets, implying the mechanism was understood by respondents and the incentives were clear. While the instructions had to be adapted slightly in order to make them suitable for administration on members of the public, this was not at the cost of significant structural changes to the task.

In the WTA section, participants were given two tokens which could be used to gain entry to a prize draw. There were two rounds. In each round, participants recorded their 'reserve price' (minimum WTA to sell the token back to the moderator and forego entry into the draw) in the knowledge that this would be compared to a sealed bid in an envelope, already randomly selected from a box of 100 bids ranging from £0.01 to £1.00 and visible at the front of the room. If their 'reserve price' was lower than or equal to this sealed bid they sold the token but received the higher (or equivalent) sealed bid. If higher, they did not sell the token and it was put forward into the draw.

In the WTP section, participants were given £2, and told they could spend £1 in each round to buy two tokens which could be used to gain entry to a prize draw. In each round, participants recorded the maximum they would be willing to pay (any amount up to but not exceeding £1, if anything, to buy a token to enter into a new prize draw, again for £10. This was carried out in the knowledge that their offer would be compared to a sealed bid in an envelope, already randomly selected from a box of 100 bids ranging from £0.01 to £1.00 and visible at the front of the room. If their 'maximum WTP' was higher than or equal to this sealed bid they bought the token but paid the lower (or equivalent) sealed bid. If lower, they did not buy the token and enter the draw, but kept the £1.

Therefore, when respondents were faced with the health valuation questions, they were already familiar with the valuation terminology and the rules of the 'game', on which the health valuation questions would be based.

Health valuation questions

Below, we reproduce in full the WTA and WTP scenarios placed to respondents. As noted, valuations were elicited for two health states over three time durations. Monetary values were elicited using the card-sort procedure introduced in Carthy *et al.* (1998) with the option of an open-ended follow up. Demographic data were collected at the end of the session, which culminated in the prize draws.

WTA

• I want you to imagine that you have a health problem. You visit your doctor who tells you that if left alone the problem will heal by itself in a given period of time. However there is a treatment that is available that will remove all of the symptoms immediately. There is one slight problem. The manufacturer is temporarily unable to make enough and it has been decided that the best way to cope with this problem is to ask those who will **not be treated** to accept money for putting up with the symptoms.

This amount has already been decided. Let's call it the preset amount. However, it has not yet been released to your doctor. But he will get it later today.

The system that is in place is as follows. You must let your doctor know what is the lowest i.e. the minimum amount that you would accept to 'put up with the symptoms' associated with your problem. Let's call it your 'reserve price'. Later today your doctor will compare your reserve price with the preset amount to see whether you value recovery from the illness more than the money on offer, so he can make the right decision for you about whether you get the money or the treatment.

If your reserve price is less than or equal to this preset amount, you will receive money but will have to put up with the symptoms. The nice part is you will receive the preset amount rather than your reserve price.

If your reserve price is higher than this preset amount, you will be put forward for the treatment but will not receive any money

Remember, if you ask too much you may not be eligible for the money as the preset amount may be lower than your reserve price.

If you ask too little you may get the money and not receive the treatment, even if you would prefer the treatment as the preset amount is too low for you.

So the preset amount works just like the sealed bid in the earlier questions.

ASSISTANT: HAND OUT THE HEALTH MEMORY JOGGER (wta)

[OVERHEAD 4: MODERATOR GO THROUGH OVERHEAD]

The first health problem that I want you to consider is a stomach complaint[5]. The symptoms that you will suffer are:

a) You will have some slight discomfort whilst eating;
b) You will have some pain in your stomach at certain times in the day;
c) You will feel slightly 'under the weather';
d) Your normal daily activities will be otherwise unaffected.

The problem is self limiting, i.e. will go without any treatment after a period of time. These symptoms are written in your response book.

We are going to ask you about three different periods of suffering, 1 week, 1 month and 3 months.

Please turn to Question 4(a) in your response book. You are asked for the amount that is your minimum willingness to accept for not having the treatment and suffering the symptoms associated with these effects if they lasted 1 week.

The key things to remember are that **you only receive the preset amount**. Also**,** if you ask too much you may not be eligible for the money and if you ask too little you may get the money and not receive the treatment, even if you would prefer it. You can use your memory jogger to remind you of this.

WTP

I want you to imagine that you have a health problem. You visit your doctor who tells you that if left alone the problem will heal by itself in a given period of time. However there is a treatment that is available that will remove all of the symptoms immediately. There is one slight problem. The treatment is not available on the NHS, but you can have a private prescription from your doctor.

The price of the private prescription is not yet known by your doctor. She will be told the amount later today, the preset amount, and wants to know the maximum that you would pay to avoid the symptoms, so that she can either write the prescription for you or not.

The system that is in place is as follows.

You must let your doctor know the highest amount that you would pay for the private prescription. Later today your doctor will compare your offer with the preset amount to see whether you value the treatment highly enough to want to pay the preset amount for it. She will then write the prescription if your maximum willingness to pay, your offer, is more than or equal to the preset amount (just like with the chocolate and the tokens). However, the nice part is that you will only pay the preset amount for the treatment.

If you offered less than the preset amount you will not receive the prescription and will have to endure the symptoms, but you will keep your money.

Remember, if you offer too much what might happen you may end up paying more for it that you think getting rid of the symptoms is worth.

If you offer too little you may end up not getting the treatment even if you want to.

So, the preset amount works just like the sealed bid in the earlier questions.

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[5] Corresponding symptoms for laryngitis were a)You will have a slight sore throat; b)You will have some difficulty talking; c)You will feel slightly 'under the weather'; d) Your normal daily activities will be otherwise unaffected

The first health problem that I want you to consider is a stomach complaint. The symptoms that you will suffer are:

a) You will have some slight discomfort whilst eating;
b) You will have slight pain in your stomach at certain times in the day;
c) You will feel slightly 'under the weather';
d) Your normal daily activities will be otherwise unaffected.

The problem is self limiting i.e. will go without any treatment after a period of time. These symptoms are written in your response book.

Please turn to Question 9(a) in your response book. You are asked your maximum willingness to pay for the medicine if the symptoms lasted 1 week. What we really need to know is how much you would pay, if anything, given what can afford. You should also try to bear in mind what other things would have to be given up.

The key things to remember are that **you will only pay the preset amount. Also,** if you offer too much what might happen you may end up paying more for it that you think getting rid of the symptoms is worth. While, if you offer too little you may end up not getting the treatment even if you want to. You can use your memory jogger to remind you of this.

After going through the first scenario the respondents were asked for their minimum WTA to not receive the treatment if the health condition (symptoms associated with a stomach complaint and also symptoms associated with laryngitis) lasted for either, 1 week, 1 month or three months. Respondents were asked for their maximum WTP to have the treatment after the second scenario if the same health conditions lasted for either, 1 week, 1 month or three months.

4. Results

Experimental sessions which each involved between 5-12 participants were carried out during September 2009 in Newcastle-upon-Tyne. A convenience sample (n=155) was drawn from the local community by a market research firm. The summary demographics are presented in Table 1.

Table 1   Sample Demographics

Indicator	North East England	Study sample
Male/Female (%)	52/48	40/60
Mean Age (years)	37.8	36.9
Household Size	2.3	2.6
Home ownership (incl. those with a mortgage) (%)	52.9	69

Job Classification: Employed (unskilled/semi skilled) & Middle level employee	41	42
Professional & Self employed	32	32
Unemployed & Retired & Full time student	27	26

The mean and median responses for each decision that respondents made, after removing three high value outliers, are presented in Table 2.

Table 2.   Mean and Median Responses.

	WTA Stomach			WTA Laryngitis		
	1 week	1 month	3 months	1 week	1 month	3 months
Mean (Std. Deviation)	130.75 (189.61)	579.39 (1280.10)	1932.77 (2886.67)	106.31 (133.25)	522.25 (1001.44)	1555.32 (2400.07)
Ratio to 1 week		4.43	14.78		4.91	14.63
Median	50.00	250.00	750.00	50.00	200.00	600.00
Ratio to 1 week		5.00	15.00		4.00	12.00

	WTP Stomach			WTP Laryngitis		
	1 week	1 month	3 months	1 week	1 month	3 months
Mean (Std. Deviation)	20.74 (51.13)	68.69 (172.23)	152.14 (232.65)	17.62 (34.09)	54.07 (77.67)	141.00 (224.99)
Ratio to 1 week		3.31	7.34		3.07	8.00
Median	10.00	30.00	75.00	10.00	25.00	75.00
Ratio to 1 week		3.00	7.50		2.5	7.5

Both data sets (stomach complaint and laryngitis) appear plausible, consistent and well-behaved. The WTA responses are broadly comparable between the conditions, in fact a t-test cannot reject the hypothesis at a 5% level that for each condition the mean is the same for each time period. The 1 week response is approximately equal to 1 days pay for the average worker in the UK. The 'ratio to 1 week' represents the values for 1 month and 3 months divided by the value for 1 week and shows that respondents increased their WTA's broadly in proportion to the increase in time that they had to endure the symptoms. The median responses show a similar pattern.

The WTP responses are significantly lower, and although they rise more or less in proportion to the elapsed time between 1 week and 1 month, the three month ratios show a distinct decline in proportionality. This might be a result of the budget constraint biting for higher levels of payment, a reflection of diminishing marginal utility or both.

Individual WTA/ WTP ratios were computed for each respondent for both health complaints for the differing durations of suffering. Five different patterns in the magnitude of the ratios across these different time periods are observable in the data, which we term Types 1,2,3, 4 and 5.   Table 3 contains a descriptor of these Types and summarize the number of respondents whose ratios followed the particular pattern, whilt Table 4 contains the means of the WTA/WTP ratios at the sample level.. At an aggregate level, for both health problems, responses conform to Type 1 (in Table 3).

Table 3 WTA/WTP Ratio Relationships (Count)

Direction: movement of Ratio ($\kappa \to 0$).	Stomach (no.)	Laryngitis (no.)
TYPE 1: Strictly converging to unity (3 months - 1 month – 1 week)	83	71
TYPE 2: Diverging from unity (3 month-1 month) then converging to unity (1 month – 1 week)	16	28
TYPE 3: Constant and greater than unity (3 months, 1 month, 1 week)	5	10

TYPE 4: Converging to unity (3 months - 1 month, then diverging from unity (1 month – 1 day)	22	20
TYPE 5: Strictly diverging from unity (3 months - 1 month – 1 week)	28	25

Table 4. WTA/WTP Ratios per period

WTA/WTP ratio	Stomach			Laryngitis		
Full Sample	**1 week**	**1 month**	**3 months**	**1 week**	**1 month**	**3 months**
Mean (Std. Deviation)	11.41 (22.15)	14.92 (26.94)	30.14 (95.38)	9.84 (15.08)	18.67 (49.25)	25.14 (57.73)
Type 1's only						
Mean (Std. Deviation)	8.73 (15.05)	16.34 (26.79)	43.89 (125.57)	9.50 (16.48)	20.47 (33.93)	42.90 (79.80)

The predominant pattern for both health problems is a converging ratio as the duration decreases (Type 1), providing support for the assumption of "smooth" preferences. Nevertheless, it is simple to generate, via a hypothetical thought-experiment, response patterns of Types 2-5 using differing but plausible WTP and WTA responses. As such, these responses cannot be automatically considered as random noise in the data and may imply that preferences are not "smooth", at least for some of these respondents. The assumptions used in the thought experiment about WTP and WTA are as follows:

1.   Both WTA and WTP values increase in direct proportion to the increase in duration.

2.   and/or WTA and WTP increase at an increasing rate as duration increases reflecting, for example, the perception that the level of suffering will increase as the duration of suffering increase.

3.   and/or WTA and WTP increase but at a decreasing rate as duration increases, perhaps reflecting the perception that the level of suffering will increase only to a relatively minor extent for longer time periods, given that once they have lived with the condition they will be able to cope much more easily with the associated suffering over longer time periods.

A t-test of the comparison of the means of the ratios for each time period between health problems cannot reject the hypothesis that they are the same at a 5% level of statistical significance, critical value t = 1.96 (i.e. Pr 1 month Stomach = I month Laryngitis is 0.6343 t = 0.4764; Pr 3 month Stomach = 3month Laryngitis is 0.3212 i.e. t = 0.9942; Pr 6 month Stomach = 6 month Laryngitis is 0.7951 i.e. t = 0.5248). The same result holds when comparing the means of the Full sample and the Type 1 respondents for one week and one month durations. Table 4 above shows that whilst the ratios for the first two periods are very similar when comparing the 'Full sample' to the Type 1's, the three month ratios are significantly different.

As such, we conjecture that for small perturbations in the utility of wealth of function conditional on normal health, the responses of the Type 1 respondents can be used as a proxy for the full sample responses. We therefore carry out regression analysis on these response ratios against time. Of particular interest here is the 'constant' term. We hypothesise that this represents the respondents' ratio as time approaches zero, i.e. the smallest possible perturbation in the utility function. As stated in section 2, neoclassical theory would predict that at this point the ratio should be unity. A t-test of whether the constant terms are unity have t-statistics for the Stomach condition 0.96 and Laryngitis 1.92 against a critical vale of 1.96, we can therefore not reject the hypothesis that the constant is unity at the 5% level. Qualitatively, these findings are replicated at a sample level.

Table 5(i) OLS Regression Analysis: Type 1 WTA/WTP Ratios

Stomach				

WTA/WTP N = 243 F = 5.7 R – sq. = 0.04				
	Coefficient	Std. Error	T	P > |t|
Duration	3.25	1.36	2.39	0.018
Constant	4.54	3.66	1.24	0.22
Laryngitis WTA/WTP N = 204 F = 9.75 R – sq. = 0.07				
	Coefficient	Std. Error	T	P > |t|
Duration	2.98	0.96	3.12	0.002
Constant	7.4	3.32	2.23	0.027

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5. Discussion and Conclusions

We have employed a methodology that utilises the Plott and Zeiler (2005) mechanism to capture experimental spillover effects to obtain plausible and well behaved WTA and WTP responses.. While different patterns of response ratios are present within the sample, the majority are of Type 1. These responses comply with the neoclassical predictions associated with 'smooth' preferences. Given the statistical similarity between these responses and those of the sample as a whole for smaller durations of illness (1 week and 1 month), we show that under reasonable assumptions that the ratio tends to unity as the perturbation becomes infinitely small. On a more practical level, this implies that, for small changes, population samples may proxy the type 1 respondents, negating any need to screen respondents for their response-type before carrying out VPF-related stated preference studies.

As noted at the beginning of ths paper, there is an ongoing debate into the existence of a disparity between individual's WTA and WTP responses. If present in the context of health and safety goods, then this would have potentially serious implications regarding the assumption of well-defined marginal rates of substitution between illness/death and wealth, which underpins economic WTP-based valuation studies. While this paper provides the first emprical evidence in support of 'smooth' preferences, we acknowledge it does not rule out 'kinked' preferences, at least on the part of some respondents. Whether these exist and how much they matter is a yet unproved. As such, this paper should be viewed as the start of a much needed empirical debate as opposed to the end.

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