

# Design of a Strategic-Tactical Stated-Choice Survey Methodology Using a Constructed Avatar

Postprint of:

Le Vine, S., Lee-Gosselin, M., Sivakumar, A., Polak, J. (2011) Design of a Strategic-Tactical Stated-Choice Survey Methodology Using a Constructed Avatar. *Transportation Research Record* #2246. <http://dx.doi.org/10.3141/2246-08>

## **Scott Le Vine<sup>1</sup>**

PhD candidate, Centre for Transport Studies  
Department of Civil and Environmental Engineering  
Imperial College London, Exhibition Road, London, SW7 2AZ, UK  
Telephone: +44 20 7594 6105  
Fax: +44 20 7594 6102  
Email : [slevine@imperial.ac.uk](mailto:slevine@imperial.ac.uk)

## **Martin Lee-Gosselin**

Emeritus Professor, École Supérieure d'Aménagement du Territoire et de Développement Régional,  
and Centre de Recherche en Aménagement et Développement  
Université Laval, Quebec City, G1V 0E6, Canada  
Visiting Professor, Centre for Transport Studies, Imperial College London  
Phone: + 1 418 656 7558  
E-mail: [Martin.lee-gosselin@crad.ulaval.ca](mailto:Martin.lee-gosselin@crad.ulaval.ca)

## **Aruna Sivakumar**

Research Associate, Centre for Transport Studies  
Department of Civil and Environmental Engineering  
Imperial College London, Exhibition Road, London, SW7 2AZ, UK  
Telephone: +44 20 7594 6036  
Fax: +44 20 7594 6102  
Email : [a.sivakumar@imperial.ac.uk](mailto:a.sivakumar@imperial.ac.uk)

## **John Polak**

Director, Centre for Transport Studies  
Department of Civil and Environmental Engineering  
Imperial College London, Exhibition Road, London, SW7 2AZ, UK  
Telephone: +44 20 7594 6089  
Fax: +44 20 7594 6102  
Email: [j.polak@imperial.ac.uk](mailto:j.polak@imperial.ac.uk)

Copyright © 2014 National Academy of Sciences. All rights reserved.

---

<sup>1</sup> Corresponding author

**ABSTRACT**

This paper presents findings from a small-sample qualitative study into people's activity-travel behavior in the presence/absence of carsharing. A carsharing service provides its subscribers with short-term access to a fleet of shared cars. In previous research, subscribers have reported distinctive travel patterns, such as more car usage than non-car-owners, but less than car-owners.

Reflexive techniques were employed in which interviewees adapted a week of their recent activity-travel behavior in response to stimuli. Findings from this study informed the design of a stated-choice survey which addresses three principal forms of complexity 1) strategic-tactical choice situations, 2) where respondents may select multiple interacting options in a single choice situation, and 3) where sufficient knowledge of the individual survey respondent to tailor such a complex choice situation cannot feasibly be gathered during a single interview.

In the proposed design the respondent indicates a strategic choice of which methods of travel to make available for use given a set of representative out-of-home activities. Accessibility to each activity by various means of travel is generated using empirical distributions from Britain's National Travel Survey datasets, to maximize plausibility of the information presented to respondents. An avatar (a virtual character for purposes of the survey) is constructed for each respondent on the basis of a small set of self-reported demographic characteristics. Employing multi-day activity-travel diaries would ideally involve multiple points of contact with each respondent at substantial cost, and therefore we sought an alternative method involving a single interview per respondent.

(244 words)

## 1. INTRODUCTION

Analysts have used stated-choice [SC] survey techniques (also referred to in the literature as stated-preference, stated-response, conjoint or discrete choice experiments) to study people's decision making for a variety of applications (1,2). In general, researchers considering an SC design wish to understand how people trade off the levels of various attributes of alternative options, according to their perceptions, constraints and preferences. Typically, much effort has focused on suitable experimental formats that allow large numbers of potential combinations of attributes and levels to be studied across a sample. For an individual respondent, this can be burdensome, even if the choice to be made is limited in scope, such as the selection of a mode of travel for a particular class of trip. But what about choices amongst strategic options that have far-reaching implications for activity participation and travel?

This paper presents findings from a set of qualitative in-depth interviews. We study mechanisms of change in people's activity-travel behavior associated with carsharing, a novel and evolving form of personal mobility. The principal outcome is a proposed methodology for an SC survey design in particular complex choice situations, which makes use of an *avatar*. In other words, survey respondents are invited to advise a virtual character in an attenuated strategic-tactical decision context, for reasons that we discuss below.

The rest of this paper is organized as follows: Section 2 presents an overview of SC techniques and the particular complexities under study. Section 3 describes the substantive context (carsharing). Section 4 presents the methods employed on the qualitative interviews. Section 5 and 6 present the results and challenges they raise to survey design, respectively, and Section 7 describes use of the proposed *avatar* construct. Section 8 discusses the proposed methodology, Section 9 presents findings from the initial field testing, and Section 10 concludes the paper.

## 2. BACKGROUND (METHODOLOGICAL)

*Ceteris paribus*, real-world data is generally accepted as more reliable than SC data for drawing inferences about real-world decision making behavior. (3) An SC survey may, however, be appealing in situations where new (or radically different) alternative options are to be introduced into an existing marketplace, a market in an entirely new sort of product or service is to be created, sufficient information on the attributes of the alternative options is not known or readily inferable, or attributes of alternative options are highly collinear (such as in the case of quality and price) or have elements with low variability. In such cases RC data may be either unavailable or unsuitable. (4)

Whilst the researcher has [near-]complete freedom with respect to the principal design issues of an SC survey – sampling method, definition and presentation of the choice situation, the nature of the *choice set* of alternative options as defined by the presence/absence of specific options and the options' attribute levels, whether alternative options carry qualitative labels, the number of replications, any socio-demographic, attitudinal, or debrief questions, etc. – the credibility of any inferences drawn from the survey datasets ultimately rests on whether respondents can be thought to have made choices in a behaviorally-realistic manner. (5) This in turn rests on issues such as whether the design of the choice situation is well-

understood by respondents and plausible to them, and whether the “response burden” is commensurate with their ability and willingness to process the information presented.

When preparing to analyze novel forms of behavior, researchers may have little knowledge upon which to base the framing of choice situations that are to be presented to respondents. Qualitative research techniques (e.g. focus groups, in-depth interviews, etc.) may be employed in such circumstances to draw inferences as to how people view the substantive situation, which in turn inform how the researcher designs the SC survey instrument. (1,2)

### **3. BACKGROUND (SUBSTANTIVE)**

A carsharing service provides its subscribers with short-term access (frequently in 30-minute increments) to a fleet of shared cars. Subscribers pay relatively low fixed costs and high marginal costs (compared to the cost structure of a privately-owned car) for their carsharing travel, make reservations via phone or the internet, and self-access vehicles which are distributed in neighborhoods. (6)

Personal automobility may be considered, in a simplified manner, as a continuum with opposing poles of “no car access” and “personal car ownership.” In the space between one would find various forms of limited car access such as car rental, sharing a car with a household member, regularly or occasionally borrowing another person’s car, using taxi services, etc. One may view carsharing to be situated within this space as well; in some respects it is an evolution of traditional car rental services as greater operational flexibility is provided by ever-cheaper information technologies. Among other differences, however carsharing services generally require users to *subscribe* in order to access the service (sometimes with a fixed cost to remain a subscriber).

Prior research has found that carsharers tend to travel via a carsharing vehicle relatively infrequently (several times a month on average), and that they report differences in their travel patterns beyond the subset of their journeys which are made in a carsharing vehicle. (6, 7, 8, 9, 10) For instance, they typically report walking, bicycling and using public transport more often than they would if they instead owned a car.

Carsharing services continue to adapt as technology improves and market conditions change. The motivation for this research is to develop techniques which are appropriate given the attributes of carsharing service models both in their current form and as they may evolve.

### **4. METHODOLOGY (SEMI-STRUCTURED IN-DEPTH INTERVIEWS)**

In designing the qualitative research, we considered a number of aspects of how novel mobility services might be viewed by the research interviewees. (10) It was expected that interviewees may be unfamiliar with the context, and that adopting the service may involve broader changes in their activity-travel pattern. It was also thought that the multidimensional structure of the context (the separate but related issues of subscribing to and using a mobility service such as carsharing) should be addressed in the interviews.

In view of these issues, gaming-simulation [GS] techniques were chosen for the qualitative research. GS techniques in general involve collecting a revealed base of behavior from interviewees, which frames a subsequent in-depth interview on the topic of interest. (1)

In the transport domain, this is typically done with the use of activity-travel diaries. During the in-depth interview, interviewees are then presented with perturbations which either relax or tighten the constraints on their revealed activity-travel behavior, to which they respond as they see fit (i.e. without the constraint of a choice set of defined alternative options, as in an SC survey). They are asked to consider their likely response(s) in the context of their diary period. The interactive nature of the interview helps to identify the range of responses to the stimulus, and ensure that interviewees' intentions are consistent with their spatio-temporal needs and with significant opportunities and constraints in their lives.

The pedigree of the GS methods we employed is found in research undertaken in the 1970's. (11) Such procedures were developed to assist in specifying quantitative models for assessing the effects of a given policy proposal. In the taxonomy developed in (1), GS techniques are identified as particularly suited to "stated-adaptation" methods, which are characterized by fixed constraints that are presented to the interviewee in the form of scenarios, with interviewees formulating open-ended responses (rather than being presented with a set of responses from which to choose).

GS techniques were employed on the present research by virtue of their dual functionality. First, they provide the desired grounding of interviewees' responses in the reality of their recently-experienced diary week, yielding useful insights into the robustness or fragility of their mobility patterns. More importantly, however, they are ideal for framing the subsequent discussion of carsharing within the broader context of people's overall mobility needs.

During the research development phase, it was decided to use households as the unit of analysis, based on literature documenting the complexity of carsharing subscription and associated secondary impacts. (6, 9) Hence, all adult household members completed activity-travel diaries and participated in the in-depth interview.

The key instruments in our application of GS techniques to the carsharing market were:

- intake forms, collecting socio-demographic, life trajectory, and other related data
- 7-day activity-travel diaries
- Single-sheet summaries of each interviewee's activity-travel diary (prepared by staff in advance of the in-depth interview)
- acetate overlays of the summary sheets

Feedback from the first households to complete the survey process was taken into account in revising several of the instruments.

Households were recruited from amongst Imperial College London staff, members of the public, and carsharing subscribers, and were provided gifts worth £20 for their efforts. Interviewees lived in London's inner suburbs. The effort for each interviewee household implied a quite small sample size. For these reasons, the sample was not intended to be representative of the population at large. Accepting these limitations, the sampling protocol was designed to encompass different segments of potential market for carsharing:

- Segment 1: Carsharing subscribers (non-car-owning) (3 households took part)
- 2: Non- subscribers, non-car-owning (2)
- 3a: Non- subscribers, car-owning, ‘heavy’ drivers (2)
- 3b: Non- subscribers, car-owning, ‘light’ drivers (1)

Following recruitment of interviewees, an intake interview was held to gather the household’s background information, and to distribute the activity-travel diaries. Then, after household members completed their diary week, each person’s activity-travel diary was summarized onto a single sheet of paper.

The in-depth interview, which all adult household members attended, was held shortly after completion of the diary week. The interview began with a brief review of the interviewees’ activity-travel behavior during the diary week. The interviewees were then presented with a series of scenarios, consisting of perturbations to their particular activity-travel behavior.

The interviewer ensured that potential responses raised by interviewees were considered within the context of the events, opportunities, and constraints of their diary week. The interviewer facilitated the discussion by presenting each scenario, providing transport information as requested (such as maps), and asking probing questions regarding interviewees’ potential responses.

When interviewees had settled on a response to a particular scenario, they noted the changes with colored markers on an acetate overlay over the summary sheet of their weekly activity-travel behavior. Each member of the household prepared a single acetate for each scenario, which then remained as a physical artifact of their response.

At some point during the course of the scenarios, non-carsharing-subscriber interviewees are presented with the opening of a carsharing service in their neighborhood, and a brief explanation of the service model. Interviewees who are presently carsharing subscribers are presented with at least one scenario in which their carsharing service is unavailable. Non-car-owning interviewees were also offered at least one scenario in which they were given a car for free by a relative.

After interviewees completed the final scenario, the interviewer announced that that stage of the discussion had ended, and that they would now revisit their responses to each scenario.

The interview then proceeded (following an unrelated task which is not reported here – see (10)) to an open-ended discussion. This portion of the interview made use of the GS exercise to frame a discussion of interviewees’ broader mobility decisions—such as getting licensed to drive, acquiring or disposing of a car, purchasing a transit season ticket, and subscribing to a carsharing service. This was included in the research design to investigate whether (and how) people view linkages between *subscribing to* a carsharing service and *using* a carsharing vehicle. If interviewees did not choose to use a carsharing vehicle at any point, we explore what types of service attributes might lead them to consider subscribing to such a service.

The interview then concluded with a “debrief” stage, in which the interviewer began to pack up the interview materials whilst discussing the GS exercise with an aim of setting an

informal atmosphere. The interviewer paid particular attention to comments that reveal assumptions interviewees had made about the purpose of the research, or about the choice and meaning of scenarios, and explored any comments concerning the authenticity or the reliability of their responses. This portion of the interview explored the transferability of interviewees' stated choices during the hypothetical exercise to a real-world context.

## 5. FINDINGS FROM THE IN-DEPTH INTERVIEWS

The results which we present here address the design questions pertaining to the SC survey instrument. Readers are referred to (10) for further discussion of findings from the in-depth interviews as they relate to carsharing.

Interviewees' responses to the stimuli presented to them in each scenario confirmed findings in the literature that carsharing and other methods of travel may be either substitutes or complements to each other. In several scenarios, for instance, interviewees chose to switch from cumbersome public transport journeys to use of a carsharing vehicle. But in other scenarios where interviewees responded to losing access to a personal car, their coping strategies for their diary week frequently made use of both carsharing and public transport services.

Interviewees – whether currently carsharing subscribers or not – indicated that they would perform relatively little carsharing travel in nearly every scenario with which they were presented. The general perception of carsharing was as a “gap-filler” method of transport which interviewees could see themselves using occasionally. Non-car-owning interviewees indicated that they perceived a difficult trade-off between the comparatively-high *fixed* costs and “bother” of car ownership (residential parking, road tax, purchase cost, etc.) and the comparatively-high *usage* costs/bother of carsharing (making an advance reservation, travelling to the parking bay, inspecting the vehicle, paying an hourly rate, keeping to the duration of the reservation, etc.) The car owners in the sample tended to perceive this as a less-difficult trade-off, as the fixed costs of car ownership was perceived to be more than offset by the much higher usage costs of carsharing for the relatively high level of car use which their activity patterns imply.

The points in time at which interviewees perceived themselves to be in a choice situation of whether to subscribe to a carsharing service varied quite strongly with their present level of automobile access. Car-less interviewees tended to view carsharing as a new, low-commitment option with which they could experiment. For them, carsharing was perceived to offer opportunities to access new activities or access their existing activities easier, for a relatively moderate monetary cost. They frequently reported activities which they perceive to be facilitated by car access, such as bulk grocery shopping. Several had experimented with online grocery shopping, though members of one household indicated that they had found this unsatisfactory and were keen to consider other alternatives.

Car-owning interviewees, however, tended to have activity-travel patterns tailored to personal car use. Switching from personal car ownership to a carsharing subscription was generally not something they would consider in the short term. One interviewee had voluntarily taken this step several months before the interview; she had sold her car upon subscribing to a carsharing service. She described her feeling as “stepping off the edge of a swimming pool and seeing if there's water.”

Most car-owning interviewees did, however, see carsharing as an option to consider at a future point in time when their personal car ownership might come into question – such as their personal car requiring major repairs, its lease term ending, moving home or job, or family life-cycle events. Amongst non-car-owning interviewees who were not inclined to subscribe to a carsharing service at present, many saw life cycle events or career changes as potentially causing them to reconsider.

Interviewees' responses to scenarios frequently involved changing their patterns of activity participation, either in response to the opportunities afforded by carsharing becoming available to them ("if I could use a car club [the British equivalent of the North American term *carsharing service*] I'd visit \_\_\_\_\_ on Saturday afternoon in Oxford"), or other stimuli (e.g. deciding to work from home several days during the week in response to losing access to a personal car).

Non-subscribers expressed significant discomfort with one particular aspect of carsharing services: the accrual of hourly charges during the full duration of a reservation. In the current commercial service model, a carsharing vehicle must be returned to the same location from which it is taken, and hourly charges accrue during a reservation regardless of whether the vehicle is in transit or parked. Non-subscribers generally found this unpleasant – one described it as feeling like a "taxi meter" would be running whilst they visit friends.

Interviewees uniformly stated that they would make different use of private cars than carsharing vehicles. In some cases these differences were simply the number of journeys by car (for instance, interviewees did not see carsharing vehicles as desirable for commuting purposes due to the hourly charges), though more complex responses were also indicated. Several respondents stated that they would combine multiple car-dependent activities (e.g. a visit to a relative and grocery shopping) into a single carsharing-use episode, whilst they would not do so if using a personal car.

In the post-GS-exercise segment of the interview, interviewees generally reported experimenting with different options for their day-to-day travel, such as road routes or public transport connections. They generally saw carsharing (provided it did not involve trading a personal car for a carsharing subscription) as an option akin to a monthly public transport pass in the level of personal commitment involved – and having significantly lower commitment than that associated with a car or bicycle.

When discussing car ownership interviewees tended to draw a distinction between "car people" and "public transport people", and viewed car ownership decisions as coupled with life-cycle events (e.g. birth of first child, moving to a new home, career progression, etc.) Interviewees indicated that their consideration of their travel requirements at such points in life was generally not one of seeking optimality. For instance, one respondent reported that, when moving home within Central London several times during his 20s, he did not concern himself with considering travel options in detail as he felt he could rely on good access to the Underground system within that part of London.

## **6. CHALLENGES FOR DESIGNING THE STATED-CHOICE SURVEY**

It was concluded from the qualitative research that the SC survey design should be sensitive to two aspects of people's decision-making behavior which were found to be relevant to this context.

First, carsharing was viewed by interviewees as interacting with other elements in their activity-travel lifestyle. Rather than carsharing journeys simply substituting for journeys by private cars or non-car methods of travel, interviewees frequently opted to also restructure other elements in their activity-travel pattern in response to changes in the availability of a carsharing service. Hence, it was concluded that the SC instrument should incorporate a multi-day activity-travel pattern as the basic unit defining each choice situation, rather than individual journeys as in traditional analyses of people's choice of travel mode. Respondents would therefore be invited to select a *portfolio* of travel methods to perform a set of journeys, rather than one travel method for a single journey.

Second, the trade-offs which interviewees perceived between the [strategic] fixed costs of making methods of travel available and the [tactical] usage costs of traveling led us to conclude that the SC instrument should provide respondents with the opportunity to consider such trade-offs.

Whilst addressing these challenges for the SC survey design, it was necessary to ensure that the level of respondent burden would not be unreasonably large, and that respondents would perceive a high degree of plausibility in the choice situations.

These issues are discussed in turn in the remainder of this section; Sections 7 and 8 present the SC design which we propose to address them.

### 6.1 Portfolio formulation

The first challenging aspect of survey design relates to structuring the choice situations such that for the purposes of quantitative analysis people may be considered to choose a *portfolio* containing zero, one or multiple elemental alternative options from an  $n$ -element choice set. (12) In the most general form, where the decision maker can choose anywhere from zero to  $n$  elemental alternative options without restrictions, the decision maker faces a fully-factorial choice set of  $2^n$  separate and distinct composite alternative options.

Portfolio choice analysis is well-established outside the transport domain (13, 14). The focus on the determinants of portfolio choice within the transport domain, however, is in its infancy, reflecting the broader ongoing development of subtler and more flexible forms of quantitative choice analysis in the domain. (see (15) for a discussion)

A form of preference inference termed the Multiply Discrete-Continuous Extreme Value [MDCEV] model, developed by Bhat and colleagues, has recently been used to analyze situations in which a decision maker synthesizes a portfolio from a set of elemental alternative options. These include explaining the number and type of automobiles/light trucks a household owns (and the distance that each is driven), and, on the basis of inferences from revealed-choice data, analyzing how households would adjust their portfolio of spending on transport and other classes of expenditure in response to structural increases in fuel price. (16, 17) At the time of writing, this form of preference-inference has not been reported to have been employed in conjunction with SC survey data.

Wiley and Timmermans (12) report on a proposed methodology for SC survey design that accommodates portfolio choice explicitly. They provide instances within the transport domain where portfolio choice may be appropriate, such as combined mode-destination choice and the choice of types of activities to which one allocates one's time. The authors present design principles for designing portfolio SC surveys such that parameters for both

*own* and *cross-effects* can be estimated, where *own effects* refer to parameter vectors found in traditional discrete choice analyses, and *cross-effects* are parameters which capture possible inter-alternative complementarity/substitutability; in other words, the attractiveness of an  $n$ -alternative portfolio could be more or less attractive than the sum of the attractiveness of the  $n$  elements treated individually.

## 6.2 Strategic-tactical formulation

The second challenge encountered was a choice situation structure which can be termed “strategic-tactical”. In certain choice situations higher-order [strategic] choices may be considered to constrain (or condition) the alternative options available to the decision maker in lower-order [tactical] situations. (18, 19).

For instance, one may for the sake of exposition posit that a person’s [strategic] choices about labor market participation, residential location, workplace location, work schedule and their level of personal access to travel instruments such as an automobile condition their [tactical] choice of which method of travel (if any) to use to commute between home and work on any given day. Whether this is an appropriate way of conceptualizing this particular example of behavior is a judgment left to the researcher; one may alternatively posit that the strategic-tactical nature of this example choice is precisely reversed – i.e. that a person may view their unconstrained choices for daily commuting as conditioning their options for the first five choice situations listed in the previous sentence.

In the context under study, an *a priori* commitment [which we term strategic] to subscribe to a carsharing service must be made in advance of [tactical] use of a carsharing vehicle. The strategic-tactical framework is proposed here as a person’s strategic choice to subscribe to a carsharing service may provide them with little or no value aside from facilitating the expected tactical uses, though it is recognized that this is a possibility rather than a certainty (see (21) for further discussion of this point). For the purposes of this paper, it is only necessary that functional value as described here is present and plays a significant role in the choice-making process.

## 6.3 Understandability/plausibility of the choice situation

In considering these criteria for the SC survey instrument, we were concerned about whether we would be presenting appropriately-designed choice situations to survey respondents. (5) This may be an issue for a number of reasons, two of which we discuss here.

First, respondents may have difficulty stating behaviorally-realistic choices in situations with a high degree of unfamiliarity, or in hypothetical situations which they do not perceive to be applicable to them. For instance, asking a respondent who has never eaten a particular type of ethnic food to choose amongst different hypothetical varieties of that food may generate behaviorally-unrealistic stated choices. A “pivoting” technique is sometimes employed to mitigate any biases due to this effect, whereby the attributes of alternative options are varied around the respondent’s actual behavior in a real-world situation. (e.g. 22, 23,24, 25)

Second, the definition of the choice situation may be more complex than the respondent’s cognitive capabilities can manage, particularly during the limited duration of the SC survey, perhaps due to the amount of information with which respondents are presented.

(5, 26) Hence any preferences inferred from an analysis of an SC dataset gathered in a hypothetical context where real-world conditions would provide people with greater opportunities to respond to choice situations in their own timeframe may be subject to undesirable bias.

Our understanding of the substantive context which on which we focus – informed by the findings of the qualitative interviewing – led to challenges in presenting respondents with synthetic choice situations that they would perceive as applicable to them. The approach we selected to address these challenges is described in Sections 7 and 8. Section 7 outlines the proposed use of an *avatar* (a virtual character), and Section 8 presents the survey design.

## 7. AVATAR CONSTRUCT

The proposed design involves introducing the survey respondent to an *avatar* in advance of the stated-choice exercises, and asking the respondent to advise their avatar in each choice situation. The difficulty in presenting respondents with complex choice situations that are plausible given their own life circumstances, without gathering a large set of information in a long-duration stage prior to the stated-choice game, motivated the desire to construct an avatar for each respondent. The avatar's life circumstances are at the discretion of the survey designer, hence can be structured to suit the substantive issue under study and presented to the respondent as part of the description of the stated-choice game.

To our knowledge, this is an innovative application of decision-making-by-proxy within the transport domain. There are, however, a small number of studies in other disciplines which examined the degree of congruence between decisions made for oneself and those made on behalf of another. (c.f. 28, 29, 30, 31, 32, 33, 34)

Polman (29) found that *personal* decision makers tended to exhibit higher degrees of “attribute prominence” in their decision-making than advisors. He interprets this as a greater tendency to seek the ability to “justify” choices made on behalf of others rather than those made for oneself.

McCubbin and Weisstub (32) analyze decision-making-by-proxy in cases of mentally-ill patients & report that any of a number of various decision-making rules are plausible – the patient's *actual needs* (as determined by a professional) or their *best interests* (as determined by society, family members, etc.) among them. The possibility of employing any of a number of unique decision making strategies when making choices on behalf of others highlights the potential pitfalls in using a constructed avatar in an SC survey to elicit the respondent's own preferences. (c.f. also 34)

Some studies have apparently treated data obtained from personal decision makers and advisors interchangeably (35), though more recent research on decision-making-by-proxy has identified the potential for several sources of systematic biases. Compared to making choices for oneself, when advising others we may systematically take fewer sources of information into account (28, 29), engage in risk-seeking/-neutral/-adverse behavior depending on context (31, 33, 36), or simply have flawed information or views regarding the advisee's preferences (28, 32). Perhaps counterintuitively, Kray (28) found that “little [empirical] support was obtained for the argument that advisors simply think less carefully about decisions than personal decision makers.”

One strategy identified by Hsee et al. (31) for mitigating potential sources of bias is to design the advisee to be a “vivid other” in the view of the decision maker: “this [self-other] discrepancy occurred only if the target of prediction was abstract and vanished if the target was vivid.” Language on survey instruments such as “*you are making choices for a friend who is fairly similar to you*” (33) and “*Before you start, please look around and see who sits closest to you. Do not talk to or disturb that person, but look at him/her for a second and remember how he/she looks*” (31) has been employed to define the “vivid” advisee condition, whilst “*somebody somewhere in the [same country]*” (31) and “*imagine that you have been approached by a typical student who is about to graduate*” (28) are typical examples of the language used to define the “generic” advisee condition.

Stone et al. (33) report similar findings in their study of attitudes to risk, in particular no evidence of systematic biases in self-other choice situations where the advisee is known to the decision maker. Kray (28, which reports multiple empirical studies) also examines a circumstance in which “vividness” is defined in a way which bears some similarities to the methodology which we propose. Study participants [undergraduate students] completed “demographic profiles” at the beginning of the study (containing year of study, favorite class, etc.). They were then presented with a demographic profile from another participating student whom they were told that they would be advising. The authors report that “increasing the concreteness of the other person facilitated perspective-taking, which increases the mental overlap between the self and others.”

In the context under study, we sought to maximize this mental overlap through designing a respondent’s avatar to have similar socio-demographic characteristics as he or she does. The *avatar* (named Jane/Joe for women and men, respectively, and with an on-screen cartoon illustration) is introduced to the respondent with a virtual handshake. The avatar is designed with the same employment status and within the same age band as the respondent, and to have a similar household structure. A respondent living with his/her partner and/or children is thus presented with an avatar with the same characteristics, and an avatar’s location within Inner or Outer London is determined on the basis of which of these areas the respondent lives in.

On the basis of gender (two categories), age band (three), domiciling with/without one’s partner (two), presence of children in household (two), employment status (two), and location (two), each respondent (and their avatar) is classed into one of 96 socio-demographic categories. Further, as described in Section 8, the avatar’s choice context is oriented around frequently-performed activities by people within the same socio-demographic category.

Despite these considerations, there are qualitative differences between the circumstances of the surveys in the literature and the avatar methodology we propose in this paper; it is plausible, for instance, that the mechanisms of choice-making-by-proxy may vary with such attributes as whether the *other* is a real person versus a virtual avatar, whether the other is a family member or not, whether the respondent feels attracted, repelled or neither towards the other, etc. Further, studies evaluating self-other discrepancies in decision making have tended to employ rather simple choice situations, whereas the proposed SC survey instrument is relatively complex.

## **8. PROPOSED STATED-CHOICE SURVEY DESIGN**

Given our understanding of the carsharing context and the unorthodox challenges it presents, we designed the avatar-based SC survey to be sensitive to the main substantive issues as well as the principles of SC choice situation design. (Readers are referred to (27) for a description of the quantitative structure developed to draw inferences from the dataset that will result from field implementation of the SC survey.)

First, we considered the degree of complexity for the multi-day activity-travel period to present to respondents. This design choice incorporated multiple criteria – the theoretically-desired time period (at least multi-activity, and longer time periods being preferred to shorter ones), respondent burden (to be minimized), our understanding of the carsharing context (see 10), compatibility with other datasets collected from larger samples of respondents, the amount of screen space available on a standard computer monitor (not to be exceeded) and the font size of the survey instrument (not to be so small as to be illegible.). We decided, on the basis of a considered compromise between these criteria, to present respondents with a set of representative activity-travel behavior which would include five archetypal out-of-home activities (including one which may be recurring in nature: i.e. commuting to work or school). The set of out-of-home activities was set at five as a compromise: too few activities appeared to be an unrealistically small set, but larger numbers of activities increase the number of pieces of information to be processed by respondents geometrically and are difficult to represent on a computer monitor at a reasonable font size. Respondents would be asked to select methods of travel (and necessary travel instruments) to “solve” such a representative pattern of activity-travel behavior on behalf of their avatar.

Designing such a survey as described above would ideally involve respondents completing multi-day activity-travel diaries, and staff processing them, prior to the respondent taking part in the main SC exercise. In this way, the SC instrument would pivot around a trace of each respondent’s recent activity-travel behavior. It was concluded that the level of effort a methodology of this sort would require – on the part of both respondent and researcher – was infeasible except for rather small samples. Hence alternative design options were sought that could be implemented with a single interview per respondent – which led to the use of the avatar construct.

The trade-offs which interviewees perceived between fixed and usage costs in the qualitative interviews led to our decision to design the SC survey instrument with a strategic-tactical aspect. It was decided that respondents would choose along two dimensions simultaneously – travel instruments and methods of travel. Travel instruments would have attributes which apply in a fixed manner regardless of the level of usage (e.g. costs of owning/maintaining a personal car, costs of subscribing to a carsharing service, costs of purchasing a public transport season ticket, etc.) whilst methods of travel would have attributes which apply to usage (e.g. fuel costs, hourly carsharing charges, pay-per-ride public transport fares, etc.).

An algorithm would provide respondents with a listing of consistent options along both of these dimensions in real-time. For instance, a respondent wishing to indicate a choice [on behalf of their avatar] of driving a carsharing vehicle to complete one or more journeys in the SC survey would have to first indicate that their avatar should choose to subscribe to a carsharing service and bear the associated fixed costs. Otherwise, the option of driving a carsharing vehicle was not available. At the same time, as shown on the right of Figure 2, the

cumulative time and monetary cost associated with strategic choices of travel instruments is updated dynamically.

The decision to construct an avatar for the respondent in the SC instrument was made in order to avoid the risks of presenting people with choice situations likely to be qualitatively very different from their own activity-travel behavior. Respondents are removed from the specifics of their activity-travel pattern, but invited to consider a proxy one drawn from people who are demographically similar to them and live in a similar location. The respondent's own preferences are sought as they are asked to advise their avatar what *they* would do if they were in their avatar's situation, rather than what they think *their avatar* should do.

The respondent is advised that their avatar is moving to Inner [Outer] London, is considering moving to one of four possible neighborhoods, and that they will be asked to "help Jane [Joe] choose how to get around." (Figure 1) The respondent is invited to take part in four replications of the survey's main SC exercises (presented as the four neighborhoods to which their avatar is considering moving).

Activity-travel patterns are synthesized from Great Britain's National Travel Survey (2004/05 edition), which collects a weeklong travel diary from thousands of respondents each year. Travel diary data from that survey were segmented along the same demographic characteristics as respondents in our survey, and the five most frequently-occurring activities in each segment were selected to comprise the avatar's representative set of activity/travel behavior. In order to maximize the "vividness" of the avatar's circumstances, technical activity names were changed from generic to specific to be more easily-understood by respondents, and graphics were used to complement the text activity descriptions. (e.g. the description of the "social/entertainment" category was changed for presentation to respondents to "See a film at the cinema.") Additionally, the combinations of travel times by each mode which are presented to a respondent (e.g. activity X can be accessed either by a Y-minute car journey, or a Z-minute walking journey, etc.) are drawn from the empirical distribution of such data from the National Travel Survey, to further increase the plausibility of the synthetic choice situation being presented to the respondent.

The interview concludes, after completion of the SC exercises, with a set of questions forming the debrief stage. The degree of congruence between the choices made by the respondent on behalf of the avatar, and those the respondent would make if choosing for themselves in similar circumstances, is probed using a semi-structured protocol.

## 9. FINDINGS FROM FIELD TESTING

The final stage of this methodological study was the field testing of the proposed design, which was undertaken in London, England during February 2011, shortly before the first full-scale application of the survey method in March 2011 (N=64). In the field test, three trained interviewers performed a total of 11 interviews and met on four occasions to discuss procedural and data quality issues. The principal findings from the field testing appear to be generalizable and to warrant changes to the instrument package.

There were several indications that the choice experiment was sufficiently complex and burdensome that reliability could be compromised if we continued introducing it within a fully self-administered computer-aided personal interview (CAPI), without verifying that the

respondent had satisfactorily understood the functionality of the key components. A number of respondents, for instance, reported during the debriefing stage of the interview that they had not been aware of one or more of the ‘strategic’ choice options. Several likewise reported confusion regarding the links between the ‘strategic’ and ‘tactical’ choice dimensions, such as the relationship between choosing to purchase a public transport season ticket and choosing to use public transport to access particular activities.

We interpreted these empirical observations as indications that the protocol unduly invited respondents to take [inauthentic] mental shortcuts in their choice-making, and hence made two substantial changes to it.

The first change was in the method of introducing the respondent to the various parts of the main choice experiment screen. In the field-tested CAPI, respondents were progressively exposed to the layout of the screen, and to text communicating the various functions. The weaknesses of this approach were (a) that the on-screen text was necessarily limited in its length, and (b) that respondents could easily ‘opt out’ of learning particular pieces of information. The protocol was changed to a directed practice, using all parts of the screen in a standardized order. Following a script, the interviewer instructs the respondent in a neutral manner to experiment with each on-screen function, and verifies understanding before the respondent is allowed to proceed to the next function.

The second change was to the layout of the choice experiment screen, to make the linkages between the strategic and tactical choice options much clearer. (See Figure 2.) The functional linkage between the two choice dimensions is now reflected by physical proximity and vertical alignment on the screen.

A number of other survey design issues that are familiar from other types of SC experiment were addressed in the field test. An example was the possibility that the characterization of relatively “green” modes such as walking, bicycling or carsharing in the choice experiment could give rise to social desirability bias in the advice given to avatars (indeed, bicycling was implausibly popular in the field test). Valuable insights into such issues were gained from the “post game” questioning of the respondents, and these led to other improvements to the instrument package, including to the “post-game” protocols themselves.

## 10. CONCLUSION

A small-sample qualitative research study was undertaken into people’s activity-travel behavior associated with subscribing to a carsharing service. Carsharing services are relatively recent (and rapidly-evolving) entrants to the commercial marketplace, and the method of travel remains a novelty to many potential subscribers.

The findings from this study informed the design of a stated-choice survey to support quantitative analysis of this behavior, in the context of the concurrent adoption and use of other means of travel as well. Drawing on the insights from the qualitative interviews, we developed a method for a stated-choice survey that explicitly accommodates strategic-tactical behavior and the selection of a portfolio of choices in each of the survey’s choice situations. It proved feasible to use Great Britain’s National Travel Survey to derive the tactical choices presented, and their costs, from the revealed aggregate behaviour of those belonging to 96 socio-demographic categories. Under the constraints of performing a single interview with

each survey respondent, the proposed methodology makes use of an avatar, constructed for the purposes of the survey, that belongs to the respondent's own socio-demographic category.

The literature on decision-making-by-proxy highlights a number of potential biases relative to personal decision making, as well as design strategies for minimizing them. The proposed design is consistent with guidance in the literature for mitigating the potential for such biases – ensuring that the “other” being advised is as “vivid” and “concrete” as possible to the “advisor.”

Field testing of the proposed methodology highlighted several ways in which respondents were interpreting information that we had not foreseen. We sought to mitigate them by, among other modifications, making use of the presence of a trained interviewer to introduce the various interactive elements of the choice experiment in sequence. Further empirical study will be required, however, before we can state with any certainty whether this methodology will produce suitable data for analyzing responses to evolving means of travel such as carsharing in an appropriately-broad context of activity-travel choices.

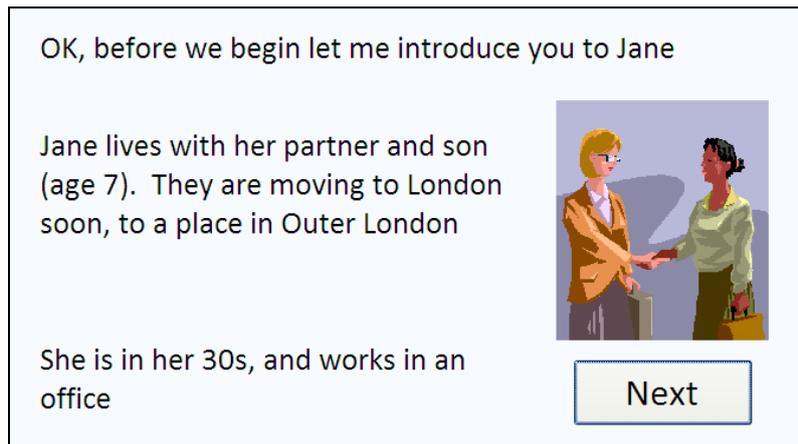
### **Acknowledgements**

The authors would like to thank Nicolo Daina and Peter Jones for thoughtful discussions and advice on the subject matter, and the RAC Foundation for Motoring for supporting the field data collection. Any errors are the authors' responsibility.

## References

- (1) Lee-Gosselin, M.E.H. (1995) Scope and potential of interactive stated response data collection methods, paper presented at *Conference on Household Travel Surveys: New Concepts and Research Needs*, Irvine, March 1995.
- (2) Louviere, J.J. and Hensher, D.A. and Swait, J.D. (2000), *Stated Choice Methods—Analysis and Application*, Cambridge University Press, UK.
- (3) Ortuzar, J. and Willumsen, L. (2004) *Modelling Transport*. John Wiley and Sons Inc. West Sussex, UK.
- (4) Cherchi, E. and Ortuzar, J. (2006) On fitting mode specific constants in the presence of new options in RP/RP models, *Transportation Research 40A (1)*, 1-18.
- (5) Richardson, A.J. (2001) Never mind the data – feel the model. *International Conference on Transport Survey Quality*. August 5-10, 2001, Kruger National Park, South Africa.
- (6) Martin, E.W. and Shaheen, S.A. (2010) Greenhouse gas emission impacts of carsharing in North America. Prepared for California Department of Transportation.
- (7) Communauto customer survey (2006)
- (8) Millard-Ball, A. et al. (2005) Car-sharing : Where and how it succeeds. Transit Cooperative Research Program Report 108.
- (9) Cervero, R., Golub, A., Nee, B. (2006) San Francisco City CarShare : Longer term travel demand and car ownership impacts. Prepared for Department of Transportation and Parking, City of San Francisco.
- (10) Le Vine, S, Lee-Gosselin, M.E.H., Polak, J. (2009) An analysis of car club participation and its environmental effects. *UniversityTransport Studies Group annual conference*, 5-7 January 2009, University of London.
- (11) Jones, P. (1979) HATS : A technique for investigating household decisions. *Environment and Planning*, 11 (1).
- (12) Wiley, J.B. and Timmermans, H.J.P. (2009) Modelling portfolio choice in transportation research. *Transport Reviews*, 29 (5). 569-586.
- (13) Elton, E.J. et. Al. (2009) *Modern portfolio theory and investment analysis*. 8th edition. Wiley & Sons.
- (14) Dube, J.P. (2004) Multiple discreteness and product differentiation in the demand for carbonated soft drinks. *Marketing Science*, 23 (1), 66-81.
- (15) Hess, S. (2005) *Advanced discrete choice models with applications to transport demand*. PhD thesis, Imperial College London.
- (16) Bhat, C.R., S. Sen, and N. Eluru (2009), "The Impact of Demographics, Built Environment Attributes, Vehicle Characteristics, and Gasoline Prices on Household Vehicle Holdings and Use," *Transportation Research Part B*, Vol. 43, No. 1, pp. 1-18
- (17) Ferdous, N., A.R. Pinjari, C.R. Bhat, and R.M. Pendyala (2010), "A Comprehensive Analysis of Household Transportation Expenditures Relative to Other Goods and Services: An Application to United States Consumer Expenditure Data," *Transportation*, Vol. 37, No. 3, pp. 363-390
- (18) Radford, K.J. (1984) Tactic selection in a complex decision situation. *IEEE Conference Proceedings: Systems, Man & Cybernetics*.
- (19) Osborne, M.J. and Rubenstein, A. (1994) *A course in game theory*. MIT.
- (20) Pinjari, A.R., R.M. Pendyala, C.R. Bhat, and P.A. Waddell, (2007)"Modeling the Choice Continuum: An Integrated Model of Residential Location, Auto Ownership, Bicycle Ownership, and Commute Tour Mode Choice Decisions,"

- Technical paper, Department of Civil, Architectural & Environmental Engineering, The University of Texas at Austin, August 2007
- (21) Kurani, K., Turrentine, T., Heffner, R. (2007) Narrative self-identity and societal goals: Automotive fuel economy and global warming policy. In *Driving Climate Change: Cutting Carbon from Transportation*. Sperling, D., and Cannon, J.S., Elsevier.
  - (22) Train, K. & Wilson, W. (2008) Estimation on stated-preference experiments constructed from revealed-preference choices. *Transportation Research Part B: Methodological*, 42 (3) 191-203.
  - (23) Hensher, D. (2006) Revealing Differences in Willingness to Pay due to the Dimensionality of Stated Choice Designs: An Initial Assessment. *Environmental and Resource Economics*, 34 (1), 7-44.
  - (24) Rose et al. (2008) Designing efficient stated choice experiments in the presence of reference alternatives. *Transportation Research Part B: Methodological*, 42 (4), 395-406.
  - (25) Axsen et al. (2009) Combining stated and revealed choice research to simulate the neighbor effect: The case of hybrid-electric vehicles. *Resource and Energy Economics*, 31 (3), 221-238.
  - (26) Sammer, G. (2003) Ensuring Quality in Stated Response Surveys, in *Transport Survey Quality and Innovation*, edited by Stopher, P & Jones, P., Elsevier.
  - (27) Le Vine, S., Sivakumar, A., Krishnan, R., Polak, J., Lee-Gosselin, M.E.H. (2009) An integrated methodology for analyzing the acquisition and use of mobility products and services. *European Transport Conference*, Netherlands, October 2009.
  - (28) Kray, L. (2000) Contingent weighting in self-other decision making. *Organizational Behavior and Human Decision Processes*, 83 (1), 82-106.
  - (29) Polman, E. (2010) Information distortion in self-other decision making. *Journal of Experimental Social Psychology*, 46, 432-435.
  - (30) Fischhoff, B. (1992) Giving Advice. *American Psychologist*, 47 (4) 577-588.
  - (31) Hsee, C.K., and Weber, E.U. (1997) A fundamental prediction error: Self-other discrepancies in risk preference, *Journal of Experimental Psychology*, 126 (1) 45-53.
  - (32) McCubbin, M. and Weisstub, D. (1998) Towards a pure best interests model for proxy decision making for incompetent psychiatric patients. *International Journal of Law and Psychology*, 21 (1), 1-30.
  - (33) Stone, E., Yates, A., Caruthers, A. (2002) Risk taking in decision making for others versus the self. *Journal of Applied Social Psychology*, 32 (9), 1797-1824.
  - (34) Stancliffe, R.J. (2000) Proxy respondents and quality of life. *Evaluation and Program Planning*, 23, 89-93.
  - (35) Kishi, G., Teelucksingh, B., Zollers, N., Park-Lee, S., & Meyer, L. (1988). Daily decision-making in community residences: A social comparison of adults with and without mental retardation. *American Journal on Mental Retardation*, 92, 430-435.
  - (36) Beisswanger, A. H., Stone, E. R., Hupp, J. M., & Allgaier, L. (2003). Risk taking in relationships: Differences in deciding for oneself versus for a friend. *Basic and Applied Social Psychology*, 25, 121-135.



**Figure 1: Sample screen introducing the survey respondent to her [his] avatar**

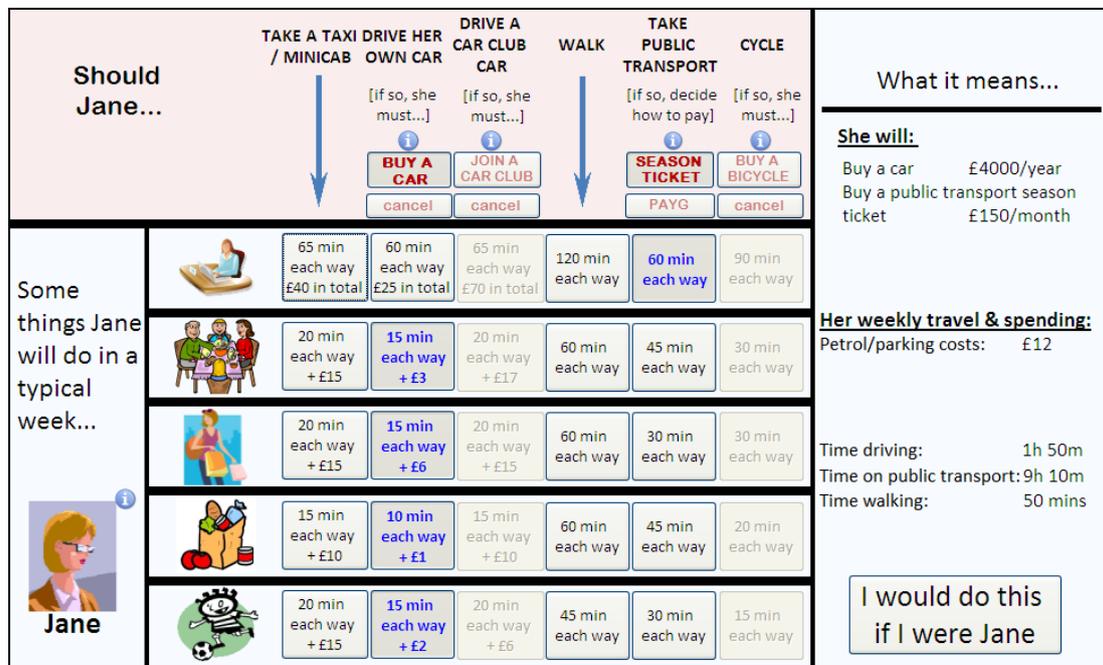
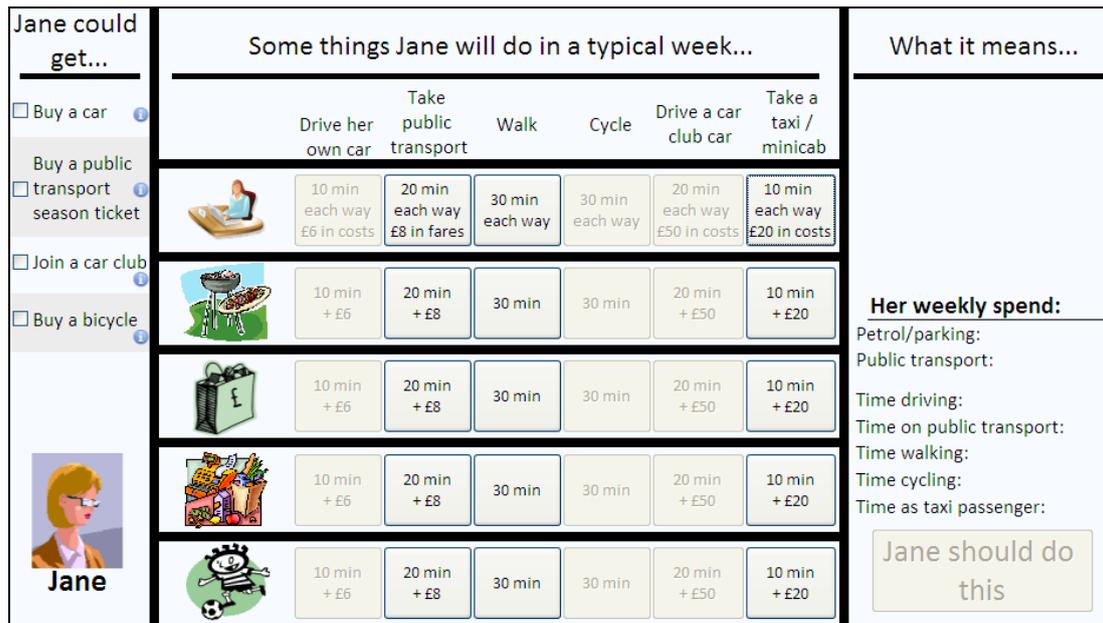


Figure 2: Sample of the main survey screen in prototype form prior to field testing (top) and as re-designed following field testing (bottom)