Order in Product Customization Decisions: Evidence from Field Experiments

Jonathan Levav

Columbia University

Mark Heitmann

Christian-Albrechts-University at Kiel

Andreas Herrmann

University of St. Gallen

Sheena S. Iyengar

Columbia University

Differentiated product models are predicated on the belief that a product's utility can be derived from the summation of utilities for its individual attributes. In one framed field experiment and two natural field experiments, we test this assumption by experimentally manipulating the order of attribute presentation in the product customization process of custom-made suits and automobiles. We find that order affects the design of a suit that people configure and the design and price of a car that people purchase by influencing the likelihood that they will accept the default option suggested by the firm.

We are grateful to James Bettman, Ray Fisman, Brett Gordon, Daniel Kahneman, Emir Kamenica, Dean Karlan, Oded Netzer, John Lynch, John Payne, Dan Silverman, Catherine Thomas, and Olivier Toubia for their comments on previous drafts and to Dan Ariely, Colin Camerer, Uri Gneezy, Michael Riordan, and Richard Thaler for helpful discussions. We are particularly grateful to Eric Johnson for facilitating our collaboration and for his helpful comments. We would also like to acknowledge the Center for Excellence in E-Business at Columbia Business School for its financial support.

[*Journal of Political Economy,* 2010, vol. 118, no. 2]

Differentiated product models are a popular econometric tool to estimate demand for a wide variety of goods, including housing, wines, automobiles, and computers (McFadden 1974; Rosen 1974; Epple 1987; Berry, Levinsohn, and Pakes 1995; Bajari and Benkard 2005; Berry and Pakes 2007). These models are predicated on the belief that a product's utility can be derived from the summation of utilities for its individual attributes or characteristics (Lancaster 1966; Rosen 1974). If consumers are utility-maximizing agents, their preferences for any finished product should be independent of the order in which they considered its attributes: any order should yield an equivalent "final" bundle. Where attribute decisions are reversible, a difference due to order might cast doubt about the robustness of the assumption that utility from products is derived from the summed utilities of the products' attributes.

Product customization is a particularly appropriate context to test this possibility both because of its ubiquity in the modern marketplace and, more important, because it requires consumers to directly construct their preferred product via a sequence of attribute decisions. Each attribute might have different numbers of options from which to choose, with greater variety within each attribute increasing the likelihood of a consumer maximizing her welfare by selecting the option that best matches her preferences. For instance, a homeowner who renovates her apartment engages in a complicated sequence of decision steps, with each step including dozens of options that she can select from (e.g., a typical U.S. paint manufacturer offers 2,000 different colors).

We argue and demonstrate empirically in framed and natural field experiments (Harrison and List 2004) involving financially consequential decisions that, in some circumstances, order of attribute presentation can influence the bundle of attributes a consumer purchases. In addition, we attempt to characterize the pattern of this influence and show that it can create an opportunity for firms to exploit. The experiments we discuss below involve major durable products possessing multiple attributes that are configured by a consumer. Each attribute includes multiple options from which the consumer can choose; different attributes have different numbers of options. The configuration process is ordered either such that the attributes with a greater number of options come first in the sequence and are followed by the attributes with a successively smaller number of options or vice versa. This is our only experimental treatment.

Our argument relies on three basic premises. The first is that, where consumers lack expertise in a product class, they assess the prospective utility from an option at the time that they make their decision (Payne, Bettman, and Johnson 1993; Slovic 1995); options that elicit utility beyond some minimum threshold level are more likely to be chosen. For instance, when a shopper decides which ceiling fan to purchase for her new home, she makes an on-the-spot assessment of the utility she will derive from each of the fan's aesthetic and technical features (Kahneman 1994). Following this assessment, she selects the fan that elicits sufficient utility (i.e., the option that "satisfices" [Simon 1955]).

The second premise is that assessing utility requires effort that depletes a limited mental resource. This idea is derived from the concepts of bounded rationality and cost of thinking, the twin notions that economic agents have limited computational abilities and that computations incur a mental cost (Simon 1955; Rubinstein 1998; Ortoleva 2008). In other words, assessing the utility from the fan in the example above is mentally costly. Furthermore, we conjecture that the cost of evaluating options is convex, so that assessing the utility from the next fan in the sequence is relatively more costly. The latter is inspired by research in psychology and economics that models self-control as a muscle that "contracts" in the face of temptation (Muraven and Baumeister 2000); each subsequent encounter with a tempting stimulus requires greater willpower resources than an identical earlier encounter (Ozdenoren, Salant, and Silverman 2008). Likewise, recent research shows that a similar decline in self-control can be caused by having made repeated choices in a previous task (Vohs et al. 2008).

The third premise is that consumers are partially "myopic" in their allocation of mental resources. Instead of distributing their mental effort efficiently across the configuration process, we invoke the Gabaix et al. (2006) directed cognition model to predict that consumers will behave as if the current decision in a sequence is practically their last (despite the fact that in our experiments it is obvious that subsequent decisions will follow). Consequently, in our setting, consumers "overspend" their mental capacity early in the configuration sequence, leaving them with fewer resources to assess their utility from subsequent attributes in the sequence.

In product customization decisions these three premises can conspire to undermine the principle that the utility from a product is the sum of the utilities of its attributes. More specifically, we suggest that the effort invested in previous attribute decisions affects subsequent attribute decisions because the previous decisions deplete people's capacity to evaluate options. Here, however, depletion is a function not only of the number of decisions that the consumer has made, but also of the number of options that she had to evaluate at each stage. Our investigation focuses on the combined effect of these two factors and how they influence revealed preferences. Our thesis is that early decisions in a customization sequence affect subsequent decisions in the sequence because the early decisions deplete people's mental capacity but that this depletion effect depends on whether the early decisions involve attributes that are high in number of options (high variety) or low in number of options (low variety).

People's depleted capacity may heighten the difficulty of finding any option to be above their minimum utility threshold and, hence, to be chosen. Such an experience of "choice overload" can prompt people to forgo making a choice altogether, or when avoidance is not a practical or possible alternative to making a choice, it can prompt them to embrace options that are relatively simple and easier to understand. A notable study of decision avoidance conducted by Iyengar and Lepper (2000) at an upscale grocery store in Menlo Park, California, presented shoppers with one of two displays of gourmet jams. Every hour the display alternated between 24 different jams and six different jams (representing a subset of the 24). Each shopper who approached the display was given a discount coupon. Coupon redemption (and purchase) rates were 10 times greater for shoppers who had encountered the smaller subset of jams rather than the complete display. Similarly, a field study by Bertrand et al. (2006) offers evidence that loan take-up is significantly greater when a single loan is offered than when multiple loans are offered. Iyengar and Kamenica (2007) investigate a context in which people feel compelled to make a choice: retirement decisions. They find that the presence of a large variety of funds in employees' 401(k) plans leads them to simplify their retirement allocations by increasing their contribution to bond and money market funds.

The simplifying strategy that we focus on in our experiments is people's likelihood of accepting the default alternative for a given decision in the sequence. Defaults simplify choice because they reduce decision effort and can sometimes be interpreted as options that are endorsed by the firm or policy maker (Johnson and Goldstein 2003; McKenzie, Liersch, and Finkelstein 2006). Their influence on people's revealed preferences is pervasive. For instance, Madrian and Shea (2001) report that employees are much more likely to contribute to their retirement savings plan (401[k]) if enrollment in the plan is automatic (see also Choi et al. 2004). Similar effects have been observed in the domains of preferences for privacy and participation in e-mail lists online (Bellman, Johnson, and Lohse 2001) and, more dramatically, for participation in national organ donation programs (Johnson and Goldstein 2003; Abadie and Gay 2006).

As we explain above, our experimental treatment manipulates the configuration process such that the attributes with a greater number of options come first in the sequence and are followed by the attributes with a smaller number of options, or vice versa. Normatively, the sequence should not affect choices or willingness to pay; the same preference should be revealed irrespective of the sequence. If, however, choices are sensitive to the individual's capacity to evaluate options, then each sequence should yield different revealed preferences because decision makers will be depleted at different parts of the sequence depending on the experimental condition. In particular, we predict that people who encounter high-variety, depleting choices early in the sequence will evince a tendency to accept the default alternative in subsequent decisions even if these decisions involve relatively few options that would ordinarily require less capacity to evaluate. In contrast, those who begin the sequence with less complex decisions offering fewer options from which to choose will evince little effect of depletion later in a sequence, even if these subsequent decisions are of the complex, high-variety sort. This differential choice pattern provides firms with an opportunity to extract higher revenues from their customers by manipulating the order in which they present product attributes and the option that they select as the default alternative. We conduct our empirical tests in one framed and two natural field experiments involving real choices in financially consequential domains: custom-made men's suits and automobiles.

I. Suit Study

Design

We recruited 73 master of business administration (MBA) students at the University of St. Gallen in Switzerland under the aegis of a study about clothing taste in Switzerland and the United States. Participants were told that we would be raffling two business suits, custom made according to their specifications and taste by a well-known local tailor shop with which the students were familiar. MBA students are an ideal participant pool for a study involving suits because, at some point or another, they all purchase at least one suit for job interviews and summer internships. Participants were told that they would be asked to design a suit ensemble, including a shirt and tie, and that they would have to contribute SF 75 (Swiss francs) toward its cost (which was approximately SF 2,000) in the event that they won the raffle. The fee, a substantial charge for the typical student participant, was included in order to ensure that participants would understand that their selections had a significant financial consequence.[1]

Under the tailor's close guidance, we created a makeshift tailor shop in a laboratory space at the university. The tailor provided the shop's seven booklets of swatches of suit fabric (100 options), suit lining fabric (5), shirt fabric (50), tie fabric (42), suit buttons (20), dress belts (8),

[1] Participants were unaware of their odds of winning. Note that the expected value of the prize was approximately SF 53, derived by multiplying the odds of winning (2 in 73) by the value of the suit (SF 2,000 minus the SF 75 fee).

and dress socks (20). Upon arrival in the lab, participants were asked to complete a short survey in order to be provided "a standard set of recommendations" by the tailor. The survey asked participants to indicate their prospective use for the suit (multipurpose, business, private), whether and how often they intended to travel in their suit, and a subjective rating of their preference for a classic versus a modern look (on a seven-point scale with "rather modern" and "rather classic" as anchors). The survey was handed to an assistant, who proceeded to compile its results.

Next, participants were randomly assigned to one of two treatment conditions, high (hi) to low (lo) ($n = 34$) or lo to hi ($n = 39$). In the hi-to-lo condition, participants were presented with the booklets beginning with the attribute that had the most options (suit fabric, 100 options) and ending with the attribute that had the fewest options (suit lining, five options) in descending order; in the lo-to-hi condition, the order was reversed, that is, options were ordered in ascending order. The final choice for all participants in both conditions was the sock category (20 options). We included this item in order to ascertain the effect of our treatment for a category that was offered at the same point in the decision sequence for both conditions.

Participants were presented with each booklet of options in succession. For each booklet one of the options was randomly chosen to be the tailor's recommended option given the participant's survey responses.[2] This option was indicated by a small piece of poster board that was labeled "standard recommendation" and was attached to the item; the recommended option was considered the default option in our analysis. Participants' choices were recorded by the experiment's administrator. The dependent variable was whether the participant accepted the standard recommendation for each suit attribute. Thus, each participant provided seven observations, of which six belonged to the target attribute sequence.

After participants completed the suit configuration process, they were asked to complete a self-reported satisfaction survey that asked them to rate (on a 1–7 scale) their satisfaction with the ensemble that they had selected, how certain they were that their selections matched their preferences, their likelihood of making a similar selection in the future, and their satisfaction with the decision-making process.

[2] In order to make the study's administration more manageable, the recommended option was randomly chosen from a subset of three possible options that the tailor reported were mainstream.

Analysis and Results

The first six choices were analyzed using a series of four population-averaged logistic regressions with default choice as the dependent variable (socks were excluded and analyzed separately).[3] These analyses tested the effect of order using different assumptions about its functional form. More specifically, they allowed us to test for differences in the overall propensity to accept the default between conditions as well as the pattern of default taking in each experimental condition. The results are presented in table 1.

Our first specification included a dummy variable indicating the experimental condition, order (1 = hi-to-lo, 0 = lo-to-hi), and dummy variables indicating each of the suit's attributes, thus allowing for a nonlinear effect of the attributes on the probability of selecting a default. The reference category for the attribute dummy variables was the lowest-variety attribute, lining, with the remaining attributes coded in ascending order from low variety (attribute 2) to high variety (attribute 6). We observe a significant and positive effect of order, indicating that participants' revealed preference for their suit was influenced by the order of attribute presentation. In particular, the overall tendency to accept the default was greater when the number of options available decreased through the decision sequence (i.e., hi-to-lo). We also observe that the attribute coefficients progressively decreased, an intuitive result implying that the likelihood of default selection increases as variety increases.

However, our predicted depletion effect entails that default acceptance will be greater in the low-variety items when these are preceded by high-variety items, but not in the reverse order. In the second specification we test this hypothesis by adding an interaction term between each attribute and the order dummy variables. We find that the interaction parameters tend to decrease as attribute variety increases; that is, the difference between default choice early in the sequence and late in the sequence is greater in the hi-to-lo condition than in the lo-to-hi condition. This pattern is reflected in figure 1: the slope of the proportion of customers accepting the default across the decision sequence is negative in the hi-to-lo condition but appears to be approximately flat in the lo-to-hi condition.

We also tested versions of specifications 1 and 2 that assume a linear effect of the attributes. In particular, the third specification included an order dummy and an attribute variable, and the fourth added to this

[3] We also ran the same analysis using a random effects logistic regression, with participants treated as a random factor in order to account for the individual-specific tendency to accept a default (i.e., observations were "grouped" by individual). The results were virtually identical to the population-averaged models, attesting to the robustness of our findings.

TABLE 1
Analysis of Default Choice for the Suit Study

Variable	Specification 1	2	3	4
Order	.630***	1.052**	.629***	1.345***
	(.226)	(.494)	(.225)	(.372)
Attribute			−.188***	−.031
			(.062)	(.087)
Attribute 2	−.059	.123		
	(.339)	(.487)		
Attribute 3	−.241	−.585		
	(.343)	(.538)		
Attribute 4	−.715**	−.585		
	(.361)	(.538)		
Attribute 5	−.641*	.000		
	(.357)	(.493)		
Attribute 6	−.871**	−.130		
	(.369)	(.501)		
Attribute 2 × order		−.359		
		(.681)		
Attribute 3 × order		.585		
		(.718)		
Attribute 4 × order		−.270		
		(.729)		
Attribute 5 × order		−1.296*		
		(.717)		
Attribute 6 × order		−1.527**		
		(.748)		
Attribute × order				−.310**
				(.125)
Constant	−.721***	−.934***	−.668***	−1.032***
	(.267)	(.356)	(.212)	(.268)

Note.—N = 73. Order is a dummy variable indicating the experimental condition (0 = lo-to-hi; 1 = hi-to-lo). In specifications 1 and 2, attribute is a dummy variable that indicates the suit's attribute. The attribute dummies are numbered in ascending order of variety, with the lowest-variety attribute omitted. In specifications 3 and 4, attribute is coded to reflect an assumption of a linear effect. Standard errors are in parentheses.
* $p < .10$.
** $p < .05$.
*** $p < .01$.

an order × attribute interaction effect. As in specification 1, the results of specification 3 reflect a negative effect of variety on the selection of defaults—as is apparent from the negative attribute parameter—and also replicate the main effect of order. Adding an interaction between order and the linear attribute term reveals that the slope of default taking across attributes in the hi-to-lo condition ($b = -.341$, standard error [SE] = .0876, $p < .01$) is steeper than the corresponding slope in the lo-to-hi condition ($b = -.031$, SE = .0891, $p = .724$).[4]

[4] The results for the sock decision also hint at a depletion effect. Hi-to-lo condition participants were much more likely to accept the default sock than their counterparts in the lo-to-hi condition (53 percent vs. 36 percent, respectively). Unfortunately, because of sample size limitations, this difference was not statistically significant at conventional α levels ($\chi^2 = 2.14$, $p = .14$).

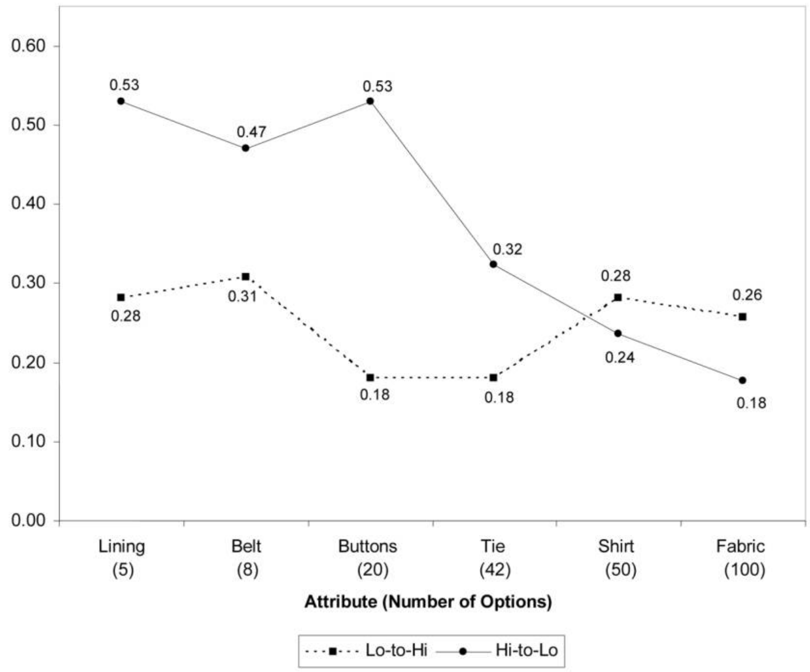

Fig. 1.—Default choice in the suit study: proportion of default choice as a function of attribute. Hi-to-lo participants advanced from right to left and lo-to-hi from left to right.

Finally, the responses to the satisfaction questions were highly correlated with each other (Cronbach $\alpha = 0.77$), so we created an overall satisfaction index. Participants reported being more satisfied in the lo-to-hi condition than in the hi-to-lo condition (4.8 vs. 4.2, respectively; $t(71) = 2.66$, $p = .01$). This difference is important because customer satisfaction is related to stock price and financial performance measures such as return on investment (Gupta and Zeithaml 2006), and firms spend considerable financial resources on surveying satisfaction and using it as an input to corporate decisions.

II. Car Study I

Next we tested our order effect on the purchase of a high-priced durable good: an automobile. This test also enables us to show how depletion can be exploited by firms to increase their revenue. The two experiments that we report next are natural field studies that were conducted in dealerships of a major European automobile manufacturer.[5] Participants

[5] The manufacturer requested that we withhold its name.

were 750 car buyers (450 in the first study and 300 in the second) across three major metropolitan areas in Germany. There are some small but important design differences between the two studies, so we present them separately.

In Germany, customers of the manufacturer that participated in our experiments configure their vehicle to their own specification and purchase it in advance of delivery; cars are not purchased off the dealer's lot. Typically customers either configure their car using the company's configuration software on the Internet or use a catalog that is presented to them by the salesperson at the dealership. Our studies were conducted at a computer terminal in the dealership using the same configuration software available to customers who configure their car on the Internet. We restricted our sample to customers who had come to the dealership to purchase the manufacturer's entry-level sedan and who had not previously configured their car online. The screening was conducted by the salesperson; if prospective customers did not meet both of these criteria, they were not invited to participate. Participants were told by the salesperson that the manufacturer was testing the use of its configurator at its dealerships and that they could configure the car that they had come to purchase on the computer. Those who chose to participate were given a free miniature toy car (approximate value US$7) as a token of appreciation for using the computerized configuration. (Note that the salespeople were blind to the purpose of the experiment.)

The configuration process includes a sequence of 67 decisions about attributes of the car, made one at a time by clicking on the desired option, and takes approximately 30 minutes to complete. Each decision appears on a different screen, with a sidebar indicating the total price of the car to that point and all the features it includes. With each configuration decision the price is updated on the screen, and at any point, customers are free to revise their previous choices or scroll (click) forward. This is an important aspect because it means that all customers can have access to information about any attribute at any point in time.[6] Each attribute consists of a different variety of options, and different options have different prices; for instance, there are 56 interior colors and 13 types of wheel rims from which to choose. At every screen there is a default option that is already checked off by the manufacturer (e.g., the default engine is 1.6 liters with a five-speed manual transmission). For all attributes except exterior color, the default is the cheapest option

[6] Some readers might be concerned about interattribute dependencies in our experiment, such that choosing one option would restrict potential choices in subsequent options. This was not the case for any of our target attributes (in fact, only the top-of-the-line sport package creates a restriction on some attributes; only two participants in the control conditions actually chose this package).

and appears at the top of the list.[7] We selected eight "target" attributes for the purposes of our experiment (number of options in parentheses): interior color (56), exterior color (26), engine and gearbox (25), wheel rims/tires (13), steering wheel (10), rearview mirror (6), interior decor style (4), and gearshift knob style (4). The target attributes were placed at the beginning of the configuration sequence, and our manipulation consisted of changing their order.

Design

After the initial screening questions, each customer-participant began by completing a short questionnaire in which he (or she) was asked to state his willingness to pay for the new sedan. This question was designed to make the customer's budget constraint salient and as a way to emphasize the magnitude of the financial commitment at stake. Next respondents were asked to rate their knowledge about the vehicles produced by the participating manufacturer (on a 1–7 scale). Finally, in the last phase of the preconfiguration survey, participants were asked to rate the importance of each of the target attributes using a constant sum scale in which they allocated 100 points across the eight attributes according to subjective importance. The software forced participants to allocate all 100 points but allowed for ties and for zeros. The purpose of this survey item was to test whether self-rated importance exerted any effect on customers' choices in our study.

Next participants were randomly assigned to one of three groups by the configuration software. As in the suit study, we manipulated the order in which participants made their decisions regarding the (eight) target attributes. The target attributes appeared at the beginning of the configuration process. In the hi-to-lo group ($n = 150$) participants were presented with a sequence that was sorted by descending variety such that the attribute that had the most options (interior color, 56) appeared first and the attribute with the fewest options (gearshift knob style, four) appeared eighth. The lo-to-hi group ($n = 150$) was presented with the exact opposite, ascending sequence (i.e., gearshift style was first and interior color eighth). Control condition participants ($n = 150$) were presented with a randomly determined sequence of the eight attributes. The remainder of the configuration was identical for all participants. Our dependent variable was whether or not the customer-participant accepted the default option at each of the eight stages of the (target) decision sequence. Thus, each customer provided eight observations.

[7] Note that the manufacturer specified the default levels and did not allow us to manipulate them. Recall, however, that we randomized the default in the suit study. This indicates that our order effect does not depend on the default being set at a specific level or price.

In addition to recording the customer's selections, the software also recorded the price of the chosen option, the time taken to arrive at the choice, and the total price for the configured car.

At the end of the configuration process participants were asked to indicate their satisfaction with the configuration software and the car, their likelihood of configuring the same car again, their satisfaction with the decision-making process, and the extent to which the car they had configured matched their preferences (all measured on 1–7 scales). Having completed the configuration process, participants notified the dealer, who then proceeded to print a summary of their selections and to input them directly into the manufacturer's ordering system, as would normally be done any time a car was configured (at the time of our study this process was conducted manually). The latter system generated a purchase order that participants then proceeded to sign and that represented the contract for the car's purchase (there was no opportunity to bargain on the car price). Thus, the data we analyze from the configurator matches the purchase order that customers signed.[8]

Analysis and Results

We used the exact same approach as in the suit study to analyze our eight manipulated attributes in this study, except that here we included the covariates of self-rated knowledge and importance. We controlled for the knowledge variable because we suspected that more knowledgeable customers would be less likely to be affected by our experimental treatment. The importance parameter was added to ascertain whether participants show greater resistance to the default when they consider the attribute to be important. Note that the decisions of control condition participants were not included in the regression analyses since we did not expect to find the same depletion pattern when the order of attributes was random rather than ordered.

Table 2 presents the key summary statistics, and table 3 presents the results of our analyses of the influence of order in this study. The proportion of participants accepting the default for each attribute, in each

[8] Note that theoretically it was possible to change the purchase order until a few weeks prior to the car's delivery. Only some of the attributes were changeable and only up to a certain date (e.g., the engine could be changed until 4 weeks prior to delivery). For various reasons related to German privacy laws, we were not able to obtain the data on the exact correspondence between the configured car and the ultimately delivered car. However, in data collected subsequent to our studies, we were able to obtain the price of the configured car and the price of the delivered car for a separate sample ($N = 113$) of buyers of the same entry-level sedan. The average configured price was €38,196, and the average final order price was €39,818. The €902 represents only a 2.2 percent difference between the configured and the delivered car. Thus, the correspondence between the configured and the delivered car was expected to be extremely high.

TABLE 2
Summary Statistics for Car Study I

Attribute (Options)	Lo-to-Hi	Hi-to-Lo	Control
Gearshift style (4):			
Default proportion	.28	.41	.37
Average price	169.67	115.80	136.33
Standard deviation	146.28	130.43	140.22
Average time (secs.)	17.19	29.82	24.31
Standard deviation	11.78	17.92	14.23
Interior decor (4):			
Default proportion	.33	.39	.36
Average price	181.53	108.53	147.13
Standard deviation	300.82	182.13	246.39
Average time (secs.)	19.43	30.47	27.41
Standard deviation	12.69	20.03	19.47
Rearview mirror (6):			
Default proportion	.40	.55	.51
Average price	191.33	141.33	148.77
Standard deviation	165.57	155.69	158.36
Average time (secs.)	22.09	31.82	29.73
Standard deviation	14.97	24.08	18.09
Steering wheel (10):			
Default proportion	.28	.38	.37
Average price	262.53	193.90	203.67
Standard deviation	200.33	183.15	186.37
Average time (secs.)	68.31	94.09	82.96
Standard deviation	60.27	97.01	81.07
Rims and tires (13):			
Default proportion	.30	.37	.37
Average price	1,006.00	895.00	906.33
Standard deviation	557.98	456.82	495.53
Average time (secs.)	76.25	102.17	93.63
Standard deviation	60.77	84.53	120.80
Engine and gearbox (25):			
Default proportion	.19	.11	.12
Average price	28,543.53	29,986.93	29,346.53
Standard deviation	3,264.16	3,580.49	3,177.73
Average time (secs.)	115.65	81.35	91.77
Standard deviation	123.87	64.09	89.85
Exterior color (26):			
Default proportion	.33	.29	.31
Average price	561.27	660.27	625.87
Standard deviation	486.31	532.64	520.62
Average time (secs.)	157.83	121.87	133.17
Standard deviation	162.62	98.68	114.16
Interior color (56):			
Default proportion	.19	.13	.13
Average price	131.93	347.27	199.47
Standard deviation	579.27	940.03	756.69
Average time (secs.)	135.25	107.43	117.79
Standard deviation	156.65	95.19	118.45

TABLE 2
(*Continued*)

Attribute (Options)	Lo-to-Hi	Hi-to-Lo	Control
Total price (euros)	35,808.00	37,290.37	36,424.07
Standard deviation	3,900.53	4,147.92	3,730.18
Total time (secs.)	1,763.35	1,762.23	1,760.12
Standard deviation	442.57	395.75	457.89

NOTE.—The table lists the attribute and (in parentheses) the number of options available for that attribute, proportion of customers accepting the default for the attribute, the average price paid for the attribute, and the average time in seconds it took from the moment that the attribute was displayed to the moment that the customers clicked over to the next attribute for each treatment condition and the control. In addition, the last rows display the total price and time taken. Note that in the lo-to-hi condition customers began with "gearshift style," i.e., the first row of the table, and moved "down" the table, whereas in the hi-to-lo condition customers began with "interior color," i.e., the last row of attributes, and then moved "up" the table.

treatment condition, is graphed in figure 2. We replicate the results of the suit study: a mere change in attribute order appears to influence revealed preferences and subsequent real purchase orders, even where attribute information is equally available to all participants at all times and there are no interattribute dependencies that restrict choice (see n. 6).[9] More specifically, all four regression specifications indicate that the overall tendency to accept the default was greater in the hi-to-lo condition than in the lo-to-hi condition. Furthermore, the effect of attribute and the pattern of increasingly negative (and significant) attribute × order interactions in the second regression specification indicate that the likelihood of accepting the default increased as participants progressed through the hi-to-lo sequence. The linearized version of this analysis, specification 4, showed a similar effect. The attribute × order interaction term indicates that the difference between the slope of default acceptance in the hi-to-lo condition ($\beta = -.137$, SE = .0413, $p = .001$) and the corresponding slope in the lo-to-hi condition ($\beta = .004$, SE = .0445, $p = .928$) was significant. Finally, greater knowl-

[9] Note that the pattern of results in the control condition appears to be mixed. Although the decision time for each attribute and the prices paid for the car were generally in the middle of the range of decision times and prices paid for each treatment condition (as were the satisfaction ratings, which we do not report here), for some attributes (e.g., engine) the proportion of default acceptance tended to resemble the hi-to-lo condition more closely. At first blush, the latter may seem at odds with our interpretation that the default choice pattern that we observe is the result of a depletion effect in the hi-to-lo condition rather than some kind of "repletion effect" in the lo-to-hi condition. We believe, however, that the control condition results are not inconsistent with our depletion explanation. As can be seen in table 2, in the low-variety items (e.g., gearshift style or interior décor), default taking in the control condition falls between the two treatment conditions. As we explain in the introduction, the effect of depletion should be most apparent in low-variety choices that follow high-variety choices, since high-variety choices should be depleting regardless because of the sheer amount of options that need to be considered. Hence, we see little difference in the proportion of default taking between both treatment conditions (i.e., hi-to-lo vs. lo-to-hi) and the treatment and control conditions for high-variety items but do find differences for low-variety items.

TABLE 3
ANALYSIS OF DEFAULT CHOICE FOR CAR STUDY I

Variable	Specification 1	Specification 2	Specification 3	Specification 4
Order	.216**	.579**	.211**	.648***
	(.092)	(.247)	(.090)	(.157)
Attribute			−.083**	−.014
			(.023)	(.030)
Attribute 2	.072	.232		
	(.172)	(.251)		
Attribute 3	.528***	.522**		
	(.168)	(.247)		
Attribute 4	−.059	.000		
	(.173)	(.257)		
Attribute 5	−.018	.124		
	(.174)	(.255)		
Attribute 6	−.756**	−.173		
	(.369)	(.420)		
Attribute 7	−.024	.368		
	(.203)	(.271)		
Attribute 8	−.962***	−.448		
	(.212)	(.286)		
Attribute 2 × order		−.302		
		(.344)		
Attribute 3 × order		.030		
		(.339)		
Attribute 4 × order		−.112		
		(.349)		
Attribute 5 × order		−.264		
		(.348)		
Attribute 6 × order		−1.163***		
		(.413)		
Attribute 7 × order		−.750**		
		(.350)		
Attribute 8 × order		−1.026**		
		(.406)		
Attribute × order				−.136***
				(.040)
Importance	−.009	−.009	−.020***	−.020***
	(.008)	(.008)	(.004)	(.004)
Knowledge	−.060**	−.060**	−.059**	−.059**
	(.028)	(.028)	(.027)	(.272)
Constant	−.825***	−1.021***	−.662***	−.887***
	(.145)	(.192)	(.102)	(.123)

NOTE.—N = 300. Order is a dummy variable indicating the experimental condition (0 = lo-to-hi; 1 = hi-to-lo). In specifications 1 and 2, attribute is a dummy variable that indicates the car's attribute. The attribute dummies are numbered in ascending order of variety, with the lowest-variety attribute omitted. In specifications 3 and 4, attribute is coded to reflect an assumption of a linear effect. Importance is an attribute importance constant-sum scale rating provided by the customer. Knowledge is an index summarizing a series of questions about the customer's self-rated knowledge about the participating manufacturer's automobiles. Standard errors are in parentheses.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

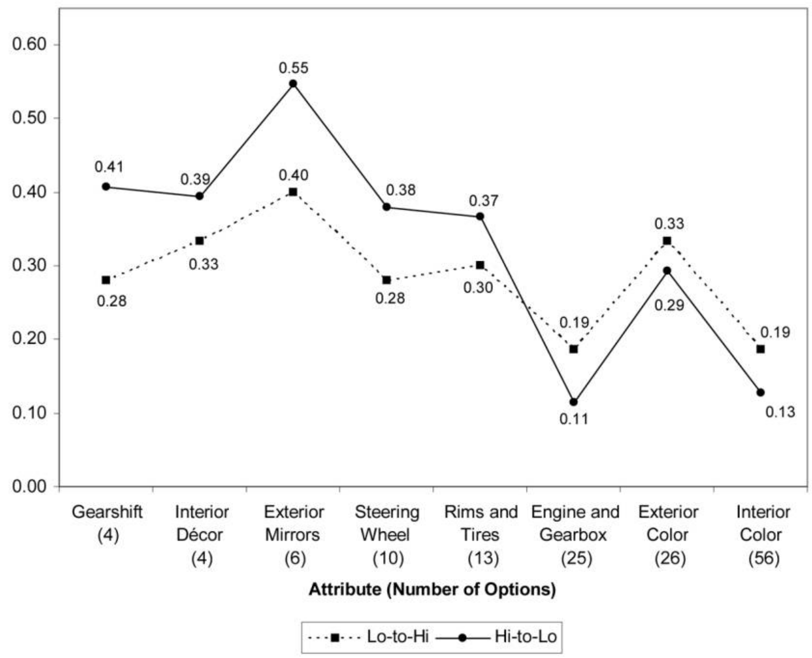

FIG. 2.—Default choice in car study I: proportion of default choices as a function of attribute. Hi-to-lo participants advanced from right to left and lo-to-hi from left to right.

edge was associated with a reduced likelihood of default acceptance. The effect of importance depended on the specification used.

We also obtained data on how long it took each participant to make his or her choice for each attribute, as well as the duration of the overall configuration process. The average total configuration completion times were within 3 seconds of each other in all conditions and stood at just under 30 minutes (see table 2). The timing data for the eight manipulated attributes (in the treatment conditions) are plotted in figure 3. Note that the pattern of the time taken tracks the choice pattern: where participants chose the default, they also took longer. If time is taken as a proxy for decision effort, then it appears that participants did not disengage from the decision process when choosing the default. It is noteworthy that for every attribute decision, times differed significantly between experimental conditions. Nonetheless, it is possible that one segment of participants chose the default as a way to disengage quickly from the decision process whereas the other remained engaged for a very long time before making a choice. In order to examine this possibility, we compared the mean time taken by customers who chose the default for a given attribute with the mean time taken by customers who

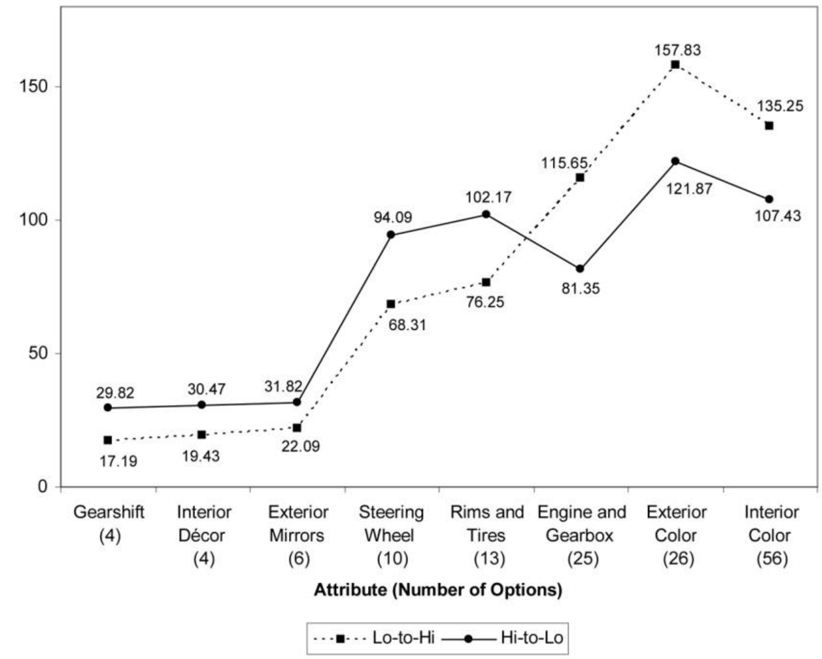

FIG. 3.—Timing of choices in car study I: time taken in seconds as a function of attribute. Hi-to-lo participants advanced from right to left and lo-to-hi from left to right.

did not accept the default, for each condition. Of the 16 possible comparisons that we tested, only one was significant at a conventional α level of .05, about what would be expected by chance alone.

An analysis of the total price for the configured automobile demonstrates the potential financial consequences of our experimental manipulation in this study. Table 2 shows the prices for each of the eight target attributes and for the car overall in each condition. Since the order manipulation affected the features of the vehicle that participants chose and where participants accepted the default, it also affected its price: participants in the hi-to-lo condition paid €1,482.37 more than they did in the lo-to-hi condition, a statistically significant difference ($t(298) = 3.18, p < .01$). This difference indicates that the effects of our subtle order manipulation—recall that order was altered for only eight of the automobile's 67 configurable attributes—were of financial consequence. The results hint that, under certain circumstances, the firm might be able to increase its revenues using a potentially costless manipulation of strategically altering the order of the configuration as well as the default option for certain attributes.

Finally, owing to the high correlation between the satisfaction measures, we combined them to form a satisfaction index (Cronbach $\alpha = 0.91$). In a replication of the suit study, participants reported greater satisfaction in the lo-to-hi condition than in the hi-to-lo condition ($t(298) = 5.12$, $p < .0001$). It is noteworthy that there was no statistically significant correlation between self-reported satisfaction and purchase price ($r = -0.02$, not significant).

III. Car Study II

The price difference that we found in the previous study raises the question of whether a higher willingness to pay is endemic to hi-to-lo sequences. We suggest that this is not the case. Instead, we believe that the reason we observed price differences was that the target attribute sequence included a relatively high-priced item, an engine, whose default option was substantially cheaper in absolute terms than its nondefault options (a difference of €4,200 between the default and the next more expensive option). Since the engine was a high-variety item (25 options), hi-to-lo participants chose it early in the sequence, hence increasing their likelihood of choosing a more expensive, nondefault engine. Thus, we reason that placing the engine after the target attribute sequence should diminish the price difference that we observed in car study I because, by the time they make their engine selection, participants in both the hi-to-lo and lo-to-hi conditions should be relatively depleted. This is a particularly important issue for firms because it means that willingness to pay might depend not only on the configuration sequence but also on the price of the attributes in the sequence.

In order to address this matter we replicated car study I in a follow-up study with another group of 300 entry-level sedan purchasers in the same participating dealerships approximately 6 months after the first study. In addition to replacing the engine with a cheaper item, a radio (four options), we also removed the importance rating task from the preconfiguration questionnaire. The engine now appeared after the target attributes in both the hi-to-lo ($n = 150$) and lo-to-hi ($n = 150$) conditions. We did not include any control conditions in this follow-up study.

Analysis and Results

We followed the same analytic strategy in this experiment as in the previous study. Table 4 presents the summary statistics, and table 5 presents the results of the four regression specifications that tested the effect of our order manipulation. The order effect that we observe in this study is consistent with the effect observed in the suit and car I studies, although here its influence is weaker. Furthermore, in the sec-

TABLE 4
Summary Statistics for Car Study II

Attribute (Options)	Lo-to-Hi	Hi-to-Lo
Radio (4):		
Default proportion	.28	.31
Average price	506.60	471.03
Standard deviation	358.49	348.67
Average time (secs.)	26.25	30.73
Standard deviation	17.80	18.59
Gearshift (4):		
Default proportion	.29	.35
Average price	160.40	128.27
Standard deviation	143.69	129.44
Average time (secs.)	19.73	26.91
Standard deviation	11.21	16.02
Interior decor (4):		
Default proportion	.31	.35
Average price	160.93	144.53
Standard deviation	276.46	237.95
Average time (secs.)	20.17	29.63
Standard deviation	12.02	20.60
Rearview mirror (6):		
Default proportion	.39	.49
Average price	194.40	155.20
Standard deviation	163.42	159.23
Average time (secs.)	21.53	29.67
Standard deviation	12.64	18.63
Steering wheel (10):		
Default proportion	.31	.38
Average price	242.23	215.70
Standard deviation	196.12	197.55
Average time (secs.)	76.69	89.50
Standard deviation	63.68	75.27
Rims and tires (13):		
Default proportion	.32	.34
Average price	955.33	931.67
Standard deviation	502.88	482.42
Average time (secs.)	83.47	81.19
Standard deviation	64.27	57.74
Exterior color (26):		
Default proportion	.34	.29
Average price	575.13	625.87
Standard deviation	505.05	555.79
Average time (secs.)	151.13	128.67
Standard deviation	107.93	75.24
Interior color (56):		
Default proportion	.19	.22
Average price	164.87	305.13
Standard deviation	631.67	758.25
Average time (secs.)	145.11	106.47
Standard deviation	99.84	82.08

TABLE 4
(*Continued*)

Attribute (Options)	Lo-to-Hi	Hi-to-Lo
Total price (euros)	36,435.83	36,200.80
Standard deviation	4,176.08	4,181.72
Total time (secs.)	1,755.65	1,759.65
Standard deviation	386.85	392.00

NOTE.—The table lists the attribute and (in parentheses) the number of options available for that attribute, the proportion of customers accepting the default for the attribute, the average price paid for the attribute, and the average time in seconds it took from the moment that the attribute was displayed to the moment that the customers clicked over to the next attribute for each treatment condition. In addition, the last rows display the total price and time taken. Note that in the lo-to-hi condition customers began with "gearshift style," i.e., the first row of the table, and moved "down" the table, whereas in the hi-to-lo condition customers began with "interior color," i.e., the last row of attributes, and then moved "up" the table.

ond regression specification, the pattern of increasingly smaller attribute × order interactions is far less evident than in the previous studies (see fig. 4). Finally, whereas the slope in the hi-to-lo condition significantly differs from zero ($\beta = -.058$, SE $= .0263$, $p = .027$) and its lo-to-hi counterpart does not ($\beta = .024$, SE $= .0272$, $p = .379$), the fourth regression specification indicates that these slopes are not significantly different from each other. The weaker effects that we observe in this study are not surprising given the fact that we replaced a high-variety item (the engine had 25 options) with a low-variety item (the radio had only four options), which would naturally reduce the degree of depletion experienced by our participants. Indeed, this observation highlights the link between depletion, variety, and attribute order: higher- (lower-) variety items early in the sequence will lead to greater (lower) depletion and, in turn, larger (smaller) effects of attribute order on choices.

The average duration of the total configuration process in this study was within 5 seconds of the duration in the previous car study and again stood at just under 30 minutes. Figure 5 plots the average duration of each decision in the configuration process in each experimental condition. As in the previous car study, here, too, the timing data pattern tracks the choice data pattern and suggests that the default choice was not the result of a lack of effort. Furthermore, for six of the eight attributes the difference in time taken between conditions is significant (and marginally so for the seventh). We also analyzed the time taken to reach a decision conditional on whether the customer had chosen the default. As in car study I, time to decision did not depend on the default choice in this study either.

Removing the engine from the target attribute list eliminated any statistically significant differences in purchase price between conditions

TABLE 5

ANALYSIS OF DEFAULT CHOICE FOR CAR STUDY II

Variable	Specification 1	2	3	4
Order	.171*	.129	.168*	.285*
	(.094)	(.254)	(.093)	(.159)
Attribute			−.041**	−.024
			(.019)	(.027)
Attribute 2	.141	.065		
	(.175)	(.252)		
Attribute 3	.186	.160		
	(.174)	(.250)		
Attribute 4	.639***	.483**		
	(.170)	(.244)		
Attribute 5	.246	.160		
	(.174)	(.250)		
Attribute 6	.171	.191		
	(.175)	(.250)		
Attribute 7	.095	.281		
	(.176)	(.248)		
Attribute 8	−.467**	−.484*		
	(.189)	(.272)		
Attribute 2 × order		.146		
		(.351)		
Attribute 3 × order		.051		
		(.349)		
Attribute 4 × order		.306		
		(.341)		
Attribute 5 × order		.166		
		(.348)		
Attribute 6 × order		−.038		
		(.349)		
Attribute 7 × order		−.377		
		(.352)		
Attribute 8 × order		.034		
		(.378)		
Attribute × order				−.034
				(.038)
Knowledge	.003	.003	.002	.002
	(.035)	(.035)	(.034)	(.034)
Constant	−.966***	−.944***	−.680***	−.740***
	(.136)	(.181)	(.093)	(.115)

NOTE.—N = 300. Order is a dummy variable indicating the experimental condition (0 = lo-to-hi; 1 = hi-to-lo). In specifications 1 and 2, attribute is a dummy variable that indicates the car's attribute. The attribute dummies are numbered in ascending order of variety, with the lowest-variety attribute omitted. In specifications 3 and 4, attribute is coded to reflect an assumption of linearity. Knowledge is an index summarizing a series of questions about the customer's self-rated knowledge about the participating manufacturer's automobiles. Standard errors are in parentheses.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

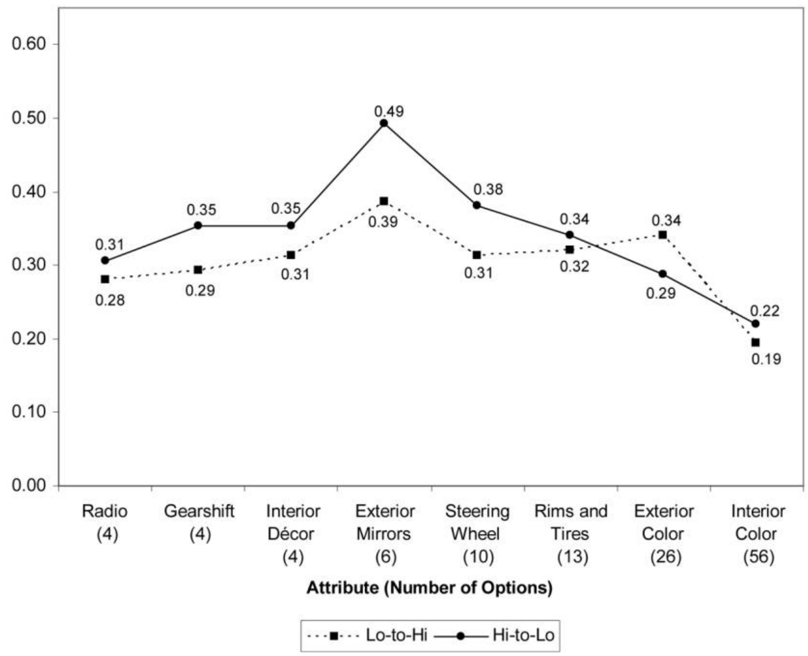

Fig. 4.—Default choice in car study II: proportion of default choices as a function of attribute. Hi-to-lo participants advanced from right to left and lo-to-hi from left to right.

(see table 4), indicating that higher prices are not endemic to certain sequences, for example, hi-to-lo, but instead that prices are sensitive to which attributes are in the sequence and where those attributes appear. This insight suggests that a firm can potentially exploit its customers by adjusting the placement of its high-priced attributes in the configuration sequence to either coincide or not coincide with the periods in which its customers appear to evince depletion. In our setting the firm was able to achieve significantly higher revenues in car study I by manipulating the location of the engine; prices were higher in the condition in which customers elected to purchase something other than the lower-priced, default engine option.

Finally, we replicate our satisfaction result from the previous studies. We again created a satisfaction index from the satisfaction questions (Cronbach's $\alpha = 0.88$); lo-to-hi participants reported being more satisfied than hi-to-lo participants ($t(298) = 3.68$, $p < .0001$). As in the previous study, satisfaction was not correlated with price ($r = -.05$, not significant).

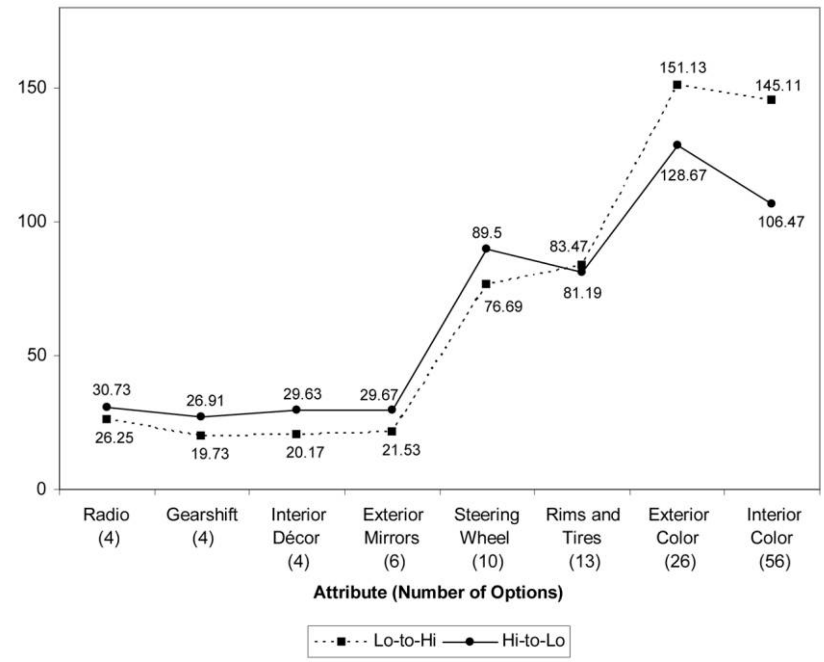

FIG. 5.—Timing of choices in car study II: time taken in seconds as a function of attribute. Hi-to-lo participants advanced from right to left and lo-to-hi from left to right.

IV. Conclusion

We have examined the influence of attribute order on product customization decisions. Our results suggest that in some circumstances order of attributes can change people's revealed preferences in customization decisions of major durable goods. When attributes with relatively few options follow attributes with relatively many options—a high-to-low sequence—people appear more likely to accept default options than when this sequence of attributes is reversed. In particular, the tendency to accept the default appears to increase through the high-to-low sequence despite the fact that attributes with relatively few options can be theoretically less costly to consider. The tendency to accept the default in a reverse, low-to-high sequence remains unchanged throughout the customization process. The fact that we observe our effect across entirely unrelated product categories that are characterized by completely different attributes hints at the generalizability of the effect of order in product choice.

Our findings offer implications for the conception of preferences in differentiated product models as well as for firms. First, although the representation of product preferences as the summation of attribute preferences is both intuitively and econometrically attractive, it may embody an idealization that does not hold in some contexts, just as it did not hold in our empirical tests. The price differences that we report in the car studies suggest that price differences observed by the econometrician might not always reflect stable underlying preferences (i.e., demand) for product attributes.

Second, a firm that offers customizable products might be able to increase its revenues in contexts in which its customers appear sensitive to attribute order. For instance, the firm can use the order manipulation reported herein and then offer a higher-priced default alternative for attributes that appear later in the decision sequence. Note that it is not necessarily the case that, at equilibrium, all firms should converge on the same attribute order, for example, hi-to-lo, because price paid is a function of the *combined* effect of order and which option is the default, and this might vary depending on the product. An added complication is that different orders yield different levels of customer satisfaction, which in turn can affect future sales. Revenues in the short run must be balanced against the potential loss of customers in the long run. Although we cannot measure the actual magnitude of the welfare implications of our order effect, if one makes the reasonable assumption that high-priced items have higher margins, the price difference that we observe suggests that firm surplus is likely positively affected.

Finally, the order effect we observe offers empirical evidence consistent with a tradition of research in experimental psychology and behavioral economics about the malleability of revealed preferences (Payne, Bettman, and Johnson 1993; Payne et al. 2000; Ariely, Loewenstein, and Prelec 2003). This literature shows that sometimes normatively equivalent decision contexts—as is the case for our experimental groups—yield different decisions. Although this research is typically viewed as a challenge to the assumption that people maximize utility and possess a complete preference ordering, some have argued that consumers rationally use decision context as a way to obtain market-related information (Wernerfelt 1995; Kamenica 2008). Similarly, it may be possible to explain the results we report here with a rational framework, albeit under relatively implausible assumptions. First, suppose that consumers infer that attributes that come earlier in the sequence are somehow more important. Next, assume that the return on the effort spent on the important attributes increases with the number of attribute options available whereas the return on effort spent on the nonimportant attributes is fixed. A fixed or highly convex time budget would lead to our observed results.[10] We believe, however, that the findings that we

[10] We thank a reviewer for this suggestion and reasoning.

report herein are unlikely to be the consequence of such rational thinking on the part of consumers, if only because it is difficult to conjure rational thinking that would lead one group of consumers to choose a different car than another group simply because of a trivial difference in the order of eight of 67 attributes. Instead, it is more likely that our findings are a consequence of people's bounded rationality and its effect on their revealed preferences, even for highly consequential decisions.

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