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# Complexity in choice experiments: choice of the status quo alternative and implications for welfare measurement*

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We examine the propensity of respondents to choose the status quo (SQ) or current situation alternative as a function of complexity in two separate state-of-the-world choice experiments. Complexity in each choice set was characterized as the number of single and multiple changes in levels of attributes from the current situation and the order of the choice task in the sequence of multiple tasks provided to respondents. We show that increasing complexity leads to increased choice of the SQ and that a respondent's age and level of education also influenced this choice. We outline the effects of the alternate approaches for incorporating the SQ into welfare measurement. These findings have implications for the design of stated preference experiments, examining passive use values and for empirical analysis leading to welfare measurement.

**Key words:** choice experiments, status quo, welfare measurement.

## 1. Introduction

An attraction of choice experiments (CEs) is their ability to place respondents into situations in which they must make trade-offs among multiple attributes of alternatives. While CEs have the potential to yield greater information than contingent valuation (CVM) approaches, this can come at a cost of requiring considerable cognitive effort by respondents (Swait and Adamowicz 2001a). Thus, a dilemma encountered in CEs is the trade-off researchers must make between thorough, accurate descriptions of alternatives and the ability of respondents to understand and process the information provided. Little research has been carried out to define the boundaries of complexity leaving researchers concerned about bias in CE results, especially in terms of welfare measures (Mazzotta and Opaluch 1995; DeShazo and Fermo 2002).

One response to complexity by subjects involved in 'state-of-the-world' CE tasks may be the repeated choice of the current situation or status quo (SQ). SQ bias is a well known and documented phenomenon in the literature (Samuelson and Zeckhauser 1988; Hartman *et al*. 1990). Evidence of the

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choice of the SQ being a response to complexity has been found in experimental markets and in revealed preference data (Dhar 1997a; Beshears *et al.* 2008). Research by Adamowicz *et al.* (1998) and Salked *et al.* (2000) indicate this effect may be present in CEs. Increases in complexity may generate a desire by respondents to retain what is known in the face of uncertainty (a type of endowment effect) or to avoid the decision entirely by deciding not to choose (omission bias). The purpose of this study is to gain insights into whether complexity encourages SQ selection as a heuristic strategy. Furthermore, as the SQ parameter includes various components, such as SQ bias, unobserved attributes and the impacts of complexity such as fatigue effects, we explore welfare measurement using alternative strategies to account for complexity effects.

The number of single and multiple attribute differences between alternatives and the number of choice tasks in the CE characterize complexity in this study. This is a somewhat simpler definition than those used in other studies (e.g. Swait and Adamowicz 2001a), but is a relatively easy to measure characterization of task complexity. It is hypothesized that as the number of single and multiple attribute differences among alternatives in a choice set increase, respondents will be more likely to choose the SQ alternative. A second hypothesis is that as the number of choice tasks increases, there will be an increasing probability that respondents will choose the SQ. Individual characteristics, such as age and education levels, are hypothesized to affect the degree of SQ bias. Heterogeneity in SQ bias may be in part explained by the individual characteristics of respondents.

## 2. Reasons for status quo choices

### 2.1 The endowment effect

Over the last two decades, the endowment effect has been revealed in the economics literature as an interesting 'irregularity'. Morrison (2000) demonstrated that the shape of indifference curves may not actually conform to that expected by theory (see also Knetsch 1989). Indifference curves may be kinked at the point of endowment. Evidence provided in experimental economics supports the hypothesis that their initial point of reference affects consumers' preferences. Thus, there may be utility for an individual in maintaining the SQ which could have serious consequences in all forms of preference elicitation methods because of the nature of the surveys used. For CEs, the state-of-the-world tasks commonly used to estimate passive use values typically comprise three alternative states of the world, with one of these reflecting the current state or SQ (e.g. Adamowicz *et al.* 1998). Most valuation studies employing CEs ignore SQ effects and report marginal welfare measures. However, if SQ effects are actual behavioural phenomena (as revealed in the experimental literature), then they should be taken into account in welfare measurement.

## 2.2 Omission bias and avoiding choice

Choice of the SQ may in part be a result of an omission bias (Ritov and Baron 1992; Baron and Ritov 1994; Schweitzer 1994) or simply a decision not to choose (Tversky and Shafir 1992; Dhar 1997a,b). Beshears *et al.* (2008) report that complexity often leads to a delay of choice, as the agents wish to avoid the costs of complexity.

In CEs, the SQ alternative acts both as a potential legitimate choice in that the respondent may feel that it is most in line with their preferences, or it may act as a default response in which the respondent opts 'not to choose'. The decision 'not to choose' can be further subdivided into a preference for inaction (omission) or a statement of non-participation ('choose none'). The selection of the SQ alternative may be attractive to respondents, as it allows them to avoid making difficult trade-offs that may be intimidating on either a cognitive or emotional level. Thus, in order to remain with the SQ, an action is not required of a respondent; only an omission, whereas if a respondent wishes to choose a new option an action is required (Baron and Ritov 1994). Thus, omission bias can be described as an amplified preference for inaction (Schweitzer 1994).

Preferences for inaction may result from the complexity of the task and emotional difficulty (Ritov and Baron 1992; Beshears *et al.* 2008). Baron and Ritov (1994) and Schweitzer (1994) suggest that participants consider actions that lead to bad outcomes are worse than omissions that lead to bad outcomes. As the SQ is often confounded with the inaction option, individuals may develop a strategy in which they choose the SQ in order to avoid negative emotions such as regret and responsibility associated with taking an action that results in a poor outcome. Baron and Ritov (1994) refer to this as a 'do no harm' heuristic.

When a respondent wishes to not participate in the decision-making task, one response could be to remain with the current situation or in effect selecting the 'choose none' option. For example, Tversky and Shafir (1992) showed that the addition of a similar alternative increased the complexity of the decision to the point that respondents will be more likely to forgo a choice or to remain with the SQ. Dhar and Sherman (1996) determined that when the 'good' attributes of alternatives are shared and 'bad' features are unique, participants will be more likely to opt out of the decision-making task by choosing the 'no choice' alternative despite similar overall attractiveness.

More recently, Iyengar and Kamenica (2007) found that when presented with a choice between complex and simple options, respondents tended to opt for the simple (to understand) option. The SQ may fall into the situation of being a simpler to understand option (see Iyengar and Kamenica (2007) for additional examples of complexity leading to deferred choice or altered choice strategies). A summary of the research on complexity and choice in Beshears *et al.* (2008) indicates that complexity generates delay in choice, bias in choice and response noise in choice – all of which may arise in typical CE contexts.

Other literature on complexity in choice has indicated that increasing complexity can affect the variance of choices or the stochastic component of the random utility (Swait and Adamowicz 2001a; Louviere *et al.* 2008). Louviere *et al.* (2008) outline how experimental design strategies that generate more complex choices result in less consistency in response and higher variances which they attribute to cognitive burden. In addition to effects on the stochastic component, there is some evidence that complexity generates different processing strategies or different preferences for attributes (Swait and Adamowicz 2001b). In this paper, we do not address the effect of complexity on the stochastic component of utility. We leave this as an extension for further research. We do not examine preference changes as a result of complexity, as preliminary assessment illustrated that changes in attribute preferences did not appear to vary with changing levels of complexity in our data – only the SQ parameter appeared to be significantly and robustly affected by changes in complexity. Therefore, we concentrate on the impact of complexity on the SQ parameter, and leave changes in attribute preferences and the stochastic component for future research.

## 3. Hypotheses

In this study, we examine two sets of data involving state-of-the-world designs. The first dataset is the Adamowicz *et al.* (1998) study which examined willingness to pay for improvements to a threatened population of Woodland Caribou in Alberta (WCAB). The second is a forest management study in which passive use service flows characterized alternative management actions in Saskatchewan (FMSK) (Moon 2004). Both studies involved a three alternative state-of-the-world choice task in which respondents were asked to select one of two alternate management states or the current situation. Sample choice sets for each are shown in Figure 1.

In both datasets, we assessed various measures of complexity and how these influenced choice of the SQ. The first complexity measure we define as a 'single attribute change' when the level of one attribute is different among one of the alternatives. Similarly, a 'multiple attribute change' occurs when an attribute level is different across all three alternatives in a choice task. The number of single and multiple attribute changes can be considered measures of complexity, because as the number of single and multiple attribute changes increase, the greater the alternatives differ. Thus, there are more attributes for consideration by participants. This in turn increases the number of trade-offs that an individual respondent must consider when making a choice. Therefore, we propose single or multiple attribute changes as representative measures of information load when evaluating alternatives.

DeShazo and Fermo (2002) hypothesized that increasing the number of attributes that differed across alternatives would mentally tax respondents leading to an increase in the variance on the error term in their model. However, DeShazo and Fermo (2002) found results that favoured their prediction

FMSK choice task
Version L7

| Attributes of forest region | Option one Current situation | Option two Alternative situation | Option three Alternative situation |
|---|---|---|---|
| Moose (ungulates) | 7500 Moose | 2000 Moose | 14 000 Moose |
| Special species | 400 Caribou | 600 Caribou | 1600 Caribou |
| Forest age class (% old) | Current amount (% old) | Considerably more than current amount (% old) | Current amount (% old) |
| Recreation restrictions & forest age class | Two-wheel drive | Foot access only | Four-wheel drive |
| Protected areas (%) | Current amount | 15% above current amount | 5% above current amount |
| Forest industry employment | 600 Jobs | 590 Jobs | 620 Jobs |
| Provincial household income tax change | No change in household taxes/year | $120 decrease in household taxes/year | $15 decrease in household taxes/year |
| Preferred option: (check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

WCAB choice task

| Attributes | Option 1 Current situation | Option 2 Alternative situation | Option 3 Alternative situation |
|---|---|---|---|
| Mtn Caribou | 400 Caribou | 400 Caribou | 1600 Caribou |
| Moose population | 8000 moose | 8000 moose | 2000 moose |
| Wilderness area | 150 000 ha | 300 000 ha | 100 000 ha |
| FMA area | 1 012 000 ha | 1 012 000 ha | 862 000 ha |
| Recreation restrictions | Level 2 | Level 2 | Level 2 |
| Forest industry employment | 1200 jobs | 1200 jobs | 450 jobs |
| Provincial income tax change | No change in taxes/year | $150 increase in taxes/year | $50 decrease in taxes/year |
| Choose one only | ☐ 1 | ☐ 2 | ☐ 3 |

**Figure 1** Examples of choice tasks used in the Forest Management in Saskatchewan and Wilderness caribou in Alberta Surveys.

of increasing error variance. Dellaert *et al.* (1999) found that the cognitive burden associated with an increased number of trade-offs led to less confidence in making a decision that is the ‘right’ choice.

As previous research indicated that an increased number of trade-offs can be daunting to survey respondents, the following hypothesis was formulated:

H1: As the number of single or multiple differences in attributes across multiple alternatives increase, the probability of choosing the current situation or SQ alternative increases.

Accumulating complexity, resulting from respondents facing a series of choice tasks, may cause fatigue among respondents. Swait and Adamowicz

(2001b) attempted to determine if respondents became tired or bored upon completing 16 choice tasks regarding various consumer products such as orange juice. They concluded that as respondents completed the choice sets, they moved from an attribute based strategy to a broader, simpler overall strategy that may include opting out.

Hensher *et al.* (2001) attempted to determine if respondents exhibited fatigue as they complete CEs of varying lengths. They actually found that respondents appeared to be making more trade-offs between alternatives, not less, as they completed the choice sets.

These studies involved products, such as orange juice and airline travel, which may be familiar to respondents. In the present study, respondents faced tasks pertaining to endangered species and forest management programs in which they may be less familiar and could experience greater difficulty in making choices (see Beshears *et al.* 2008 for additional details on the effects of limited personal experience). Given these considerations a second hypothesis was proposed:

H2: As the number of completed choice tasks increase, the probability of choosing the current situation or SQ alternative will increase.

Individual characteristics may also influence the ability of a respondent to apply the appropriate effort to make a decision when faced with a complex choice task (Swait and Adamowicz 2001b). For example, the experience one has can be represented by some of demographic characteristics such as age and levels of education. Several studies have found that demographic characteristics such as age and levels of education affected decision making (e.g. Beenstock *et al.* 1998; Finucane *et al.* 2002). As previous literature has indicated that there can be linkages between age, education, and SQ bias, we examine the impact of these factors on the choice of the SQ. This allows us to hold these effects constant while assessing the impacts of complexity on choice of SQ.

## 4. Implications for welfare measurement

The SQ parameter is typically ignored in welfare measures arising from CEs (e.g. Bennett and Blamey 2001). Conceptually, the SQ effect is a component of the indirect utility function and as such should be included in the calculation of welfare. The SQ parameter may include unobserved attributes (known to the individual but not the researcher) as well as ‘pure’ SQ bias (a preference for the current situation). As we estimate the effect of complexity on the SQ parameter as an attempt to control these influences, we can also examine welfare measures that arise when the effects of complexity are removed or modified (assuming that our specification is ‘correct’). Furthermore, we can account for changes in welfare that arise when fatigue (or learning) effects on the SQ parameters are modified.

In our welfare analysis, we examine four cases. The first (*Complexity Zero*) examines welfare measures when the complexity elements are set to zero in the welfare calculations. This approach assumes that the impacts of complexity should not be included in the calculation of welfare. The second approach (*Complexity Light*) calculates welfare measures assuming an approach similar to CVM with a single attribute change and a single task characterizing the level of complexity included in the welfare measure. The third (*Complexity Real*) uses the actual number of single attribute changes that the welfare change is based on, as well as a single task, when computing welfare measures. We compare these three strategies to the case where the SQ is ignored in welfare calculation (as in most CE studies). These strategies explore a continuum from ignoring the SQ, to approximating the presence of a 'pure' SQ effect, independent of the influence of task complexity. It is not clear which treatment of complexity is 'correct' as this depends on assumptions regarding the degree of influence of the choice task setting to include or remove in welfare calculation. Nevertheless, the approach outlines the range of effects that arise from the different treatments of complexity.

## 5. Data

The two CE datasets used to examine these hypotheses were WCAB ($N$ = 519 respondents) and FMSK ($N$ = 192 respondents). Both were designed using orthogonal main effects designs. A large set of choice tasks was produced from these designs based on the number of attributes and levels of the attributes in each study. From the total number of choice sets produced, smaller 'blocks' were developed. In both the FMSK and WCAB studies, a total of 64 choice sets were produced. However, in the FMSK, these were blocked into versions containing 16 choice sets in each survey and in the WCAB survey, these were blocked into eight versions, each containing eight choice sets. The attributes among alternatives in each study were balanced among the choice sets. Table 1 provides a summary of the characteristics of these two CEs, and Table 2 outlines the attributes and levels utilized in each study.

The numbers of single and multiple differences in attributes across alternatives for each choice set were developed for the two CEs. The number of tasks that a respondent was asked to complete was also considered as a measure of

**Table 1** Description of choice task characteristics for the Woodland Caribou in Alberta choice experiment (WCAB) and Forest Management in Saskatchewan (FMSK) choice experiment

| Choice set characteristics | WCAB | FMSK |
|---|---|---|
| Number of alternatives | 3 | 3* |
| Number of attributes | 6 | 5–7† |
| Number of attribute levels | 4 | 4 (continuous) |
| Number of choice tasks | 8 | 16 |

*In each study, one of the three alternatives was labelled the 'Current Situation'.
†These varied depending upon the survey version (see Moon 2004).

**Table 2** Attributes and levels used in Woodland Caribou in Alberta (WCAB) and Forest Management (FMSK) in Saskatchewan choice experiments

| Attribute | Levels |
|---|---|
| WCAB | |
| Caribou population | 50; 400; 600; 1600 (animals) |
| Wilderness area | 100 000; 150 000; 220 000; 300 000 (ha) |
| Forest management agreement area | 1 061 000; 1 012 000; 942 000; 862 000 (ha) |
| Recreation restrictions | 1 no restrictions, 2 activities in designated areas, 3 no hunting fishing off road vehicles, helicopters; horses, camping, hiking 4, similar to three with limited camping and hiking |
| Forest industry employment | 450; 900; 1200; 1250 (direct jobs) |
| Tax | \$50 decrease, no change, \$50 increase, \$150 increase (provincial household income tax) |
| FMSK | |
| Moose | 2000; 6000; 7500; 14 000 (animals) |
| Caribou | 50; 300–500; 600; 1600 (animals) |
| Forest age (% old) | Less than current amount; current amount; more than; considerable more than |
| Recreation restrictions and forest access | Two wheel drive (2WD) access (1); 4WD access (2); ATV required (3) and foot access only (4) |
| Protected areas | Current amount; 5%; 10% and 15% above current amount |
| Forestry employment | Jobs range between 270 and 860 (current = 600) (direct and indirect jobs) |
| Tax | (Current = no change) taxes ranged between a decrease of \$120 to an increase of \$205 year (provincial household income tax) |

complexity/fatigue. In the FMSK surveys, respondents were asked to complete 16 choice tasks, whereas in the WCAB surveys respondents were asked to complete 8 tasks. To approximate the impact of the increasing sequence of tasks respondents faced, we coded each choice task with a number reflecting its order in the sequence presented to respondents. For example, in WCAB, the first choice task in the sequence was given a value of 1 for the task variable, the second a value of 2 and so on until the last task which for WCAB was given a value of 8. A similar process was performed on the FMSK data, except the task sequence variable went to a maximum of 16. If a respondent missed answering a task in the sequence, that choice observation was omitted, but the remaining choices that were answered were associated with their full task sequence values, as we assumed the respondent still examined the choice task that they did not answer. This approach of coding the task sequence indicates that the panel of responses from the respondents was unbalanced.

## 6. Model specification

Utility maximizing behaviour in a CE is based on Random Utility Theory. The following equation describes the utility function associated with alternative $j$ for a representative individual:

$$U_j = V_j + \varepsilon_j \quad \text{where} \quad V_j = \alpha_{SQ} + \sum\nolimits_{k=1}^{K} \beta_k X_j^k \tag{1}$$

where $V_i$ is comprised of the sum of $\alpha_{\text{SQ}}$ a parameter representing an alternative specific constant (ASC) for the 'current situation' or SQ, the product of a vector of $K$ taste weight parameters ($\beta$) and a vector of $K$ attribute levels ($X$) for alternative $j$, and a random error term ($\varepsilon_j$). It follows that the probability that alternative $j$ will be chosen over $i$ is the probability that $U_j > U_i$ or $V_j + \varepsilon_i \geq V_i + \varepsilon_i$. If the random terms are assumed to be independently distributed Type-I extreme value variates, McFadden (1974) showed that the probability of choosing $i$ takes the form:

$$\pi(i) = \frac{\exp^{\mu V_i}}{\sum\limits_{j \in C} \exp^{\mu V_j}} \tag{2}$$

where $\mu$ is a scale parameter set to a value of 1.0 in this study.

In each dataset examined in this study, the current situation alternative was presented first in the three alternatives offered in each choice set (Figure 1). This alternative was associated with a set of specific attribute levels that represent the value of the attributes currently experienced by respondents. Thus, the attribute levels for the SQ were coded as such in the data for both datasets. The addition of the $\alpha_{\text{SQ}}$ parameter, while improving the fit of choice models by accounting for the average effect on utility of exempt attributes (Train 2002), was interpreted as the utility of the SQ alternative. Following Adamowicz *et al.* (1998), this parameter is plied with a 'behavioural assumption of the SQ bias' (p. 73), as the attributes associated with the current situation are explicitly accounted for in the estimation of the other attribute parameters.

The first models estimated in this study were the standard conditional logit (CL) models for each dataset. However, the CL can be restrictive as the coefficients for all variables entering the model are forced to be the same across all respondents in the dataset. Accordingly we re-estimated each model setting $\alpha_{\text{SQ}}$ as a random parameter with $\alpha_{\text{SQ}} \sim N(\eta_{\text{SQ}}, \sigma^2_{\text{SQ}})$. This permitted the examination of the degree of heterogeneity in SQ bias in each dataset holding other attributes constant.

However, in order to examine the effects of the complexity measures and individual specific characteristics on SQ bias, we conducted a third set of estimations where the mean $\eta_{\text{SQ}}$ was decomposed into a number of components as follows:

$$\eta_{\text{SQ}} = \gamma_1 + \gamma_2 S + \gamma_3 M + \gamma_4 Task + \gamma_5 Age + \gamma_6 Ed$$

where $S$ refers to the number of single attribute changes, $M$ the number of multiple attribute changes, *Task* is the choice set number in the sequence of the total number of tasks, *Age* and *Ed* refer to the age and education of the respondent, respectively. The $\gamma$s represent estimated parameters that 'shift' the mean of the random parameter distribution according to the associated variables. Based on H1 described above, we expected $\gamma_2 > 0$ and $\gamma_3 > 0$, suggesting that higher numbers of single and multiple attribute changes have positive effects on the magnitude of SQ bias (i.e. shift the mean parameter on $\alpha_{SQ}$ to the right). Similarly, based on H2, we expected $\gamma_4 > 0$, since as a respondent answered greater number of tasks the propensity to choose the SQ increases. Finally, we examine $\gamma_5$ and $\gamma_6$ to assess the effect of age and education on SQ choice.

## 7. Results

The first set of estimations involved CL models for both datasets in this study. To hold constant the effects of attributes on the choice of the SQ, all attributes in the CE were included in the estimation. The parameters on these attributes are shown in the Appendix, as they are not of interest in this examination of choice of the SQ. However, inspection of these parameters in both studies reveals that respondents behaved as expected – increasing taxes have a negative effect on choice, the species and other environmental variables have positive influences on choice, and the effects of recreation restrictions are mixed. The employment level variables are insignificant in the WCAB data which was also found by Adamowicz *et al.* (1998). However, the parameter on employment in FMSK is positive suggesting that respondents were concerned about employment in the region of the study.

Table 3 provides estimates of the SQ effects. The ASC parameters for SQ alternative in the CL models each dataset are positive and significant in each dataset. Thus, it is apparent that respondents in both datasets had a propensity to prefer the SQ alternative holding the levels of the other attributes constant. This suggests that respondents in two separate state-of the-world CE studies were disproportionately drawn to the current situation over other alternatives, raising the potential for SQ bias.

The size, sign and significance of the SQ parameter leads one to question whether respondents were uniform in their taste for the SQ option. As it is feasible that a respondent could have either a negative or positive preference for the SQ, the RPL models specified the SQ ASC as a random normally distributed parameter. The third and sixth columns in Table 3 report the $\eta_{SQ}$ and $\sigma_{SQ}$ for this random SQ ASC in each dataset.[1] The parameter estimates reveal that the mean of the SQ parameter is positive and that the mean and SD parameters are statistically significant in both sets of data. Thus, the SQ parameters vary over respondents in both datasets, but the distribution falls mostly in the positive region. Based on the imposed normal distribution, the

[1] To estimate the RPL models, the procedures outlined by Train (2002) were used. LIMDEP software was used for this purpose, with 100 Halton draws based on Hensher and Green (2003).

**Table 3** Conditional logit (CL), random parameters logit (RPL) and random parameters logit (RPL) with heterogeneity (HET) in the mean alternatives specific constants, random parameters and heterogeneous variables for WCAB and FMSK datasets

| Status quo alternative specific constant | Woodland Caribou in Alberta | | | Forest Management in Saskatchewan | | |
|---|---|---|---|---|---|---|
| | CL | RPL | RPL-HET | CL | RPL | RPL-HET |
| $\alpha_{SQ}$ | 1.0849 (0.0652)* | — | — | 1.0294 (0.0540)** | — | — |
| $\eta_{SQ}$ | — | 1.3193 (0.1073)** | — | — | 1.1776 (0.1143)** | — |
| $\gamma_1$ | — | — | −1.0219 (0.5448)* | — | — | −0.4158 (0.6851) |
| $\gamma_2$ No. of single attribute change | — | — | 0.2823 (0.0646)** | — | — | 0.1845 (0.0869)** |
| $\gamma_3$ No. of multiple attribute change | — | — | 0.2051 (0.0795)** | — | — | 0.1741 (0.0949)* |
| $\gamma_4$ Order of task in sequence | — | — | 0.1180 (0.0185)** | — | — | 0.0204 (0.0100)** |
| $\gamma_5$ Respondent age | — | — | 0.0304 (0.0061)** | — | — | 0.0164 (0.0072)** |
| $\gamma_6$ Respondent education level | — | — | −0.1432 (0.0504)** | — | — | −0.0436 (0.0568) |
| $\sigma_{SQ}$ | — | 1.6956 (0.0912)** | 1.6673 (0.0910)** | — | 1.2328 (0.0927)** | 1.1887 (0.0909)** |

$*P < 0.10$; $**P < 0.05$.

mean and SD parameters suggest that 78% of the respondents in the WCAB dataset hold an SQ ASC greater than 0. Similar results emerged in the FMSK population where about 83% of the respondents held an SQ parameter that fell in the positive region of the distribution.

Columns four and seven in Table 3 present information on the random parameters models with heterogeneity in the mean (RPL-HET in Table 3). For the WCAB data, all of the variables used to explain the mean of the random parameter were significant at least the 10% level. Note that the intercept term, $\gamma_1$, is negative suggesting that the five other mean shift variables once added, moved the remainder of the distribution of the mean SQ into the negative portion of the normal distribution. Thus, the mean shift variables added to this RPL model explain a considerable portion of the mean SQ parameter. For the FMSK data, similar results were found, except that the shift parameter on education is insignificant, as is the intercept, $\gamma_1$. The five shift factors similarly explain a considerable portion of the SQ mean, as once they are added to the model the intercept in the mean shift is not significant, but there is still considerable SQ bias.

In both sets of choice data, the numbers of single and multiple attribute changes as well as the task sequence effect had positive influences on SQ choice. Thus, we accept the first and second hypotheses proposed above (H1 and H2) and suggest that increasing complexity of choice tasks results in an increasing probability that respondents choose the SQ.

**Table 4** Annual welfare measures ($/household) for a caribou improvement program in each province

| | Alberta model | | | | Saskatchewan model | | | |
|---|---|---|---|---|---|---|---|---|
| | SQ included | | SQ parameter excluded | | SQ included | | SQ parameter excluded | |
| | Mean | SD* | Mean | SD* | Mean | SD* | Mean | SD* |
| CL | −257.98 | 39.52 | 57.04 | 28.97 | −130.26 | 20.41 | 102.71 | 18.64 |
| RPL (SQ random) | −262.99 | 45.66 | 81.78 | 29.36 | −128.88 | 27.29 | 113.80 | 19.99 |
| RPL (SQ random with mean shifts) | −301.25 | 55.44 | 93.89 | 34.8 | −132.44 | 27.73 | 118.79 | 21.32 |
| RPL (*Complexity zero* – SQ random with mean shift complexity variables left out of welfare calculation) | 260.29 | 128.71 | — | — | 102.49 | 104.05 | — | — |
| RPL (*Complexity 'light'* – one single, one task, zero multiples) | 147.09 | 105.29 | — | — | 62.73 | 86.11 | — | — |
| RPL (*Complexity 'real'* – # of singles, 1 task, 0 multiples; 3 singles AB, 4 singles SK) | −15.15 | 71.65 | — | — | −52.43 | 47.17 | — | — |

*The SD of the welfare measure was calculated using the procedures outlined by Krinsky and Robb (1986). This involved estimating WTP for 5000 random draws of the parameters from a multivariate distribution where the parameter vector represents the mean and the covariance matrix the variances. The estimates above are the mean and SD from the resulting vector of WTP estimates.

The effect of complexity on respondents is also revealed when the task sequence variable was included as a linear explanatory of the utility of the SQ. The positive coefficients on task sequence are consistent with the hypothesis that as fatigue increases people will begin to opt out or hold more strongly to the current situation. We also specified the task sequence as a dummy variable which allowed comparison of the first half of the sequence with the second half. The results (available from the authors) supported the linear specification reported in Table 3 – the last half of the tasks exhibited positive influences on the SQ.

The older a respondent is, the greater chance she would choose the current situation in either dataset. This supports some of the previous studies that suggest that older respondents tend to adhere to the endowment. Increasing education levels, however, have a decreasing effect on this choice for the WCAB respondents, but not the FMSK respondents. However, the sign of this shift parameter in the FMSK data is negative. This indicates that increasing education decreased the probability of choosing the SQ.

Table 4 presents welfare measures for the caribou improvement program assessed in Adamowicz *et al.* (1998) and a similar program for the Saskatchewan case. This involves increasing the caribou attribute by one level, and other attributes associated with this increase (in Alberta – increase wilderness area and recreation restrictions; in Saskatchewan – decreasing moose populations and increasing forest age and protected areas). Examining the welfare measures without SQ effects provides positive welfare measures in both studies and across all three models (CL, RPL and RPL-HET). The corresponding measures with the SQ included are three times or more larger in magnitude but negative in the Alberta data, and are similar in size but negative in the Saskatchewan cases. These results illustrate the presence of a substantial SQ effect. Note that this SQ effect may arise from 'pure' SQ bias and/or from the influence of complexity and fatigue.

The bottom three rows in Table 4 provide welfare measures that remove and/or incorporate various degrees of our complexity measures into the welfare measures. The first (Complexity Zero) sweeps away all measured complexity effects from the SQ parameter. In the Alberta case, this results in a welfare measure larger than when SQ is ignored. In effect, removing complexity results in SQ aversion. In the Saskatchewan case, removing complexity results in a point estimate that is similar to the measure when SQ is ignored, but with a significantly larger variance. In this case, removing complexity reveals an absence of any SQ effect, but the variability is high. The variability is high because the remaining SQ effect, while a large coefficient, has a high SD (see Table 3).

In the Complexity Light case, we include one single attribute change and one task as representative of the complexity level. We find that in both studies, the positive welfare measure is approximately half the size of the Complexity Zero measures. Incorporating some complexity reduces the welfare measures as SQ effects arise. The measures, however, are quite variable compared with the cases where SQ is ignored. The Complexity Real case includes more single attribute changes (three in the Alberta case and four in Saskatchewan) and a single task. These measures are negative and have high variance. There is a considerable SQ preference in this welfare scenario, but this is variable in the samples employed.

## 8. Discussion

Our analysis suggests that complexity can enter choice models as a significant component affecting results. The positive and statistically significant increase in the number of single and multiple attribute changes that differ across alternatives supports the hypothesis that as more alternatives differ respondents face greater difficulty in making a choice. The findings support the potential for respondents choosing the SQ alternative to be employing a heuristic strategy. This could arise because respondents are forced into a situation in which it is necessary to make more trade-offs, increasing the amount of effort that is required. In selecting the current situation, respondents may be choosing a 'safe' alternative which requires little work and is more attractive. Respondents also are more likely to opt-out as the number of tasks increase.

Respondent characteristics such as age and education were also incorporated as potential explanations for SQ choice. Age was the only variable that produced consistent significant results across both models. The coefficients on age in both datasets were positive indicating that as people age they are more likely to select the SQ.

We examined welfare measures using various assumptions about what levels of complexity are the 'correct' ones to use in their calculation. It is unclear what measures of complexity are 'correct' as in any choice situation (including an actual referendum) there will be some level of complexity. We provide a variety of complexity scenarios ranging from removing complexity entirely to incorporating complexity based on the environmental quality change we assess. The resulting welfare measures are quite different than those typically computed in applied research, and have higher variance. However, they are considerably larger than the welfare measures that arise when the entire SQ is included (e.g. rows 1–3 in Table 4). Accounting for complexity in the SQ effect results in a middle ground between ignoring the effect entirely and incorporating it without consideration of the impacts of fatigue and task complexity.

## 9. Conclusions and future research

The objective of this study was to determine if particular characteristics of choice complexity and participant characteristics could account for selection of SQ choices. We also examine the impact of such complexity effects on welfare measurement. If systematic SQ effects exist, this suggests the existence of SQ bias. This bias is a troubling result in CE studies, as it may be an indicator that respondents do not fully comprehend the choice tasks and are not completing the expected trade-offs necessary to reveal preferences. This will affect welfare measures derived from the choice model parameters (e.g. see Adamowicz *et al.* 1998).

The analysis of these two datasets draws fairly clear conclusions on the influence of complexity on the selection of the SQ. In both groups, respondents were affected by the number of attribute differences and the number of choice tasks. Both studies also found that some individual characteristics also played a role in increased selection of the current situation. Thus, researchers should be cognizant of the impact of the number of attributes and attribute level differences on complexity and response. For example, fewer attributes or attribute levels might be included. This would caution researchers to avoid including attributes that may be less relevant, and to insure that considerable emphasis in the planning stages should be placed on determining the most relevant attributes and levels.

As mentioned in this paper, the SQ effect may be comprised of an endowment effect, omission bias and/or an opting out desire. This paper focused on how complexity and individual characteristics may help explain overall SQ bias. There may be other explanations for the aggravated tendency towards the SQ. For example, the empirical applications on which the studies presented in this paper are based may have invoked a protest against Canadian forest management policies. These protests may have been manifested as a selection of the SQ. In addition, the placement of the SQ in the sequence of choice alternatives (first) could have led to its frequent choice. Testing this would require designs that randomly place the SQ among the alternatives in the presentation to respondents. It is also possible that respondents frustrated with the choice tasks used other heuristic strategies.

Examination of welfare measures under different assumptions of the role of complexity shows that the treatment of complexity has a significant and policy relevant impact. Ignoring SQ effects generates positive and significant welfare measures for caribou conservation in AB and SK, whereas incorporating SQ effects with various levels of complexity produces much smaller and often insignificant welfare measures. These preliminary results suggest that additional attention should be paid to the role of the SQ parameter in welfare measures in CE models.

A caveat must be applied to this research – the study was completed *ex post*. The original studies were not designed with the hypothesis of the current study in mind. Therefore, the variables used to account for complexity may be imperfect. However, this leaves room for researchers to design and implement studies that more formally test the effects of complexity on SQ bias. Potential options would be to conduct the same type of survey, but actually incorporate complexity variation into the experimental design when testing for these effects.

An important extension of this research might be to devise a method for accounting for the different possible effects in the choice model. In fact, research by Von Haefen *et al*. (2005) moves in this direction by attempting to account for respondents who are not participating as opposed to those who simply have a preference for the current situation by using single and double hurdle discrete choice models. A further extension of this study would be to assess the impact of complexity differences (and choice task sequence) on the variance of the random component of utility.[2] It may be that as in Swait and Adamowicz (2001a) the effects of complexity are captured in the random component more than in the apparent heterogeneity in the systematic component. Identification of the relative contribution of the random and systematic components will be challenging and remains an area for future research.

[2] We attempted to examine this using a covariance heterogeneity framework. Although we obtained estimates, there were convergence difficulties and hence we are hesitant to place confidence in the results. However, the estimates revealed that the variance was significantly affected by demographic factors (age and education) and task sequence, but not significantly affected by our measures of complexity (single and multiple).

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## Appendix

### Table of parameter estimates associated size choice models estimated with two sets of data

| Variables | Woodland caribou in Alberta study | | | Forest Management in Saskatchewan study | | |
|---|---|---|---|---|---|---|
| | CL | RPL | RPL-HET | CL | RPL | RPL-HET |
| Moose (1000) | — | — | — | 0.0004<br>(0.000005)** | 0.0005<br>(0.000007)** | 0.00006<br>(0.000006)** |
| Caribou (100 AB; 1000 SK) | 0.0463<br>(0.0049)** | 0.0543<br>(0.0054)** | 0.0522<br>(0.0055)** | 0.0007<br>(0.00007)** | 0.0008<br>(0.00006)** | 0.0008<br>(0.00006)** |
| Wilderness area (10 000 ha) | 0.3214<br>(0.0376)** | 0.4171<br>(0.0421)** | 0.4201<br>(0.0434)** | — | — | — |
| Recreation 1† | 0.2965<br>(0.0462)** | 0.3294<br>(0.0504)** | 0.3774<br>(0.0513)** | −0.0865<br>(0.0725) | −0.2421<br>(0.0955)** | −0.3118<br>(0.0912)** |
| Recreation 2† | 0.1903<br>(0.0474)** | 0.2043<br>(0.0507)** | 0.1878<br>(0.0528)** | 0.0977<br>(0.0915) | 0.1604<br>(0.0978) | 0.1662<br>(0.0789)** |
| Recreation 3† | −0.2061<br>(0.0517)** | −0.2177<br>(0.0548)** | −0.2199<br>(0.0557)** | 0.1600<br>(0.0936)* | 0.2200<br>(0.1010)** | 0.2508<br>(0.0912)** |
| Forest age (proportion) | — | — | — | 8.8422<br>(0.9152)** | 9.7335<br>(0.9642)** | 9.9119<br>(0.8095)** |
| Protected area | — | — | — | 0.1194<br>(0.0432)** | 0.1842<br>(0.0507)** | 0.2049<br>(0.0469)** |
| Jobs (100 jobs) | 0.0065<br>(0.0090) | 0.0130<br>(0.0098) | 0.0166<br>(0.0101) | 0.0022<br>(0.0003)** | 0.0026<br>(0.0003)** | 0.0027<br>(0.0002)** |
| Taxes | −0.0036<br>(0.0004)** | −0.0039<br>(0.0004)** | −0.0035<br>(0.0004)** | −0.0045<br>(0.0006)** | −0.0049<br>(0.0006)** | −0.0049<br>(0.0005)** |
| Log likelihood at convergence | −3684.92 | −3332.31 | −3288.10 | −2611.14 | −2427.05 | −2419.14 |

These estimates are associated with the other estimates in Table 3.
$*P < 0.10$; $**P < 0.05$.
†Effects coded variable.