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Abstract

The scope sensitivity test is used to validate value estimates of non-market environmental goods and services derived from the contingent valuation method. The absence of economic scope points to the invalid value estimates. Recent studies have attributed scope insensitivity to affective, cognitive, and behavioral factors. In this study, we extend the behavioral insights in explaining scope insensitivity by incorporating insights from the theory of mental accounting. Our empirical results indicate that if subjects consider the environmental good as part of their recreational budget within a mental accounting framework, we can explain the scope insensitivity with otherwise standard preference.

Keywords:: Scope insensitivity; Contingent Valuation; Mental accounting; Bootstrap.

JEL Code: Q510; D910

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1 Introduction

The valuation of environmental goods, is crucial for policy-making. However, for non-market environmental goods the standard methods to elicit *Willingness to Pay* (WTP) fails due to the absence of prices. A common alternate method, *Contingent Valuation* (CV), recovers the preference by posing contingent questions to respondents, where they are asked to report how much they are willing to pay should an environmental improvement program be implemented. To ensure the valuation thus obtained is not inconsistent or unstable, a scope test is often conducted that checks whether the subjects value the environmental improvement more when greater environmental good is offered, i.e., *more is better*. This property is known as scope sensitivity in CV studies. According to the National Oceanic and Atmospheric Administration (NOAA) Blue Ribbon Panel on CV, the presence of scope sensitivity indicates internal or construct validity of values estimates (Arrow et al, 1993 [4]) . This recommendation was recently reaffirmed in Johnston et al, 2017 [11] general principles for stated preference (SP) research. However, several papers conducting CV studies have reported scope insensitivity, i.e., failure of scope test in CVM studies (Kahneman and Knetsch, 1992 [15]; Desvousges et al , 1993 [8]; Diamond and Hausman, 1994 [9]). In this paper, we explore possible reasons behind the scope insensitivity. Behavioral anomalies may create scope insensitivity even if the usual preference axioms of consumer theory hold (Banerjee and Murphy, 2005 [5]; Whitehead, 2016 [21]). Herberlein et al, 2005 [13]) discovered that knowing more, liking more, and having more experience at a local level than at a larger level leads respondents to appreciate local diversity more than biodiversity in a broader region.

In the same vein, we argue that scope insensitivity may neither imply an inconsistent nor unstable preference. We extend the possible set of behavioral explanations to include the mental accounting theory, as proposed by Thaler, 1985 [20]. Our theoretical and empirical exercises show that we can accommodate consistent and stable preferences with scope insensitivity. Applying the extended mental accounting theory for non-market good we show that if subjects in CV studies use mental accounts, then under some conditions, they may violate scope insensitivity tests even when their valuation of *more* of the environmental goods is indeed higher than *less* of it. Our analysis suggests that if researchers incorporate mental accounting in a CVM questionnaire, the resulting estimation of WTP would be more robust.

The following sections are organized as follows. Section 2 introduces mental accounting theory, extends it for non-market goods, and shows how it works in our context through an illustrative example. Section 3 elaborates on the empirical application and produces predictions in the context of our empirical application using results from Section 2. Section 4 reports all results. Section 5 discusses our assumption and

specification; and, finally, Section 6 concludes the research.

2 Theoretical Framework

2.1 Mental Accounting

Thaler (1985) [20] first proposed mental accounting theory as a possible explanation for non-standard behavior. According to this theory, agents have different mental accounts for topically and temporally separate purchases. This idea implies that even if agents have a rational preference, their choices can be different from those of a standard, neoclassical agent due to mental accounts in determining optimal choices.

In this paper, we consider a model of mental accounting with only topical separation of psychological accounts[1]. For example, consumers can have different mental accounts for food, recreation, and education. The critical assumption of the model is that money is not fungible across these different mental accounts.

Let us consider an agent who maintains n mental accounts that are topically separate. For simplicity, let us assume $\mathbf{x}_i$ denotes the vector of goods in account i, and $u_i(\mathbf{x}_i)$ denotes the utility function for account i. Suppose the total utility is additive over all accounts and is given by Equation 1

$$U(\mathbf{x}_1, \ldots, \mathbf{x}_n) = \sum_{i=1}^{n} u_i(\mathbf{x}_i) \tag{1}$$

Let M be the total income of the agent in a given period, and θ_i denotes the proportion of income they have set aside for account i, i.e., $\theta_i M$ denotes the budget for account i[2]. Thus, the budget constraint of the agent with a mental account would be different from the same for a neoclassical agent. Let $\mathbf{p}_i$ denotes the price vector in account i and $\mathbf{x}_i$ denotes the consumption vector. Then we can rewrite the budget constraints as follows in Equation 2

$$NC: \quad \sum_i \mathbf{p}_i \mathbf{x}_i \leq M \tag{2}$$

$$MA: \quad \mathbf{p}_i \mathbf{x}_i \leq \theta_i M \quad \forall i \in \{1, \ldots, n\}. \tag{3}$$

where $\mathbf{p}_i \mathbf{x}_i$ denotes the total expenditure in account i. Inequality 2 denotes the budget equation for a neoclassical agent (NC), and the second set of inequalities (Equation 3) refers to an agent with mental accounting (MA).

[1] For a mental accounting model with temporal separation, refer to Egan et al, 2015 [10]; Montogomery et al, 2016 [17]

[2] The choice of θ_i is not modeled as it can reflect various behavioral biases, e.g., present bias or temptation (Thaler, 1985 [20]).

We extend this model to incorporate non-market goods for which prices are not available. Suppose account j contains only two goods, a non-market good x_j and a composite good x_{-j}. For simplicity, let us write the utility function for account j as

$$u_j(\mathbf{x}_j) = v(x_j) + x_{-j} \tag{4}$$

i.e., the utility function in account j is quasi-linear in the non-market good x_j[3]. Instead of a price, we assume that the consumer is offered a choice of a given amount $\bar{x}_j$ of the non-market good x_j. The agent can respond "YES" or "NO" to the offered bid b for $\bar{x}_j$. Let $v(\bar{x}_j)$ and $v(x_{x_0})$ denote the levels of utility when the consumer chooses YES and NO, respectively. Under the neoclassical paradigm, the agent would be willing to opt for $\bar{x}_j$ if, and only if,

$$\sum_{i \neq j} u_i(\hat{\mathbf{x}}_i) + v(\bar{x}_j) + \hat{x}_{-j} \geq \sum_{i \neq j} u_i(\hat{x}'_i) + v(x_0) + \hat{x}'_{-j} \tag{5}$$

$$\sum_{i \neq j} \mathbf{p}_i \hat{\mathbf{x}}_i + b + p_{-j}\hat{x}_{-j} = \sum_{i \neq j} \mathbf{p}_i \hat{\mathbf{x}}'_i + p_{-j}\hat{x}'_{-j} \leq M \tag{6}$$

where $\hat{\mathbf{x}}_i$ and $\hat{\mathbf{x}}'_i$ in Equation 5 and Equation 6 denote the optimal choices for all other accounts $i \neq j$, and $\hat{x}_{-j}$ and $\hat{x}'_{-j}$ denote the optimal choices in account j, excluding the non-market good under YES and NO options, respectively, and p_{-j} refers to the price in account j excluding the non-market good.

However, the agent faces a different choice problem under the mental accounting framework. Note that the choice of YES or NO in account j does not affect choices in any other accounts since the MA agent has separate mental accounts for different types of expenditures. Thus the MA agent would be willing to opt for $\bar{x}_j$ if, and only if,

$$v(\bar{x}_{-j}) + x_{-j} \geq v(x_0) + x'_{-j} \tag{7}$$

$$p_{-j}x_{-j} + b = p_{-j}x'_{-j} \leq \theta_j M \tag{8}$$

where x_{-j} and x'_{-j} denote the optimal levels of all other goods except the non-market good x_j in account j under YES and No choices, respectively. Inequality in Equation 7 implies that the net value of opting for the non-market good in account j is better than not opting for it. Inequality in Equation 8 ensures that the budget constraint for account j is satisfied.

To explore these inequalities further, let us assume that $p_{-j} = 1$[4]. We can thus

[3]One can consider x_{-j} as the dollar left after consuming x_j in account j. If x_j denotes a small proportion of the total consumption in account j, this assumption is justified.

[4]This simplification along with our assumption of quasi-linearity of $u_j(\mathbf{x}_j)$ implies x_{-j} reflects the leftover amount in account j in dollar terms upon deciding the pay for the non-market good.

rewrite Equation 7 for the MA agent as Equation 9

$$v(\bar{x}_{-j}) + \theta_j M - b \geq v(0) + \theta_j M \tag{9}$$

Upon simplification, we can rewrite the optimization condition of MA agents as

$$v(\bar{x}_{-j}) - b \geq v(0) \tag{10}$$

$$b \leq \theta_j M - x_{-j} \equiv M_j. \tag{11}$$

Combining the two inequalities in Equation 10 and Equation 11, we find that the agent would be willing to opt for YES if, and only if, inequality in Equation 12 holds.

$$b \leq \min\left\{M_j, v(\bar{x}_j) - v(0)\right\} \tag{12}$$

Using this framework we want to investigate the scope sensitivity of an MA agent. To define scope we consider two different levels of the offered environmental good in account j, such that one level is strictly higher than the other. Proposition 1 explains the impact of mental accounts on scope sensitivity.

Proposition 1. *Suppose $v(x_j)$ is strictly monotonically increasing in the amount of x_j and b is given. For an MA agent, the probability of opting for the non-market good in account j, (i.e., choosing YES), will not be monotonically increasing in $v(x_j)$ if M_j' is sufficiently small.*

Proof. Let us consider two possible levels of the non-market environmental good $\bar{x}_j^1$ and $\bar{x}_j^2$ and a bid b. If $\bar{x}_j^1$ denotes a strictly higher amount of environmental good then by strict monotonicity of $v(x_j)$

$$v(\bar{x}_j^1) > v(\bar{x}_j^2) \tag{13}$$

Thus, if $v(\bar{x}_j^2) - v(0) > b$ then with probability 1 we have $v(\bar{x}_j^1) - v(0) > b$.

However, we also need to consider the budget constraint of the MA agent here. Suppose M_j is sufficiently small such that

$$b > \theta_j M - x_{-j} \equiv M_j \tag{14}$$

This can happen if either θ_j is sufficiently small, i.e., the consumer has allotted a small budget for account j or x_{-j} is sufficiently large, i.e., the consumer has already spent a significant amount out of account j.

Under Equation 14, the optimal choice for the MA agent would be NO under both

offers $\bar{x}_j^1$ and $\bar{x}_j^2$ as given in by Equation 15 and Equation 16

$$b > \min\left\{M_j, v(\bar{x}_j^1) - v(0)\right\} \tag{15}$$

$$b > \min\left\{M_j, v(\bar{x}_j^2) - v(0)\right\} \tag{16}$$

.

Thus the probability of choosing YES would be zero in both cases when M_j is sufficiently small, i.e., Equation 14 is satisfied.

This shows even if $v(\bar{x}_j^1) > v(\bar{x}_j^2)$, the probability of choosing YES is not strictly higher when $v(\bar{x}_j^1)$ is offered for bid b. Hence, proved. □

Note that the same would not be valid for an NC agent. Since they do not use separate mental accounts, they would be willing to choose YES if the benefit from doing so is higher than the cost, assuming the budget constraint is not binding, i.e., if M is sufficiently high compared to b.

2.2 An Illustrative Example

Let us consider an agent who decides whether and how much to contribute to a non-market good. Following CVM studies, the agent is offered a bid b for the environmental good. The agent chooses whether to pay bid b based on two principles: first, the standard neoclassical argument, given by Equation 17 as

$$w \geq b, \tag{17}$$

where w denotes the marginal value of the environmental good, i.e, $v(x_j) - v(0)$, and b denotes the bid price. If $w < b$, i.e., if the agent's willingness to pay is less than the proposed bid, they would not contribute. Second, whether the total expenditure, i.e., the bid amount b exceeds the amount E (residual budget for environmental good) specified by the mental account j that contains the environmental good, given as Equation 18

$$b \leq E. \tag{18}$$

Note that if the w is sufficiently higher than the bid price, but E is sufficiently small, the second constraint is binding while the first one is not. For example, suppose a respondent has a marginal value of $w = 900$ for restoring one native tree. This implies that if they are offered to restore only one-third of a tree, their marginal valuation would be $w = 300$. Consider a bid price $b = 250$; if the respondent does not have mental account constraints, they would be willing to pay irrespective of how

much environmental good is offered. To summarize, for any $b \in (300, 900)$, the rational respondents will only pay for one tree, not one-third of a tree. By similar logic, for any $b < 300$ a respondent will pay for both, and if $b > 900$ the respondent will pay for neither.

Now consider a respondent who has a residual budget $E = 150$ for the environmental good in question. If $b = 250$, they will not pay irrespective of how much of the environmental good is offered, whereas if $E = 300$, they will pay, again irrespective of the amount of good offered. Thus, a stringent mental accounting constraint can create scope insensitivity.

3 Empirical Application

3.1 Overview

To show this, we consider a field experiment from sardana, 2019 [18]. In the study, respondents' valuations for restoring native trees is measured using the CV method. The respondents are randomized into one of two split samples to implement the scope test. In Split Sample I, for every visitor who paid the higher entrance fee, one tree (*more*) would be restored. In Split Sample II, for every three visitors who paid the higher entrance fee, one native tree (*less*) would be restored.

To apply the mental accounting model in this context, we need to measure the relevant mental accounts that the respondents might be using when deciding how much to pay for the environmental good. Since the environmental good considered here is a national park, we assume that the subjects put the expenditure for the same in their recreational budget. In the absence of a direct measure of the recreational budget, we use the spending data, namely total trip expenditure and the respondents' entrance fees. Using their spending data, we can show that subjects who are more likely to be constrained by their mental account for recreational goods are less likely to pay for the environmental good. Our proxy for recreation budget is relevant for only a subsection of the sample, for whom we also show the evidence of scope insensitivity.

Egan et al, 2015[10] tested the mental accounting hypothesis in a contingent valuation model by providing a split sample treatment where payment schedules differ. They found evidence that mental accounting explains a modest difference between one-time and annual WTP when presented with ongoing payments. Since, in our study, the time dimension across the split sample is irrelevant, a similar analysis would not be informative.

3.2 Methods

3.2.1 Predicting Probabilities and Measuring WTP

Given that respondents would respond with a 'YES' or 'NO' response to a single bid amount, the probability of respondents paying a given bid amount is statistically estimated using a qualitative choice model. However, the statistical distribution of WTP must be established before the model can be estimated. We use the Logit Model for the parametric model and Turnbull Estimator for the non-parametric model.

3.2.2 Parametric Model

We predict probability of the respondent saying "YES" and their WTP using the Logit Model given by Equation 19 as

$$Pr(Y = 1|X) = G(X\beta) \tag{19}$$

where, X is the matrix of explanatory variables and G(.) takes on vales in the open unit interval $0 < G(z) < 1$ for all $z \in \mathbb{R}$.

$$G(z) \equiv \Delta(z) \equiv \frac{exp(z)}{1 + exp(z)} \tag{20}$$

is standard logistic distribution given by Equation 20. Explained variation in response probabilities, i.e., X in Equation 19 is given by the variables described in Table 1.

Table 1: Description of Variables Used to Estimate Parametric WTP and Predicted Probabilities.

Variables	Description
Bid Amount	For a visiting party consisting of a single person, this is the hypothetical surcharge that the individual was asked to pay in the CV scenario. (INR)
Age	Age of the respondent (years)
Education	Years in education
Household Income	Household monthly income (INR) For a visiting party consisting of a single person, just that person's income. For a visiting party consisting of multiple members of a household, income summed across all members of the household
Location dummies	Iruppu (Bharmagiri Wildlife Sanctuary) Madalpatti (Pushphagiri Wildlife Sanctuary) Nagarhole National park(base)

WTP is estimated using Equation 21

$$WTP = -X\beta/\beta_{bid} \tag{21}$$

3.2.3 Non-Parametric Model

We use the Turnbull estimator for the non-parametric model. The benefit of this technique is that it eliminates the need for a precise WTP distribution assumption. The lower bound WTP is given by Equation 22 (Haab and McConnell, 2002 [12])

$$E_{LB}(WTP) = \sum_{j=0}^{M^*} t_j(F^*_{j+1} - F^*_j) \tag{22}$$

F^*_{j+1} is the Turnbull estimated cumulative distribution function that have the property that the proportion of no responses declines as the bid price increases, for bids indexed $j = 1, 2, ..M^*$ where, $F^*_j = \frac{N^*_j}{T^*_j}$, N^*_j is the number of NO responses to bid t_j and T^*_j is the total number of offered bid t_j.

3.3 Measuring Mental Accounts

To implement the idea of mental accounting in our empirical model, we need to know the mental account the subject had assigned for the environmental good and how to estimate it. Unfortunately, this data was not collected in the original survey. To circumvent this issue, we instead considered data regarding the actual financial decision that we can observe in the data. In the survey, subjects were asked to report their entrance fee payment for the national parks. Since the environmental good in question enhances the recreational experience of visiting national parks, we assume that both these expenditures, i.e., entrance fee and contribution to restoring native trees (as a surcharge above the entrance fee) would belong to the same mental account, which we refer as R (for recreation). Moreover, in the survey, the subjects were asked about their WTP to restore native trees through an increase in the entrance fee, which further strengthens our argument.

Suppose an agent has a residual budget of $E = 400$ for account R. If they have paid the entrance fee of $f = 250$, they would have only 150 left in the account and would not be willing to contribute if the bid was $b = 250$. On the other hand, they might be willing to contribute if they had paid only $f = 75$ and were left with 325. Assuming both types of expenditures are part of the same account, we can use the heterogeneity in one to learn about the other, assuming R is known. Even though we can measure the entrance fee for each respondent, the account R is not observable in our data.

We argue that the total trip expenditure can proxy for the unobserved value of

R. For each respondent, we measure the ratio of the entrance fee to the total trip expenditure. Based on this ratio, we divide the entire sample into several *expenditure classes* with a range of subjects spending 1-5% to spending more than 40% of their trip expenditures on national park visits. However, the wide range of the possible values of this ratio implies that total trip expenditure may not proxy for R for the entire subject pool in our analysis.

The incorporation of mental accounting theory suggests that the measured WTP for respondents does not necessarily reflect the marginal valuation of the environmental good. Consider an agent who chooses NO for a bid value of $b = 200$. For an NC agent, this would imply the marginal value for the environmental good $w \leq b$. However, the same cannot be said about an MA agent. If their psychological budget for recreation after paying the entrance fee is at $E - f = 150$, then even with $w > b$, they will choose NO. Thus, under mental accounting, the estimated WTP reflects the environmental good's valuation and the relevant mental accounting constraint.

3.4 Predictions

We conjecture that agents for whom the proportion of entrance fee to the total trip expenditure is high, i.e., who belong to a higher *expenditure class* would be more likely to be constrained by the mental account i.e., $E - f$. Consequently, the probability of choosing YES would be more likely to be smaller for the higher *expenditure classes*. Since MA constraints directly affect the WTP for the agents, we would instead consider the probability of choosing YES for a random b offered to the agents. Thus, using Preposition 1, we make the following predictions.

Prediction 1. *If the respondents are subjected to mental accounting constraints, the probability of choosing YES would be lower for a higher expenditure class.*

Note that standard neoclassical arguments cannot explain this decreasing pattern. In our empirical specification, we control for income, ensuring the income effect cannot explain this behavior. If we argue that agents in a higher *expenditure class* have a higher valuation for recreational activities, then they will be more willing to say YES, not less. Moreover, Proposition 1 also shows the impact of mental accounting on scope insensitivity. If mental accounting constraints are the binding ones, i.e., $M_j \leq\leq w(x_j)$, then the probability of saying YES would not be monotonically increasing in the amount of x_j offered.

Prediction 2. *Suppose the respondents are subjected to binding mental accounting constraints for the environmental good. In that case, the probability of choosing YES will not vary monotonically with the level of environmental good offered, i.e., scope insensitivity would be observed.*

Following Proposition 1, when respondents are subjected to binding mental accounting constraints for the environmental good, the relevant inequality for decision making becomes whether $b \leq M_j$. Thus, even if the value of the offered good is higher than the bid amount, the agent will not choose YES.

4 Results

4.1 Observations Summary and Further Analysis

Sardana (2019) finds scope sensitivity, (i.e., respondents who are offered more of the environmental good have a higher probability of saying "YES" to the WTP question). The study uses the standard way to check scope sensitivity by using the dummy for split sample in the probability model. Borzykowski et al, 2018[6] discusses the importance of systematic scope tests, both parametric and non-parametric, for revealing scope effects. This indicates further investigation of the data to establish scope effects.

4.2 Systematic Scope Test

For routine scope tests, we bootstrap WTP and differences in WTP across two split-samples using the parametric model (Logit specification) and non-parametric model (Turnbull specification) in Table 2. We find that difference is statistically insignificant in both the specifications — Logit and Turnbull— pointing to economic scope insensitivity. Additionally, we also estimate arc elasticity, proposed by Whitehead, 2016 [21], to test the scope elasticity of the WTP estimate. According to Lopes and Kipperberg, 2020 [16] elasticities with confidence intervals in the [0;1] range are feasible since they follow the positive but declining marginal utility theory. More precisely, Whitehead, 2016 [21], conducted a Monte Carlo simulations of the WTP and elasticity estimates and found 95% confidence interval of elasticity estimates ranges from 0.17 to 0.99. This simulation isn't definitive, but it does point to a range of realistic elasticities that could be expected from willingness-to-pay functions with statistically significant scope effects. In Table 3, we report arc elasticity estimates, bootstrap standard errors, and 95% confidence intervals for parametric model (Logit specification) and non-parametric (Turnbull specification). For both parametric and non-parametric specification, in this case, 95% confidence interval is suggestive of scope insensitivity.

4.3 Testing for Direct Channel of Non-Economic Scope

Several papers Kahneman, 1986 [14], Ajzen and Peterson, 1988 [1], Herberlein et al, 2005 [13] have argued that scope tests may fail even for consistent and stable prefer-

Table 2: Willingness to pay Estimates from Parametric and Non-parametric Models.

Model	Split Sample I	Split Sample II	Difference
Logit Model	152 (8.126) (136.074;167.926)	144 (6.755) (130.761;157.239)	8.0 (10.972) (-13.505;29.505)
Turnbull Model	125.62 (11.35) (103.37;147.88)	113.59(6.86) (100.13;127.04)	12.03(12.66) (-12.78; 36.86)

Bootstrap standard errors and 95% confidence intervals in first and second parenthesis, respectively.

Table 3: Arc Scope Elasticity Estimates for Parametric and Non-parametric Model.

Model	Arc Scope Elasticity	CI
Logit Model	.01 (.03)	-.06; .08
Turnbull Model	.10 (.04)	.02;.17

Bootstrap standard errors and 95% confidence intervals in first and second parenthesis, respectively.

ences. Kahneman and Knetsch, 1992 [15] use an embedding experiment to discover that the same good has a lower WTP when valued as part of a bundle rather than on its own. The authors found that respondents who are willing to pay to obtain moral satisfaction rather than revealing their true preferences for the environmental good, changing the scope of the good should have little effect on WTP. Herberlein et al, 2005[13] explore the role of non-economic factors (behavioral) in the scope test. They explore whether there exists evidence of a non-economics scope between the *more* and the *less* (i.e., does the respondent like, know, or think more about the more rather than the less of the environmental good.) In Herberlein et al, 2005 [13], the scope is introduced at the beginning before the non-economic factor questions appear, thus introducing a possible channel through which the WTP can be affected by scopes in the non-economic factors. However, in Sardana, 2019 [18], the scope is introduced after the respondents answer non-economic factor questions. Thus, ensuring a direct channel of non-economic scope explaining WTP differences (for *more* and *less*) is not present. Nevertheless, we check whether the behavioral factors mentioned in Herberlein et al, 2005 [13] explain the WTP differences (for *more* and *less*). We consider the impact of the following four factors on WTP: cognitive factors; trust in government; attitudes towards the environment; and exposure to similar environmental goods, namely national parks. Table 4 summarizes the factors that can potentially affect the WTP for the environmental good.

We consider the cognitive factors (1st row, Table 4) to ensure that agents understand the program proposed to be implemented and pay attention during the survey.

Table 4: Non-Economics Factors

Factors	Survey Questions
Cognitive (understanding)	"do you understand the program" "do you understand how the program will work if it was implemented" "paying attention during the survey" (enumerator reported)
Trust	"do you believe the program will be successful if implemented" "do you believe govt usually spends money efficiently" "do you think govt spends too little on environmental issues"
Attitude towards environment (Affective)	"do you consider yourself as environmentalist" "does the loss of native trees affect your overall recreational experience".
Experience (behavioral)	"have you visited this or any other national park before"

[5] Since the local authorities would have implemented the program as an addition to existing entrance fees for the national park, trust in government is a key factor for a truthful revelation of the WTP; this is counted in the trust-related questions (2nd row, Table 4). Following Herberlein et al, 2005 [13] , the attitude towards the environment and experience with the environmental good in question can potentially affect the WTP. The last two factors (3rd and 4th rows, Table 4) capture these effects. To test the impact of these factors, we repeat the scope test controlling for each factor in the following ways. - For each factor, we restrict our sample to the group that says "YES" to at least one question for the factor. We test for significant differences in value estimates across two split-samples for this restricted sample. In Table 5, we report WTP and differences in WTP across two split-samples, with bootstrap standard errors and 95% confidence intervals.[6] We find no statistically significant difference across the split sample for any factors, indicating that these factors are most likely not responsible for the observed scope insensitivity. Note that our results support the findings of Herberlein et al, 2005 [13]. They argued that economic scope is related to non-economic scopes, such as behavioral and affective. Since we find no evidence of a non-economic scope in our data, we should not expect to see any economic scope sensitivity. However, their analysis fails to explain why we observe the lack of an economic scope. We argue that the mental accounting model is a more plausible explanation for scope insensitivity in our study.

[5] Chetty et al, 2009 [7]; Taubinsky and Rees-Jones, 2018 [19]; Alcott et al, 2019 [2], show impact of inattention, Alcott and Taubinsky, 2015 [3] show impact of miscalculation on WTP.

[6] Note, for brevity, we restrict our estimation for this exercise to the parametric model.

Table 5: Willingness to Pay Estimates from Logit Regression Equation for Sample with Similar Factors

Model	Cognitive	Trust	Affective	Behavior
WTP (Split-Sample I)	158 (7.376) (143.543-172.457)	143 (8.792) (125.768-160.232)	141 (7.015) (127.251-154.749)	146 (8.364) (129.606-162.394)
WTP (Split-Sample II)	171 (7.261) (156.769-185.231)	157 (11.379) (134.698-179.302)	145 (8.509) (128.324-161.676)	152 (10.205) (131.998-172.002)
Difference	12 (10.050) (-7.698-31.698)	14 (14.216) (-13.862-41.862)	4 (10.653) (-16.879-24.879)	5 (13.692) (-21.837-31.837)

4.4 Testing Presence of Mental Accounts

In this section, we test for Prediction 1. Prediction 1 says that, for an MA agent, there will be a negative relationship between the probability of saying YES and *expenditure classes*. We test this when we consider two hypotheses.

Hypothesis 1: The probability of saying YES, which is measured by the logistic regression mentioned in section 3.2, will be identical across different *expenditure classes*. Mental accounting can only be a valid explanation for our data if hypothesis 1 is rejected.

Hypothesis 2: If we reject hypothesis 1, we want to test whether the proportion of respondents saying YES has a negative relationship with *expenditure class*.

Our main results are shown in the Table 6. It reports the proportion of respondents saying YES to the WTP question(based on predicted probabilities estimated using the Logit model) for each expenditure class. Expenditure classes are characterized as *low group* and *high group* based on the proportion of entrance fees to total trip expenditures. A *low group* indicates respondents with a lower proportion of entrance fees to total trip expenditures and vice versa.

Table 6: Percentage of "YES" Respondents to WTP question, by Expenditure Class, based on Logit Equation.

Expenditure Class	.01-	.05-	.08-	0.1-	0.15-	0.2-	0.4-
	Low			High			
Prob YES	57.76	59.76	75.00	72.84	67.16	62.98	47.62

We conduct the chi-square test with the null hypothesis that the percentage of

respondents saying "YES" to the WTP question is the same for different expenditure classes. Our chi-square statistic is 10.5, with a p-value of 0.10. We reject the null in favor of the alternative, i.e., the proportion of respondents saying "YES" to the WTP question is statistically different across the expenditure classes at a 10% significance level. The rejection of hypothesis 1 implies that the application of mental accounting is valid in our context.

However, we do not find consistent evidence of hypothesis 2 across all *expenditure classes*. To differentiate between the subgroup for which hypothesis 2 is satisfied, we divide all *expenditure class* into two groups. As shown in Table 6, in the *high group* as the proportion increases, the probability of saying "YES" to the WTP question decreases. This aligns with our mental accounting hypothesis. For this group, the total trip expenditure is more likely to proxy for account R (recreational budget as explained in section 2.1); as a result, as the proportion increases, the respondents are more likely to be constrained in their budget for R. In this case, the mental accounting theory would predict that the higher the proportion, the lower the probability of saying YES to the WTP question, which is, indeed the case here.

For the *low group*, however, we do not find evidence supporting hypothesis 2. Since too little of a portion of their total trip expenditure is spent on the national park visit, it is unclear whether the expenditure share variable, (i.e., the share of entrance fee to total trip expenditure), would proxy for the mental account that is applied for the relevant decision making here. We observe that the proportion of people saying YES increases with the increase in expenditure share for the group. This can be due to various reasons, including mental accounting, but we cannot test it given our data limitation.

4.5 Testing for Scope Differences across Various Mental Accounts

In this section we test for prediction 2 that states if mental accounting constraints are binding then the respondents will exhibit scope insensitivity. Given our results from previous section, we can only claim the scope insensitivity result for the *high group*.

Table 7 shows the predicted probabilities of respondents saying "YES" to the willingness to pay questions across expenditure classes for the two split samples. We conduct the chi-square test of differences across the split sample for different expenditure classes. Our chi-square statistic is 8.65 with a p-value of 0.19. We fail to reject the null that there are no statistically significant differences across two split samples for the different expenditure classes. This means that for the *high group* (respondents in the rightmost columns), the mental accounts are binding, and we observe scope

insensitivity.

Table 7: Percentage of "YES" Respondents to WTP Question by Expenditure Class.

Expenditure class	.01-	.05-	.08-	0.1-	0.15-	0.2-	0.4-
Prob Yes	Split Sample I						
	58.22	58.89	60.00	73.33	71.05	58.23	37.50
	Split Sample II						
	57.33	60.76	100	72.22	62.07	66.67	53.85

The same cannot be argued about the *low group* for whom the entrance fee was a small portion of their total trip expenditure (i.e., those in the leftmost columns). But we also observe scope insensitivity for this group as well. This neither contradicts nor supports our hypothesis since our measure for mental accounting is not applicable to this subset of respondents. To shed further light onto this, we explore the relationship between *expenditure class* and the probability of saying YES. We find that, for both the two sub-samples, we observe an inverted U-shape for the proportion of people saying YES. However, the peak of the U varies across the two sub-samples, thus making it difficult to compare the *high group*across them. Despite this, using our definition of *high group* (from before, i.e., respondents spending more than 10% of their trip expenditure on entrance fees), we find no statistically significant difference across the two sub-samples. We further analyzed the data for the *low group* to identify the characteristics of this population. We find that this group of individuals are coming from far away-off and engage in specific recreational activities distinct from other activities (- i.e., they are mainly engaging in wildlife safari and wildlife photography as compared to picnicking trekking, or bird watching). Thus, understanding the behavior of this second group would require further investigation which is beyond the scope of this study.

5 Discussion

5.1 Need for Testing Mental Accounts For Internal Validation of CVM Estimates

Mental accounting theory does not assume that agents have inconsistent or unstable preferences. Instead, the deviation from neoclassical predictions is due to the deviation from the standard decision-making process where agents behave *as if* money is not fungible.

In our study, similar to a rational agent, respondents' willingness to pay decreases

with the bid amount but the lack of scope-sensitivity challenges the assumption of *homo economicus*. Thus, a mental accounting assumption seems more plausible than an inconsistent and unstable preference. Moreover, if indeed the mental accounting constraints lead to scope insensitivity, incorporating them implicitly in the questionnaire or explicitly testing for them would be able to generate consistent WTP values.

Note that the estimated WTP data we use for our results control income and other socio-economically relevant variables. Thus the result we obtain is unlikely to be due to the income effect. More importantly, the inverted U-shape of the probability saying YES data (across both sub-samples) across *expenditure classes* suggests that the responses are neither random nor due to the valuation effect (people pay higher if they have a higher valuation for the same recreational experience). The former would imply the proportions are random, and the latter would imply it is monotonically increasing.

5.2 Difficulty Interpreting WTP Data

One important finding of our study is that if respondents are subjected to mental accounting constraints then WTP conveys information about both the valuation of the environmental good and the extent of the mental accounting constraints. More specifically, such constraints downward biases the WTP estimates, since the discrepancy occurs when agents have high valuation of the environmental good but are constrained by their mental accounting budget.

Traditional survey methods, assuming neoclassical agents, do not explore the extent of mental accounting constraints. We argue doing so will benefit the measurement of WTP in two ways. First, it would separate the role of valuation and the mental accounting constraints, and, second, it can possibly increase the reported estimate of WTP if agents can be made to think about a larger (less constrained) mental account.

5.3 Limitation of the Study

The temporal dimension is one possible variation in psychological accounts that we fail to capture here. Mental accounting theory suggests money is not temporally fungible as well. However, since the survey asked for a one-time payment as part of the entrance fee, we cannot test the temporal nature of the mental accounting model.

6 Conclusion

In this paper, we show that scope insensitivity may not necessarily imply that the preferences are inconsistent or unstable. We propose that mental accounting theory can plausibly explain the observed scope insensitivity.

According to this theory, since agents use separate and non-fungible accounts for various expenditures, they are more likely to be budget constrained than a neoclassical agent. We conjecture that the relevant psychological account is related to recreational experience and find a proxy for that in our study. We find support for our mental accounting theory in the sub-group for which this proxy is meaningful. However, since the study was not designed by us, and keeping this explanation in mind, we cannot test it directly. More research is needed to understand this phenomenon.

Given our analysis, we hope future CVM studies will generate more robust predictions. If researchers can analyze which mental account the subjects refer to when asked to pay for a bid, they can ensure that the relevant constraints are considered. Alternatively, the future researcher can evoke mental accounts experimentally and obtain a more robust WTP value.

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