Word Count = 4,452

Are Patients utility maximizers?

Gethin L. Griffith[1*], Val Morrison[2], J. Mark G. Williams[3], Rhiannon Tudor Edwards[4]

[1] Health Economics Research Group, Brunel University.

[2] School of Psychology, University of Wales, Bangor.

[3] Department of Psychiatry, University of Oxford.

[4] Centre for Economics and Policy in Health, Institute of Medical and Social Care Research, University of Wales, Bangor.

***** Correspondence to:

Gethin L. Griffith, Health Economics Research Group, Brunel University, Uxbridge, Middlesex UB8 3PH.

Tel: +44(0)1895 265454

Fax: +44(0)1895 269708

E-mail: Gethin.Griffith@brunel.ac.uk

Preference elicitation techniques such as visual analogue, time-trade off, contingent valuation and discrete choice modelling amongst others are used every day in economic evaluations to evaluate, guide service provision and budget allocation of finite resources. These preference elicitation techniques are based upon the implicit assumption of utility theory. In 1989 leading academics working in the field of normative, descriptive and prescriptive utility theory participated in the 'Utility: Theories, Measurement and Applications' conference [1]. The delegates unanimously agreed that expected utility and subjective expected utility were still the best normative theories for decision making under risk or uncertainty [1, 2] but that utility maximization (the primary assumption/axiom and the one constant in all utility theories) is currently indefensible as a descriptive decision theory [1]. In the meantime utility theory has been assumed to be the best approximation available and stated preference techniques have been used in economic evaluation.

Eppel et al. [2], Sarin [3] and Schoemaker [4] suggested that many of the violations of utility theories when experimentally tested were the result of psychological attributes that were not accounted for in the experiments. Generalised utility theories such as regret theory [5, 6] and prospect theory [7] highlighted the issues of regret, subjective distortion of probabilities and utilities, choices and options being judged from a reference point and framing or context effects leading to completely different choices being made for mathematically equivalent choices. In light of this evidence Wroe et al. [8] concluded that utility theory, or to be more precise its primary assumption of utility maximization, had failed under experimental conditions as it had been applied in too narrow a fashion. They proposed utilising utility maximization explicitly within Beck's cognitive model [9], emphasising the influence of subjective beliefs, proposing that the individuals' decisions are based upon their beliefs and the information that is available and deemed to be relevant to them at the time. Wroe and Salkovskis [10] propose that apparently inconsistent decisions are not the result of an illogical decision process but the information and beliefs upon which the perceived outcomes and ultimately the decisions are based.

In a series of studies Wroe et al. [8] have successfully predicted anticipated likelihood of obtaining genetic testing and attendance at screening [8, 10-12]. Wroe et al. [12] found that 96.4% of participants were correctly classified as to their subsequent decision whether or not to take a test for bone density screening based upon their intention to have testing; both

intention and actual uptake complied with utility maximization. However, research into the impact of information upon the hypothetical decision to have genetic testing by Cameron and Diefenbach [13] contradicts Wroe and Salkovskis' [10] findings and raises further doubts as to the descriptive validity of utility maximization and as a result the validity of utility theory.

In this paper we report the results of an information manipulation experiment, based upon the work of Wroe and Salkovskis [10], to test if utility maximization is being used.

Methods

Aims, Objectives and Hypotheses

Utility maximization assumes that an individual weighs up the pros and cons of a choice and chooses the option that provides them with the most perceived benefit or minimises undesirable consequences. To experimentally test this proposition it is necessary to ascertain an individual's desire for a commodity and the pros and cons they associate with that commodity. For the purposes of this study the commodity in question was cancer genetic testing and counselling.

Aims

Experimentally examine by means of an information manipulation if respondents are adhering to the utility theory axiom of utility maximization.

Objectives

- Ascertain if the experimental information manipulation will result in participants evaluating and making choices in relation to genetic testing and counselling for breast cancer in accordance with utility maximization, specifically in relation to: the relative importance of the perceived pros and cons of genetic services and as a result the intention to have testing and counselling (hypotheses 1, 2, 4 and 5).
- Ascertain if there is an information ordering/primacy effect (hypotheses 3 and 6).

- Compare the strength of the relationship between the relative importance of the perceived pros to cons of testing with the intention to have testing and counselling pre and post information manipulation (hypothesis 7).

Hypotheses

The hypotheses and a lay explanation are presented in table 1. A graphic representation of the hypotheses is presented in Figure 1.

Insert Table 1 approximately here.

Insert Figure 1 approximately here.

Design and procedures

A repeated measure experimental design was used. Assessments were made in one sitting, pre and post the information manipulation with self-administered questionnaires. The sample comprised of 158 first year undergraduate students of the School of Psychology, University of Wales, Bangor that had not yet begun to study health psychology modules (68.4% participation rate). They were randomised into positive, negative and control groups. The positive group were given information on detection and prevention of genetic breast cancer, the negative group received the same information in addition to information on the limitations of these methods, and the control group were given information relating to the common cold. The information issued in this experiment was the same information as was used by Wroe and Salkovskis [10]. Unlike Wroe and Salkovskis [10], two negative group were used in this experiment, one received the positive information first and the other the negative information first. This allowed the results to be examined for any potential ordering (primacy/recency) effects [14-16]. In order to ensure that any visual or hearing impairment on the part of the participants did not affect the experiment, information was issued on information sheets, displayed in large print on an overhead projector and read aloud simultaneously. All information was then removed to ensure that all participants were exposed to the information for the same length of time. Participants were then told to forget about their previous answers and not to look back at them; they could then answer the follow-up assessment.

In order to ensure that participants' baseline experience, knowledge or psychological status did not confound the results of the experiment a series of screening questions were posed (all questions are available on request from the lead author). Positive answers on the experience questions were compared to negative (negative and don't know), knowledge scores of 50 or above were compared to those below 50 (0 = Know nothing -100 = Very Knowledgeable) and clinical anxiety and depression scores (11+) [17] on the Hospital Anxiety and Depression Scale (HADS) [18] were compared with non-clinical scores on the three outcome measures. Respondents providing a positive response to the experience items, a rating of 50+ on the knowledge items and a score of 11+ on the HADS scales were excluded from the study if they provided substantially different responses to their counterparts on the outcome measures.

Measures

Two measures were used to assess the intention of respondents to have cancer genetic testing and counselling; an adaptation of Wroe et al.'s [10] 'likelihood of booking an appointment for testing and counselling' question and Cameron and Diefenbach's [13] two item 'interest in genetic testing score'. The pros and cons associated with genetic testing and counselling were measured by asking respondents to list separately all the pros and cons associated with genetic testing and counselling for them and to weight the importance of these items to them on a 0 to 100 likert scale. The weighted ratio of pros to cons [8] was calculated by subtracting the weighted barriers from the benefits and dividing by the sum of the weighted benefits and barriers. Weighted ratio = (∑Benefit Importance - ∑Barrier Importance)/(∑Benefit Importance + ∑Barrier Importance). For example, if a respondent had 3 benefits (pros) for genetic testing with respective importance to them of 80, 80 and 90, and 3 disadvantages (cons) with respective importance weightings of 70, 80, 90 the weighted ratio score would be 0.020 [(80+80+90)-(70+80+90)/(80+80+90+70+80+90)].

Violation of the utility theory axioms of continuous preference and transience, and the related assumption of non-satiation were tested by examining responses to a discrete choice modelling questionnaire. The questionnaire consisted of six attributes identified from a review of the literature on applications of discrete choice modelling of patient preferences for health service provision, research on attendance at cancer genetics clinics, guidance papers on delivery of genetics services and consultation with a consultant cancer geneticist. The

attributes and levels selected are listed in Table 2. The attributes and levels were combined into 25 scenarios using a fractional factorial design devised on Speed 2.1 software [19]. The results of the discrete choice questionnaire and discussion of the appropriateness of censoring the sample in relation to the results of dominance, transience and non-satiation tests will be discussed elsewhere.

Insert Table 2 about here.

A number of demographic and psychological issues have been found to be significantly related to decision making in relation to cancer genetic services such as age, anxiety and family history of cancer [8, 11, 13, 20]. In addition to age, anxiety and depression (HADS) [18] and family history of cancer, data was also gathered upon dispositional optimism (LOT) [21], social class [22], knowledge and experience of genetics and oncology, and previous experience of psychology and/or economics. Knowledge of psychology and economics was collected as these disciplines study behaviour models and this may lead respondents to realise what the experiment was designed to test and they may deliberately comply or amend their responses strategically.

The anonymous research participants were categorised as having a family history of breast or breast ovarian cancer if their family history complied with the Cancer Genetics Service in Wales's referral guidelines [23]. Violation of the axiom of continuous preference was tested for by looking for a dominant preference patterns on the discrete choice questionnaire. Respondents were deemed to have a dominant preference for an attribute if they always selected the scenario with the most favourable value of that attribute in each paired choice and had ranked that attribute as the most important of all the six attributes [24]. Four paired choices were included in the questionnaire where one of the two scenarios was equal or better on all attributes (dominant). Three of the four choices in conjunction formed a test of transience (If A > B and B > C, then A (should be) > C). The remaining test was purely a test of non-satiation, where one scenario was clearly superior to the other.

Results

Exclusions

In order to ensure that participants knowledge, experience and psychological wellbeing did not confound the results of the experiment, results on the screening questions were compared on the three key outcomes (weighted ratio of pros to cons of genetic testing and counselling for breast cancer, likelihood and interest in obtaining genetic testing and counselling). For the majority of screening questions it was possible to compare results on the three outcome measures using inferential statistics, where sample size prohibited this, mean scores at least 1.5 times larger in one group than another were considered substantially different and merited exclusion. It was necessary to remove 16 respondents from the initial sample of 158 before analysing the experiment results. The participants that were excluded were: one that had had cancer, two with a family history of cancer, one with a genetic disorder, 11 who had previously considered going for genetic testing and one with a clinically depressed rating on the HADS scale.

Reliability and validity

The internal consistency of the composite measures used in the experiment were assessed using Cronbach alpha coefficients. As would be expected the weighted ratio score had a low coefficient at baseline (0.4588) and follow-up (0.4468) given that it comprises of the completely opposing variables of the sum of the weighted pros and the sum of the weighted cons of genetic testing and counselling. All remaining items had alpha coefficients of 0.6877 or above and as a results the internal consistency of the measures used in this experiment were acceptable.

Acceptable convergent validity, comparing variables that we would expect to be associated with each other, was found with correlation coefficients of 0.3 or above [25]. Examples of convergent validity included; likelihood with interest scores and HADS anxiety with HADS depression. Evidence of discriminant validity was also found with a negative relationship between dispositional optimism and HADS anxiety and dispositional optimism with HADS depression.

Sample Characteristics

Of the 142 first year psychology students meeting the inclusion criteria 23 were male (16.3%) and 118 were female (83.7%) (missing data = 1). The mean age of respondents was 20.2 years (min = 17, max =53, median =18, std. deviation = 6.0), 16.4% were mature students at 21 years of age or greater (7.9% were 25 plus). In terms of ethnicity the majority of participants were white (90.8%). 62% of participants were from a household where the head was categorised as professional or higher managerial in terms of socio economic classification [22].

No significant differences were found between the information groups (positive, pos-neg, neg-pos and control) on age, gender, number of respondents that were parents, social class, anxiety, depression, dispositional optimism, whether or not they had studied psychology or economics before, or on the test of the axioms of continuous preference and transience.

Weighted Ratio of Pros to Cons (Hypotheses 1 - 3)

Hypotheses one to three were tested by means of a repeated measures general linear model (GLM) and the accompanying post hoc tests. The dependent variable change in weighted ratio of pros to cons from baseline to follow-up (post information) was compared by a list of independent variables and the interaction of the independent variables. The independent variables comprised of information group, demographic characteristics (age, gender and social class), psychological characteristics (anxiety [HADS], depression [HADS] and dispositional optimism [LOT]) and the potentially biasing factors of previous social science experience (having previous studied psychology and/or economics) and failing the utility theory axiom tests (dominance, transience and non-satiation).

Results on the dominance, transience and non-satiation tests had a strong relationship with previous social science studied and dispositional optimism. The variable ‘failing the axiom tests’ was excluded from the analysis as it was causing collinearity problems. Examination of the unstandardised residuals revealed one outlier for the baseline data and one outlier and an extreme for the follow-up data (two respondents in total); both residual outliers were excluded. Repeated measures GLM detected a significant effect of time [F(1,118)=16.330,

P=0.000] and this relationship was mediated by dispositional optimism [F(1,118)=7.026, P=0.009] and information group [F(3,118)=4.930, P=0.003].

The estimated marginal means associated with dispositional optimism (independent of the other significant variable, information group) declined between assessments from 0.3967 (N=123, std. error = 0.00062) to 0.3829 (N=123, std. error = 0.00680). The decline signifies a reduction in the importance of pros relative to cons as a proportion of all the pros and cons reported by each respondent.

Insert Table 3 approximately here.

Irrespective of information group, weighted ratio scores declined between the baseline and follow-up assessments (see Table 3), mirroring the findings in relation to dispositional optimism. The largest reductions were recorded by the pos-neg and ne-pos groups, the largest change being recorded by the latter information group. The neg-pos group recorded a decline in their weighted ratio scores of 0.297 out of a maximum possible change of ±2.00.

Interest in and Likelihood of Having Cancer Genetic Testing and Counselling (Hypotheses 4 - 6)

The dependent variables change in likelihood and interest scores from baseline to follow-up (post information) were compared by the same independent variables as were used with the weighted ratio scores. The repeated measures GLM detected a significant interaction effect of time with information group on both likelihood [F(3,125)=7.843, P=0.000] and interest [F(3,125)=7.217, P=0.000] scores. There was a significant effect upon interest scores by the interaction of time with previous social science experience [F(3,125)=5.674, P=0.001]. Finally, the interaction of time with information group and social science studied was significant for both likelihood [F(8,125)=2.530, P=0.014] and interest scores [F(8,125)= 2.807, P=0.007].

The descriptive statistics in Table 3 reveal that on likelihood ratings the positive group was completely different to the remaining information groups. The positive group recorded an increase over time of 23.7 in likelihood ratings (range 0 – 100) compared to a decline in all

other groups of 9.6 to 11.2. Post hoc tests found no significant differences in baseline or follow-up ratings by information group. The latter finding indicating that the net change in likelihood scores was non-significant.

The results on interest scores were similar to those on likelihood, with the positive group recording an increase in their interest in having testing whilst the remaining groups recorded reduced interest (see Table 3). In contrast to the likelihood scores, the pos-neg group showed substantially more of a reduction in interest scores than the neg-pos or control group; a drop of 2.25 compared to 0.56 – 0.57 out of a maximum possible change of 14 points. No significant differences were found by post hoc tests of baseline or follow-up interest scores by information group.

No descriptive statistics or analysis are presented in relation to the previous social science experience of experiment participants as there were insufficient numbers of participants with experience of economics and both economics and psychology. Reducing this variable to the dichotomous categories of having or not having experience of psychology and/or economics was not an option as students having studied psychology and economics were completely different to students having studied one of these disciplines alone on their interest in genetic testing scores.

The Relationship between Pros and Cons and the Desirability of Opting for Testing (Hypothesis 7)

The relationship between weighted ratio scores and the likelihood ($r=0.191$, $N=123$, $p<0.05$) and interest scores ($r=0.242$, $N=122$, $p<0.01$) at baseline were weak. By the follow-up assessment the degree of agreement between these measures had improved, however, the magnitude of the correlation coefficients were low to moderate at 0.404 ($N=123$, $p<0.001$) for likelihood and 0.343 ($N=122$, $p<0.001$) for interest.

Discussion

The measures used in this experiment were found to be reliable and valid. The internal consistency of the composite measures was acceptable with the majority recording Cronbach alphas coefficients approaching or exceeding 0.7. Evidence of acceptable convergent and discriminant validity was found for the measures used in the experiment.

Hypothesis 1 was confirmed with the experiment's information inducing statistically significant change in the weighted ratio of pros to cons. Hypothesis 2 was rejected, despite the control and negative groups (pos-neg and neg-pos) reacting as predicted, the positive group did not. A decline in mean weighted ratio scores was recorded for the positive group when compliance with utility maximization would have resulted in the importance of pros relative to cons increasing.

The greater decline in weighted ratio scores for the neg-pos and pos-neg groups relative to the remaining information groups (Table 3) indicate that including negative information along with the positive information substantially impacted upon the ratio of important pros to cons, with the importance of cons increasing. Surprisingly positive information alone had little impact, and the effect was to reduce the mean score of the weighted ratio of pros to cons. The small decline for both the positive and control group suggest that this decline may be, in part for the positive group and completely for the control group, due to the questionnaire. The weighted ratio questions were located at the beginning of the questionnaire; it may well be that by the time participants data on the pros and const of testing at follow-up that answering the baseline questions had caused them to consider the consequences of developing genetic cancer.

Hypothesis 3 was also rejected. Although the larger decline in weighted ratio scores for the neg-pos group than the pos-neg group suggests that there was an ordering effect it was not statistically significant.

Hypothesis 4 was supported in that information significantly changed participants' intention to have genetic testing and counselling for breast cancer on both the likelihood and interest measures. Hypothesis 5 was rejected. Although the positive group recorded an increase in

likelihood and interest scores and both negative information groups (pos-neg and neg-pos) recorded reduced scores on both measures, as predicted in hypothesis 5, the control group recorded a reduction similar to those of the neg-pos group on both measures. The decline for the control group suggests that the decline recorded by them and the negative (pos-neg and neg-pos) groups is related to the questionnaire and not merely the information issued to them. By the time participants provided follow-up ratings, answering the baseline questions may have caused them to consider the consequences of developing genetic cancer. Hypothesis 6 was rejected as the pos-neg group recorded a greater reduction on interest scores than the neg-pos group.

Hypothesis 7 was rejected with the analysis revealing only a weak to low correlation between weighted ratio scores and the likelihood and interest scores. A moderate to very strong correlation was predicted in the hypothesis as theory dictates that if individuals are utility maximizers that they weigh up the pros and cons of their options (likelihood of having/ interest in genetic testing) and choose the option with the maximum subjective utility [8], the option they perceive to be most likely (subjective probability) to yield the maximum utility (subjective utility). In contrast to these findings Wroe et al. [8] in their descriptive study found a strong correlation between weighted ratio scores and the likelihood of opting for genetic testing ($r=0.75$, $p<0.0001$). The substantial discrepancy between these results may be a result of Wroe et al. [8] conducting this correlation on data obtained from 62 members of the general public that had considered going for genetic testing.

Although the likelihood and interest meaures showed strong convergent validity, providing a Pearson correlation coefficient of 0.864 ($N=141$, $p<0.001$) at baseline and 0.878 ($N=142$, $p<0.001$) at follow-up, results were inconsistent upon these two items. The neg-pos group showed a sharper decline on likelihood compared to the pos-neg group and the converse was seen on interest scores. The discrepancy in the results supports the use of multiple measures to assess the desirability of testing and counselling in this study. It is likely that the discrepancies between the results on the two measures used stems from the wording of the questions. Whilst Cameron and Diefenbach's [13] interest questions referred solely to genetic testing the likelihood question also considers genetic counselling (testing is accompanied by counselling when provided by the NHS in the UK) and makes it explicit that the services would be free of charge. Additionally the second of the two interest questions states "I intend to have genetic testing" whilst the likelihood item refers to the likelihood of "booking an appointment". The

former is far more definite than the latter in terms of the decision of whether or not to have genetic testing.

There are some potential limitations to this experiment. Firstly, the experiment was conducted during breast awareness month. Local and national newspapers and national magazines were publishing articles and supplements with information upon and references to further information on genetic breast cancer. In order to prevent media coverage and discussion of the issues with others between assessments taking place, both the pre and post information measurement were conducted within one sitting and with all the information groups at the same time.

Secondly, there was a danger of baseline knowledge and experience of genetics and/or breast cancer biasing the experiment. As a result a series of screening questions were posed to combat this problem. Thirdly, conducting both assessments of the experiment in one sitting to combat the media coverage and discussion between participants raised the potential problem of recall bias; respondents recalling their original responses and answering the second set of questions in light of this. We attempted to minimise this bias by preventing respondents from looking at their previous answers and asking them to ignore their original ratings and responses (if they could recall them) when completing the follow-up assessment.

Fourthly, at first sight it may appear that information with a stronger emphasis of the positive and negative aspects of cancer genetic testing and counselling could or should have been used in the experiment. However, the information used in this study has been successfully used by Wroe and Salkovskis [10]. In addition, in the event that the information did not have a significant affect on the outcome measures, the design of the experiment would still identify decision making that complied with utility maximization. If utility maximization were in use hypothesis 7 (moderate to very strong positive correlation (0.5 – 1.0) will exist between weighted ratio scores and likelihood and interest in testing scores) would be confirmed. The rejection of hypothesis 7 was also confirmed when weighted ratio scores and other independent variables identified from the literature were tested as potential predictors of likelihood and interest using multiple linear regressions techniques; these findings are reported elsewhere.

The remaining limitations all relate to the sample of respondents used in this experiment. A sample of students was used in this experiment rather than a sample of individuals with a family history of cancer. A cohort of individuals with a family history of cancer could not be used for a variety of reasons, including; their knowledge of cancer and genetic cancer could negate the effects of the information manipulation, it is ethically questionable to manipulate the likelihood of an individual opting to have genetic testing and counselling when they are at increased risk of developing genetic cancer (debriefing has been found to be ineffective in a similar study [12]). However, as the focus of the study was to test if respondent were complying with the assumption of utility maximization rather than estimating interest in testing by actual service users, conducting the experiment with students was not as limiting as it may appear at first. Cameron and Diefenbach [13] point out that laboratory studies looking at the implications of health information and psychosocial factors on behaviour perceptions [26, 27], are based on the principal that information processing effects will be similar across socio-demographic groups.

Conclusions

The primary conclusion of this experiment is that utility maximization, the key tenet of utility theory, did not explain respondents' ratio of pros to cons or hypothetical interest in genetic testing or likelihood of having testing and counselling. This finding is in keeping with the findings of the 'Utility: Theories, Measurement and Applications' conference [1]; where leading academics working in the field of normative, descriptive and prescriptive utility theory concluded that utility maximization is indefensible as a descriptive model of decision making [1]. Given the contradiction between the findings of this study and those of Wroe and colleagues [8, 10-12] there is a need to conduct further research into utility maximization.

Acknowledgements

We would like to thank the undergraduate students of the School of Psychology, University of Wales, Bangor, who participated in the experiment and Caroline Taylor, Abbie Unwin and Nonn a'ch Dafydd who assisted in conducting the experiment.

References

[1] Edwards W. Towards the demise of economic man and woman; bottom lines from Santa Cruz. In: Edwards W, ed. *Utility theories: measurement and applications*. Boston: Kluwer Academic Publishers 1992:253-67.
[2] Eppel T, Matheson D, Miyamoto J, Wu G, Eriksen S. Old and new roles for expected and generalised utility theories. In: Edwards W, ed. *Utility theories: measurement and applications*. Boston: Kluwer Academic Publishers 1992:271-94.
[3] Sarin RK. What now for generalized utility theory? In: Edwards W, ed. *Utility theories: measurement and applications* Boston: Kluwer Academic Publishers 1992:137-63.
[4] Schoemaker PJH. The expected utility model: its variants, purposes, evidence and limitations. Journal of Economic Literature. 1982;20:529-63.
[5] Bell DE. Regret in decision making under uncertainty. Operations Research. 1982;30:961-81.
[6] Looms G, Sugden S. Regret theory: an alternative approach to rational choice under uncertainty. Economic Journal. 1982;92:805-24.
[7] Kahneman D, Tversky A. Prospect theory: an analysis of decision under risk. Econometrica. 1979;47(2):263-91.
[8] Wroe AL, Salkovskis PM, Rimes KA. The prospect of predictive testing for personal risks: attitudes and decision making. Behavioural Research and Therapy. 1998;36:599-619.
[9] Beck AT. Cognitive therapy and emotional disorders. New York: International University Press 1976.
[10] Wroe AL, Salkovskis PM. Factors influencing anticipated decisions about genetic testing: Experimental studies. British Journal of Health Psychology. 1999;4:19-40.
[11] Salkovskis PM, Dennis R, Wroe AL. An experimental study of influences on the perceived likelihood of seeking genetic testing: "Nondirectiveness" may be misleading. Journal of Psychosomatic Research. 1999;47(5):439-47.
[12] Wroe AL, Salkovskis PM. The effects of 'non-directive' questioning on an anticipated decision whether to undergo predictive testing for heart disease: An experimental study. Behaviour Research and Therapy. 2000;38:389-403.
[13] Cameron LD, Diefenbach MA. Responses to information about psychosocial consequences of genetic testing for breast cancer susceptibility: Influences of cancer worry and risk perceptions. Journal of Health Psychology. 2001;6(1):47-59.
[14] Ley P, Spelman MS. Communicating with the patient. London: Staples Press 1967.
[15] Ley P. Primacy, rated importance and the recall of medical information. Journal of Health and Social Behaviour. 1972;13:311-7.
[16] Ley P. Giving information to patients. In: Eiser JR, ed. *Social Psychology and Behavioural Medicine*. New York: Wiley 1982.
[17] Carroll BT, Kathol RG, Noyes R, G. WT, H. CG. Screening for depression and anxiety in cancer patients using the Hospital Anxiety and Depressions Scale. General Hospital Psychiatry. 1993;15(2):69-74.
[18] Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand. 1983;67:361-70.
[19] Bradley M. Users manual for the speed version 2.1 stated preference experiment editor and designer. The Hague: Hague Consulting Group; 1991.
[20] Brain K, Gray J, Norman P, Parsons E, Clarke A, Rogers C, et al. Why do women attend familial breast cancer clinics? Journal of Medical Genetics. 2000;37:1-5.
[21] Scheier MF, Carver CS. Dispositional optimism and physical well-being: the influence of generalized outcome expectancies on health. Journal of Personality. 1987;55:169-210.

[22] Rose D, O'Reilly K. The ESRC review of government social classifications. London and Swindon: Office for National Statistics and Economic and Social Research Council 1998.
[23] Griffith GL, Edwards RT, Gray J, Butler R, Wilkinson C, Turner J, et al. A micro costing of NHS cancer genetic services. British Journal of Cancer. 2005;92(1):60-71.
[24] Scott A. Identifying and analysing dominant preferences in discrete choice experiments: An application in health care. Journal of Economic Psychology. 2002;23:383-98.
[25] Kline P. The handbook of psychological testing. London: Routledge 1993.
[26] Croyle RT, Williams KD. Reaction to medical diagnosis: The role of illness stereotypes. Basic and Applied Social Psychology. 1991;12:227-41.
[27] Gintner G, Rectanus E, Achord K, Parker B. Parental history of hypertension and screening attendance: effects of wellness appeal versus threat appeal. Health Psychology. 1987;6:432-44.

Table 1

Hypotheses and Lay Explanation

Testable hypotheses	Lay explanation
1. Experiment information will induce statistically significant change in the weighted ratio of pros to cons of testing and counselling.	
2. Positive information will increase the pros relative to the cons of genetic testing and counselling recoded by respondents, both the pos-neg and the neg-pos information will increase recorded cons relative to the pros, and little or no change will occur for the control group.	If individuals are adhering to utility maximization: Positive information should result in an increase in the importance of the pros of testing and counselling. Information on the limitations of testing and counselling should result in an increase in the importance of the cons. Control information should not cause change in the weighted ratio of pros to cons.
3. Neg-pos information will result in a statistically significantly greater decline in the ratio of pros to cons between assessments (baseline to follow-up) than the pos-neg information (ordering/primacy effect).	An ordering effect is assumed. The information issued first is assumed to influence the weighted ratio of pros to cons e.g. giving negative followed by positive information will result in cons having more importance than when positive information is given followed by negative information.
4. Experiment information induces statistically significant change in intention (likelihood and interest) to have testing and counselling.	
5. Positive information will increase likelihood and interest scores, both pos-neg and neg-pos information will reduce likelihood and interest scores, and little or no change in scores will occur for the control group.	If individuals are adhering to utility maximization: Positive information should result in an increase in the intention to have testing and counselling (likelihood and interest). Information on the limitations of testing and counselling should result in a decrease in testing intention. Control information should not cause change in the intention to have testing and counselling.
6. Interest in testing and likelihood of booking an appointment for genetic testing and counselling for breast cancer will decline between assessments statistically significantly more for the neg-pos than the pos-neg information group (ordering/primacy effect).	An ordering effect is assumed. The information issued first is assumed to influence the intention to have testing and counselling e.g. giving negative followed by positive information will result in testing and counselling being less desirable than when positive information is given followed by negative information.
7. Moderate to very strong positive correlation (0.5 – 1.0) will exist between weighted ratio scores and likelihood and interest in testing scores.	Individuals weigh up the pros and cons of a choice and chooses the option that provides them with the most perceived benefit or minimises undesirable consequences.

Table 2

Attributes and Levels of the DCM Questions

Attributes	Levels
Staff seen for counselling	Specialist genetics nurse, Consultant geneticist, Genetics associate
Waiting time for a letter confirming clinical risk status	1 months, 2 months, 4 months, 6 months
Distance to counselling	20 miles, 40 miles, 60 miles, 80 miles
Duration of counselling	30 minutes, 1 hour, 1 hour 30 minutes, 2 hours
Availability of testing	High risk, All
Cost of service	£1500, £2000, £2500, £3000

Table 3

Estimated Marginal Means of Weighted Ratio, Likelihood and Interest by Information Group by Time

Measure	Information group	Assessment	N	Mean	Std. Error	95% Confidence Interval	
						Lower Bound	Upper Bound
Weighted ratio of pros to cons	Pos	Baseline	33	.517(a)	.061	.395	.639
	Pos	Follow-up	33	.491(a)	.053	.386	.597
	Pos-neg	Baseline	32	.628(a)	.063	.504	.753
	Pos-neg	Follow-up	32	.426(a)	.055	.317	.534
	Neg-pos	Baseline	26	.507(a)	.069	.369	.644
	Neg-pos	Follow-up	26	.210(a)	.060	.090	.329
	Control	Baseline	32	.391(a)	.062	.267	.514
	Control	Follow-up	32	.375(a)	.054	.268	.483
Likelihood	Pos	Baseline	38	51.647(b)	10.351	31.161	72.132
		Follow-up	38	75.370(b)	10.060	55.460	95.281
	Pos-neg	Baseline	36	65.436 [2]	10.577	44.503	86.368
		Follow-up	36	55.852	10.280	35.507	76.197
	Neg-pos	Baseline	31	58.458	9.327	39.998	76.918
		Follow-up	31	47.222	9.066	29.280	65.164
	Control	Baseline	35	56.925	8.604	39.896	73.953
		Follow-up	35	46.329	8.362	29.779	62.880
Interest	Pos	Baseline	38	6.178(b)	1.180	3.844	8.513
		Follow-up	38	8.244(b)	1.201	5.868	10.620
	Pos-neg	Baseline	36	8.883	1.205	6.497	11.268
		Follow-up	36	6.648	1.227	4.220	9.075
	Neg-pos	Baseline	31	7.170	1.063	5.066	9.273
		Follow-up	31	6.610	1.082	4.469	8.751
	Control	Baseline	35	7.311	.980	5.371	9.252
		Follow-up	35	6.737	.998	4.761	8.712

a = Covariates appearing in the model are evaluated at the following values: Dispositional optimism score = 18.2602.

b = Based on modified population marginal mean.

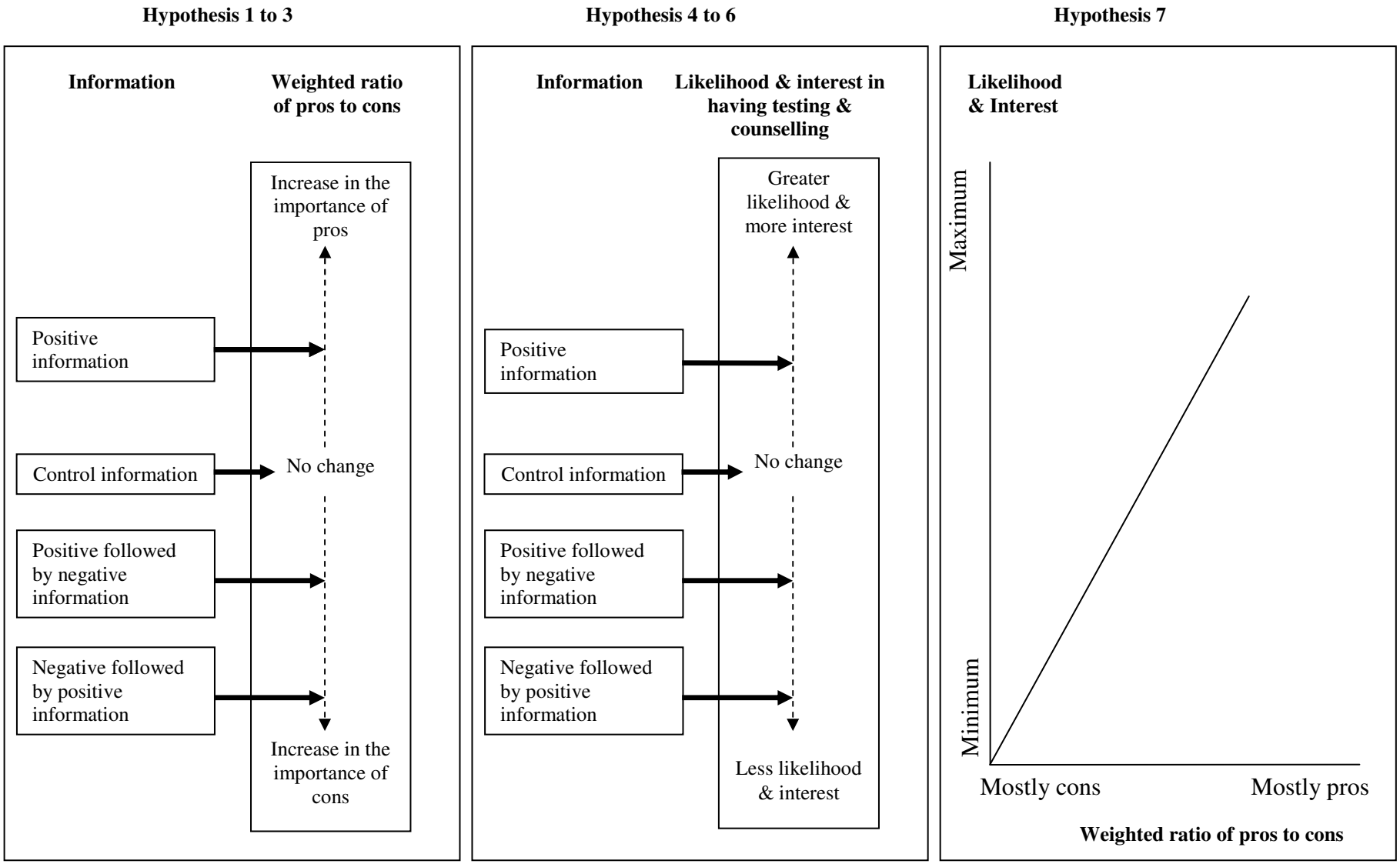

Figure 1. Graphic representation of hypotheses.