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Emotions and Scope Effects in the Monetary Valuation of Health

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Abstract

This study presents evidence about the role of emotions in the monetary evaluation of health technologies, namely, Drug Eluting Stents (DES) in our case. It is shown that subjects who are very afraid of having to undergo an angioplasty are: a) less sensitive to the size of the risk reduction provided by DES and b) willing to pay more. The lack of scope sensitivity questions the normative validity of the responses of highly emotional subjects. We provide evidence of this effect using what we call the Cognitive-Emotional Random Utility Model and the responses of a face-to-face, computer assisted personal interview survey conducted in a representative sample of the Spanish general population (n=1663).

1. Introduction

The influence of emotions in human behaviour has attracted an increasing interest in economics (Bechara *et al*., 1997; Diamond and Vartiainen, 2007; Rick and Loewenstein, 2008). It has been shown that emotions shape individual preferences in consumer behaviour (Ariely, 2009; Lee *et al*., 2009; Hermalin and Isen, 2008; Shiv and Fedorikhin, 1999), investment choices (Chan and Andrade, 2011), economic transactions (Shiv *et al*., 2005; Lerner *et al*., 2004) and in policy evaluation (Araña and León, 2009; Bodenhausen *et al*., 2000; Bernheim and Rangel, 2007).

The role of emotions can be particularly important in health technology evaluation, since changes in health status are likely to trigger patients' emotional reactions. Emotions such as anxiety or embarrassment have been shown to influence patients' preferences for treatments or screening tests (Elit *et al*., 1996; Sebban *et al*., 1995; Robbins *et al*., 2002, Yasunaga *et al*. 2007; Jonas *et al*. 2010). Subjects are willing to pay substantial amounts of money to avoid injectable drugs and this is explained by emotions such as anxiety associated with needles (Matthews *et al*., 2001; Sadri *et al*., 2005). The emotional load of caregivers influence preferences for Alzheimer treatments (König *et al*., 2013; König and Wettstein, 2002; Gervès *et al*., 2013). Parents' emotions influence their willingness to pay (WTP) for treatments that improve their children's health status (Kuppermann *et al*., 2000; Liu *et al*., 2000; Meyerhoff *et al*., 2001). Araña *et al*. (2008) found that emotional individuals are less prone to take appropriate decisions in the context of health care evaluation. Lee *et al*. (1997) found that fear influences patients' WTP for an autologous blood transfusion, concluding that cost-effectiveness analysis should include the benefits of avoiding patient's fear for such a measure. In summary, there is evidence emotions influence WTP for a health intervention. However, there is no evidence about the potential relationship between emotions and the sensitivity of WTP responses to the magnitude of the benefit provided by a health technology. The existence of this sensitivity is crucial if the results of a WTP can be used as a guide of social policy, that is, health providers are expected to pay more for a new technology as long as it is better than the status quo. If this marginal WTP has to be based on the responses of individuals to a survey, subjects have to be WTP more for the better technology. This paper presents evidence that emotions reduce the sensitivity of WTP values to the size of the benefit provided by a medical technology questioning the use of those responses in social policy.

Evidence that emotions may affect sensitivity to scope was provided for the first time by Hsee and Rottenstreich (2004) in a very different context (music CDs). They showed that when subjects are in a highly emotional state their WTP hardly changes with the amount of the good provided. They argue that high levels of anticipated emotions reduce sensitivity to scope because "feelings depend on the nature of a stimulus but not on its scope" (p.24). Emotions are driven by the presence or the absence of the stimulus and not by the amount of it (scope). The implication of this effect would be that WTP values very influenced by emotions would not be good indicators of the social value of health technologies. Sensitivity to scope is a desirable property of elicited utility functions, and an important requirement by many analysts who use contingent valuation results to inform health policy (Carson and Mitchell, 1993; Hausman, 2012).

Despite the relevance of this research question, there is scarce evidence in the economics literature in general, and in the case of medical technologies in particular, about the implications of emotions in contingent valuation. This paper explores the role of emotions in the monetary valuation of an specific health technology (i.e. DES): will emotions produce WTP values for medical treatments sensitive to the magnitude of the health benefits associated with different interventions? We provide this evidence using data from a study where subjects were asked their WTP to reduce the risk of restenosis (i.e. the risk of needing an operation to implant a stent in their arteries). Different types of stents would result in different risk reductions (Baumgart *et al*., 2007; Chan *et al*., 2005; Greenhalgh *et al*., 2010; Kelbaek *et al*., 2006; Suttorp *et al*., 2006) making it possible to test the sensitivity of elicited WTP to changes in risk reduction. If the Hsee and Rottenstreich (2004) hypothesis is confirmed, the monetary value of stents will hardly change with the risk reduction associated with the technology for highly emotional subjects.

It is true that willingness to pay is not the main methodology to evaluate medical technologies, however some agencies allow the possibility of using willingness to pay studies (Mathes et al 2013). In the specific case of Spain, while Cost-Effectiveness and Cost-Utility are the techniques most widely used, willingness to pay studies are also allowed if it is understood that they can provide more information about the social value of a health technology (Corbacho and Pinto-Prades, 2013). There are also many regulations that affect the health of populations that are influenced by willingness to pay studies; for example, concepts like the Value of a Statistical Life and non-fatal injuries used to evaluate some investments are based on willingness to pay studies. It is highly possible that surveys used to estimate willingness to pay for risk reductions in those fields are also influenced by emotions.

The main results of our study are: a) subjects who are more afraid of having an angioplasty are WTP more than those who were less afraid; b) subjects who are more afraid of having an angioplasty are less sensitive to the amount of benefit (e.g. risk reductions) provided by new stents than subjects who are less afraid c) the difference in WTP between subjects with high and low fear was mainly concentrated in the smallest level of risk reduction, and was significantly reduced for the highest risk reduction level. Therefore, it seems that emotions change the utility function.

The results have direct implications for the analysis of stated preference methods in health economics. In particular, the validity of the monetary values that do not consider the emotional dimension is in question as guides for social policy (e.g. the price that the health system has to pay for a new and better stent). These results provide empirical support in the area of valuation of health technologies of previous findings of lab experiments using students and simple objects like music CDs (Hsee and Rottenstreich, 2004). This is important since it suggests that the role of emotions in the monetary valuation of objects can be a general phenomenon present in very different contexts. Finally, the role of emotions can also be relevant for other preferences elicitation techniques like Time Trade-Off. We believe that our results have interest for a broad audience, not only for those interested in the evaluation of one medical technology like stents.

The rest of the paper is organized as follows. Section 2 presents the details of the fieldwork and the experiment. Section 3 defines the main hypothesis based on the random utility model (RUM) (McFadden, 1974). Section 4 presents the results. Finally, section 5 discusses some implications of the results, the limitations of the analysis and some avenues for further research.

2. Fieldwork

Sampling

The survey was conducted using a Computer Assisted Personal Interview (CAPI) methodology in February-April 2009. The sampling universe was population living in

Spain older than 19 years old. The sampling procedure was as follows: primary sampling units were 108 municipalities selected from the 17 Spanish regions. Municipalities were selected to be representative of seven categories of habitat size: less than 2,000; 2,001-10,000; 10,001-50,000; 50,001-100,000; 100,001-400,000; 400,001-1,000,000, more than 1,000,000 residents. Secondary sampling units were houses selected with random routes. In-house selection was according to proportions based on gender and age. The survey sample size was 1,663.

The Intervention: The Angioplasty Programme

The questionnaire was divided into three main sections. In the first section participants were informed that the objective of the study was to estimate the value of a health technology. The interviewer provided information about causes, symptoms and consequences (angina, heart attack) of coronary stenosis. The description was facilitated with cards and pictures (Visual Aid). Once the problem was described the survey proceeded to explain the medical treatment. It was explained what an angioplasty involves and that in most cases a stent is implanted in the occluded artery. Two types of stents were described, a Bare-Metal Stent (BMS) and a Drug-Eluting Stent (DES). It was explained that BMS were not coated with drugs while DES were. We explained that the objective of coating the stent with drugs was to reduce the need of having a new angioplasty but that the risk was never zero.

The Evaluation Task

This section presented the subjects the WTP question. It started with some questions to check that respondents understood the benefits of DES over BMS. They were shown 4 different probabilities of needing a second angioplasty with BMS (e.g. 39%, 34%, 29%

and 24%) and they were asked to compare those probabilities with the probability of needing a second angioplasty with a DES. The probability for a DES was kept at 7%. They were asked in which of the four cases a DES produced a higher benefit. If they did not provide the right answer the system invited them to rectify although their original response was recorded.

The next task was to choose between DES and BMS based only on the health benefit (reduction in the risk of restenosis). They were asked:

Now imagine you feel symptoms like chest pain or shortness of breath and you are diagnosed with the kind of heart problem described in the previous section: a coronary artery is blocked and you require surgery. The doctor then asks you whether you would prefer to have implanted a drug eluting stent or a bare metal stent.

Individuals who preferred the BMS (in spite of having higher risks) were asked the reason for choosing a treatment with higher risks. They were not asked any WTP question and they were taken to the sociodemographics section.

Those who preferred a DES were asked to assume that the national health service only funded the BMS and that they had to pay for the DES. They had to choose between a stent with higher risk and no cost (BMS) or with lower risk and higher cost (DES). They were reminded that the money they were WTP would not be available for other purposes. They were also reminded that they could also pay with a loan, gradually over time. Then they were asked the following WTP question[1]:

Assume that the doctor tells you that if you choose a Bare Metal Stent, without extra costs for you, you have a 39% probability of requiring further surgery. That is, out of 100 patients that have the Bare Metal Stent, 39 patients will have to undergo surgery *within one or two years because the artery will be blocked again and they will suffer the symptoms. The doctor also says that if you choose a Drug Eluting Stent, you have a 7% probability of requiring further surgery. That is, out of 100 patients that have the Drug Eluting Stent, 7 patients will have to undergo surgery within one or two years. However, there are some costs involved for you. Therefore, you have two options:*

Option A: a Bare Metal Stent implanted	Option B: a Drug Eluting Stent implanted
• You have a 39% risk of repeated revascularization (39 out 100 patients needs further surgery within one or two years) • No costs involved	• You have a 7% risk of repeated revascularization (7 out 100 patients needs further surgery within one or two years) • You have to pay for it

Would you choose the Drug Eluting Stent if the cost is Y€ or would you rather prefer not to pay and have the Bare Metal Stent instead?

A second question followed, with a higher or lower bid depending on the previous response. The second bid was higher than the first if the respondent had accepted the bid (bid_up) and it was lower if s/he has rejected it (bid_down). The values of the first bid are selected randomly from a set of bids. The bids were tested in a pilot survey (n=100) and they were chosen so that the range was wide enough to obtain the true WTP curve. Bids are shown in Table 1.

The evaluation task was repeated three more times with different health benefits. That is, each subject was asked 8 WTP dichotomous choice questions corresponding to two WTP questions for each of the four risk levels. There were two different versions of the questionnaire according to the amounts of benefits presented to participants. In one version (the "descending" version), subjects started with a 32% absolute risk reduction

[1] We present the question for a 39% risk of the BMS. The question was repeated for three other risk

(that is, from 39% to 7%) and then they moved to 27%, 22% and 17%. In the second version, (the "ascending" version) subjects started with 2% and they moved to 7%, 12% and 17%. These health benefits were selected to reflect the variability of results observed in the literature[2]. Patients with risk factors such as complicated lesions or diabetes show an average absolute risk reduction in the probability of restenosis of more than 30 points if they are implanted a DES instead of a BMS, and for those with uncomplicated lesions, the difference between DES and BMS can be as small as 2 percentual points (Moses *et al*., 2003; Greenberg *et al*. 2004). This design makes it possible to test the consistency of the results since the same risk reduction (i.e. 17%) is presented in two different contexts (ascending and descending). At the end of this section the subject was asked: "does the idea of being operated on cause you fear and/or anxiety?". Individuals responded using a Likert scale from 0 (no fear) to 10 (max fear). This was the question used to measure the emotional impact of an angioplasty. Finally, information was collected on sociodemographic characteristics.

3. Theoretical Model

Cognitive Random Utility Model

In order to be able to estimate patients' preferences for the health intervention from the responses to the contingent valuation study, a utility-based choice model was specified. We adopt the representation of the RUM based on McFadden (1974).

Let us define $x = (x_1, \ldots, x_g)$ as a composite private good, with $x \geq 0$, and $p = (p_1, \ldots, p_g)$ a vector of associated prices ($p > 0$). Let us also consider that the individual has

levels.

[2] The degree of risk reduction depends on several characteristics of the patient (e.g. diabetic or not) or of the lesion (e.g. diameter of the artery in the occluded part).

exogenous income, $m \geq 0$, socio-demographic characteristics represented by vector s, a set of emotional states $e = (e_1,\ldots, e_k)$, and faces a certain risk of restenosis q. For a well-behaved preference map (*i.e.* represented by a strictly increasing, continuous, and strictly quasi-concave utility function), utility maximization leads to the following indirect utility function:

$$\mathrm{v}(\mathrm{p},\mathrm{m},\mathrm{s},\mathrm{e},\mathrm{q}) = [\max(\mathrm{u}(\mathrm{p},\mathrm{m},\mathrm{s},\mathrm{e},\mathrm{q})) : \mathrm{px}\text{-}\mathrm{m} \leq 0] \qquad (1)$$

where v is the maximum utility that can be achieved given the individual's budget constraint, socioeconomic status, emotions and the level of health risk she faces.

Let us consider that q_A is the risk associated with a BMS (option A in the choice task). If the patient chooses the DES (option B in the choice task), risk will be q_B, where $q_B < q_A$. Therefore, the patient valuation of a DES can be measured as the equivalent variation or WTP for such intervention (WTP_{it}). Thus, WTP_{it} can be defined as the maximum amount of money that individual i would be willing to pay for the proposed intervention at moment t, i.e. the monetary equivalent loss that would leave her indifferent between both situations. That is,

$$v(p,m,s,e,q_A) = v(p,m - WTP_{it},s,e,q_B) \qquad (2)$$

This formulation is deterministic, since it assumes that the individual knows her utility function and can determine her WTP as a function of her socio-economic characteristics and the level of risk reduction level (Hanemann, 1984). This restriction can be relaxed by assuming that the latent variable WTP_{it} is a function of a random unobservable component in addition to the deterministic component of equation (2) (Cameron, 1988). Thus, we can write the WTP of individual i at moment t for the health intervention as,

$$WTP_{it} = X_{it}^{'}\gamma + e_i\alpha + HRR_{it}\beta + \varepsilon_{it} \qquad (3a)$$

where ε_{it} is a random error term, which is assumed normally distributed with zero mean and σ standard error, $X'_{it}\gamma$ is the linear predictor associated with a regression parameter vector γ and a covariate vector X_{it} including *(p, m, s)*, e_i the emotional state corresponding to individual *i*, and HRR_{it} denotes the health risk reduction, that is, q_A-q_B.

Cognitive-Emotional Random Utility Model

A more general specification of the RUM needs to be specified in order to test the role of emotions in the monetary value of stents. In order to do so, we need to extend the standard algebraical representation of the RUM in the context of emotional choices. Based on the existing evidence on the impact of emotions on individual decision-making problems (Hsee and Rottenstreich, 2004) and previous efforts aimed at modelling the role of emotions in RUM environments (Araña and León, 2008; León *et al.*, 2014), we propose below an extension.

Emotional Shift Effect on Patient's Valuation

The emotional variable (e_i) is operationalized as a dichotomous variable (HE_i, high emotions) taking value 1 if the anticipated emotional level is high, and 0 otherwise. Thus, the anticipated emotional level of the intervention directly affects the WTP for such intervention, that is, the higher the fear for the intervention the higher the WTP for reducing the risks (assuming $\alpha > 0$). We can call this effect an "emotional shift effect" in the utility function, and can be included as an extra term in the deterministic part of the WTP weighted by a parameter α.That is,

$$WTP_{it} = X'_{it}\gamma + HE_i\alpha + HRR_{it}\beta + \varepsilon_{it} \quad (3b)$$

Scope Sensitivity Effect on Patient's Valuation

Hsee and Rottenstreich (2004) claim that individuals experiencing high levels of anticipated emotion will not only value the outcome differently, but also emotions will affect how they value changes in the quality of the good under valuation. In other words, the valuation of any improvement in the intervention (e.g. health risk reduction) will also be completely different among subjects' experiencing high and low level of emotions. More emotional subjects will be less sensitive to the size of the benefit. This hypothesis can be called the "emotional scope sensitivity effect" and can be included in equation (3b) by allowing the parameter vector for subjects experiencing low level of emotions β_{LE} to be significantly different from that one of highly emotional patients $\beta_{HE} = \beta_{LE} + \beta^*$.

More specifically we expect $\beta^* < 0$. That is, we expect people who are highly emotional to be less sensitive to the magnitude of the health gain.

Therefore, an alternative expression of equation (3a) that would make it possible to test both hypotheses (shift and emotional scope sensitivity effects) would be,

$$WTP_{it} = X'_{it}\gamma + HE_i\alpha + HRR_{it}\beta_{LE} + HRR_{it} \times HE_i\beta^* + \varepsilon_{it} \quad (3c)$$

Shift effects would be estimated using the parameter α and scope sensitivity using β^*. The predictions are that $\alpha > 0$ and $\beta^* < 0$.

4. The Econometric Model

Since each individual provided eight responses (two WTP questions for each health benefit, and four different health benefits), they could be correlated. The random effects probit model allows these responses to be freely correlated by assuming that the error term of the latent variable WTP (ε_{it}) is the sum of an unobservable characteristic specific to individual i (w_i) and a random error term (v_{it}) that varies across individuals and responses (Haab, 1997), where t indexes the number of responses per individual. Both w_i and v_{it} follow a normal distribution with a mean of zero and a standard deviation of σ_w and σ_v, respectively.

The random disturbance w_i is assumed to be uncorrelated with the other regressors and since it only varies with the individual and remains constant over the individual's responses, it introduces correlation between responses of the same individual according to the expression:

$$Corr(u_{it,}u_{is,}, t \neq s) = \frac{\sigma_w^2}{\sigma_w^2 + \sigma_v^2}$$

where t and s stand for two different responses of individual i.

The probability of a "yes" response, conditional on w_i, is:

$$P\,r(yes) = P\,r(WTP_{it} \geq bid_{it})$$

$$= P\,r\left(X_{it}^{'}\gamma + HE_i\alpha + HRR_{it}\beta_{LE} + HRR_{it} \times HE_i\beta^* + \; w_i + v_{\,it} \geq bid_{it} \right)$$

$$= Pr\left(\frac{X_{it}^{'}\gamma + HE_i\alpha + HRR_{it}\beta_{LE} + HRR_{it} \times HE_i\beta^* + \; w_i - bid_{it}}{\sigma_v} \geq -\frac{v_{\,it}}{\sigma_v} \right)$$

$$= \Phi\left(\frac{X_{it}^{'}\gamma + HE_i\alpha + HRR_{it}\beta_{LE} + HRR_{it}\times HE_i\beta^* + w_i - bid_{it}}{\sigma_v}\right) = \Phi_{\text{it}}$$

where Φ is the standard normal cumulative density function. The unconditional sample log-likelihood function is obtained by considering all the responses and removing the conditioning on w_i:

$$lnL = \sum_i ln \int \prod_t \Phi_{\text{it}}{}^{y_{\text{it}}}(1 - \Phi_{\text{it}})^{1-y_{\text{it}}} g(w)w$$

where y_{it} is an indicator variable that takes a value of 1 if the *t* response of the individual *i* is yes, 0 otherwise; and g(.) is the normal density function of the w_i.

From these parameters, the mean WTP is computed by using the average of the explanatory variables. In order to make fair comparisons between WTP estimates, these averages have been computed considering the whole sample.

5. Results

Sample population is representative of the Spanish population; socioeconomic characteristics of sample and Spanish populations are shown in Table 2. Final sample size was 1,479 distributed in the ascending version (n=716) and in the descending version (n=763) of the questionnaire. There were 149 individuals that preferred the BMS over the DES. The most common cause to reject a DES was fear of the drug that it contains. Observations of 35 individuals that did not provide information on age, employment status or answered "N/A" to a bid were excluded from the analysis.

In order to study the effect of emotions, individuals were classified as having high emotions (i.e. HE=1) when their declared level of anxiety and fear was above the median in the Likert scale (i.e. 8, 9 and 10) (n=729), and as LE when the score was 7 or less (n=750). In this way the two subsamples were of similar size (n=729 for HE and n=750 for LE). The use of the median guarantees enough statistical power to test the proposed hypotheses by using an even distribution of respondents in the high and low emotions group (King and Zeng, 2001).

To control for differences in the composition of the sub-samples, a number of covariates were included in the WTP function: age (number of years), gender (male/female), education (years of study) and employment status (employed/unemployed). The distribution of the covariates age, education and labour status in the four groups is rather similar (see Table 3) but this is not the case for gender. HE groups show a higher presence of female respondents (58 percent), than LE groups (41-44 percent).

Parameter estimates and mean WTP estimates for four different models applied to the ascending and descending groups are shown in Tables 4 and 5, respectively. Model 1 is the base model, where the HE and LE groups are pooled together with no distinction and including the HRR as a continuous variable. Model 2 includes the emotional shift and scope sensitivity effects (variables HE and HRRxHE, respectively). Model 3 includes the HRR by means of the dummy variables HRR_{RR}, where RR stands for the risk reduction (HRR_{7}, HRR_{12}, HRR_{17} in the ascending group, and HRR_{27}, HRR_{22} and HRR_{17} in the descending group) rather than one continuous variable as done in Model 1, which allows more flexibility in the WTP estimates for each health benefit. Finally, Model 4 uses dummy variables for each level of risk reduction similarly to Model 3, but making a distinction between the HE and the LE groups (LE_{RR} and HE_{RR} dummy variables).

As can be seen in Tables 4 and 5, the portion of the model variance accounted for by individual variation is significant at the 1% level, indicating that the responses from the first to the eighth question are correlated. This supports the use of a REM econometric specification to analyse the data.

Emotional Shift Effect on Patients' Preferences

Results obtained show the existence of an emotional shift. The coefficients associated to the HE variable in model 2 are positive and highly significant, leading to higher WTP estimates for the HE groups in the ascending and descending versions (Tables 4 and 5). This result is not surprising at all since it could be expected that those subjects who are more afraid of the intervention are also WTP more. However, the result is relevant for our research since it shows that the question we used to measure feelings is actually discriminating between subjects according to this characteristic, namely, level of fear.

Similar conclusions are obtained from Models 3 and 4. In these models, the effect of the magnitude of the health benefit on WTP is not constrained to be linear, since dummy variables are used for each level. A likelihood ratio test between Models 3 and 4 finds that there are significant differences on WTP between the HE group and the LE groups for the different levels of health benefit jointly considered (the test statistics are 32.19 and 21.72 in the ascending and descending versions respectively, whereas the 1% critical value for the chi-squared distribution with 4 degrees of freedom is 13.28).

Moreover, from Model 4, several likelihood ratio tests were carried out to test, for each level of risk reduction and sequence, the equality of coefficients between the HE_{RR} and the LE_{RR} dummy variables. In all these tests, the null hypothesis of equality is rejected at the 1% significance level (1% critical value for the chi-squared distribution with 1 degree of freedom is 6.63). This point, together with the fact the coefficient estimates of the HE_{RR} dummy variables are always higher than their LE counterpart, confirms the presence of an emotional shift in the responses.

Scope Sensitivity Effect on Patient's Valuation

The results show that WTP estimates increase with the amount of risk reduction (e.g. health benefit). The associated parameter to HRR is significant and positive in Models 1 and 2. Similar conclusions are obtained when using dummy variables (Models 3 and 4).

However, sensitivity to scope is sensibly higher for the LE group. The presence of scope effect is tested with the parameter (β*) associated to the interaction HExHRR. For both the ascending and the descending sequences, β* are significant at the 5% level and negative, indicating that the slope of the HE group is lower than the slope of the LE group. This effect is more evident for the ascending sequence since in this case the coefficient of the interaction HExHRR is more strongly negative and more significant (Tables 4 and 5).

Similar conclusions are drawn looking at the WTP estimates obtained with Model 4 (Tables 4 and 5). In the "ascending" version, the WTP estimates for the HE group go from 7,615.86€ to 10,526.95€, whereas in the LE group go from 2,597.67€ to 7,953.33€, almost doubling the HE increase. In the descending version, the WTP estimates go from 13,108.86€ to 12,096.22€ for the HE group and from 9,365.39€ to 7,178.24€ for the LE group, being again this difference higher for the LE group (more than doubling in this case).

Finally, the existence of differences for the 17% risk reduction in the "ascending" and descending versions was tested. This was done by putting together both versions for each level of fear (HE and LE groups). This way all the dummy variables for each risk reduction in the HE group (HE_{RR}, RR=2, 7, 12, 17, 22, 27, 32) were estimated simultaneously, making a distinction between HE_{17} from the ascending version (HE_{17Asc}) and from the descending version (HE_{17Desc}), same for the LE group. Next, these two models were re-estimated constraining these two dummies to be equal (HE_{17Asc}= HE_{17Desc} in the HE model, and LE_{17Asc}= LE_{17Desc} in the LE model). Two likelihood ratios test were computed between the constrained and unconstrained models, concluding that estimates for a 17% risk reduction in the ascending and descending versions for each level of fear are not statistically different at the 1% significance level (the test statistics are 1.682 and 0.842 while the 1% critical value for the chi-squared distribution with 1 degrees of freedom is 6.63).

6. Discussion and Concluding Remarks

The paper shows that emotions can influence the monetary value of health technologies (in this case DES)[3]. Choosing between health technologies is a highly emotional issue and it is not surprising that the evaluation of such technologies is influenced by emotions. The first lesson of this paper is that researchers should try to measure the impact of emotions in the evaluation of such health technologies. This is especially important given that highly emotional subjects not only are WTP more for a reduction in the risk of restenosis (this is perfectly reasonable) but they are not very sensitive to the magnitude of the risk reduction. This seems to confirm Hsee and Rottenstreich (2004) hypothesis that responses to WTP questions mainly reflect the 'nature' of the good (e.g. reduction in the risk of restenosis) and not so much the magnitude of the effect (size of the risk reduction) when emotions are high.

This result has implications for the use of WTP as guidance for public health policy. Assume, for example, that we want to estimate how much a National Health System has to pay for new stents. The main reason that the health system is WTP a higher price for new stents is that they produce better outcomes, namely, lower number of restenosis. If we want to use contingent valuation to estimate social WTP, subjects have to be sensitive to the magnitude of the benefit. However, we have seen that, when emotions are high WTP estimates hardly change with the amount of the benefit.

This result questions the normative status of highly emotional responses for social policy. Can we use WTP estimates that do not make any distinction between a 2% and a 7% risk reduction? Can we use WTP estimates that reflect a WTP for a 32% risk reduction that is only 8% higher than the WTP for a 17% risk reduction? We think that the response should be negative, that is, emotions should be considered a bias to be corrected. This also opens the issue of the role of emotions in methods like the Time Trade-Off or Standard Gamble. It is not uncommon that subjects provide the same utility for health states that have different severity level. For example, in the case of very bad health states (the so-called worse than death health states) it is quite common for subject to provide the lowest possible utility (e.g. -39 in the former Euroqol protocol). Dolan and Kahneman (2008) suggest that those evaluations are highly influenced by the fear generated by the description of the health problem, so it is possible that the finding that subjects collapse the utility of bad health states (that are actually different) to the lowest possible utility is because all those health states generate the same negative emotions.

We share the Slovic approach (Slovic, 2007) in order to deal with feelings and emotions. Slovic (2007) suggests that people are insensitive to the number of victims in the case of mass murder or genocides because the emotional impact is the same for very different absolute number of victims. In that case, the amount of resources devoted to

[3] Similar conclusions in relation to our hypothesis were drawn when using only the response to the first dichotomous choice question for each of the four risk reduction levels. These results are available from the authors upon request.

prevent mass murder cannot be driven by the emotional reaction to the number of victims since it is highly insensitive to scope. In the same way, the price of a stent has to reflect the magnitude of the risk reduction. For this reason, researchers should try to incorporate questions to pick up the effect of emotions in WTP studies of health treatments. They can be used as a debiasing tool or simply as a personality trait that helps to improve our understanding of the responses. If we observe that subjects are not sensitive to scope because they are in a highly emotional state those responses should not be taken into consideration in the case of a public authority that wants to use the results of those studies in order to reimburse the firm that has developed the better stent. We understand that this is a very personal approach about the role of emotion. However, whatever our normative approach to the role of emotions this seems to be a research area that deserves more attention when measuring health benefits.

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Table 1. Offered bids for each sample (in euros)

First_bid	*Follow-up bid*	
100	bid_{up}	400
	$bid_{\_down}$	30
400	bid_{up}	900
	$bid_{\_down}$	100
900	bid_{up}	1,500
	$bid_{\_down}$	400
1,500	bid_{up}	3,000
	$bid_{\_down}$	900
3,000	bid_{up}	6,000
	$bid_{\_down}$	1,500
6,000	bid_{up}	12,000
	$bid_{\_down}$	3,000
18,000	bid_{up}	30,000
	$bid_{\_down}$	12,000

Table 2 Socioeconomic characteristics. Survey and Spanish populations

Variables	Sample population (n=1,479)	Spain (2009)
Age[1]		
20-34	29.5	28.3
35-49	28.3	29.9
50-64	22.5	21.5
65+	19.6	20.3
Gender[2]		
(% female)	50.7	50.6
Level of studies[3]		
Compulsory education	37.9	23.1
1st level Secondary	34.5	27.5
2nd level Secondary	8.3	21.0
Higher Education	19.2	28.5
Employment[4]		
Employed	59.9	60.1
Unemployed	40.1	39.8
HH average size[5]		
Number of individuals	3.1	2.9
Net HH income[6]		
Up to 1,200€	39.6	45
From 1,201 to 3,000€	55.3	51.2
More than 3,000€	5.1	3.8

[1,2] Estimations from Census, January 2009. (*Padrón Municipal*)
[3] Data from the Ministry of Education (*Sistema Estatal de Indicadores en Educación*) http://www.institutodeevaluacion.mec.es/contenidos/pdfs/c4_2007.pdf
[4] Employment Survey. (*Encuesta de Población Activa*) First Quarter 2009.
[5] Household Budget Survey,(*Encuesta de Presupuestos Familiares*), 2005.
[6] Income Survey (*Encuesta de Estructura Salarial*), 2006.
Source: [1,2,4,5 and 6]: National Institute of Statistics. *INE (http://www.ine.es)*

Table 3 Covariates distribution, by group

	LE-A (n=351)	LE-D (n=399)	HE-A (n=365)	HE-D (n=364)
Age (average)	45.4	46.5	48.3	47.7
Gender (% female)	44.4	41.1	58.9	58.5
Years of study (average)	9.7	9.7	9.2	9.6
Laboral Status (% employed)	58.1	61.7	59.2	61.8

Table 4. Parameters estimates. Ascending Sequence

Covariates	Model 1		Model 2		Model 3		Model 4	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
Constant	.1079	.8030	-.3312	.4484	.1712	.6930	-.2678	.5410
Bid	-.1985	.0000	-.1994	.0000	-.1983	.0000	-.1995	.0000
Age	.0040	.4593	.0016	.7595	.0040	.4564	.0016	.7657
Gender	-.1749	.3058	-.0716	.6738	-.1741	.3087	-.0707	.6784
Laboral status	.4526	.0205	.3780	.0555	.4562	.0197	.3802	.0547
Education	.0500	.0304	.0540	.0199	.0500	.0308	.0539	.0205
HRR	.0561	.0000	.0708	.0000	-	-	-	-
HE			.9957	.0000	-	-	-	-
HRRxHE			-.0288	.0000	-	-	-	-
HRR_7					.3539	.0000		
HRR_{12}					.6970	.0000		
HRR_{17}					.8182	.0000		
LE_7							.5206	.0000
LE_{12}							.8579	.0000
LE_{17}							1.0685	.0000
HE_2							1.0011	.0000
HE_7							1.2028	.0000
HE_{12}							1.5544	.0000
HE_{17}							1.5819	.0000
ρ	.8043	.0000	.7996	.0000	.8046	.0000	.8001	.0000
LnL	-2,558.450		-2,543.546		-2,555.111		-2,539.017	

WTP estimates

	Model 1	Model 2		Model 3	Model 4	
		HE	LE		HE	LE
2	5,417.64	7,698.85	2,997.11	5,192.58	7,615.86	2,597.67
7	6,832.18	8,751.30	4,773.14	6,976.52	8,626.41	5,207.44
12	8,246.72	9,803.75	6,549.17	8,706.14	10,388.71	6,897.82
17	9,661.26	10,856.21	8,325.20	9,317.24	10,526.95	7,953.33

Table 5. Parameters estimates. Descending Sequence

Covariates	Model 1		Model 2		Model 3		Model 4	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
Constant	.3781	.5204	-.8332	.1507	1.3282	.0236	.3700	.5166
Bid	-.2472	.0000	-.2484	.0000	-.2473	.0000	-.2484	.0000
Age	.0035	.6379	.0097	.1910	.0033	.6556	.0097	.1909
Gender	-.0543	.8028	.2860	.2037	-.0564	.7956	.2866	.2033
Laboral status	.5290	.0371	.6337	.0112	.5272	.0378	.6317	.0115
Education	.0996	.0005	.1018	.0004	.0992	.0005	.1019	.0004
HRR	.0279	.0000	.0364	.0000				
HE			1.5451	.0000				
HRRxHE			-.0193	.0196				
HRR_{27}					-.2175	.0064		
HRR_{22}					-.3673	.0000		
HRR_{17}					-.4180	.0000		
LE_{27}							-.2530	.0142
LE_{22}							-.4548	.0000
LE_{17}							-.5434	.0000
HE_{32}							.9301	.0001
HE_{27}							.7585	.0018
HE_{22}							.6733	.0057
HE_{17}							.6718	.0050
ρ	.8967	.0000	.8904	.0000	.8969	.0000	.8905	.0000
LnL	-2,355.989		-2,345.139		-2354.755		-2343.895	

WTP estimates

	Model 1	Model 2		Model 3	Model 4	
		HE	LE		HE	LE
32	10,861.05	12,936.49	9,213.35	11,028.82	13,108.86	9,365.39
27	10,296.56	12,592.59	8,479.33	10,149.20	12,418.35	8,347.08
22	9,732.07	12,248.69	7,745.30	9,543.68	12,075.45	7,534.81
17	9,167.57	11,904.78	7,011.27	9,338.45	12,069.22	7,178.24