ITLS

INSTITUTE of TRANSPORT and LOGISTICS STUDIES

The Australian Key Centre in

Transport and Logistics Management

The University of Sydney

Established under the Australian Research Council's Key Centre Program.

NUMBER:	Working Paper ITLS-WP-15-18
TITLE:	**Power and the illusion of control: Do individual's correctly anticipate how much influence they have within a household choice?**

ABSTRACT:	Choices of groups remain one of the lesser studied behaviours in the choice literature. This continues to be an oversight as many choices are made at a household or even social level. In particular, studies that seek to further our understanding of the role of individual influence in group choices remain uncommon. This paper presents the first steps of research into an even less researched area of group choice; the level of influence that individuals think they have over a group choice. In the context of motor vehicle choice among household dyads, we find that individuals mostly perceive influence to be equally shared across vehicle attributes, with the primary user of the motor vehicle, on average, perceiving themselves to be more influential than their partner. While the primary user may perceive them self to be more influential this is mismatched with what is uncovered by modelling group powers. Influence of the primary agent is limited to the type of fuel the vehicle uses. We find that perceptions of influence are predominantly a function of attitudes about vehicle emissions and the age of the individual. Overall we provide new evidence into the ability of people to assess their own influence in a negotiation process, the influence of another and the sources of discrepancy that may exist, thus adding richer insights to the contextual understanding of group decisions.

KEY WORDS:	*group choice, influence, power, negotiation, vehicle choice, preferences*
AUTHORS:	**Beck and Rose**

CONTACT:	INSTITUTE OF TRANSPORT AND LOGISTICS STUDIES (H73)
	The Australian Key Centre in Transport and Logistics Management
	The University of Sydney NSW 2006 Australia
	Telephone: +612 9114 1824
	E-mail: business.itlsinfo@sydney.edu.au
	Internet: http://sydney.edu.au/business/itls

DATE:	September 2015

Introduction

Understanding the choices that people make are fundamental to our understanding of human behaviour; what product to purchase, what colour to order, which activity to engage in, which mode to use while travelling, which route to take while driving, what energy source to use and in what quantity, what food to consume, what hospital to visit, or which job to take are diverse examples where understanding these choices has real economic and social implications. Given the ubiquity of choices, researchers across a breadth of social sciences, be it marketers, transportation planners, energy forecasters, environmental scientists, or health and labour economists, have investigated this behaviour.

While our knowledge of these choices continues to grow and our suite of techniques for modelling these choices increases in sophistication, the overwhelming majority of studies have investigated the choices made by a single decision maker. Many decision, however, are not made by a single person alone. Arguably, some of the more important life decisions, many with a combination of long-term impacts and significant financial implications, are made by multiple people acting in concert. Within a household alone, where to live, what house to purchase, what employment to take, which school to send children, where to go for holiday, and what car to buy are small number of examples where, more often than not, multiple decision makers are involved acting with varying degree of influence and bargaining power.

The role of influence in group choices has been a matter of interest for many years. Coulson (1966) observed that other members of the family exert considerable influence on the housewife in making brand decisions. A decade later Wind (1976) emphasises that having identified members of the buying unit, one would ideally like to examine the dynamics of the purchase and consumption decision processes among all the relevant members of the unit, a decade after that Corfman and Lehmann (1987) investigated the process of conflict resolution in household purchase decisions and in an econometric framework Chiappori (1988) demonstrated that households act altruistically to make Pareto efficient choices, rather than engaging as unitary decision makers. Another decade later, a convergent stream of formalised models of household choices that sought to formally estimates degrees of influence within the random utility framework began to emerge.

Krishnamurthi (1988) proposed the first of the published two stage conjoint models that provide a framework over which influence can be measured. The first stage is to collect the preference of the individuals in the household pair, the second stage collecting the ultimate choice of the household. Other nascent examples that use a similar approach include Arora and Allenby (1999) who examine the choices of husbands and wives in the household choice of lawn-mowers and ovens; Brewer and Hensher (2000) who use a slightly different approach to examine choices between employers and employees; Aribarg et al. (2002) who investigate the choice between teenagers and their parents over computers and snack foods; and Dosman and Adamowicz (2002; subsequently published in 2006) who investigated family recreation vacation choice using both stated and revealed preference data.

Extant in the literature are a growing number of subsequent examples that use a similar approach in a variety of choice contexts. While these studies seek to understand the role of influence in the household decision making process, there is scope for analysis to better understand how the individuals themselves perceive influence. Prior to the use of the two-stage random utility approach to estimate influence, researchers interested in the role of power and influence asked respondents what degree of influence

they perceived them and their partners held. In examining these types of studies, Davis (1971) observed that past studies examining how often husbands and wives reported similar perceptions of influence and involvement in aspects of family decision making rarely exceeded 50 percent. Filiatrault and Ritchie (1980) found that husbands were perceived to exert the greater influence over the majority of the sub-decisions involved in household vacation decisions. Interestingly, this study also concluded that children had relatively little perceived influence over holiday choices but may still affect the outcome of the choice. Spiro (1983) found that perceptions of when a partner is attempting to exert influence are not in agreement. Foxman et al. (1989) find that household disagree over their perceptions of the influence of adolescents in household decisions, but that they are generally perceived to have some influence.

In this paper, we build on this largely dormant area of work in understanding the construction and perception of influence within a household choice. We use the two stage model approach to estimate the degree of influence each household member exerts over the household choice of an automobile. In the same study we also collected data on how much influence each individual perceived that they had and how much influence they perceived that their partner had. The following section presents the preferred research methodology, along with the extant set of related research methods. Section 3 details the empirical procedure utilised to obtain the requisite choice data for our econometric models. This is followed by the presentation of empirical results. Lastly, the paper offers concluding remarks relating to the results and the next step forward in using such evidence

1. Methodology

The methodology involves two agents independently evaluating a series of choice tasks consisting of the same sets of alternatives described by precisely the same attributes and attribute levels. In the modelling process, these utility functions are specified by the analyst and form the starting point for the analysis of the group decision. These are given as

$$V_{ai} = \alpha_{ai} + \sum_{k=1}^{K} (\beta_{ak} x_{ik}), \text{ and} \tag{1}$$

$$V_{bi} = \alpha_{bi} + \sum_{k=1}^{K} (\beta_{bk} x_{ik}), \tag{2}$$

where V_{ai} represents the observed utility derived by agent a for alternative i, α_{ai} represents a constant specific to alternative i (this value can also be generic across alternatives), x_{ik} is a vector of k design attributes associated with alternative i, β_{ak} is the corresponding vector of marginal (dis)utility parameters. A similar set of utility functions are estimated for agent b, which is represented by replacing subscript a with b in Equation (2). Note that the total utility would be a summation of this observed utility plus an error term which captures unobserved utility.

In the interactive agency process, the initial choices made by agents are compared. If the same alternative has been selected by both agents then it is inferred that this would be the alternative chosen by the group. Where agreement has been reached between the parties, the choice is said to be in

equilibrium. After each pass, choice tasks where no equilibrium decision was reached are sent back to each agent for re-evaluation where one or more of the agents may revise their choice. This process continues until an equilibrium choice is reached or the analyst terminates the process. For the current study, a maximum of three passes of feedback and revision were allowed before the process was terminated as it was felt that an equilibrium outcome would be unlikely to be reached by that agent pair beyond that point.

Likewise, the inferred utility of group g for alternative i defined by k attributes can be defined as:

$$V_{gi} = \alpha_{gi} + \sum_{k=1}^{K} (\beta_{gk} x_{ik}).$$
(3)

However, if an assumption is made that the group utility is a function of the individual preferences of each agent weighted by the level of influence of the agent (or perhaps in the case of a cooperative household, the agent's level of responsibility for the decision or the importance of the decision for one agent relative to the other) then it is possible to define the utility of group g as:

$$V_{gi} = \alpha_{gi} + \omega_a (V_{ai}) + (1 - \omega_a)(V_{bi}),$$
(4)

which can be reformulated at as the weighted sum across k attributes given by:

$$V_{gi} = \alpha_{gi} + \left(\sum_{k=1}^{K} \omega_{ak} (\beta_{aik} x_{ik}) \right) + \left(\sum_{k=1}^{K} (1 - \omega_{ak})(\beta_{bik} x_{ik}) \right),$$
(5)

where ω_{ak} is the measure of influence of agent a possesses relative to agent b with respect to attribute k. In this specification the influence measures represented by ω_{ak}, along with any alternative specific constant used by the analyst, are the only parameters that vary freely within the model. In other words: parameters reflecting the tastes of the individuals within the group are taken from the estimated individual-level models (2.1 and 2.2). Values of ω_{ak} range from zero to one, with a zero result representing influence being held solely by agent b, and a value of one equating to the situation where the utility of agent a is wholly representative of the group. The midpoint, 0.5, represents the situation where both agents contribute equally to the group's utility. To ensure that ω_{ak} is bounded, this parameter can be defined as:

$$\omega_{ak} = \frac{e^{(\theta_k)}}{1 + e^{(\theta_k)}}$$
(6)

2. Empirical Data

The data for the current study was collected in Australia in 2009 as part of a larger project designed to assess changes in new vehicle purchasing behaviour in response to a vehicle emissions charging scheme, specifically the elasticity of demand for low emitting vehicles with respect to a CO_2 emission charge per kilometre and/or per annum per vehicle. The choice experiment required respondents to trade differently fuelled vehicles (petrol, diesel and hybrid technology) across nine attributes (purchase price[1], fuel price, vehicle registration, annual emissions charge, variable emissions charge, fuel efficiency, engine capacity (cylinders), seating capacity, country of manufacture).

In establishing the choice profiles shown to respondents, a D-efficient design was used (Rose and Bliemer 2008). To qualify for the sample, respondents must have purchased a new motor vehicle in the previous year. Given that the vehicle purchase was relatively recent a quasi-pivot design was used to add relevance and aid in the comprehension of the experiment. As the exact specification the vehicle purchased by each household was not known, twelve separate experimental designs were generated that approximated the type of vehicle a household could have purchase (range of vehicles that a varied by size of vehicle, fuel type and whether the vehicle was a luxury or base model variant).

To further increase the realism of the design, attribute level constraints were placed on the design. Specifically, the annual and variable surcharge presented within an alternative was conditional on the type of fuel used and the fuel efficiency of the vehicle (dirtier fuels and inefficient vehicles paid at least the same, or more, than an otherwise identical vehicles); the surcharges for the hybrid could not be higher than any other vehicle when the fuel efficiency of the hybrid was equal to or better than any other alternative in the choice task; and there needed to be at least one alternative that was the same size vehicle (small, medium or large) as of the reference alternative. An example choice task is provided in Figure 1.

---

[1] The purchase price for the hybrid alternative is \$3,000 more at each level in order to recognise that hybrid technology is currently more expensive than conventional fuel engines and is defined only as a fuel source that is cleaner with respect to emission levels, rather than a specific type of fuel.

Figure 1: Example Choice Task

Figure 2: Respondent Perception of Influence

In collecting the sample, household dyads were recruited and completed the survey in a central location. Each pair jointly completed an initial set of questions with respect to the composition of the household vehicle fleet and driving behaviour of household members. Dyads were then separate and asked to complete four choice tasks individually and independently of each other; these formed the set of responses used to estimate individual level models. The participants then engaged in an interactive agency choice experiment whereby the responses for each agent were first compared. Choice tasks in which the same alternative was chosen independently were assumed to be the consensus group choices, choice sets in which different alternatives were chosen were fed back to respondents. In this stage a respondent could elect to maintain their first choice, or select a different alternative. Within each task the number of rounds of this feedback and revision process was limited to three; it was assumed for such choices that required more than three attempts to negotiate would be unlikely to be a consensus choice.

Following this interactive experiment, respondents remained separated to complete individual demographics and attitudinal questions before being brought back together to complete household level socio-demographics. While the sample was recruited at a household dyad level, pairs were split based on who the primary user of the new vehicle would be, the other respondent is termed the secondary. A total of 235 household surveys were completed, resulting in 940 choice observations for respondent group; primary, secondary and group. Overall the sample of respondents was found to be a suitable match to the demographics of the Sydney region where the data was collected. Comparing key statistics from the ITLS survey to the demographics of the Sydney region in the 2006 in the brackets: average age 44yrs (46yrs); male/female 49%/51% (49%/51%); average weekly income $1074.6 ($1057.69).

3. Results

Analysis of Perceived Influence of Self

Analysis of perceived influence is decomposed into the two subs-samples that exist in the data; primary versus secondary agents. Recall that perceived influence is measured by asking a respondent to assign 100 points per attribute between themselves and their partner. 100 points to either person would mean that that person is perceived to have full control over that and that a 50/50 point's allocation would imply equal influence. Also recall that the primary agent in this study is the one who will the primary user of the new motor vehicle, the secondary agent the person who was selected from the household who would have input over the purchase of a potential vehicle.

The amount of influence that the primary agents believe they have over each attribute is presented in Table 1. Analysis of variance reveals that significant differences exist in the perceived influence over each attribute ($F = 3.651$, $sig. = 0.000$). Post-hoc analysis via Tukey's HSD indicated that, in particular, the primary agent felt they had significantly more influence over the vehicle price, the fuel price, fuel efficiency, engine capacity and country of manufacture of the vehicle. Given that the primary agent will be the main user of the vehicle, wanting greater control of these relatively experiential attributes makes behavioural sense.

Interestingly, the primary agent perceives influence to be evenly distributed over the cost attributes of

vehicle registration (74% of primary agents assign equal weights), annual surcharge (76%) and variable surcharge (74%). This may be due to the financial impact on the household that the vehicle choice may have. This logic may similarly explain the high number of respondents who assign equal weight to the seating capacity attribute (75%). With respect to the distribution of weights, across all vehicle attributes only a small percentage of primary respondents perceive themselves to have all of the power (i.e. assign 100% to themselves) and even smaller percentage perceive that the secondary agent to have all of the power. However, a sizeable minority of primary agents perceive themselves to have 90% or more of the power for each attribute and there are a much higher proportion of primary agents who believe this relative to the perception that the secondary agent has 90% or more. For every attribute, the percentage of primary agents who perceive them self to be more powerful than their partner is greater than the percentage who perceive them self to be less powerful, with perhaps the exception of the annual emissions surcharge.

Table 1: Perceived Influence of the Primary Agent

	Vehicle Price	Fuel Price	Registration	Annual Surcharge	Variable Surcharge	Fuel Efficiency	Engine Capacity	Seating Capacity	Country of Manu.
100% to them	1%	4%	7%	4%	4%	5%	6%	2%	5%
100% to other	1%	1%	2%	3%	3%	0%	1%	0%	0%
> 90% to them	7%	10%	11%	6%	5%	12%	12%	5%	8%
> 90% to other	2%	1%	3%	3%	3%	1%	1%	0%	0%
Matching (50% each)	53%	68%	74%	76%	73%	52%	52%	75%	68%
% they have more	37%	26%	17%	13%	15%	35%	35%	18%	26%
% they have less	10%	6%	9%	11%	13%	13%	14%	7%	6%
Average (0 to 1)	0.57	0.56	0.54	0.52	0.51	0.57	0.57	0.54	0.56
Standard Deviation	0.16	0.16	0.19	0.16	0.16	0.19	0.20	0.13	0.15

With respect to the secondary agents, whose perceptions of their own influence are presented in Table 2, there is no significant difference in the average influence a secondary agent assigns themselves across the choice attributes ($F = 0.467$, $sig. = 0.879$). On average the secondary agent perceives themselves as having equal weight to their partner on each attribute in contrast to the primary agent who viewed themselves as being more influential over a subset of vehicle features. On the other hand, the responses of the secondary agents mirrored those of the primary in that a large majority perceive influence to be split equally for registration (75%), annual surcharge (76%), variable surcharge (74%) and seating capacity (79%). Secondary agents are slightly more likely to assign full influence over an attribute to the primary agent than the primary agent is to assign it to them. Conversely, the secondary agent is less likely to perceive themselves to be very dominate over an attribute (i.e. assign themselves a weighting of 90% or more) in comparison to primary agents. For other than the country of manufacture variable, the number of secondary agents who believe they have more control over than attribute than their partner is less than the number who perceive them self to be the weaker agent.

One similarity between the primary and secondary agents, as discussed, is that both perceive largely equal influence between agents for the annual and variable surcharges, as well as vehicle seating

capacity. While the previous explanation surrounding the household impact of these variables making them an attribute that agents would be more inclined to view as a true joint equilibrium, an alternative explanation may also exist. As both of these attributes are hypothetical constructs, it may be that either agent has no clearly defined preference for either themselves or their partner. This lack of clarity over preferences may be driving the agents do put an assign influence as being equal over these two attributes. For the seating capacity variable it may alternatively be explained that the seating requirements of a household are known and fixed, as such there may be little room for negotiation so influence is equally assigned.

Table 2: Perceived Influence of the Secondary Agent

	Vehicle Price	Fuel Price	Registration	Annual Surcharge	Variable Surcharge	Fuel Efficiency	Engine Capacity	Seating Capacity	Country of Manu.
100% to them	1%	3%	5%	2%	2%	2%	6%	2%	4%
100% to other	1%	4%	5%	3%	4%	2%	2%	1%	2%
> 90% to them	3%	5%	6%	3%	3%	3%	7%	2%	6%
> 90% to other	2%	5%	7%	5%	5%	3%	6%	1%	3%
Matching (50% each)	61%	69%	75%	76%	74%	64%	55%	79%	73%
% they have more	18%	14%	12%	11%	12%	18%	20%	10%	15%
% they have less	21%	17%	13%	13%	14%	18%	25%	11%	13%
Average (0 to 1)	0.51	0.49	0.50	0.49	0.49	0.50	0.49	0.51	0.51
Standard Deviation	0.15	0.17	0.18	0.15	0.16	0.16	0.2	0.12	0.16

An approximation of overall influence construct can be created by taking the average power each respondent assigns to them self over each attribute.[2] The analyses of these constructs are presented in Table 3. The overall influence average that the primary agents assign themselves is 55%, which is significantly higher than the equal influence average of 50% that the secondary agents assign themselves ($t = 4.377$, $sig. = 0.000$). Thus, overall the secondary agent views themselves as being an equal player in the choice of a motor vehicle, whereas the primary agent believes themselves to be the significantly influential decision maker. This can clearly be seen in the number of primary agents who, on average over all attributes, perceive them self to have more power than their partner compared to the number of secondary agents who feel the same. Interestingly, neither agent believes that they are totally dominant or that their partner has 100% of the influence either.

---

[2] This is not a true measure of overall influence as it does not take into account how much weight that respondents or groups place on each individual attribute. For example if the price of the vehicle is the dominant attribute in the choice and all the other attributes are insignificant, the agent who has most influence over price is likely to have the most influence overall, regardless of their influence on the other attributes.

Table 3: Approximate Overall Perceived Influence

	Primary Agent	Secondary Agent
100% to them	0%	0%
100% to other	0%	0%
> 90% to them	3%	1%
> 90% to other	0%	1%
Matching (50% each)	25%	32%
% they have more	55%	30%
% they have less	20%	38%
Average (0 to 1)	0.55	0.50
Standard Deviation	0.12	0.11

4.   Differences in Perceived Influence of Self

The within-household differences in the levels of influence that primary and secondary agents assign themselves are presented in Table 4. On average, the primary agent perceives them self to have a significantly higher level of influence than what the secondary self-assigns for vehicle price, fuel price, registration, fuel efficiency, engine capacity, seating capacity and country of manufacture. The only variables where there is no significant difference in the influence that each agent within the household assigns to themselves is over the hypothetical variables of annual and variable surcharge. This again suggests that the default perception for these unexperienced variables is for both agents to assign a 50/50 distribution of influence. The distribution for each variable is shown in Figure 1, and it reveals that across all 9 attributes, the vast majority of respondents perceive themselves to have equal influence to their partner, give or take 10% in either direction, and that significant differences observed in the influences that primary and secondary agents assign themselves is due to the primary agent perceiving their level of influence to be higher than the secondary agent perceives their own influence (or conversely that secondary agents perceives themselves to have less influence).

Table 4: Within-Household Difference in Perceived Influence

|	*Vehicle Price*	*Fuel Price*	*Registra-tion*	*Annual Surcharge*	*Variable Surcharge*	*Fuel Efficiency*	*Engine Capacity*	*Seating Capacity*	*Country of Manu.*
Average Diff (P – S)	6.1	6.5	4.6	2.5	2.2	7.1	8.0	3.2	5.0
Standard Deviation	23.5	24.9	28.9	24.4	25	27.7	31.7	19.2	22.8
t-value ($\mu = 0$)	***3.922***	***3.904***	***2.507***	*1.617*	*1.388*	***4.078***	***4.023***	***2.516***	***3.201***
Assign Same Influence	39%	52%	60%	62%	57%	36%	36%	63%	51%
Primary More	41%	34%	23%	21%	23%	42%	40%	23%	31%
Primary Less	20%	14%	17%	17%	19%	22%	24%	14%	18%
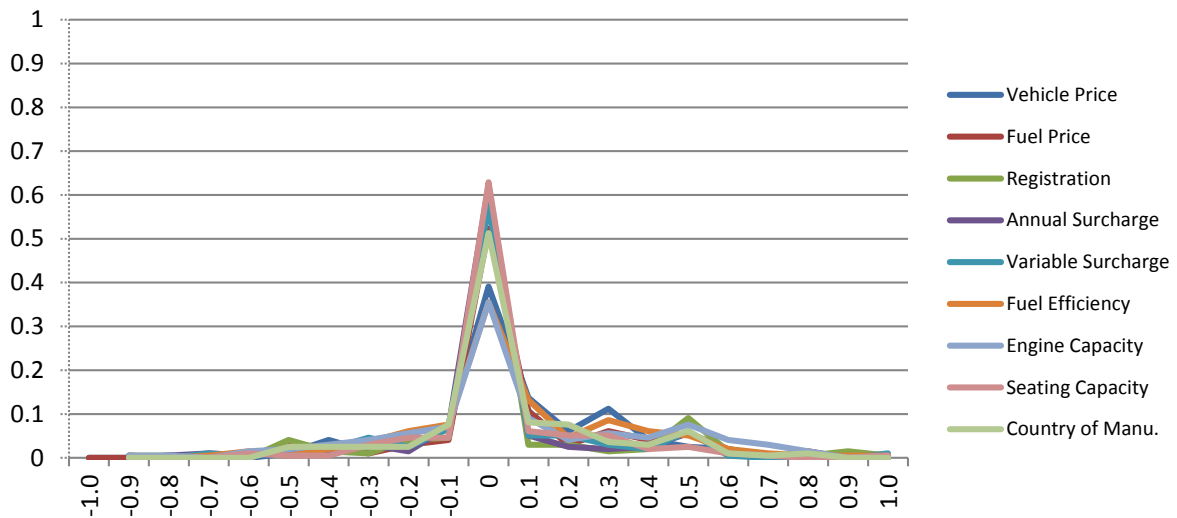
Figure 1: Distribution of Difference in Self-Perceived Influence

5.   Differences in Perceived Influence of Self vs Partner

Table 5 provides a detailed examination of how the primary agent assigns influence to themselves versus to their partner. In this table it is clearly revealed that, on average, the primary agent views them self to be significantly more powerful across all attributes except for annual and variable surcharges. The level of influence the primary agent perceives them self to have is particularly strong for vehicle price, fuel price, fuel efficiency and country of manufacture. Across all attributes the number of primary agents who assign themselves more influence is greater than the number who assign themselves less influence than their partner. For secondary agents on the other hand, as displayed in Table 6, there is no significant difference in the influence they give themselves versus their partner, indicating that, on average, the secondary agent believes that influence is equal across all attributes. On most attributes, the number of secondary agents who assign themselves less influence relative to their partner is marginally larger than those who assign themselves more.

Table 5: Primary Agent: Perceived Influence of Self vs Partner

	Vehicle Price	Fuel Price	Registra-tion	Annual Surcharge	Variable Surcharge	Fuel Efficiency	Engine Capacity	Seating Capacity	Country of Manu.
Average Diff (P – S)	13.1	11.3	8.5	2.9	2.5	14	14.5	7.7	12.3
Standard Deviation	32.2	31.7	37.1	32.4	32.8	37.3	39	26.5	30.3
t-value (μ = 0)	*5.706*	*5.021*	*3.208*	1.277	1.063	*5.273*	*5.222*	*4.050*	*5.685*
Assign Same Influence	53%	68%	74%	76%	73%	52%	52%	75%	68%
More given to Self	37%	26%	17%	13%	15%	35%	35%	18%	26%
Less given to Self	10%	6%	9%	11%	13%	13%	14%	7%	6%

Table 6: Secondary Agent: Perceived Influence of Self vs Partner

|	Vehicle Price	Fuel Price	Registra-tion	Annual Surcharge	Variable Surcharge	Fuel Efficiency	Engine Capacity	Seating Capacity	Country of Manu.
Average Diff (P − S)	0.9	-1.6	-0.8	-2.1	-2	-0.2	-1.4	1.2	2.3
Standard Deviation	29.4	33.9	36.1	29.9	31	31.4	39.6	24.2	31.7
t-value (μ = 0)	*0.436*	*-0.652*	*-0.292*	*-1.001*	*-0.895*	*-0.068*	*-0.503*	*0.707*	*1.012*
Assign Same Influence	61%	69%	75%	76%	74%	64%	55%	79%	73%
More given to Self	18%	14%	12%	11%	12%	18%	20%	10%	15%
Less given to Self	21%	17%	13%	13%	14%	18%	25%	11%	13%
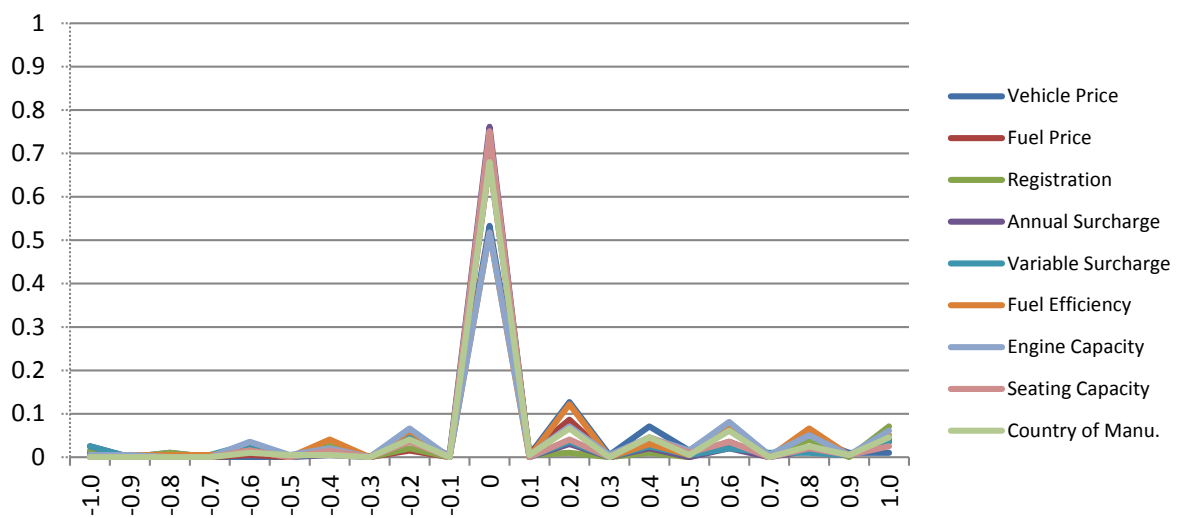
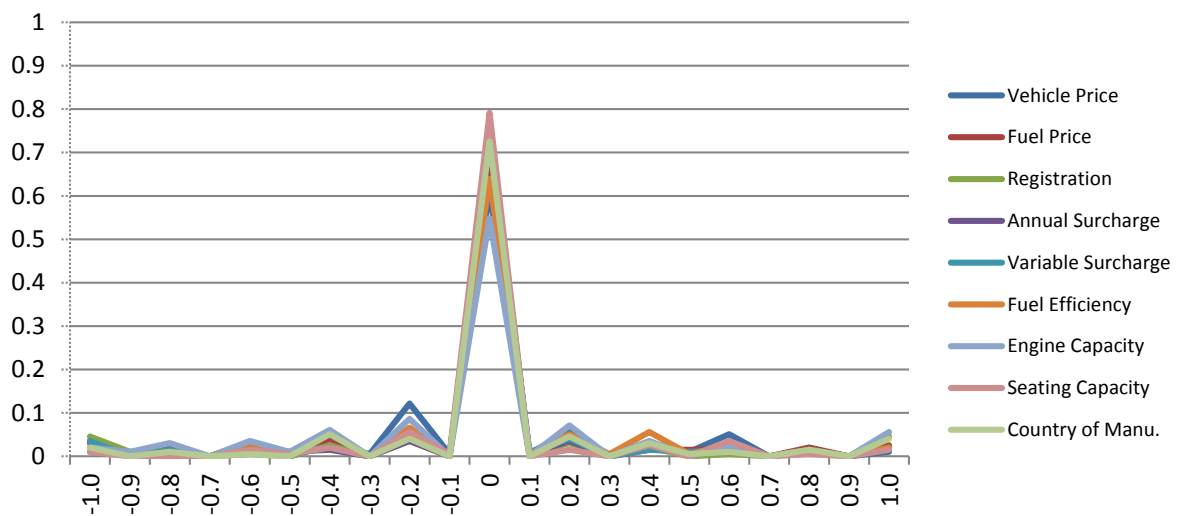*Figure 3: Primary Agent: Distribution of Difference in Self versus Partner*

Figure 4: Secondary Agent: Distribution of Difference in Self versus Partner

Figure 2 and Figure 3 show the distribution of the difference between influence assigned to the self versus the partner for the primary and secondary agents respectively. While both distributions are heavily peaked around zero difference in assigned influence, the positive tail for the primary agent distribution is noticeably heavier indicating that when there is a difference, it is largely that the primary agent is assigning themselves more influence. For the secondary respondents, who again mostly have no difference in assigned influence, there is a noticeable small peak just lower than the average (indicating activity around the 30/70 influence split).

6.   Accuracy of Perceived Influence

In this section we explore whether the influence that one agent thinks that their partner has matches their partner's perception of their own influence. Because the nature of the question forces the influence weights to sum to 100, comparing what the primary agent assigns to the secondary versus what the secondary assigns them self is identical to comparing what the secondary agents assigns the primary agent versus what the primary agent assigns them self. For example, consider a dyad where the primary agent assigns 70 influence points to them self and 30 to their partner, whereas the secondary agent assigns 60 to them self and 40 to their partner. The primary underweights how much influence the secondary agent believes they have (30 – 60 = -30), or correspondingly, the secondary agents underweights how much influence the primary agent believes they have (40 – 70 = -30). Under this scenario, a positive difference indicates that individuals over-assign influence to their partner relative to what their partner believes they themselves have and a negative difference indicates an under-assignment. The results of this analysis are presented in Table 7.

Table 7: Primary Agent: Perceived Influence Partner vs Partner's Perception of Self

	Vehicle Price	Fuel Price	Registra-tion	Annual Surcharge	Variable Surcharge	Fuel Efficiency	Engine Capacity	Seating Capacity	Country of Manu.
Average Diff (P – S)	-7.0	-4.9	-3.9	-0.4	-0.3	-6.9	-6.6	-4.4	-7.3
Standard Deviation	19.9	21.3	22.5	19.4	19.9	20.4	23.3	16.6	21.1
t-value (μ = 0)	***-4.929***	***-3.211***	***-2.408***	*-0.294*	*-0.179*	***-4.757***	***-3.942***	***-3.75***	***-4.856***
Assign Same Influence	42%	54%	61%	62%	61%	40%	41%	64%	53%
Over Estimate	17%	15%	15%	19%	20%	21%	22%	13%	14%
Under Estimate	41%	31%	23%	19%	19%	39%	38%	23%	34%

There are significant differences in the amount of influence assigned to a partner and the level of influence that the partner assigns to them self for all attributes except the annual and variable surcharges (again emphasising the point that both primary and secondary respondents are defaulting to a 50/50 split of influence in general for these hypothetical attributes). All differences are negative indicating

that, on average, a person gives significantly less influence to their partner than that person gives to them self. The relatively heavier negative tail in the distribution of differences shown Figure 5 highlight this result.
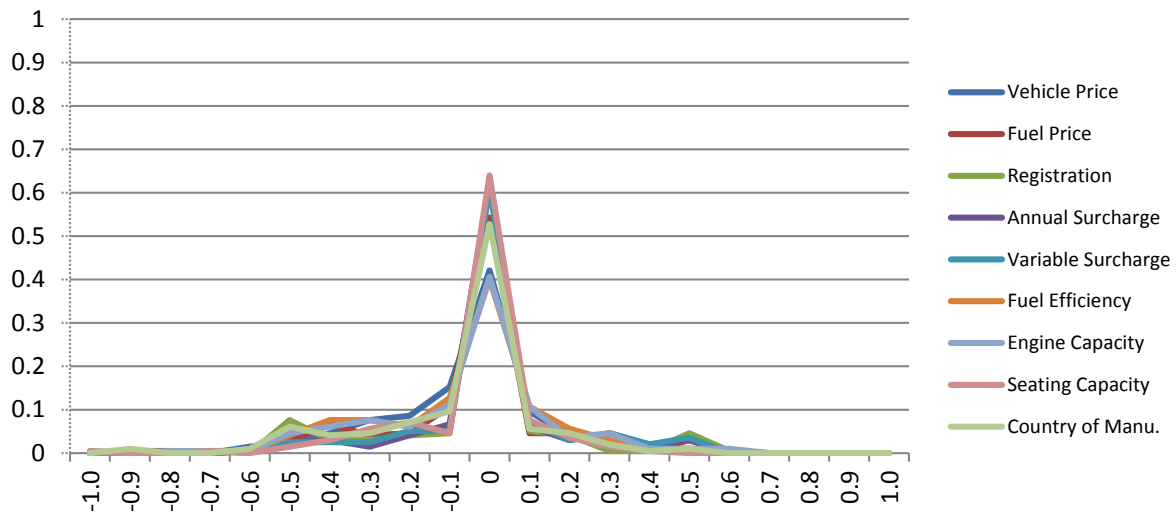
Figure 5: Difference in Partner Assigned Influence vs Self Assigned

7.   Decomposing Perceived Influence

Regression analysis was performed on each of the influence values that the respondents assigned themselves, the results of which are presented in Table 8. Interestingly, no socio-demographics could significantly explain variations in perceived influence for the secondary agent in six of the ten regressions (specifically, the overall influence measure, fuel price, annual surcharge, variable surcharge, fuel efficiency, and seating capacity). This may be a function of the relatively little variation in how secondary agents assigned themselves a level of influence for these attributes. The same could be said for the primary agent with respect to seating capacity where the vast majority of primary agents assigned themselves an equal measure of influence. It is also interesting to note that attitudes seem to play the more defining role in determining a person's perception of the own influence, rather than harder factors such as age, gender, income, hours worked per week or the number of children in the household.

Looking at the proxy for overall influence among primary agents, older respondents perceive themselves to have less influence, as do respondents to who are more in agreement with the statement that the government should introduce carbon reduction policies and that drivers of CO_2 emitting vehicles should pay more. One behavioural explanation for this is that older respondents are more likely to have been involved in a longer relationship and thus less inclined to believe that they have greater influence (as compared to younger respondents) and that those respondents who agree that something should be done about carbon emissions and that car use should be exposed to that may be more inclined to believe the choice of a CO_2 emitting car would be a joint decision.

Table 8: Regression: Socio-Demographics against Perceived Influence

	Overall Influence		Vehicle Price		Fuel Price		Registration		Annual Surcharge	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
R-squared	0.069	---	0.049	0.052	0.100	---	0.039	0.038	0.027	---
S.E. Est	11.222	---	15.765	14.454	15.318	---	18.134	17.901	16.090	---
F	3.499	---	3.218	5.283	5.250	---	3.906	3.791	5.387	---
	Beta		Beta		Beta		Beta		Beta	
Age	-0.129*	---	---	---	-0.285**	---	---	---	---	---
Hours worked / week	---	---	---	---	-0.150**	---	---	---	---	---
Climate change is an important issue	---	---	-1.757*	---	-2.523**	---	---	---	---	---
Encourage people to use enviro. friendly transport	---	---	1.893*	-3.543**	---	---	---	---	---	---
Govt. should implement carbon reduction policies	-1.087*	---	---	2.053**	---	---	---	---	-1.610	---
Drivers of CO2 emitting cars should pay more	-1.110*	---	---	---	---	---	-2.415**	---	---	---
(previous attitude question)*Age		---	---	---	---	---	---	0.035**	---	---
Vehicle emissions charge is fair to all road users	1.634**	---	1.502**	---	---	---	2.427**	---	---	---
Vehicle emissions charge effective in reducing CO2	---	---	---	---	1.300**	---	---	-1.805**	---	---

* = significant at 0.10, ** = significant at 0.05

Table 8: Regression: Socio-Demographics against Perceived Influence (cont.)

	Variable Surcharge		Fuel Efficiency		Engine Capacity		Seating Capacity		Country of Manufacture	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
R-squared	0.036	---	0.053	---	0.071	0.032	---	---	0.076	0.038
S.E. Est	16.252	---	18.212	---	18.956	19.587	---	---	15.071	15.652
F	7.168	---	3.504	---	3.606	3.171	---	---	3.538	3.773
	Beta		Beta		Beta		Beta		Beta	
Age	---	---	-0.218*	---	-0.242**	---	---	---	---	---
Gender	---	---	---	---	6.427**	---	---	---	---	---
Age*Gender	---	---	---	---	---	---	---	---	---	-0.087*
Income	---	---	---	---	---	---	---	---	-0.00008**	---
Age*Hours worked	---	---	---	---	---	---	---	---	-0.004**	---
Encourage people to use enviro. friendly transport	---	---	---	---	---	-2.289**	---	---	---	---
Govt. should implement carbon reduction policies	-1.876**	---	---	---	---	---	---	---	-1.841**	---
(previous attitude question)*Age	---	---	---	---	---	---	---	---	---	0.032**
Drivers of CO_2 emitting cars should pay more	---	---	-2.483**	---	-2.117**	---	---	---	---	---
(previous attitude question)*Age	---	---	---	---	---	0.032**	---	---	---	---
Vehicle emissions charge is fair to all road users	---	---	1.857**	---	2.192**	---	---	---	1.651**	---

* = significant at 0.10, ** = significant at 0.05

With respect to vehicle price, primary agents who felt climate change is an important issue assign themselves a lower level of influence, perhaps reflective of a more global concern and that the household should move jointly on the issue. On the other hand, those who think that people should be encouraged to use environmentally friendly transport and that vehicle emissions charging is fair to all road users assign themselves a higher level of influence. Perhaps this is a function of agreement being a proxy for knowledge about these schemes, with greater knowledge driving greater influence. With respect to the secondary agent, those individuals who agree with encouraging environmentally friendly transport assign themselves a lower influence; perhaps because they are the secondary user of the car and are happy to take alternative (most likely public transport) that is cheaper and friendlier to the environment. Secondary agents who agree that the government should implement carbon reduction policies assign themselves a higher level of influence, perhaps seeking to have greater control of the price of the vehicle given that environmentally friendly vehicles (and other technology in general) typically have higher purchase prices.

For primary agents, older respondents, respondents who work more hours per week and who agree that climate change is an important issue all perceive themselves to have relatively lower influence over the fuel price attribute, whereas the those who agree that emissions charging is an effective CO_2 reduction policy assign a higher influence. With respect to vehicle registration costs when the primary agent is more in agreement with the statement that the drivers of CO_2 emitting cars should pay more, their perceived level of influence over the attribute is lower. The same is true for both the annual and variable surcharge when the primary agent believes that the government should implement carbon reduction policies. Again, these positive environmental perspectives about carbon reduction and emissions charging are likely to have financial implications for the household, or perhaps are indicative of a person who is generally more conciliatory in their attitudes. With respect to registration costs, older secondary agents who agree that drivers of CO_2 emitting cars should pay more give themselves high levels of influence over this attribute.

Given that the fuel efficiency of the motor vehicle may only noticeably affect the primary vehicle user (in terms of number of refuelling stops needed over a week and/or the direct out of pocket expense that is a function of how much fuel the vehicle uses), it is not surprising that significant descriptors could only be found for these respondents. In particular, older primary agents perceive themselves to have less power, as do those who agree that drivers of CO_2 emitting vehicles should pay more. Primary agents who agree that vehicle emissions charging is fair to all road users assign themselves greater influence over the fuel efficiency of the vehicle (again a potential function of how knowledgeable the respondent might feel they are with respect to vehicle emissions charging).

With respect to engine capacity, again older primary agents assign themselves less influence, however in fleshing out a gender stereotype, primary agents who are male assign themselves significantly more influence over the size of the vehicle's engine. One the other hand, older secondary agents who agree that drivers of CO_2 emitting vehicles should pay more give themselves more influence over engine capacity. Lastly, older male primary agents and primary agents with lower individual incomes give themselves less power over the vehicle's country of manufacture, as do primary agents who agree that the government should implement carbon reduction policies. With respect to secondary agents, older men assign themselves less influence, but older respondents who agree that governments should implement carbon reduction policies give themselves a higher amount of relative influence, potentially as cars from different countries may be seen as more or less environmentally sound (e.g. Japanese

vehicles), particularly among older respondents.

8.   Influence Revealed by the Group Choice

Unlike previous studies influence within group choice, the influence as uncovered via the stated preference experiment, that is to say the choices of the primary and secondary agents and the group choice as a function of the utilities of the respective agents across each of the choice attributes, are estimated simultaneously. Given the exploratory nature of this methodological approach, initial research has been completed using multinomial logit models. It should be noted that while random parameters can be estimated, the MNL gives potentially the best match to the average perceived influence measures discussed. Also, while it is possible to estimate alternative specific parameters within the individual and group choice models, it was felt that for this study all parameters would be generic as the perceived influence question only prompted respondents to think generically. The model was estimated in Python BIOGEME (Bierlaire 2003) and the results are presented in Table 9.

It can be seen that, while agents may ascribe different levels of influence to themselves, when it comes to making a group choice only a smaller subset of parameters may matter; previous work on this data set has examined the trading behaviour of respondents in this data set and found plausible evidence for a reduced set of factors being important in the group decision context (Beck et al. 2013). In driving the group choice cheaper prices are preferred by both agents, as are vehicles with larger seating capacity. Relative to petrol and hybrid engines, there is a strong dislike for diesel fuelled vehicles. The alternative specific constants from the group choice equation simply show if a certain combination of alternatives that the primary and secondary agent may chose is more or less likely to lead to agreement. Of particular interest are the theta parameters estimated as per Equation (6). Under this specification, a theta parameter equal to zero is equivalent to a power weight of 0.5; that is to say it is equivalent to a joint influence outcome. The theta estimates for the vehicle price and seating capacity attributes are not different to zero, indicating that influence over these attributes is jointly shared. On the other hand, the theta estimated around the alternative specific constant for diesel is significantly positive indicating that the preferences of the primary agent for diesel is of greater influence in the ultimate choice of the group (the theta value is equivalent to a weighting parameter of 0.865).

Table 9: Estimates of Preference and Influence

Variable	Parameter	t-value
Vehicle Price (Primary)	-0.0133	-5.51
Vehicle Price (Secondary)	-0.0152	-6.2
Seating Capacity (Primary)	0.102	2.03
Seating Capacity (Secondary)	0.181	4.09
Diesel (Primary)	-0.303	-3.18
Diesel (Secondary)	-0.498	-5.17
Group Choice ASCs (Primary-Secondary)		
Petrol – Petrol	0.181	1.82

Power and The Illusion of Control: Do Individual's Correctly Anticipate How Much Influence They Have Within a Household Choice?

Beck and Rose

Petrol –Diesel	-2.090	-7.97
Petrol – Hybrid	-2.240	-10.08
Diesel – Petrol	-2.010	-9.38
Diesel –Diesel	0.072	0.79
Diesel – Hybrid	-1.950	-8.22
Hybrid – Petrol	-2.090	-9.97
Hybrid - Diesel	-1.930	-8.06
Theta Parameters		
$\theta_{Vehicle\ Price}$	-0.819	-0.86
$\theta_{Seating\ Capacity}$	-1.700	-0.68
θ_{Diesel}	1.860	2.46
Model Fit		
Initial LL	-4130.782	
Final LL	-3513.341	
Rho	0.149	
Choice Obs	940	

9. Discussion and Conclusion

Overall, the modelled parameters indicate that in the effort to make a group choice, agents are seemingly using a simplified decision making metric, whereby they are trading over alternatives (notably preferring petrol and hybrid vehicles and diesels only when the primary agents relative disutility is less than that of the secondary agent), save for some basic uniformity of agreement over price and seating capacity. This somewhat mirrors what the agents themselves perceive to be the case, as differences observed in the way in which respondents assess their own influence is largely at the margins and really only observed in the case of the primary agent. For example, the majority of secondary agents report a (near) equal allocation of influence to each person, whereas a slight number of primary agents believe they have more power but this is often expressed as a 60/40 allocation of influence.

However, it is interesting to note that the primary agents, the main user of the automobile, do view themselves to be significantly more influential than their partner, view themselves to be significantly more influential than what their partner thinks they are, and perhaps significantly more influential than they actually are. This may be explained by the fact that 55% of the initial independent choices made by agents corresponding, meaning that no negotiation was needed. Most of this occurred because both agents selected petrol of hybrid vehicles, in other words disagreement was typically only observed when one of the agents selected the diesel vehicle and then resolved when the secondary agent revised their choice to that diesel engine. In this data set, it is difficult to fully confirm if the perceived level of influence matches the actual due to the high proportion of individual choices that result in an immediate equilibrium.

It must be noted that while respondents were expressly instructed to make their own individual choices (and had no idea that those choices would be compared to their partners), there may be some respondents who may have treated the experiment as a "guessing game" and given that the motor

vehicle is a large household item, preference structure and strength of preference may be well-known within the household. The behaviour of respondents with respect to the hypothetical attributes of annual and variable surcharging provide preliminary evidence of this, as the default perception of influence over these attributes was a 50/50 split with little deviation. Future research will drill down more deeply into the choices where there is initial disagreement and examine how influence is played out under these conditions, but it would also be interesting to research choices where individual preferences may be more disparate.

In analysing the way in which respondents perceive their own influence, when age is a significant predictor the impact is such that older respondents are observed to perceive themselves to have less influence. This result is behavioural plausible as older respondents are more likely to have been in longer term relations where bargaining is more routine, or may be more likely to be purchasing a vehicle to serve a household need. Conversely, younger respondents may be part of a household but could be purchasing the vehicle almost exclusively for them. With respect to the secondary agent very few significant factors could be identified that explained perceived influence, most likely due to insufficient variation in the influence scores assigned by secondary agents. Variables were significant socio-demographics could be found were for vehicle price and vehicle registration, perhaps the largest sunk costs of vehicle ownership. Thus, perhaps the secondary agent (not the prime user of the vehicle) may only seek to differing levels of influence when the purchase of the vehicle may have a large impact on the household budget.

Generally, respondents who are more in agreement with environmental awareness or friendliness statements report a lower self-perceived influence. This is consistent with other literature which finds that people who express environmentally friendly attitudes are more likely to be altruistic (Hopper and Nielsen 1991, Schultz and Zelezny 1999). The exception is with respect to attitudes about vehicle emissions charging being fair to all road users, with those in higher agreement with this statement perceiving themselves to have more influence over the relevant variables. Behaviourally, it could be argued that to assess something as being fair required a greater intimacy and thus knowledge about the impacts of such policies. If a person views them self to be knowledgeable about a policy that influences the cost of using a vehicle it is consistent that this expertise would translate into greater perceived influence.

Overall, this study has shown some discrepancies in perceived versus actual influence both within and across groups. In this data, however, it seems to translate minimally to the choice of the group where only a few key variables are important, either because the group choice is constrained by budgets or vehicles that must be fit for a defined household purpose. Given the paucity of research in this area (let alone the wider area of group choice), we feel that we have made a significant contribution in starting analysis of perceived influence. From a policy perspective, our research has shown that attitudes play an important role in the level of influence an individual thinks they have over a decision. In the context of vehicle choice, greater awareness of environmental policies to reduce CO_2 and moderate vehicle use lead to significant differences in perceived influence. Where an attitude does impact on the level of influence an individual thinks they have over a group decision, the more likely it is that the agent will either advocate their position in search of a true group choice or urge the group to follow their lead as an expert. For example, facilitate more joint group buy-in over vehicle price, fuel price, fuel efficiency and engine capacity; or a matter such as agreeing that vehicle emissions likely being an effective policy, attempting to get the group to follow their led on features of a motor vehicle would be dramatically

impacted by emissions charging such as fuel efficiency and engine capacity. It is likely that similar attitudinal levers exist across the myriad of choices that groups make. In motor vehicle choice the raising awareness of vehicle emissions charging may be a way to bring discussion over a lot of vehicle features that directly affect emissions to the table, as respondents seek to exert their perceived influence, but it is unlikely to result in an impact in the group choice itself.

Future research will seek to make further inroads into this topic, specifically we will seek to examine if perceived power is a facilitator or impediment to group consensus, if perceived power influences the choices of individuals and groups and if perceptions of power manifest themselves in actual power. Outside of this proposed research, we encourage the examination of influence over choices that may maximise negotiation; in this instance the household preferences for motor vehicles are likely to be well-known (Beck et al. 2012), particularly over a non-labelled choice experiment. Additionally, it would also be fascinating to establish if perceptions of influence are endogenous to the negotiation process (i.e. asking what they perceive their influence to be both before and after the choice).

References

Aribarg, A., N. Arora, and H. O. Bodur (2002). "Understanding the Role of Preference Revision and Concession in Group Decisions." *Journal of Marketing Research* 39(3): 336-349.

Arora, N. and G. M. Allenby (1999). "Measuring the Influence of Individual Preference Structures in Group Decision Making." *Journal of Marketing Research* 36(4): 476-487.

Beck M.J., C.G. Chorus, J.M. Rose and D.A. Hensher (2013). "Vehicle Purchasing Behaviour of Individuals and Groups: Regret or Reward., *Journal of Transport Economics and Policy* 47(3), 475-92.

Beck M.J., J.M. Rose and D.A. Hensher (2012). "The accuracy of proxy responses in a stated choice setting: A re-examination and some controversial conclusions." *Transportation Research Part A: Policy and Practice* 46(1), 226-39.

Bierlaire, M. (2003). "BIOGEME: A free package for the estimation of discrete choice models." *Proceedings of the 3rd Swiss Transportation Research Conference*, Ascona, Switzerland.

Brewer, A.M. and Hensher, D.A. (2000). "Distributed Work and Travel Behaviour: The Dynamics of Interactive Agency Choices Between Employers and Employees." *Transportation* 27: 117-148.

Chiappori, P.A. (1988). "Rational Household Labor Supply." *Econometrica* 56(1): 63-90.

Corfman, K. and D. Lehmann (1987). "Models of Cooperative Group Decision Making and Relative Influence: An Experimental Investigation of Family Purchase Decisions." *Journal of Consumer Research* 14(1): 1-13.

Coulson, J. S. (1966). "Buying Decisions Within the Family and the Consumption-Brand Relationship." In J. W. Newman (Editor) *On Knowing the Consumer*, John Wiley and Sons, New York.

Davis, H.L. (1971) "Measurement of Husband-Wife Influence in Consumer Purchase Decisions."

Journal of Marketing Research, 8 (3): 305-312.

Dosman, D and W.L. Adamowicz (2002). "Combining Stated And Revealed Preference Data To Construct An Empirical Examination Of Intrahousehold Bargaining." *Staff Paper Series 24084*, Department of Resource Economics and Environmental Sociology, University of Alberta.

Dosman, D. and W.L. Adamowicz (2006). "Combining Stated and Revealed Preference Data to Construct an Empirical Examination of Intrahousehold Bargaining." *Review of Economics of the Household* 4(1): 15-34.

Filiatrault, P. and J.R.B. Ritchie (1980). "Joint Purchasing Decisions: A Comparison of Influence Structure in Family and Couple Decision-Making Units." *Journal of Consumer Research* 7(2): 131-140.
Foxman, E.R., P.S. Tansuhaj and K.M. Ekstrom (1989). "Family Members Perceptions of Adolescents' Influence in Family Decision Making." *Journal of Consumer Decision Making* 15(4): 482-491.

Hopper, J.R. and J. McCarl-Nielsen (1991). "Recycling as Altruistic Behavior: Normative and Behavioral Strategies to Expand Participation in a Community Recycling Program." *Environment and Behavior* 23(2), 195-220.

Krishnamurthi, L. (1988). "Conjoint Models of Family Decision Making." *International Journal of Research in Marketing* 5(3): 185-198.

Rose, J.M. and M.J.C. Bliemer (2008). "Stated Preference Experimental Design Strategies." *Handbook of Transport Modelling* (D.A. Hensher and K.J. Button (ed.), Elsevier, Oxford.

Rose, J.M., M.J.C. Bliemer, D.A. Hensher and A. Collins (2008). "Designing Efficient Stated Choice Experiments in the Presence of Reference Alternatives." *Transportation Research Part B* 42(4): 395-406.

Schultz, P.W. and L. Zelezny (1999). "Values and Predictors of Environmental Attitudes: Evidence for Consistency Across 14 Countries." *Journal of Environmental Psychology* 19(3), 255-265.

Spiro, R.L. (1983). "Persuasion in Family Decision-Making." *Journal of Consumer Research* 9(4): 393-402.

Wind, Y. (1976). "Preference of Relevant Others and Individual Choice Models." *Journal of Consumer Research* 3(1): 50-57.