

UNIVERSITY OF CALGARY

THE EFFECT OF COST AND VALUE INFORMATION ON EMBEDDING IN  
CONTINGENT VALUATION

by

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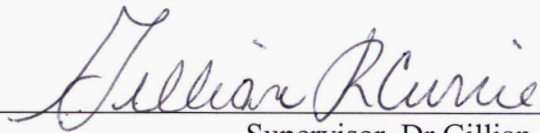
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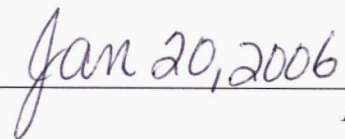
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## **Abstract**

The contingent valuation method (CVM) is a stated preference technique used to elicit values for non-marketed goods. A focus of CVM research has been validity testing, including whether WTP is sensitive to the size of the good. A special type of scope insensitivity is embedding where the value of the whole is less than the value of the sum of its parts. The aim of this paper is to determine whether giving respondents information on value and cost when completing a WTP survey reduces embedding. A computer-based survey was completed by 120 university students with a split-sample design where half received the extra information. The results indicated that at a group level, both groups displayed embedding. At an individual level, fewer in the extra information group exhibited embedding but this was not statistically significant. Regression analysis confirmed this; however, again the finding was not statistically significant. The results are suggestive that a larger study is warranted.

## **Acknowledgements**

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Thanks to all my professors who taught me so well.

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## **Dedication**

This thesis is dedicated to my best friend and wife, who has always pushed me to be better and to “The Boy”, who always has a smile to cheer up Dad.

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## List of Symbols, Abbreviations and Nomenclature

Symbol	Definition
CVM	Contingent valuation method
WTP	Willingness-to-pay
CV	Contingent valuation
$E$	Expenditure function
$p$	Price
$q$	Quantity
$Y$	Income
CS	Consumer surplus
N	Sample population

## INTRODUCTION

Allocative and technical efficiency have always been important issues in health care as new and improved technologies and citizens' expectations highlight the ever present need to allocate scarce resources in health care efficiently. In an atmosphere where the government must choose how to spend limited resources on many different programs scarcity is an ever-present influence in all decisions. Economic scarcity means that individuals and governments are resource constrained and must make trade-offs, since resources used to support one program are no longer available to support another. Thus, these decisions must consider the costs associated with each program. Opportunity costs consider not only the cost of funding a program but the forgone benefits associated with the programs that could not be funded due to scarce resources. In order to maximize efficiency, both cost, including opportunity cost, and benefit of treatments must be considered. Health benefit measurement faces many challenges, especially when individuals' preferences are considered.

The contingent valuation method (CVM) is a stated preference procedure that has increasingly been used to measure the benefits of health treatments, interventions or programs. This survey-based technique asks respondents willingness-to-pay (WTP) questions to determine their value of goods in a hypothetical market. An individual's WTP is the amount of money they would be willing to give up to obtain a specified change. In a CV survey, questions are asked to elicit from a respondent what change in income, along with the change of good in question, leaves their utility unchanged. This is assumed to be the respondents maximum WTP or value for the good. An increasing number of health benefits are being measured using stated preferences.[1-5]

There are, however, problems associated with the CVM, which have caused many to question the reliability and validity of its results.[6] Thus a major focus of the CVM research has been methodological work investigating the validity of the technique. Empirical testing has shown that respondents are not always sensitive to scope, that is, the size of the health benefits. Embedding is a type of insensitivity to scope where an individual values the same good differently, depending on the context of the WTP question. Sub-additivity is a specific way of defining embedding, where the value of a good is different if valued as a whole than if it is valued as the sum of the values of its components.

This study looks at the effect of giving respondents information about value and cost on embedding. The computer-based experiment was conducted with a sample of students at the University of Calgary.

The remainder of this thesis is organized as follows. First the theoretical background is presented for the CVM. In this section different definitions of embedding will be offered as well as methodological and theoretical explanations for its existence. Next will be the literature review. In this section, the existing empirical literature on embedding within CV studies will be reviewed and the methods and results of these studies will be compared. Following that, the Methods section will outline the objectives of the study and the experimental approach taken in the empirical study undertaken will be outlined. Finally, the results and conclusions will be presented.

## THEORETICAL BACKGROUND

### Purpose of the CVM

In an environment of increasing treatment options and increasing resource use, policy and decision makers must choose how to best allocate resources within budget constraints. Once resources have been allocated appropriately, they must also be used appropriately. This is the difference between allocative and technical efficiency.

Allocative efficiency attempts to determine whether to allocate scarce resources to a program or whether to allocate more or less resources to it. Institutions or organizations attempting to achieve allocative efficiency compare all health care programs in a competition for implementation. With technical efficiency, concern is more about how best to deliver a program or to achieve a given objective. Technical efficiency is the second step in achieving efficiency as the resources have already been allocated to the program and now must be used most appropriately.[7] CVM assists in determining technical efficiency by measuring the benefit, including process utility, of treatments within a program. Whether through the allocation of resources or the combination and use of resources, efficiency aims to maximize benefits.

In order to achieve efficient allocation of resources, the benefits of the options must be known as well as their costs. The advantage of measuring the benefits of health programs using the CVM is that benefits are measured in terms of dollars. This differs from other measures of benefit such as life-years gained or quality adjusted life-years, which can only be used to compare alternatives within health programs. The CVM allows disparate programs to be compared, such as environmental, transportation and health programs. Another benefit to the CVM is that it includes within the measurement

non-health benefits, known as process utility. This allows for consideration of non-health related benefits of health interventions, which would not be included within health specific measures of benefits. The CVM is a technique used to measure individuals' preferences for non-marketed goods and services. These preferences along with treatment effectiveness and safety are an important part of the overall measure of health benefits.

The CVM allows researchers to estimate the value of non-market goods. This becomes important in many areas of economics, particularly in environmental and health economics where markets do not always exist. In the environmental framework the CVM has been used to assess the value of environmental damage in order to determine adequate compensation.[8] In the health literature the CVM is used primarily to determine the benefit of different treatments or interventions, in particular for its ability to measure non-health outcomes or process utility.[9, 10] Theoretically, the values elicited from such studies can be combined with cost information and used to address allocative and technical efficiency issues.

### **Economic Theory for the CVM**

In a CV survey investigators ask respondents questions designed to elicit the change in income, along with the change of good in question that leaves their utility unchanged. WTP is equivalent to the compensation surplus in Hicksian theory.[6] This can be represented in terms of the difference between two expenditure functions. An expenditure function can be written as

$$e(p, q, U) = Y,$$

where  $p$  is a vector of prices,  $q$  is a vector of goods,  $U$  is a level of utility, and  $Y$  is the minimum amount of income needed to maintain the utility level given the price and goods vectors. We can represent the compensation surplus (CS) by

$$CS = [e(p_0, q_0, U_0) = Y_0] - [e(p_0, q_1, U_0) = Y_1]$$

Consumer surplus is a measure of consumer welfare, if CS is positive, then  $q_1$  is preferred to  $q_0$  and the consumer would be willing to pay the difference in  $Y_1$  and  $Y_0$  for the change.[6]

### **Methods of CV studies**

A wide range of survey techniques are used in CV studies. Following is an explanation of many of the CV study practices, including the benefits and potential problems associated with each method. The main areas of consideration are the methods of asking WTP questions, the interview format and the payment vehicle.

#### *Elicitation Format*

There are three main methods used to ask WTP questions as well as a fourth, which is less frequently used. These include: dichotomous choice, open-ended questions, payment cards and iterative bidding.

Dichotomous choice entails asking participants “take it or leave it” questions, similar to those consumers face when making a purchase. Are you willing to pay \$X for

commodity Z? Respondents then answer yes or no. An advantage of dichotomous choice is that it makes the participant's decision easier, since they are familiar with making purchases in this manner. A disadvantage of this method is that it does not give each respondent's maximum value for the amenity. This means researchers are provided with less information for each respondent and a larger sample size is needed for meaningful analysis.

Open-ended contingent valuation questions are another method of asking for a respondent's WTP. It involves asking for a direct value of a specified good. Normally this is done by giving an explanation of the good and then simply asking: What is your maximum willingness to pay for good X? A blank is left for the respondent to place their answer. The answer given is considered to be the individual's valuation for the good. Open-ended WTP questions are simple to ask and provide researchers with a single and specific value for the good. Since more information is being collected from each respondent, researchers can use a smaller sample size. A disadvantage to this technique is that it can be very challenging for the respondents. Difficulty in answering open-ended questions may result in an increased non-response, or answers which are not well thought out and are therefore inaccurate.[11]

Payment cards are similar to open-ended questions except instead of leaving a blank the researcher provides the respondent with a range of potential values. Often they are asked to mark not only their maximum willingness to pay but also the values they are sure they would pay and those they are sure they would not pay.[12] This method is easier than open-ended questioning for respondents, while still providing a single maximum WTP value. Payment cards, however, are subject to range bias. This means

respondents are more likely to choose a value within the range indicated than if their value was elicited using another method.

Iterative bidding is another method for asking WTP questions.[13] This is done by having an interviewer ask the participant if they are willing to pay \$X for the good in question. If the respondent answers “no” the question is re-asked with a slightly lower value until the respondent answers “yes”. If the respondent’s original answer is “yes” then the interviewer re-asks the question, this time increasing the value, until the respondent is no longer willing-to-pay. The highest value to which the participant answers yes is considered their maximum willingness-to-pay. This method however is prone to starting point bias. This means, similar to range bias, the WTP value is anchored to the initial value suggested by the interviewer.

#### *Survey Administration Technique*

The method of interviewing respondents also differs between studies. There are three main categories: telephone interviews, face-to-face interviews and self-administered surveys, which includes mail-in, handout and computer-based surveys.

Telephone interviews are done by calling a random sample of the population, describing the good to be valued and then asking WTP questions. This method allows a large number of respondents to be interviewed at a relatively low cost, however, many researchers avoid this method due to the inability to use visual aids during the interview process.[14]

Face-to-face surveys are interviews that are done with the respondent in-person. These are done either in the respondents’ home or a central location. Face-to-face interviews have been recommended by the National Oceanic and Atmospheric

Administration (NOAA).[15] The benefits of this survey format are a good response rate, the ability to use visual aids and answer respondents' questions as they arise. The problem with this method is that it is extremely expensive and respondents are much more prone to "yea saying". This occurs when respondents are influenced by their desire to please their interviewer. This may result in responses that do not accurately represent the individuals' preferences and that are closer to what respondents believe the interviewer wants to hear.

Self-administered surveys are those done without supervision of a researcher. They are convenient and are often much less costly than other options. Hanemann (1994) argued against self-administered surveys saying, "serious surveys of the general public avoid convenience sampling, such as stopping people in the street... They also avoid self-administered, such as mail surveys or questionnaires handed out in a mall, because of the lack of control over the interview process." [16] There are three different types of self-administered surveys: mail-in, handout and computer based surveys.

Mail-in surveys are distributed and returned, via the postal system. The benefit of using mail-in surveys is that it allows the researcher to send descriptive information including pictures, graphs, tables etc. that may be helpful for the respondent when making WTP decisions. It is also one of the less costly methods of questioning respondents. The drawback to this interview format is that response rates are often very low and as mentioned above, there is little control over the interview process.

Handout surveys are those surveys distributed in paper form, completed immediately and then handed in directly to the researcher. This format allows for all the

benefits of mail-in surveys, while lowering the cost and improving the response rate.

There is still no control over the interview.

Computer based surveys are done by inviting participants to a computer lab where they are given information about the amenity to be valued and then answer WTP questions on a computer. This allows for control over the interview process and easy data compilation with low costs. However, computer based surveys may be difficult for older respondents who are unfamiliar with the computer and those that have difficulty reading.

### *Payment Vehicles*

The payment vehicle refers to the method by which the specified WTP will be extracted from the participant. Payment methods include; out of pocket, taxation or increases in insurance premiums. Personal feelings towards the payment vehicle used in a survey may influence the WTP value elicited. In some situations the payment vehicle has caused participants to refuse to pay at all. This may occur if the respondent believes they are already paying too much in insurance premiums or do not trust the government. The chosen payment vehicle for a survey should mirror the mechanism by which the good is currently paid or will be paid. For example, if asking respondents to value a good, such as over the counter medications, that they typically pay for out of pocket, the best payment vehicle to choose would be an out of pocket payment. When valuing a health intervention, such as a new treatment, within a publicly funded tax based health care system the natural payment vehicle would be in the form of extra taxation. To determine the influence of the payment vehicle on WTP, additional questions should be included within the survey to determine reasons for zero bids.[6]

Each of these issues must be considered in the design of a CV survey and the benefits and drawbacks of each option weighed. Methodology of the CVM must be carefully chosen so as to accomplish the study goals without creating biases that might affect the credibility of the results.

### **Biases of the CVM**

Problems associated with the CVM have caused many to question the reliability and validity of its results. Mitchell and Carson (1989) have identified a number of these biases. The first bias is due to the incentives of the respondents to misrepresent their responses. This may occur in an attempt to influence the provision of the good or the respondent's level of payment for the good. It may also arise because the respondent wants to please the sponsor or the interviewer and therefore do not give their own WTP, but a value they believe will be more acceptable.

Another set of biases occurs when information in the survey is treated by the respondents as indicating the "correct" value for the good. This includes starting point bias, range bias, relational bias, importance bias and position bias.

The third category of biases is scenario misspecification. This occurs when the individual does not respond to the correct contingent scenario. This may be due to poor information by the researcher or poor comprehension by the respondent. In each case values are given that do not represent the good the researcher intended.

While these biases seem daunting, Mitchell and Carson as well as others, including a panel for the NOAA, argue that these biases can be overcome through proper survey techniques.[15] One bias of particular interest, and the focus of this paper, is

known as embedding which is defined in the next sub-section. Its occurrence has been linked to a number of possible reasons, including some of the biases mentioned above, but widely accepted conclusions have been elusive and therefore of importance for further research.

### **Embedding**

Embedding is a perplexing result of many empirical CV studies. Some have even argued that the CVM is “fatally flawed” due to the embedding phenomenon.[17] “Like many arguments in economics, the central feature of the embedding debate concerns a common sense empirical relationship economists expect to find in choice behaviour.”[18] The common sense relationship depends on the investigator’s definition of embedding. When embedding is considered to be scope effects then the expectation is that more is better. If the definition of embedding is sub-additivity effects then the expectation is that the value of two goods does not depend on whether they are valued together or individually. However, these relationships do not always hold, making embedding an important issue when considering the CVM.

Svedsäter (2000) defines two types of embedding. The first is “perfect embedding” or insensitivity to scope. This occurs when “WTP is the same, not sufficiently differentiated, between preserving environmental commodities that differ in quantities or qualities.”[19] He also defines a second type of embedding which he calls regular embedding, or part-whole bias. This refers to a situation when “the same good is assigned a lower value if WTP for it is inferred from WTP for a more inclusive good rather than if the particular good is evaluated on its own”.[20]

Hanemann (1994) further clarifies embedding by separating three distinct concepts. The first is scope effects, which is defined above as perfect embedding. The second is sequencing effects where the WTP of a good when placed first in a sequence will be higher than when placed later in the sequence. The third concept is sub-additivity effects, which "is where the WTP for a composite change in a group of public goods may be less than the sum of the WTP for the individual changes valued separately".[21]

Although many definitions of embedding exist in the literature, the definitions describe very different problems. The competing definitions are tested differently and are subject to different biases. This becomes a problem since the definition of embedding being used in empirical studies is not always explicit. This study uses the definition of embedding described above as sub-additivity

Many reasons are given in an attempt to explain embedding, including warm glow, wealth effects, mental accounting and substitution effects.

### **Potential Explanations for Embedding**

#### *Warm Glow*

Kahneman and Knetsch (1992) suggest that an individual's WTP for public goods represents their desire to acquire a sense of moral satisfaction, also called "warm glow".[20] They argue that values obtained through the CVM are not an individual's WTP for the good in question, but that respondents offer to pay because utility is derived from the contribution itself. According to this idea WTP values obtained through the CVM would not differ when the scope of the good is changed because individuals are not actually valuing the good, but valuing the giving itself.

*Cost-based*

Shiell and Gold (2002) found evidence of embedding even after controlling for the "warm glow" effect.[12] After conducting interviews to determine the reasons for embedding they concluded that the participants based their WTP for a hypothetical vaccine on expected costs and fairness rather than their own value for the good. Participants stated a lower WTP for the combined vaccine, which has the same effect as two individual vaccines, because they expected that the combined vaccine would not cost as much to produce. Thus, it was a fairness issue in expecting the production savings to be passed on to the consumer. These respondents were not expressing WTP values related to the benefit of the goods to them, but rather based on expectations of cost. This conclusion is also supported by "think aloud" tests done by Schkade (1994).[22] In this study Schkade found that 17% of participants mentioned the cost of the good and 41% mentioned fairness when using WTP to value environmental goods.

*Wealth Effects*

Kahneman and Knetsch (1992) also raise the issue of wealth effects.[20] This occurs when the value of the good is so large that by increasing the scope of the good the respondent's WTP would increase only slightly or not at all due to income constraints. This is due to diminishing marginal utility of income. A situation in which wealth effects might occur is when an individual is first asked to give their WTP for a good that is very valuable, for example the life of their child. If the individual responds that they would be willing to pay everything they have then no matter what the change in scope, maybe the life of two children, the respondent is unable to increase their WTP. However, it would be difficult to conclude that the second child's life was of no value. Wealth effects have

been dismissed as the explanation for embedding since most goods valued using the CVM are valued at less than \$100.[20]

### *Mental Accounting*

Similar to wealth effects, another explanation for embedding is the "good causes dump hypothesis".[23] This occurs if respondents have a mental account for health issues, environmental issues, or just for good causes in general. This means individuals may experience wealth effects for a category of goods. For example an individual might decide that they can afford to donate \$20 a year to environmental causes. Once this individual has spent that \$20, regardless of the increase in scope, the individual cannot afford other environmental causes according to their mental budget.

### *Substitution Effects*

If embedding is considered to be sequence or sub-additivity effects then some embedding can be explained using substitution effects and diminishing marginal rates of substitution. Hanemann (1994) states, "far from being inconsistent with economic preferences sub-additivity is likely to be the norm".[16] However, this depends on how the WTP questions are asked. If after valuing good A respondents are asked to take into account having paid for good A when valuing good B, then substitution effects would not explain any sub-additivity (embedding) measured.

### *Empirical Methods for Testing Embedding*

Embedding can be identified by using internal or external testing. Internal, also called within subject testing, is done by asking the same respondent their value for the whole good as well as the parts being valued. When individuals are asked for the value of the whole followed by their value for the parts, this is referred to as top-down internal

testing (TD). When respondents are asked in the reverse order, parts followed by the whole, it is called bottom-up internal testing (BU).

External or split sample testing is done by asking one group the value for the whole and another group for their value of the part or parts.

“An external test is often interpreted as the more demanding, but is susceptible to sample heterogeneity. In contrast, the internal test, although having substantially more power as it can control for between-subject variations, is susceptible to ‘anchoring’ effects from respondents recalling their answers to previous questions when providing subsequent values. It is possible that one testing procedure may contradict another. On the other hand, if both tests are in agreement, one could better argue there is greater internal validity than relying solely on one type of scope test.”[24]

Another methodology difference among embedding tests is the way information is presented to respondents. When internal testing is used researchers can present information using advanced disclosure or by using a stepwise approach. In advanced disclosure, respondents are informed as to what is to come before they are asked to value the first improvement.[25] This allows participants to consider the effect of current valuations on future valuations. The stepwise approach does not warn respondents as to what is to come. Instead respondents are asked each valuation question with no knowledge as to whether there will be other WTP questions. Smith et al and Brown et al. recommend that the stepwise approach be avoided, but Kahneman et al. find it “highly implausible that this minor procedural change would significantly alter results.”[20, 26, 27]

## LITERATURE REVIEW

The literature reviewed was identified using the key words and databases found in Appendix 1. It included 14 different databases available at the University of Calgary and different combinations of terms such as embedding and contingent valuation. Over 200 papers were downloaded into Reference Manager and duplicates were identified and deleted. This left 108 abstracts, which were then briefly reviewed. Those papers that did not focus on the contingent valuation method as well as embedding, as previously defined, were also deleted. After this process was completed 59 papers remained. These included 50 empirical papers and 9 review or theoretical papers. Only empirical papers were reviewed for methodology and a complete table of the empirical papers reviewed can be found in Appendix 2. The table found in Appendix 2 summarizes for each paper the type of embedding considered, the type of good valued, whether embedding was found, the type of test conducted, the elicitation format and survey administration technique.

### **Findings from the Literature**

A wide range of methods were used in the studies reviewed. Some of these differences included the format of asking WTP questions, the interview technique, the approach for testing embedding and the commodities being valued.

#### *Elicitation Formats in the Literature*

There were three main methods used to ask WTP questions in the articles reviewed. The most common method was dichotomous choice. As seen in Table 1, the dichotomous choice method had the most papers reporting no embedding, while papers

using the open-ended method were most likely to find embedding. This is supportive of the NOAA panel's assertion that dichotomous choice is the preferred question type.[15]

**Table 1. Elicitation formats used in CV studies.**

Conclusion regarding Embedding	Elicitation Type				Total
	Dichotomous Choice	Open-Ended	Payment Card	Iterative Bidding	
Mixed	3 (14%)	2 (10%)	1 (13%)	0 (0%)	6 (12%)
Found embedding	7 (33%)	13 (62%)	4 (50%)	0 (0%)	24 (47%)
Found no embedding	11 (52%)	6 (29%)	3 (38%)	1 (100%)	21 (41%)
Total	21 (100%)	21 (100%)	8 (100%)	1 (100%)	51 (100%)

Among the articles reviewed, two papers directly tested the effect of WTP elicitation form on the occurrence of embedding. Ready et al. (1996) found that although respondents answering dichotomous choice questions were not sensitive to scope effects, those same respondents were sensitive to scope when the WTP question used a payment scale.[28] Kartmen et al. (1997) found that respondents to dichotomous choice WTP questions were sensitive to changes in the scope of the good, while respondents to open-ended WTP questions were not sensitive to the same scope changes.[29]

#### *Administration Techniques in the Literature*

All of the different interview administration techniques were used in the tests reviewed. Most often used were face-to-face interviews, but many used telephone surveys or questionnaires due to cost limitations. Questionnaires included mail-in, computer based and self-administered. In the reviewed papers, tests using face-to-face

interviews were the most likely to find no embedding. Self-completed questionnaires were the most likely to find embedding.

**Table 2. Interview administration techniques used in CV studies.**

Conclusion regarding Embedding	Administration Techniques					
	Self-completed Questionnaires			Phone	Face-to-face	Total
	Computer based	Mail	Self-admin.			
Mixed	0 (0%)	4 (31%)	0 (0%)	1 (9%)	2 (11%)	7 (15%)
Found embedding	1 (100%)	4 (31%)	5 (100%)	4 (36%)	8 (44%)	22 (46%)
Found no embedding	0 (0%)	5 (38%)	0 (0%)	6 (55%)	8 (44%)	19 (40%)
Total	1 (100%)	13 (100%)	5 (100%)	11 (100%)	18 (100%)	48 (100%)

#### *Methods for Testing Embedding in the Literature*

In the literature review, 8 of the 20 studies using external testing found embedding. Of the tests using internal or within subject testing, 9 of the studies used Bottom-Up testing and only 1 study used Top-Down testing. Five of the 9 studies using Bottom-Up testing methods found support for embedding while the 4 other studies found no support for embedding. The Top-Down study found no embedding.

**Table 3. Methods used for testing embedding.**

Conclusion regarding Embedding	Testing Methods			
	External	Internal		Total
		Bottom-Up	Top-Down	
Mixed	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Found embedding	8 (40%)	5 (55%)	0 (0%)	13 (43%)
Found no embedding	12 (60%)	4 (44%)	1 (100%)	17 (57%)
Total	20 (100%)	9 (100%)	1 (100%)	30 (100%)

### *Goods Measured in the Literature*

The papers reviewed asked individuals to value many different types of commodities. They included 17 measuring health goods, 25 measuring environmental goods and 5 measuring private goods including; travel, tourism and safety.

Health and environmental goods are similar in many ways that imply the need for non-market valuation techniques such as those used in WTP surveys. Firstly individuals are not accustomed to paying directly for many of these types of goods. These include all health treatments covered by insurance or the government and all environmental commodities covered by the government. Since individuals do not pay directly for these goods, they can be considered non-market goods. This means respondents are less able to use the price of like goods as a reference when considering their WTP values. Secondly individuals often have very strong feelings about environmental and health issues. This means that individuals may consider their responses more carefully.

Another similarity between these goods is that respondents may have a use or non-use value for each. A use value is the benefit to the respondent derived from being able to personally take advantage of the good being valued. A non-use value is the

benefit derived from knowing that the good is provided, or just having the possibility of using the good without actually taking advantage of it. This non-use value may be entangled in what has previously been referred to as the “warm glow” effect, and is a suggested cause for embedding.

### *Measuring Embedding*

Some of the measures of embedding differ due to the definition of embedding being used, however, studies using similar definitions of embedding may also use different methods for measuring embedding. From the literature reviewed the most common method used to detect embedding was to compare respondents’ mean WTP for the same good measured at different scopes. This was most often done by having respondents value a good A and then asking respondents to value good B, which includes good A. If the mean WTP for good B was not significantly larger than the mean value for good A, then the group was said to be insensitive to scope.[30]

Other researchers measured sub-additivity by eliciting the value of two goods as well as the value for the combination of the two goods. Embedding was identified by comparing the addition of the mean WTP values for the two goods separately to the mean WTP of the combined goods. If the addition of the mean of the two goods valued separately was larger than the mean value of the combination good, then embedding was said to have occurred.[12, 23, 31, 32]

Three other papers use novel approaches for measuring embedding included comparing protest zeros, asking respondents what they valued, or comparing marginal WTP. Protest zeros are zero WTP values that are given as a demonstration of the participants’ disapproval for something other than the good itself. Very often the protest

is about the payment method or who should be paying for the good. Thus, the respondent is expressing zero value to a good even though they may actually value that good.

Jorgensen et al. (2001) compared the number of protest zeros depending on the scope of the good. They found that “protest beliefs were sensitive to the type of public good being valued, but less responsive to the scope of the public good change”.[33]

Another unique method for measuring embedding was to ask respondents a WTP question and then to ask them a number of questions to try to determine exactly what they were valuing. Those responders that stated during the follow-up questioning that their WTP value included something other than what the researcher intended were considered to have embedded.[34] Researchers in New Zealand employed another method for testing embedding using values for recreational fishing. To do this they compared the marginal WTP of fisherman who caught less than 4 fish to those who caught 4 fish or more. They found that fisherman who caught 4 fish or more had a significantly higher marginal WTP for the fishing trip than those who caught less fish. Their conclusion was that this significant difference in marginal WTP indicated that respondents were sensitive to scope changes and therefore did not embed.[35]

### **Critical Analysis**

The many different methods for measuring embedding allow for a critical analysis and comparison of the techniques utilized. One issue of note was the lack of a uniform method for dealing with zero and extreme values. One study used zero bids as a measure of embedding while others removed them from the analysis.[34] Some studies measured

protest zeros and outliers, but others did not consider this issue.[36, 37] These differences require further discussion.

To determine which zero bids represent actual values of the good and which are statements of dissent, surveyors often include additional questions inquiring as to the reason for the zero response. Responses considered as protests are; the government should pay, users should pay, already pay too much in taxes, etc.[30, 34]

Once protest zeros are identified they are deleted from the analysis.[21, 23, 30, 34, 38, 39] Loomis et al. dropped 20% of their responses as protest bids[30]; Christie et al. dropped 15.6% of their responses as protest bids[21] and Hoevenagel et al. considered 4.4% of their total responses protest zeros and eliminated them from the analysis[23]. While the effect of removing these zero bids was not measured in these studies it can be assumed that their removal would significantly change the mean WTP and may cause systematic bias.

Depending on the distribution of the zero bids their removal could also change the embedding results. This would occur if the number of protest zeros differed by the scope of the good being valued. Because of this possible change to the embedding result it is important that researchers take a consistent approach.

On the other extreme, some of the studies also determined outliers. Outliers are bids that are considered to be too high to be realistic. Due to the effects of outliers it is possible that most respondents avoid embedding, but in aggregate, due to a few outliers, the group is considered as having embedded. Macdonald et al.[40] and Hoevenagel et al.[23] classified bids that were 10% or greater of the respondents income as outliers and WTP values that fell into this range were excluded from the analysis. However, Lindberg

et al.[41] converted yes votes to no votes, in their dichotomous choice study, when a participant's stated WTP was greater than 1% of their reported income because they deemed this implausible.

This altering of the data set led to changes in results that ranged from a 20% change to the mean WTP value [41] to no change in results [40]. This possible change to embedding results also supports the need for consistency across studies attempting to measure embedding.

One solution for avoiding the effects of protest zeros and outliers on the mean WTP, is to measure embedding for each individual rather than as part of a group. This requires that tests of embedding be internal, so that individuals' values for the different scopes can be compared. Currently only two studies have measured embedding at an individual level Shiell and Gold (2002) and Dubourg et al. (1997).[12, 42] Doing so allows individuals with protest zeros or outliers to be removed from analysis without affecting embedding within the group. This however may create bias if those with protest zeros or outliers are more or less likely to embed.

Among the articles reviewed four of them comment on the effect of information on embedding.[27, 43-45] Carson and Mitchell (1993) state that the quality of a contingent valuation response is "crucially dependant on the information provided to and perceived by the respondent".[45] In a 1995 study by Brown et al. the amount of information given respondents on the good being valued was tested to determine its affect on embedding. They concluded that higher amounts of information did not significantly decrease embedding.[27]

Others such as Shiell and Gold have controlled for the “warm glow” effect by having respondents value goods with a benefit that is primarily individual with no substantial gain to society. The authors also controlled for income effects by having the individual assume they had acted upon their WTP for the first vaccine when considering their WTP for the second. They conclude that embedding is not avoided by controlling for warm glow, but identify cost-based responses as a possible explanation by reporting that many respondents who embed were concerned with personal fairness.[12]

The literature review undertaken shows that embedding is a methodological problem that ranges across all study types. While some methods such as dichotomous choice questions and face-to-face interviews have been recommended, [15] no one methodology has been proven immune to embedding.

The following methodology section describes the study undertaken in this thesis that attempts to control for the “warm glow” effect as per the Shiell and Gold study[12] but also adds in an experiment to test the effect of information about the difference between cost and value on embedding. The extra information tested is an attempt to explain the difference between the cost of producing the good and the actual value of the good as has been used in other contexts in CV studies but not in the context of embedding.[46] With this additional information it is expected that fairness, or the valuing of goods at what they are expected to cost, should not be an issue, and therefore should reduce embedding.

## METHODOLOGY

### Objectives

The main question addressed by this study was: does information on value and cost decrease embedding in a contingent valuation survey? It was hypothesized that by using the novel approach of adding a paragraph describing the difference between value and cost to a CV survey respondent would be less likely to embed.

Other questions to be answered were how income, travel experience, education and the information on value and cost affect the respondents given WTP values and how these variables affect embedding.

### Research Design and Methods

In order to answer this question, an empirical test involving a split sample approach was used. The number of individuals demonstrating embedding with and without information on value and cost was evaluated. The study was designed to elicit individuals' values for hypothetical vaccinations using the survey questions found in Appendix 3. Respondents were asked to value vaccine A, vaccine B and a combination of these vaccines, vaccine C. This survey instrument was developed and used by Shiell and Gold (2002).[12] Originally a handout questionnaire, the survey was converted to be computer based. Many respondents were able to take the survey at once while still having access to a moderator to whom they could pose questions.

Consistent with its original form, a bottom-up internal testing approach was used with advance disclosure. Utilizing the same survey enabled a comparison of the results between studies. In addition to the original survey, an additional experiment was added

to test the effect of supplementary information on embedding. A split sample approach was taken; half of the participants' surveys contained extra information on the difference between cost and value. Those who received the extra paragraph were considered the "experimental group" while those without the extra information were the "control".

The extra paragraph, adapted from Donaldson et al.[46] added to the experimental group was as follows.

First, let's look at a brief example to show what we mean by value. Imagine that you go to an auction and see a painting you like. Before bidding, you must decide the maximum amount of money that you would be willing to pay for the painting. You would take into account your current income and how much you spend on other things. You would consider the benefits and drawbacks of purchasing the painting, including what you may have to give up to buy it. When deciding your maximum value for the painting, the time and costs of the artist should not be considered. After careful consideration a maximum bid is determined. This maximum bid is your value for the painting or your maximum willingness-to-pay. Naturally, you would prefer to pay less, but you would be willing to bid up to this amount.

This paragraph gives information on the difference between value and cost using the simple example of an auction. It was hypothesized that by highlighting this difference the respondents would be more likely to give their true value for each vaccine in the survey without taking into account the cost of production of the vaccines. It was expected that this paragraph would solve the problem found by Shiell and Gold that 56.7% of respondents embedded and that the most common reason for doing so (28.8%) was related to expectations about what was a fair price to pay.[12] As mentioned earlier, cost based responses connect how much it is believed the good would be to produce with the WTP. Since composite goods are believed to be cheaper to produce, fairness suggests

the price would be lower. This means that respondents who consider the cost of production may give a value of what they think the price should be rather than what their own value is for the good. Reducing or eliminating cost-based answers should obtain the individual's value for each vaccine. Thus, the value of vaccine A plus vaccine B should not exceed the value of vaccine C. Embedding was expected to be less frequent.

The survey used a payment scale following the form of the original survey by Shiell and Gold.[12] The use of the payment scale may make students more likely to select vaccine values within the scale. This is not of particular concern to the study since the values themselves are not being tested but the relative values. Respondents were also asked for an explanation of \$0 responses. This was done in an attempt to identify those who might provide protest zeros.

### **Recruitment of Sample**

The project received ethical approval from the Conjoint Faculties Research Ethics Board (See Appendix 4). Selected instructors at the University of Calgary were contacted by email and permission was sought to make a short announcement to their students regarding recruitment of participants. Economics students were excluded to avoid respondents that might be familiar with the underlying economic theory and respond with the sole desire of maintaining economic consistency. Those who agreed were visited at the scheduled time and a two-minute announcement about the study was made to students while an overhead was projected with the email contact information. See Appendix 5 for recruitment material. Students who replied were scheduled to come to the Behavioural and Experimental Economics Laboratory at the university.

Students have been selected as a convenient population to survey. This may have caused selection bias, but for the purpose of this study it is not important that the responses are generalizable since it is the methodology that is being investigated. If it were found that the experimental approach could reduce embedding in this group, a replication of these results in a general population sample would be required. To determine the required sample size, it was assumed based on the Shiell and Gold results that the control subjects would embed 57% of the time, and hypothesized that the experimental group would embed 40% of the time. Assuming a 17% difference due to the intervention and using a one sided test with 5% significance and 80% power it was estimated that 200 respondents were needed.

### **Survey Procedure**

Upon arrival at the University's Behavioural and Experimental Economic Laboratory, students were asked to take a seat at one of the computers and were given a copy of the consent form (see Appendix 6). When they had completed reading the form they were asked if they had any questions. Once any questions had been resolved they were told to start the survey by reading the first screen of the computer-based questionnaire and follow the instructions. The survey was conducted using Z-tree survey program.

### **The Survey**

For both the experimental and control groups the first page was the introduction paragraph. At the end of each page they were asked to click on the next button to

continue. For the experimental group the following page was the auction example, as seen above. Both groups were then given an example of how to fill out the survey questions. They were asked their WTP for a flu vaccine, and given an explanation of how to fill out the survey. This was to be done by clicking in the box next to the value in the payment scale that would represent their maximum WTP. For the flu example they were asked to fill out the questionnaire assuming that they were willing-to-pay \$30.

The next page was section 1.1. On this page they were given information about the Dupuit's A syndrome, a hypothetical disease, and asked to give their WTP for a vaccine that would help prevent them from contracting this illness. The vaccine is delivered in a tasteless pill not an injection, so there should be no disutility associated with receiving the vaccine. Except for the situation this page was laid out identically to the example and the students were asked to fill it out similarly, giving their own WTP for Dupuit's A syndrome. Since the payment scale went from \$0 to more than \$100, they were asked to type in their WTP in a box provided if they chose "more than \$100". If they chose a WTP of \$0 they were asked to give an explanation of why they valued the good this way.

Section 1.2 on the following page asked the students to give their WTP for a vaccine for Dupuit's syndrome B, another hypothetical disease, taking into account that they had already purchased the vaccine for Dupuit's syndrome A. Taking into account that they had already purchased vaccine A is an important aspect of this valuation. Otherwise all embedding observed could be explained by substitution effects.

On the next page, section 1.3, respondents were asked to imagine that they had found out before hand that there was a combination vaccine with the same properties as

each separate vaccine, but in one pill, what would be their maximum WTP for this vaccine. Here they were told to imagine they had not acted on their previous decisions to purchase A and B separately.

In the final comment section students were asked how difficult it was to choose a value for the vaccines. They were also asked to type in the values they had chosen for the vaccines and whether the addition of their values for vaccine A and vaccine B, were less than, equal to, or greater than their value for vaccine C. The final question on this page asked why they had valued the vaccines in this way. Respondents were asked the values they had chosen for each of the three vaccines without the possibility of going back to see these values. It was hypothesized that respondents that could remember the values they had chosen had thought more carefully about selecting their WTP for each vaccine and would be less likely to embed.

Respondents entered their demographics on the next page and then the final page gave the students instructions on collecting their payment of \$10 for having completed the survey.

### **Data Analysis**

Data was transferred from the Z-tree survey program into Microsoft Excel where responses were reviewed for completion and protest zeros. Incomplete surveys and those with protest zeros were not used in the final results. Each survey was classified by three categories; whether they embedded or not, whether they passed the practice example or not, and whether they recorded the correct values in the comment section or not.

Respondents were classified as having embedded if the value given for vaccine A plus their value for vaccine B was greater than their value for vaccine C. Respondents were classified as having passed the practice example if they selected \$30 for their value of the flu vaccine as they were instructed. Respondents were said to have recorded the correct values if the values inputted into the comments sheet for each of the vaccines was equal to the values chosen in the payment scale. This information along with the responses to the WTP questions and demographics were transferred into Stata for statistical analysis. For a complete list of the model variables see Appendix 7.

Statistical analysis included group analysis, individual analysis and regression analysis. Group analysis consisted of adding each groups mean values for vaccines A and B and comparing to the mean value for vaccine C. If the sum of the mean values for vaccine A and B were greater than vaccine C the group was considered to have embedded.

Individual analysis consisted of determining the number and percentage of individuals in each group that embedded. The difference in the number of respondents who embedded was tested using a t-test. The difference in the proportion of respondents who embedded in each group was tested using a Chi-squared test.

Ordinary least squares (OLS) regression analysis was used to determine the effect of respondent demographic characteristics on WTP. Probit and Logit regressions were used to test the effect of respondent characteristics on embedding.

## RESULTS

In total approximately 852 students were asked to participate in the survey. The exact number is unknown since the initial students exposed to the recruitment invitation in class were encouraged to invite others who may be interested in participating. 124 students completed the survey of which 63 were randomized to the control group and 61 to the experimental group. 116 of these students provided useable results, 60 from the control group and 56 from the experimental group. This fell short of the originally planned sample because of difficulty recruiting during the exam period and spring semester and then finally due to time constraints.

Of the 3 participants from the control group who provided unusable answers, 2 of the 3 said they would pay more than \$100 without providing an exact amount. This was also the case for 3 out of the 5 participants for the experimental group. Of the 3 other unusable responses 2 students commented that even after paying for vaccine A, they would not be willing to pay for vaccine B, but would rather cancel the vacation all together. Although these students reported a WTP of \$0, this does not reflect their value of avoiding the hypothetical syndrome, since they would prefer to lose the benefit of Vaccine A and cancel their trip all together.

The final student's results were not included in the analysis due to a misunderstanding of the scenario. This student said they had a WTP of \$0 because they would not want to pay more for this vaccine provided privately, if it was available over the counter. Although it is unclear exactly what this student meant, it was assumed that the WTP of \$0 represented a preference against the method of provision of the drug rather than the vaccine or its benefits. While this removal may be questionable to some,

note that this participant was part of the experimental group and did not embed.

Therefore the removal of these results is the more conservative approach.

The control group and experimental group were compared according to their demographic characteristics and their responses (See Tables 4.1-4.3). This was done using t-tests and Chi-square tests. A t-test was used to test the difference between means calculated from continuous data; a Chi-square test was used to test the difference between 2 or more proportions of binomial data. The results show that the experimental and control group were not significantly different in any of their demographic responses. There was no difference in the mean age, gender, and marital status of the groups, see Table 4.1. In addition, there was no difference in student status, mean years of university, and employment, see Table 4.2. Table 4.3 shows that there was no significant difference between the groups' travel experience, self reported health status or their difficulty in answering the survey.

**Table 4.1. Comparison of the demographics between the control and experimental groups.**

	Control		Experimental		p value
N	63		61		---
Removed	3		5		---
Mean Age (range)	21.5	17-45	21.8	18-37	0.6573
Male	31	52%	26	46%	0.573
Marital Status					
Single	46	77%	48	86%	0.398
Married	7	12%	5	9%	
Living with Partner	7	12%	3	5%	
Divorced	0	0%	0	0%	
Separated	0	0%	0	0%	
Widowed	0	0%	0	0%	
Student Status					
Fulltime Student	56	93%	52	93%	0.570
Part time Student	3	5%	3	5%	
Graduate Student	0	0%	1	2%	
Unclassified Student	1	2%	0	0%	
Mean Years of University	2.0	1-6	2.6	1-6	0.1836

**Table 4.2. Comparison of employment status and income between the control and experimental groups.**

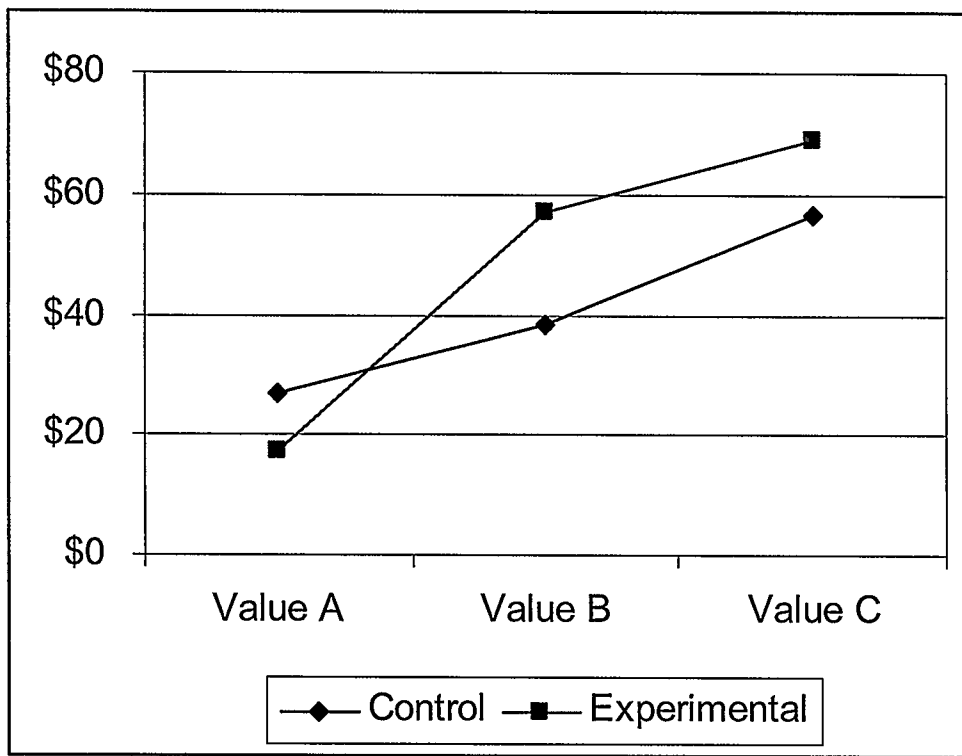
Employment	Control		Experimental		p value
Fulltime	1	2%	2	4%	0.417
Part time	26	43%	26	46%	
Part time summer	5	8%	3	5%	
Fulltime summer	9	15%	14	25%	
No Employment	19	32%	11	20%	
Personal Income					
Less than \$5,000	17	28%	9	16%	0.151
\$5,000-\$9,999	19	32%	26	46%	
\$10,000-\$14,999	12	20%	12	21%	
\$15,000-\$19,999	2	3%	6	11%	
\$20,000-\$24,999	5	8%	1	2%	
More than \$25,000	3	5%	1	2%	
Unknown	2	3%	1	2%	

**Table 4.3. Comparison of travel experience, health and question difficulty between the control and experimental groups.**

	Control		Experimental		p value
Travelled outside of Canada and the US	34	57%	38	68%	0.215
Purchased vaccine to travel	13	22%	21	38%	0.061
Mean amount spent on vaccine (range)	\$33.83	0-1000	\$57.80	0-600	0.3128
Ill while travelling	21	35%	20	36%	0.936
Excellent Health	25	42%	20	36%	0.518
Very Good Health	27	45%	30	54%	
Good Health	8	13%	5	9%	
Poor Health	0	0%	1	2%	
Very Bad Health	0	0%	0	0%	
Difficulty answering questions	16	27%	18	32%	0.517
Very difficult to answer questions	1	2%	0	0%	0.504
Difficult to answer questions	17	28%	21	38%	
Easy to answer questions	39	65%	31	55%	
Very easy to answer questions	3	5%	4	7%	

**Table 4.4. Comparison of WTP and test performance between the control and experimental groups.**

	Control		Experimental		p value
Mean ValueA	\$26.92	(0-100)	\$17.32	(0-100)	.0140
ValueA =0	4	7%	16	27%	.0016
Mean ValueB	\$38.50	(0-200)	\$57.05	(0-1000)	.3242
ValueB =0	6	10%	6	10%	.9006
Mean ValueC	\$56.67	(0-250)	\$68.93	(0-1000)	.5142
ValueC =0	2	3%	3	5%	.5955
PassPractice	46	77%	43	77%	.9880
CorrectValue	37	62%	42	75%	.1258

**Chart 1. Mean Vaccine Valuations by Group****Testing Embedding by Group Means**

After assuring the demographics of each group were not significantly different the embedding in each group was estimated. This was done as in Shiell and Gold (2002) by using the mean valuations for Vaccine A, B and C for each group.[12] Within each group the mean values of Vaccine A and B were added and compared to the mean value of C. If the mean value of A plus B is significantly higher than the mean value of C then the group is considered as having embedded.

**Table 5. Comparison of embedding for the control and experimental groups**

Group	Mean Value A (\$)	Mean Value B (\$)	Mean Value A+B (\$)	Mean Value C (\$)	P value
Control	26.9	38.5	65.4	56.7	0.0017
Stdev	(21.7)	(48.0)	(56.8)	(51.0)	
Experimental	17.3	57.1	74.4	68.9	0.0067
Stdev	(19.5)	(136.4)	(142.4)	(135.3)	

A one-sided t test was done in Stata testing whether the mean value of vaccine A plus the value of vaccine B is greater than the mean value of vaccine C for each group. It showed for both the control and the experimental group that the mean value of A+B was significantly higher than the mean value of C. These results indicate that both groups embedded, and that the extra information did not eliminate embedding altogether. The following sections investigate the hypothesis that the experimental group would embed less than the control group.

### **Testing Embedding by Respondents at an Individual Level**

The number of respondents that embedded was also tested. Maximum WTP values for vaccines A and B were added for each respondent and compared to the respondent's maximum WTP value for the combination of the two vaccines. The number of respondents that embedded (i.e. for whom the value of the sum of A+B was greater than the value of C alone) were counted for each group and compared. It was expected that respondents in the experimental group would be less likely to embed and therefore the number who do should be less than in the control group. A paired t-test was performed in Stata. Using a one sided test the alternative hypothesis, that the control

group had a higher number who embedded than the experimental group, had a p-value of 0.17. This means the difference is not significant at the 5% level.

**Table 6. Comparison of the embedding results between groups.**

Group	# of respondents	# considered as having embedded	P-value
Control	60	31	
Experimental	56	24	0.342

A Chi-square test was also used to determine if the difference in the proportion of respondents classified as having embedded between the two groups was significant.

It was found that the groups were not significantly different. This was contrary to the original expectation that the experimental group would embed significantly less than the control group. However, this may be a problem of sample size.

Originally it was planned to survey 200 students; this was assuming 57% embedding in the control group, as in Shiell and Gold (2002) and 40% embedding in the experimental group.[12] Due to time constraints and low response to recruitment the goal of 200 respondents was not met. A post-hoc sample size calculation indicates that in order to have a one sided test with 5% significance and 80% power, given the proportion of embedding in each group, it would have been necessary to have 794 respondents. This is because the effect of the intervention was much smaller than had been originally expected.

The effects of having passed the practice example and giving the correct answers to the follow up questions on embedding was also tested. It was hypothesized that individuals that passed the practice example and were able to answer questions correctly

about their previous WTP values were paying more attention to the exercise being undertaken and were more careful respondents, and thus would be less likely to embed. T-tests were conducted to test these hypotheses. However, there was no significant difference between the numbers of respondents that embedded in those that passed the practice test and those that did not. Following the same method, those that remembered their WTP values correctly were compared to those that did not. Again there was no significant difference between the numbers that embedded in each group. Thus there was no evidence that those respondents that were more careful about undertaking the exercises were less likely to embed. However, the small sample size would hinder the ability to draw conclusions here – there were only 33 who did not pass the practise example and 43 who did not recall their values.

### **A Comparison across Studies**

It was also possible to compare the number of respondents who embedded in the control group to those found by Shiell and Gold (2002). It was expected that the results would be similar, since the surveys given were almost identical. Shiell and Gold found that 56.7% of their 104 respondents embedded[12], this is comparable to the control group of which 51.7% of 60 respondents embedded. When a Chi-square test was performed it was found that the percentage of respondents that embedded in each study was not significantly different. However, the study was not powered for this comparison so this result may be due to a small sample size.

**Table 7. Comparison of the embedding results with Shiell and Gold.**

	Embedding	No Embedding	Total
Shiell and Gold	59	45	104
Spackman	31	29	60
Total	90	74	164
Degrees of freedom: 1 Chi-square = 0.39 For significance at the .05 level, chi-square should be greater than or equal to 3.84. The distribution is not significant. p is less than or equal to 1.			

When the results from Shiell and Gold (2002) were pooled with the current study results for embedding it was found that 90 out of 164 or 54.9% of the respondents embedded. A Chi-square test was used to compare the pooled analysis to the experimental group. The difference was also found to be not significant. See Appendix 8 for the calculation.

**Table 8. Comparison of the pooled group with the experimental group.**

	Embedding	No Embedding	Total
Control and S&G	90	74	164
Test	24	32	56
Total	114	106	220
Degrees of freedom: 1 Chi-square = 2.42 For significance at the .05 level, chi-square should be greater than or equal to 3.84. The distribution is not significant. p is less than or equal to 0.20.			

### Regression Analysis

Regression analysis was done in order to determine the effects of the demographics on WTP and whether or not a respondent embeds. The effect of each demographic variable on WTP was determined using an ordinary least squares (OLS)

regression, while the effects of demographics on embedding were tested by using Logit and Probit models.

### *OLS Regressions*

Three OLS regressions were run, with the natural logarithm of WTP for vaccines A, B and the Combined vaccine as the dependent variables. The regression equations are as follows:

$$\ln WTPA = \alpha + \beta_0 Age + \beta_1 Age^2 + \beta_2 Male + \beta_3 Married + \beta_4 SS\_Fulltime + \beta_5 YrsUniv + \beta_6 ES\_No + \beta_7 PIunknown + \beta_8 PIplus10 + \beta_9 Trav + \beta_{10} PurchVac + \beta_{11} SpentVac + \beta_{12} IllTrav + \beta_{13} HealthE + \beta_{14} HealthVG + \beta_{15} Difficulty + \beta_{16} ExtraInfo + \mu \quad (1)$$

$$\ln WTPB = \alpha + \beta_0 Age + \beta_1 Age^2 + \beta_2 Male + \beta_3 Married + \beta_4 SS\_Fulltime + \beta_5 YrsUniv + \beta_6 ES\_No + \beta_7 PIunknown + \beta_8 PIplus10 + \beta_9 Trav + \beta_{10} PurchVac + \beta_{11} SpentVac + \beta_{12} IllTrav + \beta_{13} HealthE + \beta_{14} HealthVG + \beta_{15} Difficulty + \beta_{16} ExtraInfo + \mu \quad (2)$$

$$\ln WTPC = \alpha + \beta_0 Age + \beta_1 Age^2 + \beta_2 Male + \beta_3 Married + \beta_4 SS\_Fulltime + \beta_5 YrsUniv + \beta_6 ES\_No + \beta_7 PIunknown + \beta_8 PIplus10 + \beta_9 Trav + \beta_{10} PurchVac + \beta_{11} SpentVac + \beta_{12} IllTrav + \beta_{13} HealthE + \beta_{14} HealthVG + \beta_{15} Difficulty + \beta_{16} ExtraInfo + \mu \quad (3)$$

The independent variables definitions are found in Appendix 7. For the OLS regression analysis it was hypothesized that age, sex, whether an individual was married or not, and a dummy variable indicating whether the person got the extra information or not would have no significant effect on WTP. It was expected that employment and having been sick while traveling would have a positive effect on WTP. It was also expected that people with a high self-assessed health would be willing to pay less for a vaccine, due to their belief of their own good health. However, it might also be the case that those with good health value their health more and would be willing-to-pay more to avoid illness. It was expected that the income variables would be positive and increasing with income level.

There was no a priori hypothesis regarding how the student status dummies and the number years in university would affect WTP. These variables may have a negative effect on WTP if the longer they have been in university means they have less money to spend on vaccines. On the other hand it may have a positive effect on WTP if those who are in university longer or for more advanced degrees have a higher expectation of their earning potential.

**Table 9. Results of the OLS regressions**

	lnWTPA			lnWTPB			lnWTPC		
	R <sup>2</sup>	Adj. R <sup>2</sup>	N	R <sup>2</sup>	Adj. R <sup>2</sup>	N	R <sup>2</sup>	Adj. R <sup>2</sup>	N
	0.1814	0.0395	116	0.1887	0.0479	116	0.1258	-	116
Variables	Coeff.	Std. Err.	T	Coeff.	Std. Err.	T	Coeff.	Std. Err.	T
Age	0.039	0.288	0.140	-0.048	0.299	-0.160	0.072	0.251	0.29
Age <sup>2</sup>	-0.001	0.005	-0.190	-0.001	0.005	-0.190	-0.002	0.004	-0.450
Male	0.139	0.274	0.510	0.411	0.285	1.440	0.202	0.239	0.840
Married	0.281	0.534	0.530	0.698	0.555	1.260	0.464	0.466	1.000
SS Fulltime	-0.620	0.552	-1.120	-0.248	0.574	-0.430	-0.224	0.482	-0.470
YrsUniv	-0.160	0.144	-1.110	0.048	0.150	0.320	-0.133	0.126	-1.060
ES NO	-0.086	0.304	-0.280	0.689	0.316	2.180*	0.133	0.265	0.500
PI unknown	1.149	0.990	1.160	0.586	1.030	0.570	0.795	0.864	0.920
PIplus10	0.195	0.268	0.730	0.365	0.278	1.310	0.404	0.233	1.730
Trav	0.187	0.292	0.640	0.035	0.304	0.110	-0.156	0.255	-0.610
PurhVac	0.018	0.368	0.050	0.320	0.383	0.830	0.004	0.321	0.010
SpentVac	0.000	0.001	0.260	-0.002	0.001	-1.180	0.001	0.001	1.010
IllTrav	0.103	0.263	0.390	0.032	0.274	0.120	-0.255	0.230	-1.110
HealthE	0.079	0.481	0.170	-0.358	0.500	-0.720	0.070	0.419	0.170
HealthVG	-0.145	0.454	-0.320	0.175	0.472	0.370	0.084	0.396	0.210
Difficulty	0.024	0.288	0.080	0.299	0.299	1.000	0.281	0.251	1.120
ExtraInfo	-0.727	0.261	-2.780*	0.246	0.271	0.900	-0.015	0.228	-0.070
cons	3.114	3.614	0.860	3.826	3.759	1.020	3.156	3.153	1.000

### OLS Regression Results

The only significant variable in the model regressing the natural log of WTP for vaccine A on a respondent's demographic characteristics was the dummy variable ExtraInfo. ExtraInfo is the group dummy and differentiates the experimental and control groups. This shows that respondents who had the extra information were willing to pay 52% less than those who did not have the extra information all else equal. This is despite the fact that respondents were randomized into these two groups, and there were no statistically significant differences in any of the demographic variables. It may be the case that these respondents more carefully considered the implications of their choices due to the extra information. It was expected, however, that this variable would not be significant.

The only significant variable in the model regressing the natural logarithm of the WTP for vaccine B on the demographics was no employment. This suggests that those who reported no employment have a higher WTP for vaccines B. This result is contrary to the expected results. There were no significant variables in the model regressing the natural logarithm of the WTP for vaccine C on the demographics.

Comparing the coefficients between the three OLS regressions shows that the signs of the coefficients are very different. The signs of the coefficients show the relationship of the coefficients to the dependant variable. As expected we see that the effect of personal income on the respondents' values for the three vaccines is positive. It was hypothesized that the amount an individual had spent on vaccines in the past would be positively associated with the amount they would be willing to pay on the three

hypothetical vaccines. The regression analyses show that the coefficients are positive for vaccines A and C, but not B, however none are significant.

The coefficient on the dummies for excellent and good health were also mixed. Coefficients that were consistently positive across regressions were associated with being male, being married, having an unknown income, having purchased a vaccine for travel previously and having difficulty answering the questions. Being a fulltime student was the only consistently negative coefficient across regressions. This suggests that fulltime students are willing to pay less for vaccines.

Since decisions of WTP are complex there are many explanations for these unexpected results. One possible reason is that the models do not capture a variable that may drive the results. Another possible reason is that the sample size is too small. This means that extreme values could be driving the model. Another possible solution is that the model is correct and that the unexpected results can be explained. Explanations for why a respondent with unknown income chooses a higher WTP include; those with high income and corresponding high WTP do not want to indicate being in this highest income category or those who do not know their income do not consider their finances very thoughtfully and therefore have a higher WTP. While explanations can be hypothesized for the other variables as well the most likely explanation for these results is that the sample size is too small.

### *Logit and Probit Models*

Both Logit and Probit regressions were undertaken in order to compare the results. There was no a priori reason to prefer one to the other since the distribution of the error term is unknown. The regressions equations are as follows:

$$\begin{aligned} \text{Embedding} = & \alpha + \beta_0 \text{Age} + \beta_1 \text{Age}^2 + \beta_2 \text{Male} + \beta_3 \text{Married} + \beta_4 \text{SS\_Fulltime} + \\ & \beta_5 \text{YrsUniv} + \beta_6 \text{ES\_No} + \beta_7 \text{PIunknown} + \beta_8 \text{PI\_5} + \beta_9 \text{PIto10} + \beta_{10} \text{PIto15} + \beta_{11} \text{PIto20} \\ & + \beta_{12} \text{PIto25} + \beta_{13} \text{Trav} + \beta_{14} \text{PurchVac} + \beta_{15} \text{SpentVac} + \beta_{16} \text{IllTrav} + \beta_{17} \text{HealthE} + \\ & \beta_{18} \text{HealthVG} + \beta_{19} \text{Difficulty} + \beta_{20} \text{PassPract} + \beta_{21} \text{CorrectVal} + \beta_{22} \text{ExtraInfo} + \mu \end{aligned}$$

Analyses of the Logit and Probit models were expected to show that age, sex, marital status, employment, whether or not an individual had travelled outside of Canada and the US, whether an individual had been sick while travelling, income and self assessed health have no significant effect on embedding. However, it was hypothesized that information does affect embedding and that there would be a negative relationship between the experimental group dummy and embedding. It was also expected that the number of years of university would reduce embedding and that the correct value variable, which identified participants able to recall their WTP bids, and the pass practice variable, which indicated whether a participant followed the instructions properly for the practice question, would also have a negative effect on embedding. It was expected that participants that were able to remember their bids and pass the practice question were thinking more carefully about the exercise and would be less likely to embed.

**Table 10. Results of the Logit Regression**

Logit	Coefficient	Std. Err.	$z^{\dagger}$
age	0.232017	0.511326	0.45
age2	-0.00285	0.008761	-0.33
male	0.103579	0.467594	0.22
married	0.452545	0.973189	0.47
ss_fulltime	-1.02558	0.970867	-1.06
ysuniv	-0.23153	0.252705	-0.92
es_no	0.821733	0.554005	1.48
piunknown	-0.38841	1.839384	-0.21
piplus10	-0.87774	0.468947	-1.87
trav	1.335194	0.532882	2.51
purchvac	-0.03721	0.684007	-0.05
spentvac	-2.3E-05	0.002614	-0.01
illtrav	0.012156	0.465056	0.03
healthe	0.09409	0.85086	0.11
healthvg	1.161254	0.829353	1.4
difficulty	-0.19709	0.496372	-0.4
passpract	1.023293	0.580545	1.76
correctval	-0.756	0.502531	-1.5
extrainfo	-0.46475	0.454966	-1.02
_cons	-3.62045	6.359172	-0.57

Number of obs = 116

LR chi2(21) = 27.17

Prob > chi2 = 0.1008

Log likelihood = -66.66582

Pseudo R2 = 0.1693

<sup>†</sup> The z test is similar to the t-test, but assumes variance is known.

In this case y varies between zeros and one.

The only variable significant at the 5% level is the travel dummy variable. This suggests that all else equal a traveler is more likely to embed than some one who has never traveled outside of North America. A priori this variable was not expected to be significant.

The variables indicating whether a respondent passed the practice and whether a respondent had a personal income over \$10,000 were the only variables significant at the 10% level. Whether or not a respondent followed the practice example instructions

properly was positively associated with embedding although it was expected to have a negative relationship with embedding. Personal income was not expected to affect embedding.

The variables for the number of years of university, whether or not a respondent remembered their valuations and whether a respondent had received the extra information all had negative coefficients, but were not significant at the 10% level.

### Probit Regression

The results of the Probit regression also show that the travel dummy was significant at the 5% level, but also shows that the variable indicating a personal income over \$10,000 was significant at the 5% level. The variable for passing the practice was significant at the 10% level.

The signs of all the variables were the same except for the variable used to indicate whether an individual had purchased a vaccine. This variable was positive in the Probit model and negative in the Logit model. However, the coefficient was not significantly different from zero in either model.

**Table 11. Results of the Probit Regression**

Probit	Coefficient	Std. Err.	$z^\dagger$
age	0.114153	0.305864	0.37
age2	-0.0013	0.005266	-0.25
male	0.069733	0.283085	0.25
married	0.334129	0.557845	0.6
ss_fulltime	-0.62827	0.579627	-1.08
yrsuniv	-0.1255	0.143515	-0.87
es_no	0.502593	0.333029	1.51
piunknown	-0.21689	1.134956	-0.19
piplus10	-0.52903	0.277469	-1.91
trav	0.786061	0.307571	2.56
purchvac	0.032699	0.396056	0.08
spentvac	-9.3E-05	0.001524	-0.06
illtrav	0.010092	0.272962	0.04
healthc	0.044012	0.510917	0.09
healthvg	0.710079	0.489643	1.45
difficulty	-0.09388	0.293679	-0.32
passpract	0.622615	0.340347	1.83
correctval	-0.45343	0.304684	-1.49
extrainfo	-0.29011	0.273804	-1.06
_cons	-1.87494	3.773641	-0.5

Number of obs = 116

LR chi2(21) = 27.19

Prob > chi2 = 0.1004

Log likelihood = -66.655872

Pseudo R2 = 0.1694

$^\dagger$  The z test is similar to the t-test, but assumes variance is known.  
In this case y varies between zeros and one.

## CONCLUSION

The CVM has been used to measure the value of both environmental and health goods. It is a method based in economic theory and can be explained using compensation surplus from Hicksian theory. Implementation of the CVM differs across studies, which makes differences in results difficult to explain. Along with each different method of implementation comes a different potential bias that must be corrected.

A bias of considerable concern is embedding. While the definition is broad and has been described in many different ways, three main definitions have become common in the literature. These are scope, sequencing and sub-additivity.

The contingent valuation study undertaken in this thesis tested for embedding as defined by sub-additivity. A split sample experiment was conducted, where half the respondents were given an extra paragraph of information on the difference between value and cost. It was hypothesized that the experimental group, those respondents with the extra information, would be less likely to embed.

A comparison of the experimental and control groups showed no significant difference between any of the demographic characteristics. These like groups were then tested and compared for embedding. It was found that when examining embedding at the group level, both groups exhibited embedding. When individuals who embed are counted within each group, analysis revealed that the experimental group had a lower percentage of respondents that embedded, however, these results were not statistically significant.

OLS regressions were run to test the effect of the demographic information collected in the survey on the WTP values elicited from the respondents. It was found that two variables had a significant effect on the WTP values for the three vaccines. One was the group dummy, which a priori was not expected to be significant and the other was the no employment dummy, which had a positive effect on WTP contrary to a priori expectations. However, given these are students, it could be that those who are not employed are actually wealthier and do not need to work during their schooling.

Logit and Probit regressions were run to determine the effect of the variables of interest on embedding. These regression results were similar in that the signs of the coefficients were the same and the variables significant at the 5% and 10% level were the same. While the extra information did not significantly decrease embedding, the coefficient was negative.

The difference in proportion of embedding between the two groups, although not significant, was in the hypothesized direction. The relationship between the extra information and embedding as shown by the Logit and Probit regressions also supported the hypothesis, but not at a significant level. From these results it is impossible to conclude that the extra information decreased embedding, however these results do suggest that studying the effect of information on embedding is warranted in a larger population and provide pilot data upon which the sample size calculations could be based.

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67. Olsen, J.A., C. Donaldson, and J. Pereira, *The insensitivity of 'willingness-to-pay' to the size of the good: New evidence for health care*. Journal of Economic Psychology, 2004. **25**: p. 445-460.
68. Brox, J.A., R.C. Kumar, and K.R. Stollery, *Estimating Willingness to Pay for Improved Water Quality in the Presence of Item Nonresponse Bias*. American Journal of Agricultural Economics, 2003. **85**(2): p. 414-28.

## APPENDIX 1 - DATABASE SEARCH STRATEGIES

Contingent valuation AND scope effects, contingent valuation AND embedding, willingness to pay AND scope effects and willingness to pay AND embedding were searched in the following databases.

Ovid Medline 1966 to April Week 3 2003

All EBM reviews

Embase 1980 to 2003 week 17

PsycInfo 1974 to April Week 4 2003

AARP Ageline 1978 to April 2003

AMED 1985 to April 2003

CANCERLIT 1975 to October 2002

CINAHL 1982 to April Week 3 2003

HealthSTAR/ Ovid Healthstar 1975 to March 2003

PubMed

Proquest

EBSCO Host Business Source Premier

Econlit

PAIS international 1972 to 2003/03

**APPENDIX 2 - LITERATURE REVIEW TABLE OF EMPIRICAL PAPERS  
STUDYING EMBEDDING**

Author	Title	Type of Embedding	Subject	Embedding Found	Testing	Administration Technique	Elicitation Format
[33]	Fairness in the Contingent Valuation of Environmental Public Goods: Attitude Toward Paying for Environmental Improvements at Two Levels of Scope.	Other	Environmental	Yes	Internal/both	Telephone	Open-ended
[48]	Considering Conservation Value in Economic Appraisals of Coastal Resources.	Scope effects	Environmental	No	External	Face-to-face	Open-ended
[20]	Valuing Public Goods: The Purchase of Moral Satisfaction.	Scope effects And Sequencing	Environmental	Yes	External	Telephone	Open-ended
[30]	Some Empirical Evidence on Embedding Effects in Contingent Valuation of Forest Protection.	Scope effects	Environmental	Mixed	External	Mail-in	Open-ended and Dichotomous choice
[49]	An Investigation of Part-Whole Biases in Contingent-Valuation Studies.	Scope effects	Environmental	Yes	External	Self-administered	Open-ended
[27]	Does Better Information About the Good Avoid the Embedding Effect?	Scope effects	Environmental	Yes	External	Telephone	Open-ended
[18].	Sequencing and Nesting in Contingent Valuation Surveys.	Scope effects	Environmental	No	External	Face-to-face	Dichotomous choice
[23]	The Validity of the Contingent Valuation Method: Perfect and Regular Embedding.	Scope effects	Environmental	Mixed	External	Mail-in	Payment card
[28]	Differences Between Continuous and Discrete Contingent Value Estimates.	Scope effects	Health	Mixed	External	Mail-in	Payment card and Dichotomous choice
[31]	Determinants of Insensitivity to Quantity in Valuation of Public Goods: Contribution, Warm	Scope effects and Sub-additivity	Health	Yes	Both/Both	Self-administered	Open-ended

	Glow, Budget Constraints, Availability, and Prominence.						
[50]	Valuation of Health Changes With the Contingent Valuation Method: a Test of Scope and Question Order Effects.	Scope effects	Health	No	External	Telephone	Dichotomous choice
[40]	Varying Levels of Information and the Embedding Problem in Contingent Valuation: The Case of Canadian Wilderness.	Scope effects	Environmental	No	External	Mail-in	Open-ended
[32]	Anomalies in the Values for Consumer Goods With Environmental Attributes.	Sub-additivity	Environmental	Yes	Internal/ Bottom-up	Self-administered	Open-ended
[34]	Willingness-to-Pay for Borivli National Park: Evidence From a Contingent Valuation.	Other	Environmental	Yes			
[29]	Contingent Valuation With an Open-Ended Follow-Up Question: a Test of Scope Effects.	Scope effects	Health	Mixed	External	Telephone	Open-ended and Dichotomous choice
[42]	Imprecise Preferences and Survey Design in Contingent Valuation.	Scope effects	Health	Yes	Internal	Face-to-face	Payment card
[39]	Willingness to Pay for Quality Improvements: Should Revealed and Stated Preference Data Be Combined?	Scope effects	Environmental	No	External	Telephone	Dichotomous choice
[51]	Does Part-Whole Bias Exist? An Experimental Investigation.	Sub-additivity	Private Goods	Yes	External	Computer based	Dichotomous choice
[41]	Contingent Valuation of Rural Tourism Development With Tests of Scope and Mode Stability.	Scope effects	Tourism	No	External	Mail-in	Dichotomous choice
[26]	Marine Debris, Beach Quality, and Non-Market Values.	Scope effects	Environmental	No	External	Telephone	Dichotomous choice
[38]	Valuing Multiple Health Risks	Sub-additivity	Health	Yes	External	Mail-in	Dichotomous

	From Long-Term Low Dosage Exposure to Hazardous Chemicals.						choice and Open-ended
[52]	Time Insensitivity for Protective Investments.	Scope effects	Private Goods	Yes	Internal/ both	Self-administered	Open-ended
[14]	Part-Whole Bias in Contingent Valuation: Will Scope Effects Be Detected With Inexpensive Survey Methods?	Scope effects	Environmental	No	External	Telephone	Dichotomous choice
[53]	Testing the Validity of Responses to Contingent Valuation Questioning.	Scope effects	Environmental	No	External	Mail-in	Dichotomous choice
[54]	On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 1-- Caveat Investigator.	Scope effects	Safety	Yes	Internal/ both	Face-to-face	Payment card
[36]	Willingness to Pay for Low-Pesticide Fresh Produce in Taiwan.	Scope effects	Health	No	Internal/ bottom-up	Face-to-face	Dichotomous choice
[55]	Internal and External Scope in Willingness-to-Pay Estimates for Threatened and Endangered Wildlife.	Scope effects	Environmental	Mixed	Both/ bottom-up	Mail-in	Dichotomous choice
[19]	Contingent Valuation of Global Environmental Resources: Test of Perfect and Regular Embedding.	Scope effects	Environmental	Yes	External	Mail-in and Face-to-face	Open-ended
[56]	A Note on the Warm Glow of Giving and Scope Sensitivity in Contingent Valuation Studies.	Scope effects	Environmental	No	Internal/ bottom-up	Face-to-face	Open-ended
[57]	Parents' Preferences for Outcomes Associated With Childhood Vaccinations.	Scope effects	Health	No	Internal/ unknown	Face-to-face	Open-ended
[37]	Sensitivity of Willingness to Pay to the Magnitude of Risk Reduction: a Taiwan; United States Comparison.	Scope effects and Sub-additivity	Health	Mixed	External	Face-to-face and Telephone	Dichotomous choice

[35]	Valuing New Zealand Recreational Fishing and an Assessment of the Validity of the Contingent Valuation Estimates.	Other	Environmental	No	External	Face-to-face	Dichotomous choice
[58]	Scope and Scale Insensitivities in a Contingent Valuation Study of Risk Reductions.	Scope effects	Health	Yes	External	Mail-in	Open-ended
[21]	A Comparison of Alternative Contingent Valuation Elicitation Treatments for the Evaluation of Complex Environmental Policy.	All	Environmental	Mixed	Both/ Top-down	Mail-in	Open-ended
[59]	An Age-Embedding Effect: Time Sensitivity and Time Insensitivity When Pricing Health Benefits.	Scope effects	Health	Yes	Both	Mail-in	Payment card
[60]	Using Life Expectancy to Communicate Benefits of Health Care Programs in Contingent Valuation Studies.	Scope effects	Health	No	External	Telephone	Dichotomous choice
[12]	Contingent Valuation in Health Care and the Persistence of Embedding Effects Without the Warm Glow.	Sub-additivity	Health	Yes	Internal/ Bottom-up	Self-administered	Payment card
[61]	Validity of Contingent Valuation Estimates From Developing Countries: Scope Sensitivity Analysis.	Scope effects	Health	No	External	Face-to-face	Iterative bidding
[62]	Willingness to Pay for Water Quality Improvements: The Case of Precision Application Technology.	Scope effects	Environmental	Yes	External	Telephone	Dichotomous choice
[63]	Embedding Effects in Valuation of Non-Market Goods.		Travel	Yes	Internal/ Bottom-up	Face-to-face	Open-ended
[64]	A Qualitative Examination of	Scope effects	Environmental	No	Internal/	Face-to-face	Open-ended

	How Respondents in a Contingent Valuation Study Rationalise Their WTP Responses to an Increase in the Quantity of the Environmental Good.				Bottom-up		
[65]	Identifying the Warm Glow Effect in Contingent Valuation.	Scope effects and Sub-additivity	Environmental	Mixed	External	Face-to-face	Dichotomous choice
[24]	Willingness to pay and size of health benefit: an integrated model to test for 'sensitivity to scale'	Scope effects	Health	No	Both/ Bottom-up	Telephone	Open-ended
[66]	Sensitivity to scale in contingent valuation: the importance of the budget constraint	Scope effects	Health	Yes	Internal/ Bottom-up	Face-to-face	Open-ended
[67]	The insensitivity of 'willingness-to-pay' to the size of the good: New evidence for health care	Scope effects	Health	Yes	Both/ Bottom-up	Face-to-face	Payment card
[68]	Estimating Willingness to Pay for Improved Water Quality in the Presence of Item Nonresponse Bias.	Scope effects	Environmental	No	Internal/ Top-down	Mail-in	Payment card
[25]	On Visible Choice Sets and Scope Sensitivity.	Scope effects	Environmental	Mixed	Both/ Both	Face-to-face	Open-ended

**APPENDIX 3 - THE SURVEY**

(the format is slightly different due to the computer program)

## Introduction

In section 1 we would like to know the value you place on certain vaccines for hypothetical diseases as well as a combination of these vaccines. This will be done using willingness-to-pay questions. This is a method that can be used to determine how strongly people value different options.

To answer the willingness-to-pay questions mark the box next to the maximum amount you would be willing to pay.

Next

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## Explanation

First, let's look at a brief example to show what we mean by value. Imagine that you go to an auction and see a painting you like. Before bidding, you must decide the maximum amount of money that you would be willing to pay for the painting. You would take into account your current income and how much you spend on other things. You would consider the benefits and drawbacks of purchasing the painting, including what you may have to give up to buy it. When deciding your maximum value for the painting, the time and costs of the artist should not be considered. After careful consideration a maximum bid is determined. This maximum bid is your value for the painting or your maximum willingness-to-pay. Naturally, you would prefer to pay less but you would be willing to bid up to this amount.

Next

### Example

Below is provided a brief explanation of how to answer willingness-to-pay questions, as well as a practice question to make sure you understand.

To answer the willingness-to-pay questions just click the circle next to the maximum amount you would be willing-to-pay for the specified vaccine. If you would be willing-to-pay more than \$100 for the vaccine being valued click the circle next to "more than \$100" and place the amount you would be willing-to-pay in the box provided. If the maximum you are willing-to-pay is \$0, click the circle next to this amount and give a brief explanation in the box provided. To go to the next screen click next at the bottom of the screen.

If as an example you were willing-to-pay at most \$30 for a vaccine against influenza you would click next to \$30. Assuming your maximum willingness-to-pay for an influenza vaccine is \$30 please complete this practice question.

What is the most that you would pay for the vaccine against influenza?

(Since we have assumed your maximum willingness-to-pay is \$30, simply click the circle next to \$30)

- \$0
- \$5
- \$10
- \$15
- \$20
- \$25
- \$30
- \$35
- \$40
- \$45
- \$50
- \$55
- \$60
- \$65
- \$70
- \$80
- \$90
- \$95
- \$100
- more than \$100

If you would pay **more** than \$100 please specify the amount you would pay \_\_\_\_\_

If you selected \$0 as the maximum amount you were willing to pay, please explain why?

---

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Next

## Section 1.1

Suppose that you are planning a month long holiday overseas. You are told of a viral disease that is prevalent at your intended destination. This is called "**Dupuit's A syndrome**" after the French engineer who was the first documented case. There is a **1 in 1000** chance that you will contract the disease in the month that you are there.

If you do contract the disease you will suffer severe stomach cramps for two weeks that will restrict you to your hotel. The disease is not fatal and has no lasting effects but the symptoms are uncomfortable and severe enough to limit your activities. The virus clears your system in 10 to 14 days after which you quickly return to full health. There is no cure or treatment other than to rest.

There is a vaccine but it is currently only available privately. You need to pay the full cost of the medication. You do not need a prescription, as the vaccine is available over the counter at your local pharmacy. It is a tasteless oral preparation with no side effects. It is only effective in **50% of cases**, however, reducing your risk of infection from 1 in 1000 to 1 in 2000.

What is the maximum amount that you would be willing to pay for the vaccine? Before you answer this question, remember that your income is limited and there are other things that you need to pay for. Anything that you say you will pay means that you must give up something else of equal value in order to be able to afford the vaccine.

What is the most that you would pay for the vaccine against Dupuit's A syndrome?

- \$0
- \$5
- \$10
- \$15
- \$20
- \$25
- \$30
- \$35
- \$40
- \$45
- \$50
- \$55
- \$60
- \$65
- \$70
- \$80
- \$90
- \$95
- \$100
- more than \$100

If you would be willing-to-pay for this vaccine, please explain why. \_\_\_\_\_

If you would pay **more** than \$100 please specify the amount you would pay \_\_\_\_\_

If you selected \$0 as the maximum amount you were willing to pay, please explain why? \_\_\_\_\_

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Next

## Section 1.2

Now suppose that you have acted on your previous decision (that is, you have purchased the vaccine at the amount circled in 1.1 or decided to risk infection by not purchasing the vaccine). You now find out about a second strand of the viral disease, **Dupuit's B** syndrome, that is less prevalent but potentially more severe than Dupuit's A. Your chances of infection are only **1 in 10,000**.

If you are infected then you can expect to be **seriously debilitated for a year on average**. You will lack concentration and suffer persistent fatigue that will prevent you from working or studying for more than one hour a day or from walking more than 500 metres at a time. You will not experience any pain but will feel listless and depressed for long periods because of your inability to complete any activity.

As before, a vaccine is available over the counter at your local pharmacy for those prepared to pay the full costs. It too is tasteless and safe but effective in only **50% of cases**.

Bearing in mind what you have agreed that you would pay for the vaccine for Dupuit's A syndrome, if anything, what is the absolute most that you would now pay **IN ADDITION** for this vaccine? Remember, just as before, that your income is limited and to be able to afford the vaccine you must be prepared to give up something else of value.

What is the most that you would pay for the vaccine against Dupuit's B, having already acted in response to 1.1?

- \$0
- \$5
- \$10
- \$15
- \$20
- \$25
- \$30
- \$35
- \$40
- \$45
- \$50
- \$55
- \$60
- \$65
- \$70
- \$80
- \$90
- \$95
- \$100
- more than \$100

If you would be willing-to-pay for this vaccine, please explain why. \_\_\_\_\_  
 If you would pay **more** than \$100 please specify the amount you would pay \_\_\_\_\_  
 If you selected \$0 as the maximum amount you were willing to pay, please explain why?

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Next

### Section 1.3

Finally, what if, instead, you knew **IN ADVANCE** that there was a vaccine available that prevented both versions of Dupuit's disease. As with the two single-purpose vaccines, the dual-purpose vaccine is tasteless and safe to use but effective in **only 50% of cases**.

What is the maximum amount that you think you would be willing to pay for the dual vaccine? Remember, just as before, that your income is fixed and if you are to afford the vaccine you will need to cut out something else from your planned expenditure.

What is the most that you would pay for the dual-purpose vaccine against both Dupuit's A and Dupuit's B?

- \$0
- \$5
- \$10
- \$15
- \$20
- \$25
- \$30
- \$35
- \$40
- \$45
- \$50
- \$55
- \$60
- \$65
- \$70
- \$80
- \$90
- \$95
- \$100
- more than \$100

If you would be willing-to-pay for this vaccine, please explain why. \_\_\_\_\_

If you would pay **more** than \$100 please specify the amount you would pay \_\_\_\_\_

If you selected \$0 as the maximum amount you were willing to pay, please explain why?

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Next

## Comments

Did you find the willingness-to-pay questions difficult to answer?

- Yes
- No

How difficult did you find it to answer the willingness-to-pay questions?

- Very difficult
- Difficult
- Easy
- Very Easy

In this space please add any other comments about the survey.

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Please enter the amount you valued the vaccine for Dupuit's A syndrome. \_\_\_\_\_

Please enter the amount you valued the vaccine for Dupuit's B syndrome. \_\_\_\_\_

Please enter the amount you valued the combination vaccine for both Dupuit's A and Dupuit's B syndromes. \_\_\_\_\_

Is your value of the vaccine for Dupuit's A plus your value of the vaccine for Dupuit's B...

- greater than your value for the combo vaccine
- less than your value for the combo vaccine
- equal to your value for the combo vaccine

Please explain why you valued the vaccines in this way.

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## Demographics

Age: \_\_\_\_\_

Sex: M\_\_\_ F\_\_\_

Marital Status: Married\_\_\_ Living with partner\_\_\_ Divorced\_\_\_ Separated\_\_\_ Widowed\_\_\_  
Single (never married)\_\_\_

Student Status: Full time undergraduate\_\_\_ Part time undergraduate\_\_\_

Graduate\_\_\_ Unclassified\_\_\_ Other (specify) \_\_\_\_\_

Total number of years of University: 1\_\_\_ 2\_\_\_ 3\_\_\_ 4\_\_\_ 5\_\_\_ Over 5\_\_\_

Employment Status:

Full-time employment\_\_\_ Part-time employment\_\_\_ No employment\_\_\_

Full-time summer employment\_\_\_ Part-time summer employment\_\_\_

Last year's personal income (includes scholarships, earned income and stipends from  
parents or others)

less than \$5,000\_\_\_ \$5,000-\$9,999\_\_\_ \$10,000-\$14,999\_\_\_

\$15,000-\$19,999\_\_\_ \$20,000-\$24,999\_\_\_ \$25,000 and above\_\_\_

Have you ever traveled outside of North America? Yes\_\_\_ No\_\_\_

Have you ever purchased vaccines prior to travel? Yes\_\_\_ No\_\_\_

If yes, approximately how much did you spend? \_\_\_\_\_

Have you ever been ill for several days while you were traveling? Yes\_\_\_ No\_\_\_

How would you describe your general state of health?

Excellent\_\_\_ Very Good\_\_\_ Good\_\_\_ Poor\_\_\_ Very Bad\_\_\_

Next

**Thanks**

Thank you for your time. Please collect your payment at the front of class.

## APPENDIX 4 – ETHICS REVIEW APPROVAL

UNIVERSITY OF  
CALGARY

## MEMO

CONJOINT FACULTIES RESEARCH ETHICS BOARD  
 c/o Research Services  
 Room 602 Earth Science  
 Telephone: (403) 220-3782  
 Fax: (403) 289 0693  
 Email: plevans@ucalgary.ca  
 Tuesday, March 23, 2004

To: David Eldon Spackman  
 Economics

From: Dr. Janice P. Dickin, Chair  
 Conjoint Faculties Research Ethics Board (CFREB)

Re: Certification of Institutional Ethics Review: The Effect of Cost and Value Information on Embedding in Contingent Valuation

The above named research protocol has been granted ethical approval by the Conjoint Faculties Research Ethics Board for the University of Calgary.

Enclosed are the original, and one copy, of a signed Certification of Institutional Ethics Review. Please make note of the conditions stated on the Certification. A copy has been sent to your supervisor as well as to the Chair of your Department/Faculty Research Ethics Committee. In the event the research is funded, you should notify the sponsor of the research and provide them with a copy for their records. The Conjoint Faculties Research Ethics Board will retain a copy of the clearance on your file.

Please note, an annual/progress/final report must be filed with the CFREB twelve months from the date on your ethics clearance. A form for this purpose has been created, and may be found on the "Ethics" website, <http://www.ucalgary.ca/UofC/research/html/ethics/reports.html>

In closing let me take this opportunity to wish you the best of luck in your research endeavor.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Patricia Evans'.

Patricia Evans  
 Executive Secretary for:  
 Janice Dickin, Ph.D., LL.B., Faculty of Communication and Culture and  
 Chair, Conjoint Faculties Research Ethics Board

Enclosures(2)  
 cc: Chair, Department/Faculty Research Ethics Committee  
 Supervisor: Gillian Currie



UNIVERSITY OF  
CALGARY

**CERTIFICATION OF INSTITUTIONAL ETHICS REVIEW**

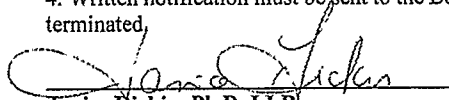
This is to certify that the Conjoint Faculties Research Ethics Board at the University of Calgary has examined the following research proposal and found the proposed research involving human subjects to be in accordance with University of Calgary Guidelines and the Tri-Council Policy Statement on *"Ethical Conduct in Research Using Human Subjects"*. This form and accompanying letter constitute the Certification of Institutional Ethics Review.

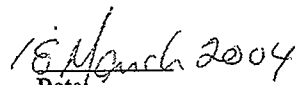
File no: **CE101-3899**  
 Applicant(s): **David Eldon Spackman**  
 Department: **Economics**  
 Project Title: **The Effect of Cost and Value Information on Embedding in Contingent Valuation**  
 Sponsor (if applicable): **AHFMR**

**Restrictions:**

**This Certification is subject to the following conditions:**

1. Approval is granted only for the project and purposes described in the application.
2. Any modifications to the authorized protocol must be submitted to the Chair, Conjoint Faculties Research Ethics Board for approval.
3. A progress report must be submitted 12 months from the date of this Certification, and should provide the expected completion date for the project.
4. Written notification must be sent to the Board when the project is complete or terminated.

  
 Janice Dickin, Ph.D, LLB,  
 Chair  
 Conjoint Faculties Research Ethics Board

  
 Date:

**Distribution:** (1) Applicant, (2) Supervisor (if applicable), (3) Chair, Department/Faculty Research Ethics Committee, (4) Sponsor, (5) Conjoint Faculties Research Ethics Board (6) Research Services.

**APPENDIX 5 - RECRUITMENT MATERIALS**

*To be read at the start of classes with the prior permission of the professor.*

Hi, my name is Eldon Spackman and I am a graduate student working on my master's thesis in Health Economics. In the next few weeks, we will be conducting a 20 min. computer questionnaire in SS 814. The survey is about exploring a particular economics based technique for valuing health services. All those who participate will be paid \$10. If you are interested in participating please email me at [cvsurvey@ucalgary.ca](mailto:cvsurvey@ucalgary.ca) and indicate the times you are available. Those who do will be contacted to set up a time to come to the lab and then your email address will be deleted and used for nothing else.

If you have any questions you are welcome to call me at 220-5865, or email at the address given on the overhead. Thanks for your time.

*Overhead to be displayed during short announcement*

IF INTERESTED IN PARTICIPATING IN MY STUDY

CONTACT: Eldon Spackman 220-5865

Department of Economics

Email: **[cvsurvey@ucalgary.ca](mailto:cvsurvey@ucalgary.ca)**

## APPENDIX 6 - INFORMED CONSENT FORM



UNIVERSITY OF  
CALGARY

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### FACULTY OF SOCIAL SCIENCES

Department of Economics  
Telephone: (403) 220-5857  
Fax: (403) 282-5262

Research Project Title: The Effects of Cost and Value Information on Embedding in Contingent Valuation

Investigators: Eldon Spackman  
Dr. Gillian R. Currie (supervisor)

Sponsor: Alberta Heritage Foundation for Medical Research

This information form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

I am conducting this research for my Master's thesis in Economics, under the supervision of Dr. Gillian Currie. This survey will explore the use of the "willingness to pay" technique as a method of eliciting the value of health services. You have been invited to participate in this study because you are a University of Calgary student.

If you participate in this research you will be asked to read all information provided and thoughtfully answer all questions. The survey will take approximately 20 minutes to complete. There are no right or wrong answers to the questions, it is your views that we are interested in. You are free to withdraw from this study prior to finishing all the questions, if you change your mind about participating. Once you have completed the survey you will please come to the front. Those having completed the survey will receive \$10.

The results of the survey will be analysed and reported in my Master's thesis. We also hope to have the results published. No names will be recorded and no attempt will be made to identify respondents. The anonymous responses to the survey will be stored in a secure location and available only to the investigators listed above.

Your completion of the survey indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

Eldon Spackman	220-5865
Dr. Gillian Currie (supervisor)	220-5602

If you have any questions or issues concerning this project that are not related to the specifics of the research, you may also contact the Research Services Office at 220-3782 and ask for Mrs. Patricia Evans.

Your completion of the following survey will indicate your consent to participate.

Please keep this copy of the consent form for your records and reference.

## APPENDIX 7 - VARIABLES

### Model Variables

Age – respondents input their age

YrsUniv - number of years in university, respondent can choose 1,2,3,4,5 or more than 5

SpentVac – the amount of money previously spent on vaccines to travel

ValueA – the amount chosen on the scale provided or greater than 100

ValueB - the amount chosen on the scale provided or greater than 100

ValueC - the amount chosen on the scale provided or greater than 100

lnWTPA – the natural logarithm of ValueA

lnWTPB – the natural logarithm of ValueB

lnWTPC – the natural logarithm of ValueC

### Dummy Variables

- Male – respondents choose male or female
- Single, Married, LivWPart, Div, Sep, Wid – respondents mark whether they are single, married, living with a partner, divorced, separated or widowed
- SS\_Fulltime, SS\_Parttime, SS\_Graduate, SS\_Unclass – respondents answer whether they are Full time, Part time, Graduate or Unclassified students
- ES\_Fulltime, ES\_Parttime, ES\_PTsum, ES\_FTsum, ES\_No – respondents choose among employment status options: full time, part time, part time summer, full time summer or no employment
- PI\_5, PIto10, PIto15, PIto20, PIto25, PIplus25, PIunknown – this indicates the respondents personal income: under \$5000, between \$5000 and \$9999, between

\$10000 and \$14999, between \$15000 to \$19999, between \$20000 and \$24999 or \$25000 over

- PIplus10 – this was calculated by combining the dummy variables PIto15, PIto20, PIto25, PIplus25 into one variable which indicates all respondents who have a personal income over \$10,000
- Trav – yes/no, if respondents have traveled outside North America
- PurchVac – yes/no, if respondents have purchased vaccines before travelling
- IllTrav – yes/no, if respondents have ever been ill while travelling
- HealthE, HealthVG, HealthG, HealthP, HealthVB – respondents choose whether they have excellent health, very good health, good health, poor health or very bad health
- Difficulty – yes/no, had difficulty answering questions
- VeryDiff, Diff, Easy, VeryEasy – respondents choose whether the questions were very difficult, difficult, easy or very easy
- PassPract – yes, if respondents put \$30 as their value for the flu vaccine as they were directed
- CorrectVal – compares whether respondents inputted the same values for the vaccines at the end of the survey. Yes, if they have all three of the values correct
- Embedding – yes, if respondents' values for A and B add to greater than their value for C
- ExtraInfo – yes, if respondents had the extra information (ie, in the treatment group)

## APPENDIX 8 - CHI-SQUARE CALCULATION

Observed Frequency

	Embedding	No Embedding	Total
<b>Shiell and Gold</b>	59	45	104
<b>Spackman</b>	31	29	60
<b>Total</b>	90	74	164

	Embedding	No Embedding
<b>Shiell and Gold</b>	0.567307692	0.432692308
<b>Spackman</b>	0.516666667	0.483333333

Expected

	Embedding	No Embedding
<b>Shiell and Gold</b>	57.07317073	46.92682927
<b>Spackman</b>	32.92682927	27.07317073

$(O-E)^2/E$

	Embedding	No Embedding
<b>Shiell and Gold</b>	0.065051074	0.079116171
<b>Spackman</b>	0.112755194	0.137134696

Chi<sup>2</sup> 0.394057

df=(r-1)(c-1) 1

If the Chi<sup>2</sup> value is larger than the critical value then data present a statistically significant relationship between the variables.