Psicológica (2012), 33, 547-574.

Understanding the attitude-action gap: functional integration of environmental aspects in car purchase intentions.

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This study aims at understanding how a general positive attitude toward the environment results in a limited purchase of environmentally friendlier cars, often referred to as the attitude-action gap. In a first experiment 27 volunteers performed a judgment task on car purchase intention. Participants were asked to evaluate the probability of buying cars varying in purchase price, environmental performance, operating cost and vehicle quality. A second experiment required 47 participants to express their purchase intention of vehicles varying in driving experience, environmental aspects, Life-Cycle Costs and vehicle quality. Results in both experiments show that participants integrate car attribute information according to a differential weighting averaging rule. Model weight and scale values show to be indicative of a positive attitude toward environmental performance. On the other hand, the empirically established model weights consistently indicate that environmental performance is outweighed by other car attributes. Conceptually, the averaging integration model provides an explanation about the psychology of the attitude-action gap. Implications for policy making are discussed.

INTRODUCTION

In a time when environmental issues on a local, regional and global scale are becoming increasingly important, the adverse effects of personal transport on the environment needs to be acted upon. A seemingly

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* Acknowledgments: Olivier Mairesse is supported by grant BRGEOZ1024 of the IOWB issued by the Brussels Capital Region under the supervision of Cathy Macharis. The authors would like to Sandy Stevens for gathering the data of the second experiment. Correspondence address: Olivier Mairesse. Vrije Universiteit Brussel. Faculty of Economic, Social and Political Sciences and Solvay Business School. Department MOSI-Transport and Logistics (MOSI-T), Room M (226) - Pleinlaan 2 - 1050 Brussels. Tel: +32 (0)2 629 24 62- Fax: +32 (0)2 629 21 86. E-mail: Olivier.Mairesse@vub.ac.be

straightforward approach to reduce the impact of transport on the environment is to reduce the use of personal transportation by means of conventional diesel and petrol vehicles, in favor of bicycle and public transport use (Purcher and Renne, 2003). However, most consumers are not disposed to let go of their car as primary means of transportation (Brög, Erl and Mense, 2002), mostly because of strong feelings of convenience and independence associated to car use (Tertoolen, Kreveld and Verstraten, 1998). Therefore, stimulating the purchase of alternatives to conventional petrol and diesel vehicles is essential. A variety of policy measures (e.g. subsidies, road pricing, green taxation…) to promote the purchase and use of environmentally friendlier vehicles (EFVs) and/or to discourage the use of conventionally fueled cars are applied in different countries, some with proven usefulness, some still in an evaluation phase (Denys and Govaerts, 2007). Despite governmental efforts, the market share of EFVs remains limited. In Belgium in 2011, only 0.6% of newly registered cars consisted of vehicles running on alternative "fuels" such as Liquid Petroleum Gas, Compressed Natural Gas, electricity (ADSEI, 2011). On the other hand, the majority of consumers report positive attitudes toward the environment (see Alwitt and Pitts, 1996) and express a general concern about the environmental impact of car use (Lane and Potter, 2007). This discrepancy between environmental attitude and purchase behavior is also known as the *attitude-action gap* (Lane and Potter, 2007).

Understanding the attitude-action gap. The attitude-action gap, has received much attention in the field of environmental psychology. According to Kaiser, Wölfing and Führer (1999), about one third of all publications in the field deal with environmental attitudes in some form. Most of these studies report at best modest correlations between attitude and behavior (Hines, Hungerford and Tomera, 1986-87). Regarding car purchase behavior specifically; attitudinal surveys often have mixed success in predicting the purchase of green cars. Those studies rather reflect consumer ideals for socially desirable values (e.g. environmental benefits) than real purchase intentions. As a result of the feel good answers for the green and progressive technologies, these studies tend to overstate the demand for environmentally friendly vehicles (Gould and Golob, 1998; Kurani, Turrentine and Sperling, 1996).

For each attempt to change the consumers' activities and lifestyles, a comprehensive understanding of determinants of consumer behavior is necessary (Thøgersen and Ölander, 2003). Therefore, numerous authors resorted in explaining the attitude-action gap by means of Azjen and

Fishbein's Theory of Reasoned Action (TRA: 1980) or its developed version, the Theory of Planned Behavior (TPB: Ajzen, 1991). The TBP states that behavior is determined by an assumed causal link of intentions, which in turn summate attitudes based on perceptions of the consequences of action, subjective norms and perceived control over action. Azjen and Fishbein pointed out that in order to find satisfactory correlations between attitudes and behavior, the attitude toward that particular behavior must be measured. However, the attitudes under investigation often are from a much broader scope (e.g. attitudes toward environmental aspects) than the measured actions (e.g. purchasing a hybrid Toyota Prius) (Newhouse, 1990). Restricting the investigation to narrowly targeted attitude may result in higher correlations, but this implies also a significant loss of information (Lehmann, 1999 in Kollmuss and Agyeman, 2002). By confining attitude theory to predicting behavior only, the TBP fails to capture the subtlety of a broader aspect of structural attitude *theory*. This discrepancy is discussed in the *process-outcome generality* debate by Anderson (2008). Outcome generality aims at generalizing behavior from a given situation to transfer situations and process generality aims at generalizing some process from an experimental situation to another. The first focuses on *prediction*, the other on *understanding*. Both concepts are desirable, but are related to specific investigation procedures. Attempts to unify both concepts, such as the TPB claims to do, generally means making trade-offs in experimental procedures which ultimately results in jeopardizing both results (Anderson, 2008).

The study discussed in this paper aims at understanding how a general positive attitude toward the environment results in a limited purchase of EFVs. To do so we adopt the principles of Information Integration Theory (IIT) on Attitude Integration (Anderson, 1981, 1982, 2008) and its methodological counterpart, Functional Measurement (FM). IIT states that thought and action are determined by the joint effect of multiple determinants (Anderson, 1981, 1996). In comparison to the TBP, IIT allows for the study of much broader concepts as both attitudes toward targets (see Eagly and Chaiken, 1993) and behavior. Cognitive algebra, by means of FM methodology, allows to algebraically describe how these determinants are integrated in a combined response toward thought or action. In the following section, we will review FM methodology briefly through a simple example of how purchase price and safety aspects of a car affect subjective purchase probability. Next, we explain how this method can be applied to study general attitudes toward the environment and purchase intention.

Functional Measurement. Central in Functional Measurement (FM) is the study of integration processes, which addresses the question how stimuli combine into a single overt response when performing a judgment task. The FM paradigm depicted in Figure 1 describes this sequence. As an example we will explain how **information** about purchase price and safety combines into a single purchase probability response.

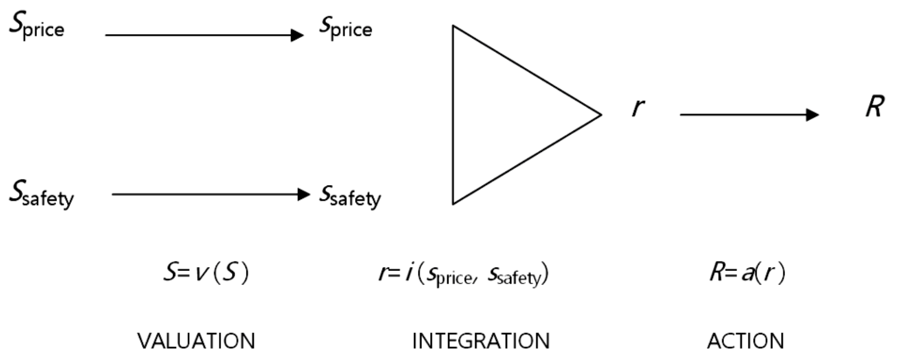

Figure 1. Functional Measurement paradigm (adapted from Anderson, 1982; Weiss, 2006). Functional Measurement paradigm (Anderson, 1981) *Sn*: observable stimuli, *sn*: the subjective stimuli, *r* the subjective response and *R* the observable response, *v*: valuation function, *i*: integration function, *a*: response function. A set of observable stimuli such as purchase price (S_{price}), and vehicle safety (S_{safety}) are transformed by the process of *valuation* into corresponding psychological representations (s_{price}, s_{safety}). Through the process of *integration* these subjective values are combined into a single implicit response (*r*). The *action* operation transforms *r* into the overt response *R* (e.g. ratings on a subjective purchase probability scale).

A typical FM judgment task consists in the evaluation of a set of different stimulus-combinations by producing a response on a rating scale. In our example, the purchase price and vehicle safety can be manipulated according to an $n \times k$ full-factorial design with n levels for the price attribute and k levels for the safety attribute. Typically, the investigator chooses levels per attribute that elicit low, medium and high responses on the dependent variable (e.g. for purchase price: 35000€; 15000€ and 6000€ and for safety Euro NCAP 1 star, 3 stars and 5 stars). Participants are required to rate the probability of buying a car given information on purchase price and vehicle safety (i.e. the observable stimuli) for as many times as the repeated measures factorial design requires it. In this case, participants would have to express the probability of buying each of 9 possible car combinations. These judgments provide the observable responses (*R*) from which the integration function *i* (i.e. the unobservable) will be inferred. Extended empirical research over the last 30-40 years (for an overview see Anderson, 1996, 2008) showed that three algebraic integration rules approximate the internal integration functions for most judgment tasks: an addition rule (Eq. 1), a multiplication rule (Eq. 2), and an averaging rule (Eq. 3). Formally:

$$r_{ij} = w_0 s_0 + w_{price} s_{price_i} + w_{safety} s_{safety_j} \quad (1)$$

$$r_{ij} = w_0 s_0 \times w_{price} s_{price_i} \times w_{safety} s_{safety_j} \quad (2)$$

$$r_{ij} = \left(w_0 s_0 + w_{price} s_{price_i} + w_{safety} s_{safety_j} \right) / (w_0 + w_{price_i} + w_{safety_j}) \quad (3)$$

In each of these integration models, the integrated response is a function of *weight* and *scale* values. Each piece of information is considered to have its own **importance** with respect to the dependent variable (=weight); and its own **location** of the underlying dependent variable (=scale value). w_0 and s_0 are parameterizations of the internal stimuli or the initial state of the respondent. This can also be conceptualized as 'prior beliefs held by the respondent' (Anderson, 1982).

Averaging theory. Although developed separately, the concept of cognitive algebra in IIT and Azjen and Fishbein's TPB is markedly similar. However, the difference between both approaches lies essentially in averaging *theory*. Surely, from a mathematical point of view, the Azjen and Fishbein's additive model and the averaging models from IIT are comparable. The difference between an averaging model and an additive model is more of a qualitative one. If an additive model is used, the rating for a stimulus combination of two stimuli always exceeds the rating for one of these two stimuli (sure-thing axiom, Anderson, 2008). In an averaging model however, this is not the case. Adding a mild stimulus to an intense stimulus will cause this rating to be lower than the rating for the intense stimulus alone. A simple example will illustrate this. Consider a 100-point response scale where high scores denote high purchase probability. For convenience purposes we set the stimulus weights equal to 1. A low purchase price (e.g. 6000€) would probably result in a high purchase probability score, say 70%. Consider now that the car is only moderately safe (Euro NCAP= 3 stars), which in itself amounts to a purchase probability score of 30%. The safety aspects of the car are valued less than the purchase price, but still positively. According to an averaging integration model, the combination of the two stimuli will be evaluated less than the value of purchase price alone (50%). Conversely, in an adding model, the evaluation of a pair of positively valued stimuli will always raise the response (Weiss, 2006). In this case an adding model would predict a 100% purchase probability. Empirical studies have repeatedly shown that consumers do not add information on attributes, but rather apply an averaging rule (Troutman and Shanteau, 1976, Gaeth, Levin, Chakraborty and Levin, 1990, Venkatarmani Johar, Jedidi and Jacoby, 1997, Adaval, 2003).

Design considerations. Discriminating between adding and averaging requires experimental design considerations. In order to test for averaging, next to the complete factorial design, all levels of one of the factors should be presented without pairing them to the levels of the other factor(s) (i.e. the method of subdesigns, Anderson (1982)). Stimuli from one factor, say purchase price, are thus also presented in absence of information on the other stimuli on vehicle safety and vice versa. In our example, the design expands to 15 possible car combinations, 9 with information about both attributes, 3 with information about purchase price only and 3 with information about safety only. Applied to purchase price, the expected internal response for unpaired stimuli formalizes as a reduction of Eq. 3:

$$r_{ij} = \left(w_0 s_0 + w_{price} s_{price_i}\right) / \left(w_0 + w_{price_i}\right) \tag{4}$$

This procedure has also implications for visual and statistical analyses of the data. In an additive model the difference between all levels of any two rows (or columns) is a constant (Weiss, 2006). Thus when plotted as a factorial graph, the curves show a pattern of parallel curves. Statistically, this parallelism results in a small, non-significant interaction effect in the ANOVA. In an averaging model, responses of uncombined attributes are also taken into account. As a result, the denominator in equations 4 and 5 is smaller than the denominator in equation 2 (Anderson, 1996). Hence the slope of the response curve r_{ij} as a function of $s_{price\ j}$ is greater since:

$$\frac{w_{price}}{w_0 + w_{price}} > \frac{w_{price}}{w_0 + w_{price} + w_{safety}} \quad (5)$$

Visually (see Figure 2), this will result in a crossover in the factorial plot, discerning the averaging model from the additive model (Anderson, 1981). Statistically, this crossover results in a significant interaction effect when including the ratings for the uncombined stimuli in the ANOVA.

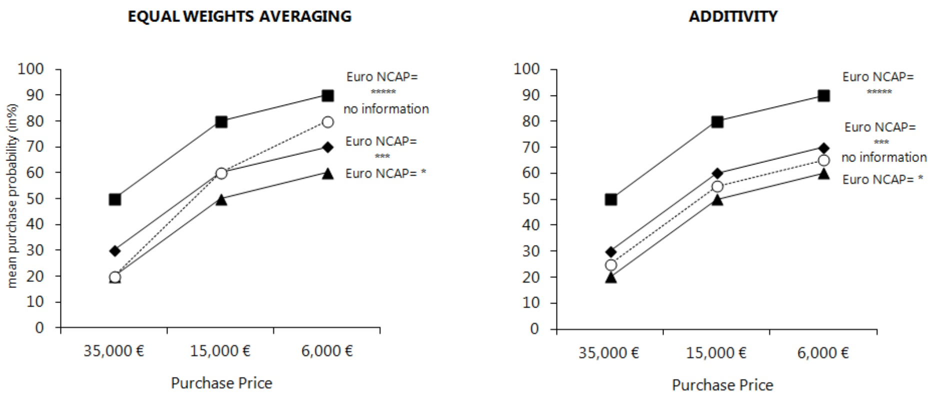

Figure 2. Visual distinction between averaging and adding integration rules.

Weight and scale values. With respect to our initial problem - understanding the attitude-action gap- the averaging model provides us with an elegant solution through its conceptual logic and the empirical identifiability of weights and scales. Consider the following example. In a judgment task, a person who has a positive attitude toward the environment is being exposed to a stimulus only conveying positive information about the environmental aspects of a car (=uncombined stimulus). Because information about other attributes is left out, this stimulus will allegedly generate a high response on the underlying variable of interest, in this case purchase probability. However, when for instance the same person is exposed to positive stimulus information about the car’s environmental aspects and less positive information about its purchase price, the probability of buying this car may decrease. Not because this person's attitude toward environmental aspects has changed, but simply because it is **outweighed** by information about purchase price. The phenomenon of other attributes outweighing the environmental one has repeatedly been reported in the literature (Lane and Potter, 2007; Kolmuss and Agyeman, 2002; Blake, 1999). In terms of the averaging model, the positive information about the environmental aspects translates in a high scale value, but fails to impact on purchase intention because of its small relative weight in comparison to information about purchase price. Put differently, the attitude converts in scale values and the behavioral intention is a function of the weight parameter, which unifies the notion of a positive attitude toward environmental aspects yet results in limited environmentally friendlier car sales.

It is important to note that while the concept of weights and scales is far from novel and appears already in some form or another in multi-attribute models (e.g. AHP [Saaty, 1980], SMARTS/ER [Edwards and Barron, 1994], etc.), most techniques rely on largely self-estimated weight values (e.g. trade-off, part-worth, point-allocation, etc.). Therefore, they may still be prone to social desirability biases, or are simply not separable from the arbitrary scale unit such as with regression weights (see Anderson, 1982, 2008; Anderson and Zalinksi, 1991; Zhu and Anderson, 1991). In averaging theory, weight and scale values are empirically separable by the method of sub-designs. Indeed, when presenting a stimulus unpaired, Eq. 4 reduces to the response being equal to its scale value[1] (Wang and Yang, 1998) and provides means to calculate valid weight and scale values through numerical estimation techniques (Anderson and Zalinski, 1991). In practice however, parameter estimation is slightly more complex, but this illustrates the general idea.

Hypotheses. Our main hypotheses for this study are straightforward: assuming that individuals have a general positive attitude toward the environment, (1) the intention of purchasing a car with good environmental performance is higher than the intention to buy a car with poor environmental performance, and (2) environmental performance is less important in comparison to other car attributes in purchase intention evaluations. In terms of IIT: scale values of the averaging model represent the attitude toward an attribute, weights the importance in purchase intentions. With respect to the scale values, we state that, if consumers have

[1] By assumption, $w_0 = 0$ (Anderson, 1982; Wang and Yang, 1998).

positive attitudes toward the environment, this will translate in (1) high subjective purchase probability scores when the subject is exposed to a single piece of "more than average" information about a vehicle's environmental performance, (2) in moderate subjective purchase probability scores when the subject is exposed to a single piece of "average" information about a vehicle's environmental performance and (3) in low subjective purchase probability scores when the subject is exposed to a single piece of "less than average" information about a vehicle's environmental performance. Visually, the slope of the curve representing the responses to the uncombined environmental stimuli should be larger than 0.

When information on environmental aspects is combined with other vehicle aspects, we posit that the weight of the environmental attribute will be the lowest in comparison to other car attributes such as purchase costs, operating costs and vehicle quality.

EXPERIMENT 1

METHOD

Participants. Twenty-seven volunteers (14 males and 13 females, M age= 32.81 yrs, SD= 9.61) performed a judgment task on car purchase intention. Inclusion criteria for the study were being in the possession of a driver's license and having purchased a car for private use.

Stimuli and design. Stimuli were selected based on literature review (Turcksin, 2011) and on the results of a survey on car purchase behavior in 939 Belgian private car owners (Mairesse, Verheyen, Turcksin and Macharis, 2008). Four quantifiable main attributes were selected for the judgment task: (a) purchase costs, (b) environmental performance, (c) operating costs and (d) vehicle quality. Purchase costs comprised purchase price, vehicle registration taxes. Environmental performance was represented by the vehicle's ECOSCORE, a method to assess environmental performance (Timmermans et al., 2005). Operating costs included sub-attributes such as fuel costs and maintenance costs and vehicle quality consisted in reliability, comfort, safety and workmanship. Main attributes such as operating costs and environmental performance were manipulated visually along 3 attribute-intensity levels (see Figure 3). Levels of intensity were symbolized by a blue arrow on the attribute continuum of interest as opposed to an average score of cars in the same segment (grey reference arrow). Blue arrows in the red area, left from the reference arrows, denoted low levels of attribute intensity. Blue arrows close to the reference arrows represented moderate levels of intensity, whereas blue arrows right from the reference arrows in the green areas stood for high levels of attribute intensity. Purchase costs and vehicle quality were graded high and low levels only. All 143 car mixes were presented in random order according to the 3×3×2×2 full-factorial design and all three-, two- and one-way sub-designs as qualitative tests for averaging integration and to allow for subsequent parameter estimation.

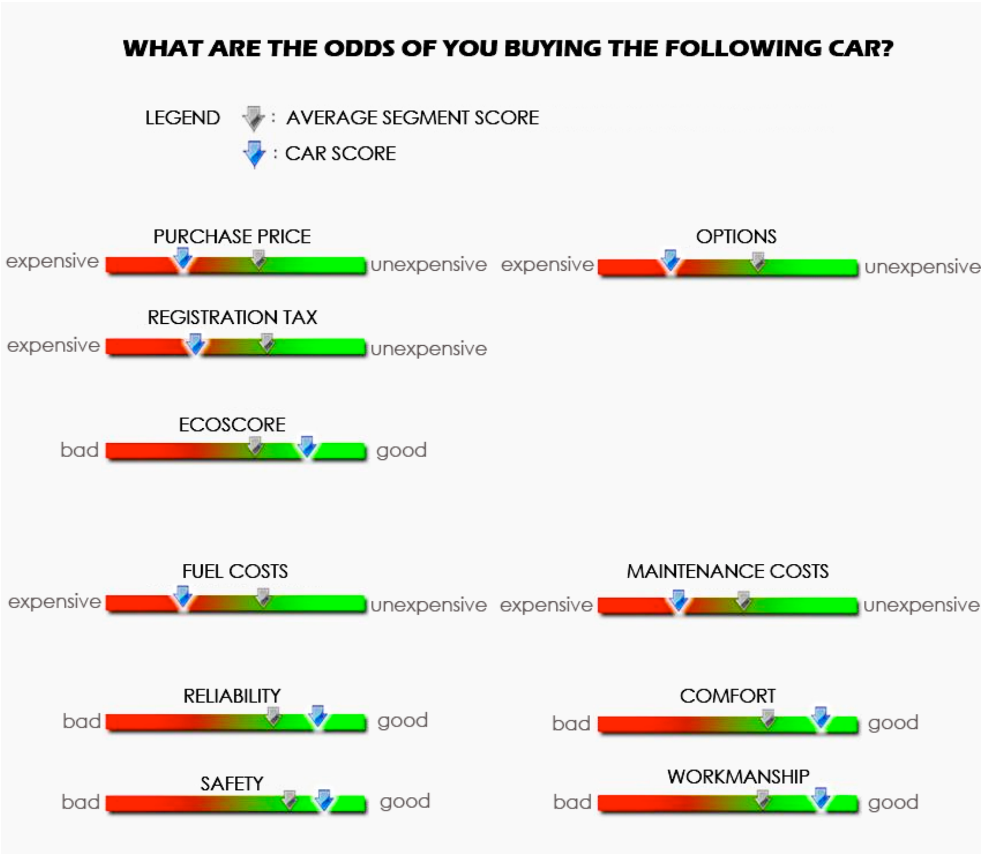

Figure 3. Stimulus example.

Procedure. The experiment was designed using FM BUILDER, a JAVA-based software program developed to conduct judgment experiments using text and image stimuli (Mairesse, Hofmans & Theuns, 2008). All participants received an email containing an attachment with the software, along with instructions on how to install the experiment and how to perform the judgment task. Participants were instructed to evaluate the probability on purchasing a car based on randomly presented combinations of information of purchase costs, environmental performance, operating cost and/or vehicle quality. When presented with stimuli from reduced designs, participants were requested to convey their judgment based only on the stimuli appearing on screen, thus ignoring the influence of the other factor(s). Subjective probabilities were obtained by means of a 100-point slider presented in the middle of the screen, taking 80% of the screen width, with "minimal purchase probability" and "maximal purchase probability" serving as end labels. In order to minimize non-compliance to the experiment (i.e. by skipping through the trials) a 1-second delay before the appearance of the next-button was built in.

RESULTS

In this section, our interest revolves around algebraic integration, or "how are environmental aspects integrated in holistic judgments regarding subjective purchase probability with respect to purchase costs, operating costs and vehicle quality?". Then, if we find an averaging model of integration, weight and scale value are calculable to verify our hypothesis

Cognitive algebra. The first step is to verify that purchase intention obeys an averaging model. The averaging model in its equal weights form, as mentioned before (see Eq. 3) predicts a pattern of parallel curves and ideally a cross-over pattern of the curve representing uncombined attribute levels or a clear deviation from parallelism with curves of the higher-order design displaying lower slopes than curves of the lower-order design.

Figure 4 displays the results. Verification of the factorial plots reveals near-parallelism of the 2-way designs in all plots with clear deviations from parallelism in the purchase costs × environmental performance and the quality × environmental performance plots. A cross-over pattern is observable in the operating costs × environmental performance plot. These patterns support the averaging effect of environmental performance over an adding one. The effect of environmental performance on subjective purchase intention is relatively high. This is depicted by the degree of the slope of the data of uncombined environmental performance stimulus (solid curve in Figure 4). This suggests that, when all other information about the vehicle's characteristics is not available, information about its environmental performance (=ECOSCORE) will strongly affect its subjective demand from the consumer. However, when other information is added (e.g. purchase costs, operating costs or quality), the effect of environmental performance is attenuated. This is pictured by a reduction of the slope parameter in the dotted curves in Figure 4 and confirms the averaging model. A deviation from parallelism in the dotted curves however, suggests that the equal weights form of the model is no longer supported and that differential weights should be allowed.

The nonparallelism depicted in Figure 4 by the dotted curves by being slightly closer to each other at low attribute intensity levels represents the *negativity effect* (Anderson, 1981, section 4.4.2), which indicates that negative information carries greater weight in the judgment. Deviations from parallelism from the uncombined levels of environmental performance as tests for averaging integration are confirmed statistically by significant interaction terms: purchase costs × environmental performance: $F[4,104]= 16.25$, $p< .001$, $\eta^2_p= .38$); operating costs × environmental performance: $F[6,156]= 10.51$, $p< .001$, $\eta^2_p= .28$) and vehicle quality × environmental performance: $F[4,104]= 19.6$, $p< .001$, $\eta^2_p= .43$). The negativity effect is also supported statistically by deviations from parallelism from the 2-way designs (dotted curves in Figure 4): purchase costs × environmental performance: $F[2,52]= 8.07$, $p= .001$, $\eta^2_p= .24$); operating costs × environmental performance: $F[4,104]= 3.47$, $p= .011$, $\eta^2_p= .12$) and vehicle quality × environmental performance: $F[2,52]= 9.69$, $p< .001$, $\eta^2_p= .27$).

Parameter estimation. Establishing the averaging model of integration allows for the separation and calculation of weights and scales by means of R-average (Vidotto and Vincentini, 2007), an optimization routine in R using the L-BFGS-B algorithm. Table 1 lists the results. As predicted, the best fitting model is an averaging integration model with differential weights (adj. $R^2= .91$). The negativity effect is prominently present as all weights of stimuli carrying negative information (w_1's in table 1) are almost twice as high as from the other stimuli. Functional scale values of the different attributes represent the subjective purchase probability of a vehicle given only information on the attribute of interest. For example, when only information is known about the car's purchase costs, low purchase costs generate a scale value of 90.55%. On the other hand, when purchase costs are higher than the segments' average, purchase intention will decrease to 11.25%. The attribute of interest in the present study is 'environmental performance'. The positive attitude toward environmental aspects translates in high scale values for positive information about environmental performance (75.75%), 54.45% for average environmental performance and 25.60% for poor environmental performance. Knowledge about the environmental performance only (i.e. the one-way sub-design), will result in a higher purchase intention.

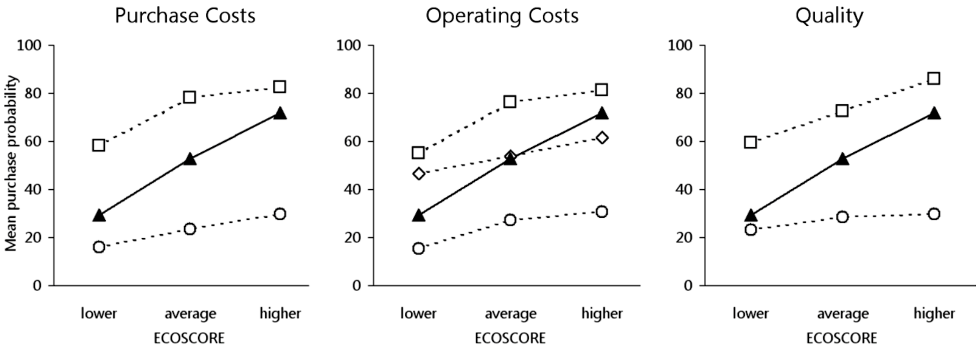

Figure 4. Visual test for averaging over adding for one-way designs. Solid curves represent the data from the environmental attribute. The curve parameter of the dotted lines stands for high (□), average (◇) and low (○) levels of the attribute of interest. The solid curve represent data from the car's environmental performance without being paired with information about other attributes (=uncombined stimuli).

Empirical weights provide a good estimation of attribute importance. Mean normalized weights were calculated in order to allow for easier comparison between attribute importance. Vehicle quality has the greatest weight in purchase probability responses: about 40%. Purchase and operating costs have a similar share in the response of respectively 24% and 22%. Finally, and as expected, environmental performance accounts for the least amount in the subjective purchase probability response (15%).

Table 1. Estimated parameters of the averaging model with differential weights. Scale values are expressed in percentage probability of purchasing a car

	s_{Low}	s_{Medium}	s_{High}	w_{Low}	w_{Medium}	w_{High}	Mean normalized weights
Purchase cost	11.25	(50)	90.55	*2.48*	*(1.73)*	*1.73*	24
Environmental performance	25.60	54.45	75.75	*1.80*	*.99*	*.99*	15
Operating cost	15.05	56.05	86.95	*2.49*	*1.46*	*1.46*	22
Quality	17.75	(50)	87.05	*4.49*	*(2.63)*	*2.63*	39

DISCUSSION

Our main hypotheses are supported by the data. Under the assumption that individuals have a general positive attitude toward the environment (Alwitt and Pitts, 1996; Lane and Potter, 2007), the participants' intention of purchasing a car with good environmental performance is higher than the intention to buy a car with poor environmental performance and environmental performance is less important in comparison to other car attributes such as costs and vehicle quality. Conceptually, the averaging integration model thus unifies the idea of a having positive attitude toward environmental product aspects nevertheless resulting in limited purchase intention.

However, Experiment 1 shows some limitations. As apparent from Figure 3, factors carry different loads of information. For instance, environmental performance was only represented by the ECOSCORE as a single piece of information, while vehicle quality consisted of four information units or sub-attributes (reliability, comfort, safety and workmanship). This may have biased our results toward greater weights for factors containing more information units. Moreover, the order of the factors remained unchanged. It is probable that participants conveyed judgments favoring factors listed on top of the screen in an attempt to reduce workload.

With respect to the choice of attributes, recent literature shows that emotional experiential factors play an important role in purchase intentions (Desmet, Hekkert and Jacobs, 2000). Marketing specialists even base advertisement campaigns by creating analogies between strong emotional experiences such as driving a particular car and giving a first kiss (Goode, Dahl and Moreau, 2010). Feedback information from experiment 1 also revealed that individuals often base their decision of driving a car after having experienced a physical encounter with the product such as driving it, sitting in it, touching the material or listen to the sound a door makes when it closes. Moreover, *"since products are nowadays often similar in technical characteristics, quality, and price, the importance of product design as an opportunity for differential advantage in the marketplace increases"* (Desmet et al., 2000, pp. 111), suggesting that aspects covering emotional and experiential aspects of driving such as car design and luxury or the car's road behavior must be included in decision-making experiments to ensure a valid approximation of the car purchase process.

Additionally, our hypothesis states that that scale values are associated with environmental attitudes. However, our first experiment does not include attitude measurements to relate to the parameters of the averaging model. Therefore, the assumption that participants have positive attitudes toward the environment is not verified.

Finally, feedback from the participants addressed the difficulty and high workload associated with the current judgment task. As the experiment occurred unsupervised, the compliance of the participants to completing the task as intended remains questionable. This may have impaired the validity of our results.

The next experiment described below will address the aforementioned issues by first designing stimuli that (1) carry similar amounts of information, (2) will be presented in different top-to-bottom order, (3) include a factor "driving experience". Furthermore, the next experiment will include measurements of general environmental attitude and participants will be tested in the presence of experimenter to maximize task compliance.

EXPERIMENT 2

METHOD

Participants. Forty-seven volunteers (21 females and 26 males, M age= 39.21 yrs, SD= 12.08) performed a judgment task on car purchase intention. Inclusion criteria were similar to experiment 1.

Stimuli and design. Four quantifiable main attributes were selected for the judgment task: (a) driving experience, (b) environmental performance, (c) Life-Cycle Costs (LCC) and (d) vehicle quality. Driving experience included sub-attributes such as acceleration, top speed, engine sound, handling, shifting-behavior, design, image. Environmental performance was represented in more detail, comprising the car's emissions of CO_2, greenhouse gasses, NO_x and particulate matter, along with noise pollution. Life-Cycle Costs referred to purchase price, fuel consumption, price of options, maintenance, insurance and taxes. Vehicle quality covered aspects such as safety, reliability, craftsmanship, choices of material, space, ergonomics, and comfort. All attributes were manipulated along 2 intensity levels: worse and better scores on the attribute than the average car. High intensity of the factor was represented by eight stars and low intensity by three stars. All 80 car mixes were presented in random order according to the 2×2×2×2 full-factorial design and all its sub-designs. An example is provided in Figure 5. Additionally, an adapted version of the behavior-based environmental attitude questionnaire (BBEA; Kaiser, Oerke and Bogner (2007) was administered in order to assess general attitudes toward the environment.

Procedure. Participants were recruited through telephone and e-mail. Volunteers agreed to an appointment with the experimenter (S. Stevens) in their own residence for a briefing and a survey on general environmental attitudes, and to conduct the experiment. All participants were randomly assigned to four different versions of the experiment, each with a different sequence of presentation of the stimuli to prevent order-effects. The approximate duration of the procedure was about one hour. The remainder of the procedure is analogous to the previous experiment.

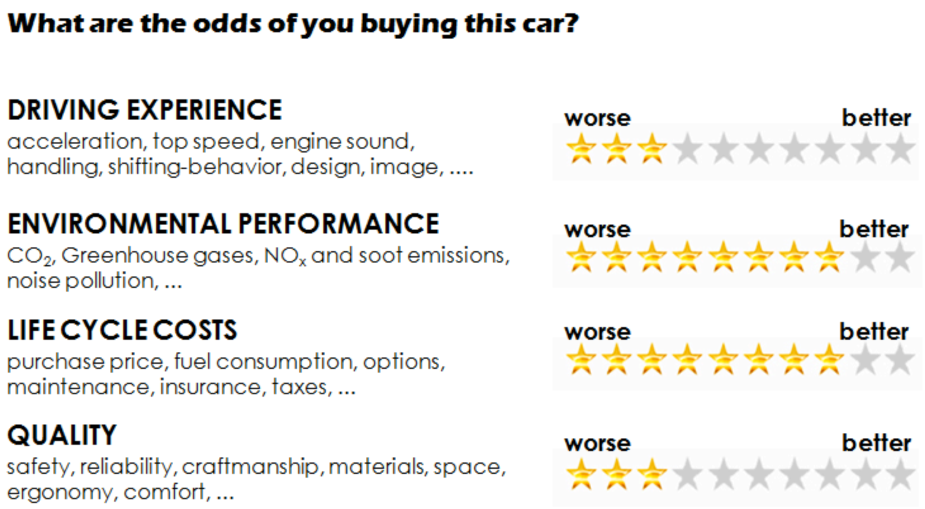

Figure 5. Stimulus example.

RESULTS

Visual analysis of factorial plots in Figure 6 reveals near-parallelism in all 2-way designs with clear deviations from parallelism for the uncombined stimuli of environmental performs. In line with experiment 1, these patterns support the averaging effect of environmental performance over an adding one. Again, the effect of environmental performance on subjective purchase intention is quite pronounced, with a high slope of the solid curves. Adding information about LCC, vehicle quality or driving experience will considerably lower the slope of the curve representing combined information of environmental performance and other attributes as predicted by the averaging model. These analyses are supported statistically with significant interactions between vehicle quality and LCC, $F[2,92]= 11.59$, $p< .001$, $\eta^2_p= .20$; vehicle quality and driving experience, $F[2,92]= 17.92$, $p< .001$, $\eta^2_p= .28$ and driving experience and LCC, $F[2,92]= 20.27$, $p< .001$, $\eta^2_p= .31$.

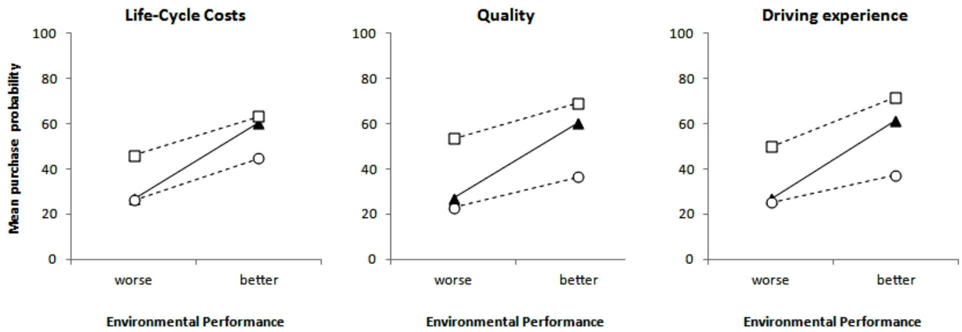

Figure 6. Visual test for averaging over adding for one-way designs. Solid curves represent the data from the environmental attribute. The curve parameter of the dotted lines stands for better than average (□) and lower than average (○) levels of the attribute of interest. The solid curve represent data from the car's environmental performance uncombined with other attributes

Parameter estimation. Table 2 shows the results of the parameter estimation for experiment 2. As in the previous experiment, the best fitting model is an averaging integration model with differential weights (adj. R^2= .94). Weights of stimuli with lower levels of intensity yield larger weights, which here again suggests the presence of a negativity effect. Similar results to experiment 1 are found regarding the scale values of environmental performance: lower than average environmental performance results in a scale value of 25.80%; higher than average environmental performance in 71.74%. When no other information is available, the car's environmental performance level suffices to raise the intention of participants to make the purchase.

Similar to experiment 1, normalized empirical weights show that the relative importance of environmental performance is lower than the other car attributes in judgments of purchase intentions. Driving experience and vehicle quality carry the largest load (respectively 31 and 29%) and LCC and environmental performance follow (21 and 19%).

Finally, with respect to general environmental attitudes, we found as expected, a significant correlation between BBEA scores and the slope parameter of the individuals scale values (r= .33, p< .05). Interestingly, when correlating normalized weights with BBEA scores, we find better agreement in the data (r= .59, p< .001).

Table 2. Estimated parameters of the averaging model with differential weights. Scale values are expressed in percentage probability of purchasing a car.

	s_{Low}	s_{High}	w_{Low}	w_{High}	Mean normalized weights
Life-Cycle Costs	24.01	70.51	*3.64*	*2.58*	21
Environmental performance	25.80	71.74	*2.90*	*2.68*	19
Driving experience	18.57	75.05	*4.87*	*3.74*	31
Quality	19.57	77.38	*4.57*	*3.50*	29

DISCUSSION

Similar results to experiment 1 are observed in experiment 2 taking into account information load, order-effects, construct and concurrent validity. Again, scale parameters of the averaging model confirm that environmental performance does impact purchase intentions, but to a lesser extent than other car attributes. Correlations with measures of general environmental attitude show that the slope parameter of the scale value function of environmental performance is related to positive attitudes toward the environment. However, this relationship is even more pronounced in weight parameters. These results suggest that, attitudes toward the environment are not only reflected in scale values but also in weights. This makes sense as, in practice, scale values can be proportionally related to weights. Scale values are also sensitive to stimulus choice (Anderson, 1982). Considering how the stimulus material actually presents (3 or 8 stars for each attributes), part of the subjects' responses could simply reflect the evaluation of a low intensity versus a high intensity stimulus, regardless of their actual meaning. Put differently, participants may reason "3 stars is bad, 8 stars is good", and convey judgments accordingly without taking into account the stimulus content. Weights, on the other hand, are more dependent of different contextual factors (i.e. the importance of an attribute in comparison to others), they may capture more of the psychological relevance of relative as well as absolute attitudinal intensity.

For obvious design reasons, elicited weights of environmental performance in experiment 1 and 2 are not comparable (Anderson, 1982). However, the larger relative weight of environmental aspects in the second experiment may not only be the consequence of a genuinely larger relative importance. Relative weights do depend on the experimental context (Anderson, 1982). Indeed, the actions undertaken to correct for discrepancies in information load in the stimuli of the first experiment may have resulted in a construct validity bias in the second. In real-life conditions, main attributes such as vehicle quality, driving experience or financial aspects consist of more units of information available for the consumer. Therefore, these aspects actually are more eligible to have more impact in purchase decisions, simply because they are subjectively present in greater quantity regardless of potential qualitative differences. In that respect, the design of the first experiment is a more valid representation of the information available to the consumers on which they base their purchase decisions. For future research we argue that designing experiments which addresses the flaws of both experiment 1 and 2 may add to the accuracy of the model parameters and the ecological validity of the judgment task. Future designs should include a stimulus set similar to experiment 1, however administered under supervision of an experimenter to improve participant compliance to the task.

GENERAL DISCUSSION

In general, our main hypotheses is supported by the data. Positive attitudes toward the environment result in making a car more attractive to the consumer. However, with respect to purchase intention, environmental aspects are outweighed by other car attributes such as vehicle quality, financial aspects and experiential aspects. As such, our results provide a quantitative and qualitative explanation of the psychology of the attitude-action gap. Understanding how individuals integrate information about environmental aspects has practical implications for policy making.

The attitude-action gap explained. One of the most prominent theories on attitudes and behavior is the Theory of Planned Behavior (TPB: Ajzen, 1991). The TBP in its simplest form conceptualizes behavioral intention as the weighted sum of attitudes toward behavior, the social norm and the perceived behavioral control. Attitudes towards behavior are defined by the strength of each belief towards the attitude and the evaluation of the outcome. Social norms are formed by the strength of each normative belief and the motivation to comply with the referent. Perceived behavioral control comprises the strength of each control belief and the perceived power of the control factor. Actual behavioral control on the other hand, impacts perceived behavioral control and behavior directly (Ajzen, 2002). With respect to the TPB, the attitude-action gap in purchasing environmentally friendlier cars is explained by constraints of *behavioral control* (Koger and Winter, 2010). More concretely, while individuals report positive attitudes towards the environment and sustainable behaviors are generally promoted as positive behaviors, the behavioral intention to actually purchase a green car can still be refrained by the belief that this will only have a minimal impact on the environment. When behavioral control is low and constraints are high (e.g. the lack of a recharging infrastructure for electrical vehicles (EVs)), the likelihood of actually buying an EV is minimal. While this explanation for the action-attitude gap makes considerable sense, explanatory models for car purchase behavior using the TPB (Lane and Potter, 2007) add to confusion between process and outcome. In Lane and Potter's model, *psychological* factors such as attitudes, beliefs and norms act jointly with *situational* factors such as vehicle attributes, economic and regulatory environments to determine car purchasing behavior. Attitudes in the TPB are here one-dimensional evaluative responses of a psychological *process* underlying behavior, and situational factors dominate the decision-making aspect of the behavior. The authors also argue that, in general, (non-environmental) situational factors play a more crucial role in the final purchase decision (Lane and Potter, 2007). It thus remains unclear whether behavioral control is responsible for gap between positive environmental attitudes and the limited purchase of green cars, or the limited relative importance of environmental aspects in the decision process. As illustrated by the *process-outcome generality* debate by Anderson (2008), the understanding of cognitive processes and the prediction of behavioral outcomes tend to interfere, resulting in mutual loss of effectiveness to capture the subtleties of both structural attitude theory and decision-making.

In this study, we aim to understand and explain the dynamics of the attitude-action gap by means of IIT. When consumers intend to buy a car, their intention judgments are governed by general attitudes towards "objective" vehicle attributes. For example, general attitudes towards money influence judgments about purchase price, fuel consumption, price of options, maintenance, insurance and taxes. Attitudes towards quality shape judgments about reliability, craftsmanship and comfort and attitudes towards (driving) pleasure impact judgments related to hedonistic aspects of driving such as design, engine sound and acceleration. Environmental attitudes affect judgments on the car's environmental performance (emissions of CO_2, greenhouse gasses, NO_x,…). These general -well-known- attitudes towards different vehicle attributes combine in a functional system (an attitude knowledge system or AKS). For most car buyers, environmental attitudes are less important than attitudes toward money, quality or pleasure. It is this difference in *attitude strength* reflected by the weight parameters in the averaging model which serves as an explanation for the attitude-action gap[2]. Most people have positive attitudes towards the environment, but they just do not prevail over attitudes associated with other car attributes. Also, the opposite holds true for consumers with strong environmental attitudes (i.e. environmentalists): they are prepared to concede some attributes such as boot space, top speed, etc. for better environmental performance. It is important to note that our explanation of the attitude-action gap limits itself to purchase intention. With respect to actual behavior, other (external) determinants may play a substantive role in actually making the purchase. However, behavioral intention is a strong *indicator* of actual behavior (Dietz, Dan and Schwom, 2005). In general terms we suggest that, even when individuals report a positive attitude towards the environment, their intention to buy a environmentally friendlier car is limited and for a majority of consumers, this translates in the behavior of not buying this type of car.

POLICY IMPLICATIONS

Pricing policies. The results of the first experiment study show that the combined weight of purchase and operating costs is comparable to the sole weight of vehicle quality aspects. Consequently, associating environmental characteristics and financial aspects is a sensible pathway for policy formulation. In Belgium, policy makers have been offering financial incentives to promote EFVs. More specifically, vehicles with CO_2 emissions lower than 105 g/km receive a 15% reduction of the purchase price, whereas vehicles with CO_2 emissions lower than 115 g/km receive a 3% reduction (FPS Finance, 2010). As a result of this incentive, the share of environmental friendlier vehicles in the total vehicle fleet has increased significantly. In the first 10 months of 2010, vehicles with CO_2 levels below 115 g/km reached 30% of total vehicle, amongst which vehicles with CO_2 levels below 105 g/km, like the hybrid Toyota Prius, represented a 18.4%

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[2] Normative and control beliefs issued from the TPB can be related to the w_0 and s_0 parameters which conceptualize 'prior beliefs' (Anderson, 1982).

share in the total vehicle sales (Mobimix, 2010). However, vehicle taxation schemes remain distorted in Belgium, still favoring cars with poor environmental performance (Turcksin, 2011). Therefore, a more sensible approach has been proposed recently regarding registration taxation using the ECOSCORE methodology (Timmermans et al., 2005; Turcksin, Macharis, Sergeant and Van Mierlo, 2009). The ECOSCORE enables the classification of vehicles with different drive trains and fuels through a well-to-wheel approach and showed that a combination of fuel taxes and an ECOSCORE based taxation system lead to better conformity between total vehicle taxes and the car's environmental impact (Turcksin, 2011). A stakeholder-analysis also revealed that members of the car industry, user-groups and policy makers agree that taxation by means of environmental performance is one of the most effective approaches to promote the purchase of EFVs (Mairesse et al., 2009b). Combining reduction of purchase costs, together with promoting the beneficial financial effects of operating an EFV by introducing a mix of policies such as lowering excises on clean fuels, introducing taxation based on environmental performance and exempting green cars of road taxes could sensibly increase green car sales, as long as these policies also sufficiently discourage the purchase of conventionally fueled vehicles (“carrots” and “sticks”).

Product education. However, considering our results, this approach may not always be effective. As apparent from our data in both experiments, vehicle quality remains one of the most important attributes when considering buying a car. Brands have indeed been marketing quality as one of their main features for many years, resulting in high sales figures (e.g. Toyota). Conversely, when consumers perceive that a brand is not up to their standards anymore as a consequence of quality issues, this results in losses in market share (see the 2009 Toyota massive recall; Andrews, Simon, Tian and Zhao, 2011). Regarding green cars, environmental friendliness is not (yet) always regarded as a marker of quality. Electric cars are often perceived to be qualitatively inferior because of reduced autonomy, long charging times and lower performance (Dagsvik, Wennemo, Wetterwald and Aaberge, 2002, Chéron and Zins, 1997). Therefore, both car manufacturers as well as policy makers should emphasize qualitative standards in EFVs together with financial incentives.

As discussed previously with respect to experiment design, in real-life attributes such as vehicle quality, driving experience or financial aspects carry a greater load of available information than environmental performance consist of more units of information available for the consumer. As such they may have a higher weight in purchase decisions, regardless of potential qualitative differences (Anderson, 2008, p.176). This is especially relevant with respect to sustainable mobility policy, as consumers often have little knowledge about green car aspects because of a lack of available information (Gallagher and Muehlegger, 2011). In terms of policy making, improving consumer knowledge about EFVs, together with the previously mentioned measures is a sensible pathway to promote their adoption by the larger public. Yet, given that uncertainties about new technology remains, one must be careful not to oversell the technology and set realistic consumer expectations (Kurani, Heffner and Turrentine, 2007).

Demonstration programs. Therefore, it is important to include real-life experiences with the product to be marketed as experiential aspects have a large impact in car purchase intentions (Desmet et al., 2000). This view is also supported by the results of our second experiment. Driving experience carries the highest weight in car purchase intention judgments. With respect to policy making, it is therefore sensible to invest in vehicle demonstration programs for alternative drive train technologies. Demonstration programs serve as excellent communication tools of new sustainable technologies through driver experiences and technical problem report for funding instances as well as for the larger public (Kurani et al., 2007; Bradley and Frank, 2009).

Concluding remarks. Regarding sensible policy making to promote the adoption of EFVs, one should consider the psychology of the attitude-action gap. Most consumers are in favor of a car with good environmental performance. However, in the purchase process, other factors play a more important role such as quality, financial aspects and the overall driving experience. In order to stimulate individuals to favor green cars over conventionally fueled vehicles (CFV), actions must be undertaken on the very aspects that motivate purchase intention most. This probably can best be achieved by financially reward green car purchases and penalize CFV purchases, emphasize qualitative aspects of EFV and provide substantive information about the technology and last but not least, let consumer experience green driving firsthand. Most importantly, combined policy measures will probably be the most effective as they affect different aspects of purchase behavior (Gordon, 2005). Further research exploring the effect of combined policies on purchase intentions is needed and the application of Information Integration Theory may prove to be an interesting path to follow to improve our understanding of the cognitive processes underlying green purchase decisions. The major distinction between this approach and other attitudinal theories or multi-attribute models is that IIT and FM provides a theoretical framework and the associated experimental methods allowing for the estimation of empirically valid weights and scale parameters (Zhu and Anderson, 1991; Anderson and Zalinski, 1991, Wang and Yang, 1998). Also, for policy research, using empirically established weights in multi-attribute decision aids to assess stakeholder-approval such as the MAMCA (Macharis, 2004) may improve its external validity and overall predictive performance.

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(Manuscript received: 26 September 2011; accepted: 4 February 2012)