Customizing a product by choosing each of its attributes individually tends to be onerous for consumers, and the benefits of product customization may thus be offset by an increase in choice complexity. As a remedy for this dilemma, the current research introduces the customization via starting solutions (CvSS) architecture, which substantially reduces the complexity of product customization while preserving all of its advantages. Under CvSS, consumers first select one starting solution from a set of prespecified products, which they then refine to create their final customized product. Evidence from nine studies (three of which were conducted in field settings) across a wide range of product domains (shirts, cars, vacation packages, jewelry, and financial products) shows that the CvSS architecture results in substantial benefits relative to the standard attribute-by-attribute product customization format for both consumers (increased satisfaction with their product choices, reduced choice complexity, and enhanced mental simulation of product use) and firms (purchases of more feature-rich, and thus higher-priced, products).

Keywords: product customization, consumer decision making, choice architecture, field experiments

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across a wide range of product domains (shirts, cars, vacation packages, jewelry, and financial products) that demonstrates its effectiveness relative to the standard attribute-by-attribute product customization format.

The remainder of this article is organized as follows: First, we characterize the essential properties of the CvSS architecture, contrasting it against the standard attribute-by-attribute architecture of product customization. Next, we develop a set of hypotheses about how CvSS affects what products consumers ultimately choose and how satisfied they are with these products. We then present evidence from nine studies, including three field studies, that test these hypotheses, and we discuss the theoretical and practical implications of the findings.

**CvSS versus Attribute-by-Attribute Customization**

The standard method of product customization is the attribute-by-attribute format, whereby consumers configure their own product by choosing each of its attributes individually. This is currently the predominant method of product customization in practice, and it is used in connection with a wide range of products (Franke and Schreier 2010; see also www.configurator-database.com), including automobiles, homes, furniture, apparel, shoes, jewelry, foods, and many types of service packages. In attribute-by-attribute customization, consumers choose from a variety of product attributes, typically by selecting one of the options available in each of multiple attribute categories (Franke, Schreier, and Kaiser 2010; Levav et al. 2010; Valenzuela, Dhar, and Zettelmeyer 2009).

As an illustrative example of attribute-by-attribute customization, consider the case of a consumer who is using Audi’s web-based customization system to configure her Audi A6. First, she selects an engine type (e.g., 3.0 TFSI), then an exterior color (e.g., black with pearl-effect paint), an interior color scheme (e.g., titanium gray with brushed aluminum inlay), a wheel type (e.g., 20” spoke-star design), a safety package, an entertainment package, and several additional features. Eventually, she has fully specified all the customizable attributes of her new A6.

Configuring a product in this way offers substantial benefits to consumers compared with choosing one from a set of prespecified alternatives, particularly the opportunity to obtain a product that closely matches their personal preference (Ansari and Mela 2003). However, prior research has identified a significant downside to attribute-by-attribute customization by showing that it leads consumers to perceive the complexity of the decision process to be higher (Dellaert and Dabholkar 2009; Dellaert and Stremersch 2005; Zipkin 2001), which in turn might erode the benefits of customization and result in a negative net effect of customization on how satisfied consumers are with their chosen products (Dellaert and Stremersch 2005; Matzler, Stieger, and Füller 2011). We refer to this dilemma, whereby the very property of the attribute-by-attribute customization format that is intended to enable consumers to configure products in line with their preferences can actually render them less satisfied, as the “customization paradox.”

The present work introduces a novel approach to product customization that is intended to be a remedy for the customization paradox. The overarching goal was to develop a customization architecture that would reduce the perceived complexity of the decision process, relative to attribute-by-attribute customization, without compromising consumers’ freedom to specify all the attributes of their product so as to match their preferences. Inspired by insights from the fields of decision making and cognitive psychology, the proposed CvSS architecture partitions the process of configuring a customized product into two stages: First, consumers are presented with a small number of fully specified multiattribute products, and they select one—presumably the one that most closely resembles their desired combination of attributes—as their starting solution. Second, they configure their final customized product by refining this starting solution one attribute at a time, with the same options that would be available to them under a standard attribute-by-attribute architecture. That is, consumers are free to make any number of arbitrary modifications to their starting solution by both adding desired product attributes and removing unwanted ones. The primary motivation for the CvSS architecture was the expectation that the partitioning of the product configuration process would reduce its perceived complexity, in line with the notion that the partitioning of complex decisions into multiple stages is often beneficial (Beach 1993; Montgomery 1994; Saaty 1987). An additional anticipated benefit of the CvSS architecture was that being presented with fully specified products, instead of a menu of individual attributes, at the start of the configuration process would stimulate consumers’ mental simulation of product use (Elder and Krishna 2012; Engel, Fries, and Singer 2001).

Returning to the example of a consumer who is configuring her Audi A6, doing so using CvSS might unfold as follows. First, she is presented with three fully specified A6 models that have different combinations of engine type, exterior color, interior color scheme, wheel type, and other attributes. She selects one as her starting solution—an A6 with a 3.0 TFSI engine, black exterior with pearl-effect paint, titanium gray interior, and 18” wheels, among other features. Next, she has the opportunity to refine this starting solution by modifying any of its attributes. She decides to change the interior color to brown leather and the wheel type to the 20” spoke-star design, but she is happy with the remaining features of her starting solution.

The CvSS architecture offers consumers the same amount of flexibility, in terms of the various attributes available to them, as the attribute-by-attribute customization format. The only difference lies in the structure of the product configuration process. Figure 1 provides a stylized example that illustrates this difference. (The task in this example is to configure a graphic object by specifying its shape, line weight, fill color, and fill pattern.)

**THEORETICAL BACKGROUND AND HYPOTHESES**

**Partitioning of the Decision Process**

Prior research has shown that, relative to choosing one of several fully specified products from an assortment, customizing a product using an attribute-by-attribute architecture demands more cognitive resources (Levav et al. 2010), requires consumers to indicate their within-attribute preferences explicitly (Huffman and Kahn 1998), and leads them to experience a high level of decision process complexity (Dellaert and Stremersch 2005). Although reducing the
number of product attributes made available to consumers might, in principle, provide a partial solution to this inherent downside of attribute-by-attribute customization, this solution would be at odds with the seemingly universal tendency for products to become increasingly feature rich (Botti and Hsee 2010; Norton, Mochon, and Ariely 2012; Thompson, Hamilton, and Rust 2005). Thus, the question arises how best to reduce the complexity that consumers experience during the product customization process in a setting in which the number of possible product configurations is large.

Insights from prior work on problem solving suggest that partitioning a problem into several smaller, more manageable ones can mitigate the perceived difficulty of solving the overall problem (Lau, Yam, and Tang 2011; Von Hippel 1994). Similarly, in the domain of decision support systems, it is common to use architectures under which different elements of a decision problem are organized in a hierarchy of more comprehensible subproblems (Saaty 1987). This parallels prior work on toolkits for user innovation highlighting the benefits of preexisting module libraries that can be used during the early phases of solution development (Franke and Piller 2004; Von Hippel and Katz 2002). Moreover, a substantial body of research on human choice behavior has shown that decision makers naturally tend to follow a two-stage process when choosing their preferred alternative (Bettman and Park 1980; Chakravarti, Janiszewski, and Ülkümen 2006; Ge, Häubl, and Elrod 2012). In particular, they often process only a limited amount of information about the available alternatives during an initial screening stage (Beach 1993; Bettman and Park 1980; Galotti 2007; Häubl and Trifts 2000; Richmond, Bissell, and Beach 1998) and subsequently focus on evaluating in greater depth the small number of alternatives that have survived the screening (Andrews and Currim 2009; Benson and Beach 1996; Elrod, Johnson, and White 2004; Ge, Häubl, and Elrod 2012). The key rationale for such a two-stage partitioning is that it results in a simplification of the decision process (Beach 1993; Bettman and Park 1980; Hauser and Wernerfelt 1990; Roberts and Lattin 1991).

We propose that, analogous to the simplifying role of using a two-stage process to choose an alternative from a set, partitioning the task of configuring one’s own product into two stages will render the product customization process less onerous. That is, we predict that having consumers first select one of a small number of fully specified starting solutions, which they can then modify to create their final customized product, reduces the complexity of the process of configuring a product relative to the standard attribute-by-attribute customization format. We expect this effect to be driven, in particular, by the notion that the choice among a relatively small number of candidate starting solutions simplifies the decision process significantly compared with the multitude of individual (option) choices consumers must make under attribute-by-attribute customization. Thus, we hypothesize that the CvSS architecture causes consumers to perceive the process of configuring a product as less complex.

H1: Relative to attribute-by-attribute customization, CvSS reduces the perceived complexity of the product customization process.

The extent to which consumers perceive the customization process to be onerous may influence how they feel about the ultimate outcome of this process (i.e., their customized product). Prior work on the metacognitive experience of processing fluency suggests that the more easily a stimulus can be processed, the more positively it tends to be evaluated (Ariely and Norton 2009; Janiszewski 1993; Labroo, Dhar, and Schwarz 2008). Indeed, experienced fluency or disfluency can affect consumers’ evaluations of choice alternatives even if it does not arise from the level of difficulty associated with the decision per se (Alter and Oppenheimer 2006; Lee and Labroo 2004).

Building on the theory of, and empirical findings related to, the concept of processing fluency, we propose that the reduction in the perceived complexity of the product customization process caused by the CvSS architecture, in turn, has a favorable impact on consumers’ appraisal of the outcome of this process. Specifically, we hypothesize that the CvSS architecture has a positive influence on how satisfied consumers are with the product that they ultimately select and that it does so via a reduction in how complex the customization process is perceived to be.

H2: Relative to attribute-by-attribute customization, CvSS leads to greater choice satisfaction with the customized product.

H3: The positive effect of CvSS on choice satisfaction (H2) is mediated by a reduction in the perceived complexity of the customization process.

Top-Down Information Processing

Apart from the proposed reduction in complexity due to the partitioning of the product customization process into two stages, the CvSS architecture also has implications for how information about the range of possible product configurations is presented, and this might influence how consumers process that information. The standard product customization architecture requires consumers to configure their product in a bottom-up fashion, one attribute at a time. By contrast,
in the case of CvSS, the configuration process begins with the presentation of fully specified products, from which consumers select one as their starting solution. Thus, the information about the products that consumers might configure is conveyed in a more holistic fashion under CvSS, and any further configuration decisions that modify the starting solution take place in the presence of a complete description of that product.

Given this essential difference between attribute-by-attribute customization and CvSS in how product information is presented, these two customization architectures might also influence how consumers process this information. In line with the distinction between top-down and bottom-up modes of processing (Engel, Fries, and Singer 2001; Norman 2002), we propose that whereas the attribute-by-attribute format is naturally aligned with bottom-up processing of product information, CvSS promotes top-down processing.

These two information processing modes differ in their neurophysiological representation such that, among other aspects, top-down processing is more strongly associated with the dorsal region of the human brain, which is responsible for motor behavior and visual control (Engel, Fries, and Singer 2001; Goodale and Milner 1992; Norman 2002). Activation of brain regions that are associated with motor behavior should be conducive to mental simulation. This is consistent with recent findings suggesting a connection between mental simulation and increased levels of motor response (Elder and Krishna 2012; Tomasin et al. 2012; White 2012).

We propose that the bottom-up process of configuring a product one attribute at a time obstructs consumers’ ability to form a holistic impression of the product (see Simonson 2005) and, consequently, makes it difficult to visualize the act of using the product in one’s mind. By contrast, presenting consumers with a set of holistically characterized starting solutions at the beginning of the customization process should promote mental simulation of product use. Thus, we hypothesize that the CvSS architecture causes consumers to engage in more extensive mental simulation of using the product that they are configuring.

H3: Relative to attribute-by-attribute customization, CvSS enhances consumers’ mental simulation of product use.

Moreover, drawing on prior findings suggesting that mental simulation may have a positive effect on product evaluations (Escalas and Luce 2003; Zhao, Hoeffler, and Zauberman 2011), we predict that the heightened level of mental simulation caused by the CvSS architecture mediates its positive effect on consumers’ choice satisfaction with their configured products.

H4: The positive effect of CvSS on choice satisfaction (H2) is mediated by consumers’ enhanced mental simulation of product use.

Beyond the positive influence of mental simulation on satisfaction with a chosen product, prior research has shown that mentally simulating the use of products also affects consumers’ choices. Specifically, research shows that mentally simulating the benefits of each of several presented alternatives shifts consumers’ focus toward the desirability (vs. feasibility) of each alternative, reduces choice deferral, increases consumers’ satisfaction with their choice, and enhances mood during the decision process (Thompson, Hamilton, and Petrova 2009). For example, to demonstrate the effectiveness of mentally simulating the use of a product or service, Gregory, Cialdini, and Carpenter (1982) randomly assigned people either to read a persuasive message highlighting the benefits of a cable television service or to mentally simulate using the features of such a service. Those asked to mentally simulate the use of the cable service were more likely to subscribe to the service relative to those who merely read about its benefits. Thus, shifting consumers’ focus from merely thinking about a product’s attributes toward mentally simulating its use may stimulate thoughts about the alternatives’ attractiveness and the desirability of its attributes. Indeed, Zhao, Hoeffler, and Zauberman (2011) show that mental simulation of a product’s benefits can result in more favorable product evaluations and greater purchase intentions as well as greater accessibility of thoughts about the product’s benefits in memory.

Against this background, we propose that, relative to standard attribute-by-attribute customization, which inherently directs consumers’ attention to individual attributes rather than holistic products, CvSS enables consumers to identify desirable product features more easily. Viewing several fully specified products as possible starting solutions should promote mental simulation of product use, make it easier for consumers to appreciate the value of individual product features, and ultimately result in the choice of products that are more feature rich in the sense that they contain a greater number of optional (i.e., nonessential) features. Thus, we hypothesize that, compared with a standard attribute-by-attribute customization format, the CvSS architecture induces consumers to configure more feature-rich products and that this effect is mediated by a heightened level of mental simulation of product use.

H5: The positive effect of CvSS on choice satisfaction (H2) is mediated by consumers’ enhanced mental simulation of product use.

Figure 2 summarizes the hypotheses about the effects of the CvSS architecture relative to the standard attribute-by-attribute product customization format.

It is important to note that all of the hypotheses are orthogonal to the specific nature of the set of products from which consumers select their starting solution. That is, our predictions generalize to any such set. In particular, rather than hinge on specific (sets of) starting solutions, the hypothesized positive effect of CvSS on the feature richness of the chosen product is driven by consumers’ exposure to several holistically characterized alternatives and occurs through the resulting increase in mental simulation of product use during the customization process. Despite these critical conceptual distinctions, we empirically examine the possibility that consumers’ reluctance to alter starting solutions might contribute to the results of our studies.

Due to the lack of a clear theoretical rationale, our conceptual model does not include a hypothesis regarding the relationship between consumers’ satisfaction with their chosen products and the latter’s feature richness. On the one hand, the choice of more feature-rich products might attenu-
ate the positive effect of CvSS on satisfaction with customized products in line with what Thompson, Hamilton, and Rust (2005) term “feature fatigue.” On the other hand, consumers might indeed value the additional options they selected; in addition, the choice of more feature-rich products can confer social benefits (Thompson and Norton 2011). Despite the absence of a hypothesis, we examine the relationship between the feature richness of customized products and consumers’ satisfaction with these products throughout our studies.

Our theorizing about the effect of CvSS on the feature richness of customized products is inspired by prior work in the domains of defaults and option framing. Yet it differs from that research in important ways. In particular, research on default effects has shown that specifying a particular option as the default that can be selected through inaction (whereas deviation from the default requires effortful action) renders that option more likely to be chosen (Brown and Krishna 2004; Goldstein et al. 2008; Smith, Goldstein, and Johnson 2013). Inherent to the study of default effects is that only a single default is present for a given choice. By contrast, if the set of candidate starting solutions that consumers choose among under CvSS were conceptualized as defaults, this would imply a multiplicity of (competing) defaults. The current state of knowledge on default effects does not apply to such a setting. An alternative conceptualization would be to treat only the starting solution chosen by the consumer as the default. However, this too fails to align with prior work on default effects, which has focused on defaults set exogenously rather than chosen by decision makers themselves. By contrast, to the extent that a consumer-selected starting solution under CvSS might resemble a default, the latter would be endogenous with respect to the consumer’s preferences, and an apparent reluctance to deviate from this default might therefore simply be due to its endogeneity.

Prior research has examined the effects of either presenting people with a fully loaded alternative and asking them to remove options they do not want (“subtractive option framing”) or presenting them with the most basic alternative and asking them to add any options they desire (“additive option framing”) (Park, Jun, and MacInnis 2000). The result of such framing is that starting from a fully loaded (most basic) alternative leads to the choice of more (fewer) options (Herrmann et al. 2013; Park, Jun, and MacInnis 2000), in line with reference dependence and loss aversion (Kahneman and Tversky 1984; Smith, Goldstein, and Johnson 2013). The initially presented alternative in a subtractive versus additive framing paradigm could be viewed as a starting solution. However, such a conceptualization differs from that of starting solutions under CvSS in some critical respects. First, the initial alternative under subtractive versus additive framing is exogenous in the same way a default is. More importantly, the initial alternative is (by definition) at the extreme end of the spectrum of feature richness, and alterations are restricted to being unidirectional—for example, subtractive option framing only permits the removal of options, but no additions. By contrast, under CvSS, consumers choose their preferred starting solution, the set of available starting solutions need not include any extreme alternatives, and subsequent modifications of the starting solution are unrestricted in the sense that they can take the form of either adding or removing options.

**OVERVIEW OF STUDIES**

In what follows, we present evidence from nine studies designed to test our predictions. In the first eight studies, consumers customized a product by using either an attribute-by-attribute format or a CvSS format. Three of these studies examine customization decisions for shirts (Study 1), cars (Study 2), and vacation packages (Study 3) in field settings. Studies 4–8 investigate the underlying psychological process through web experiments on the customization of jewelry (Studies 4 and 5), financial products (Study 6), and cars (Studies 7 and 8). Finally, Study 9 examines consumer preference for customization formats across product categories.

**STUDY 1: FIELD STUDY (SHIRTS)**

We have hypothesized that the use of the CvSS architecture (rather than the attribute-by-attribute customization format) is associated with consumers’ choice of more feature-rich products and with reduced complexity of the decision process, as indicated by shorter completion times (Dellaert, Donkers, and Van Soest 2012; Tan, Tan, and Teo 2012). To
test our predictions, we conducted a field study in collaboration with a European shirt manufacturer.

**Context and Data Collection**

The partner company provided a combination of transaction and process data for shirt purchases made through its web-based store. In particular, we obtained data on 842 male customers who each purchased exactly one shirt. They used either the company’s standard attribute-by-attribute customization interface or a CvSS architecture to configure their shirts. The attribute-by-attribute architecture was designed such that shoppers could make a selection from each of 18 attribute categories (e.g., fabric, collars, sleeves, front pockets, cuffs), with an average of 16 options per category (range: [3;54]). By contrast, in the CvSS architecture, shoppers began by choosing one of 35 starting solutions (that included 3 prespecified options on average), which they were then able to modify one attribute at a time. During the period of data collection, both customization architectures were available at the company’s website, and consumers were free to choose whichever architecture they preferred to customize their shirt (for sample screenshots of the two architectures, see Figure 3).

**Measurement**

We merged shoppers’ transaction data (i.e., the purchased shirt’s features and its price) with process data capturing the amount of time they took to complete their product choice (from when they began shopping by selecting one of the two customization formats to when they placed the order for their shirts). We measured the feature richness of the shirts as the number of optional (i.e., nonessential) features—such as a monogram—that a shopper added to the baseline shirt. Finally, we quantified the extent to which shoppers using the CvSS format modified their starting solution as the proportion of the options prespecified in the chosen starting solution that were altered in configuring the final shirt, which we refer to as the deviation from starting solutions (DSS) index.

**Results**

Of the 842 shoppers, 728 used the standard attribute-by-attribute format and 114 chose the CvSS architecture. As we predicted, compared with customers who used the attribute-by-attribute format, those who used CvSS bought shirts that were significantly more feature rich in terms of the number of optional features (M\textsubscript{CvSS} = 10.46, M\textsubscript{AbAC} = 3.76; t(840) = 8.748, p < .001) as well as higher priced (M\textsubscript{CvSS} = €73.21, M\textsubscript{AbAC} = €57.77; t(840) = 3.245, p < .01; see Figure 4). Moreover, shoppers using CvSS completed the customization process more quickly than those using the attribute-by-attribute format (M\textsubscript{CvSS} = 13.88 minutes, M\textsubscript{AbAC} = 39.86 minutes; t(840) = 2.051, p < .05). These findings are consistent with our hypothesis that the CvSS architecture leads to the choice of more feature-rich—and thus more expensive—products while reducing the complexity of the product customization process (as reflected by task completion time in this study).

All 114 shoppers who used CvSS modified their chosen starting solution to create their final shirt. On average, these consumers altered 30% of the prespecified options, representing a significant deviation from their starting solutions (M\textsubscript{DSS} = .30, tested against 0: t(113) = 23.068, p < .001). Moreover, they included significantly more optional fea-
Product Customization via Starting Solutions

Figure 4
CVSS PROMOTES CHOICE OF MORE FEATURE-RICH AND HIGHER-PRICED PRODUCTS (STUDY 1)

A: Feature-Rich Products

- **Number of Selected Features**

<table>
<thead>
<tr>
<th>Attribute by Attribute</th>
<th>CvSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

B: Higher-Priced Products

- **Price in Euros**

<table>
<thead>
<tr>
<th>Attribute by Attribute</th>
<th>CvSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>80</td>
</tr>
</tbody>
</table>

tures in their final product than the three that were prespecified in the starting solutions (M = 10.46; t(113) = 6.201, p < .001). These analyses rule out the possibility that the positive effect of CvSS on the feature richness of the purchased shirts might be due to consumers’ reluctance to deselect the optional features prespecified in their chosen starting solution; on the contrary, those who used CvSS ultimately bought shirts that were much *more* feature rich than any of the presented starting solutions.

Discussion

Using actual consumer purchases, the results of this study support the hypotheses that, relative to standard attribute-by-attribute customization, the CvSS architecture leads consumers to purchase more feature-rich products while reducing the complexity of the customization process. An intriguing side result of Study 1 is that only a small portion of shoppers chose CvSS over an attribute-by-attribute format. We examine the drivers of consumer preference between these two customization formats systematically in Study 9.

A limitation of Study 1 is that shoppers chose one of the two customization architectures for their purchase themselves. To rule out possible contamination of our findings from consumer self-selection, we designed Studies 2–8 to employ an experimental paradigm.

**STUDY 2: FIELD EXPERIMENT (AUTOMOBILES)**

We conducted a field experiment in cooperation with a German car manufacturer to obtain more conclusive evidence on the predicted effect of the CvSS architecture, relative to the attribute-by-attribute format, on the feature richness of the products that consumers ultimately choose. In addition, Study 2 examines the hypothesis that using the CvSS architecture increases consumers’ choice satisfaction with their customized product.

**Design and Procedure**

Prospective car buyers who visited the manufacturers’ website were randomly assigned to either a CvSS architecture or the manufacturers’ standard attribute-by-attribute architecture. In the CvSS condition, car buyers first chose one of three starting solutions, which they were then able to refine by modifying any of its attributes. Customers assigned to the attribute-by-attribute condition configured their preferred car in terms of seven attribute categories, with an average of five options per category (range: [2;15]) and a maximum of 57 options overall. Data were collected for 160 customers who ultimately ordered their car from one of the manufacturers’ dealers. Immediately after placing their order, these customers indicated their choice satisfaction with the car they have chosen (“How satisfied are you overall with the car you have chosen?” 1 = “not satisfied at all,” and 7 = “very satisfied”). We operationalized the customized car’s feature richness as the total number of optional (i.e., nonessential) features the car buyer chose.

**Results**

Consistent with the findings from Study 1, customers in the CvSS condition configured significantly more feature-rich cars (MCvSS = 15.74, MAbac = 12.48; t(158) = 4.382, p < .001), and they paid higher prices for them (MCvSS = €20,765, MBAbac = €18,349; t(158) = 2.071, p < .05) than car buyers in the attribute-by-attribute condition. Critically, the CvSS architecture caused customers to be significantly
more satisfied with their customized car than those using the manufacturers’ standard attribute-by-attribute architecture (M_CvSS = 5.28, M_{AbAC} = 4.84; t(158) = 2.144, p < .05). Finally, the feature richness of the chosen car did not have a significant effect on choice satisfaction (β = .02, t(158) = .926, p > .35).

Discussion
The findings of Study 2 provide strong evidence that, relative to attribute-by-attribute customization, the CvSS architecture promotes the choice of more feature-rich products and causes consumers to be more satisfied with their customized products. The latter finding is corroborated by an analysis of data on more than 80,000 visits to the manufacturer’s car configurator (not matching the participants in this field experiment), which reveals that consumers who used the CvSS architecture were significantly more likely to complete their visit with the placement of an order for their customized vehicle (M_{CvSS} = 7.4%) than those who used the attribute-by-attribute format (M_{AbAC} = 3.5%; t(83.206) = 2.649, p < .01).

Although Studies 1 and 2 shed light on the consequences of consumers’ use of CvSS to configure physical goods (shirts and automobiles), it is worth examining whether CvSS has similar effects in a setting in which consumers configure service packages instead of tangible products. We designed Study 3 to address this question.

STUDY 3: FIELD EXPERIMENT (VACATION PACKAGES)
We conducted a field experiment with a Swiss alpine resort. Data were collected on travelers who customized their vacation packages using the resort’s website and who were randomly assigned to either a CvSS format or the resort’s standard attribute-by-attribute format.

Design and Procedure
A total of 323 visitors to the alpine resort’s website who initiated the process of configuring their vacation package were assigned to one of two experimental conditions at random. Those in the CvSS condition were presented with an initial choice among three candidate starting solutions. Each of these solutions had a total of ten prespecified, nonessential options (e.g., welcome drink, daily newspaper, vouchers for local attractions). After choosing a starting solution, participants had the opportunity to modify it by changing any of its options. Those in the attribute-by-attribute condition were presented with the same set of available options (42 in total), but they configured their vacation package by selecting each option individually. Both conditions presented the price information for the individual options and the total price of the chosen vacation package in the same way.

Of the 323 visitors, 60.1% completed the customization of their package with a booking. This proportion was the same in both conditions (χ²(1) = .025, p > .87). Data on the 194 travelers (M_{age} = 42 years) who purchased their customized vacation package at the resort’s website were used in the analyses. Upon completion of their booking, travelers indicated how satisfied they were with the package they had configured (four-item scale adapted from Homburg, Koschate, and Hoyer 2005 [see the Web Appendix]; α = .76).

Results
As we hypothesized, relative to travelers in the attribute-by-attribute condition, those in the CvSS condition chose significantly more feature-rich vacation packages (M_{CvSS} = 25.42, M_{AbAC} = 17.63; t(192) = 9.469, p < .001), which also had a higher total price (M_{CvSS} = CHF1,627, M_{AbAC} = CHF1,131; t(192) = 9.469, p < .001). Moreover, as we predicted, the CvSS format caused travelers to be more satisfied with their customized vacation package (M_{CvSS} = 6.26, M_{AbAC} = 5.97; t(192) = 2.558, p < .05). The feature richness of the chosen vacation package did not have a significant effect on satisfaction (β = .02, t(192) = 1.167, p > .24).

All 99 travelers in the CvSS condition modified their chosen starting solution to create their customized vacation package. On average, these consumers altered 59% of the prespecified options, representing a significant DSS (M_{DSS} = .59, tested against 0: t(98) = 33.177, p < .001). The number of options altered by a traveler had no effect on his or her choice satisfaction with the final vacation package (β_{DSS} = .09; t(97) = .229, p > .82). Moreover, consumers in the CvSS condition included significantly more optional features in their customized package than the ten that were prespecified in the starting solutions (M = 25.42; t(98) = 25.643, p < .001). These analyses show that the positive effect of CvSS on the feature richness of the purchased vacation packages cannot be due to travelers’ reluctance to deselect the optional features prespecified in their selected starting solution. Those in the CvSS condition bought packages that were much more feature rich than any of the starting solutions.

Discussion
The results of Study 3 corroborate the findings that, relative to the attribute-by-attribute format, the CvSS architecture both promotes the choice of more feature-rich products and increases consumers’ choice satisfaction with their customized product. More importantly, they show that these effects hold not only for physical goods but also in the domain of services.

Having shown that the CvSS architecture has a profound impact on what consumers choose and how satisfied they are with their chosen products, we next examine the psychological processes that underlie these effects. In Studies 4–8, we focus on testing our hypotheses about the mediating roles of the perceived complexity of the product customization process and of mental simulation of product use.

STUDY 4: PSYCHOLOGICAL PROCESS (JEWELRY)
Using a combination of observational field data (Study 1) and evidence from two field experiments (Studies 2 and 3), we have established that the CvSS architecture has a favorable impact on consumers’ satisfaction with their customized products relative to the attribute-by-attribute format. According to our conceptual model (see Figure 2), this positive effect of CvSS on choice satisfaction is mediated by (1) a reduction in the perceived complexity of the customization process and (2) an increase in consumers’ mental simulation of product use. Study 4 examines these two mediational paths in the context of customizable jewelry.
**Design and Procedure**

We developed a web-based customization interface for earrings as the experimental environment for this study. This interface provided us with complete control over what starting solutions were used and enabled us to randomize the prespecified options.

In this study, participants were randomly assigned to either a standard attribute-by-attribute or a CvSS architecture to create a pair of customized earrings. At the outset, participants in both conditions were presented with the images of four fully configured sample earrings (see the Web Appendix). In the attribute-by-attribute condition, they were then asked to configure their own earrings by choosing one of the options in each of four attribute categories: (1) an ear clip or hook, (2) a small stone, (3) a medium-sized stone, and (4) a large stone. The numbers of options in these categories were, respectively, 4, 66, 8, and 110. In the CvSS condition, the same sets of options were available, but participants first chose 1 of 12 fully specified pairs of earrings as a starting solution, which they were then able to modify to create their final customized earrings. In both conditions, participants were required to select one of the options in each of the four attribute categories. This customization setting did not entail any (nonessential) add-on features, and thus, the feature richness of the final products was constant.

A total of 104 female members of an online consumer panel (M_{age} = 35 years) participated in the experiment in exchange for monetary compensation. To provide an incentive for participants to complete the experiment thoughtfully and to reveal their preferences truthfully, we entered participants into a raffle to win the earrings that they had configured. Ten participants, selected at random, received their product through this raffle.

**Measurement**

At the beginning of the experiment, participants’ expertise in the domain of earrings was measured (four-item scale from Flynn and Goldsmith 1999 [see the Web Appendix]; \( \alpha = .84 \)). After finishing the product customization task, participants completed a survey that included measures of their mental simulation of product use (three-item scale adapted from Escalas 2004 [see the Web Appendix]; \( \alpha = .93 \)), of the perceived complexity of the customization process (three-item scale from Dellaert and Stremersch 2005; \( \alpha = .84 \)), of how satisfied they were with the earrings they had chosen (same four-item scale as in Study 3; \( \alpha = .91 \)), and of their regret in connection with their customized earrings (three-item scale from Inman and Zeelenberg 2002; \( \alpha = .80 \)).

We used confirmatory factor analysis to examine the discriminant validity of the two proposed mediating variables—mental simulation of product use and perceived complexity of the customization process. We estimated a two-factor model as well as a single-factor model with all measured items loading on the same factor as a benchmark. According to a chi-square difference test, the two-factor model is superior to the single-factor model (\( \chi^2(1) = 13.623, p < .001 \)), indicating discriminant validity between the two constructs (Bagozzi, Yi, and Phillips 1991). Following Fornell and Larcker (1981), we found that discriminant validity was also supported when comparing the constructs’ average variance extracted (AVE) with the squared correlation of the two constructs (AVEs > .5; \( r^2 = .157 \)). Moreover, bootstrapped correlation coefficient estimates (5,000 iterations) reveal that the confidence intervals do not include –1 (95% confidence interval [CI] = [–.58, –.21]), indicating that the two constructs are distinct (Bagozzi, Yi, and Phillips 1991).

**Results**

To test whether both perceived process complexity and mental simulation of product use mediate the positive effect of CvSS on consumers’ satisfaction with their chosen product, we estimated a multiple mediation model with bootstrapped estimates (Preacher and Hayes 2008). As we predicted, relative to the attribute-by-attribute format, CvSS has a positive direct effect on choice satisfaction (\( M_{CvSS} = 5.96, M_{AbAc} = 5.14; \beta_{CvSS} = .68, t(102) = 3.469, p < .001 \)) as well as a negative effect on the perceived complexity of the customization process (\( \beta_{CvSS} = –.52, t(102) = 2.658, p < .01 \)) and a positive effect on mental simulation (\( \beta_{CvSS} = .52, t(102) = 3.181, p < .001 \)). Each candidate mediator has a significant effect on satisfaction with the customized earring (\( \beta_{MentSim} = .74, t(102) = 11.481, p < .001 \)). When we control for the proposed indirect effects of process complexity and mental simulation of product use, the effect of CvSS on choice satisfaction becomes insignificant, indicating full mediation by the two proposed process accounts (\( \beta_{ProcComp} = –.14, t(102) = –2.122, p < .05; \beta_{MentSim} = .74, t(102) = 11.481, p < .001 \)). These results do not change substantively when we include participants’ expertise in the domain of earrings either as a control variable (although expertise has a marginally significant positive effect on mental simulation; \( \beta_{Expertise} = .18, t(101) = 1.938, p = .06 \)) or as a moderator in the mediation model. Finally, an exploratory side result indicates that participants in the CvSS condition experienced less regret in connection with their customized product than did those in the attribute-by-attribute condition (\( M_{CvSS} = 2.36, M_{AbAc} = 2.89; t(102) = 2.122, p < .01 \)).

Only 1 of the 41 consumers in the CvSS condition selected her starting solution as her final customized product without modification. On average, participants in the CvSS condition altered 66% of the prespecified options, representing a significant deviation from their chosen starting solution in configuring their final earrings (\( M_{DSS} = .66, t(39) = 9.336, p < .001 \)). The number of options consumers altered had no effect on their product satisfaction (\( \beta_{DSS} = .61, t(39) = .983, p = .33 \)), perceived process complexity (\( \beta_{DSS} = .97, t(39) = 1.300, p > .20 \)), or mental simulation of product use (\( \beta_{DSS} = –.84, t(39) = 1.095, p > .28 \)).

**Discussion**

The findings of Study 4 provide strong evidence in support of the psychological processes we hypothesized to underlie the effect of CvSS on choice satisfaction: CvSS increases consumers’ satisfaction with their customized products through both a reduction in the perceived complexity of the customization process and enhanced mental simulation of product use. Indeed, these two indirect effects fully account for the effect of CvSS on satisfaction with the
chosen product in this study. To further examine these two mediational paths and to provide additional evidence that they represent independent psychological processes, we conduct the next two studies to demonstrate each of the paths in isolation.

**STUDY 5: ISOLATING ENHANCED MENTAL SIMULATION (JEWELRY)**

The objective of Study 5 is to gain deeper insight into the positive effect of CvSS on consumers’ choice satisfaction with customized products by isolating one of the two psychological processes that underlie it—that based on enhanced mental simulation of product use. This requires an experimental CvSS architecture that affords consumers the opportunity to imagine using the product but that fails to reduce the complexity of the customization process relative to an attribute-by-attribute format. In this study, we disable the complexity-reducing quality of CvSS by increasing the number of starting solutions significantly. In light of Huffman and Kahn’s (1998) finding that choosing from a larger set of fully configured products increases choice complexity, this architecture should permit a test of the indirect effect of CvSS on choice satisfaction via enhanced mental simulation of product use in isolation while exposing a theoretically important boundary condition for the indirect effect via reduced process complexity.

**Design and Procedure**

The experimental environment was the same as in Study 4. Participants’ task was to create a customized pair of earrings for themselves. A total of 100 female members of a consumer panel (M<sub>age</sub> = 34 years) were randomly assigned to either an attribute-by-attribute format or a CvSS format. As in Study 4, participants in both conditions were first presented with the images of four fully configured sample earrings. In the attribute-by-attribute condition, they were then asked to configure their earrings by choosing one of the options in each of three attribute categories: (1) an ear hook (2 options), (2) a medium-sized stone (4 options), and (3) a large stone (16 options). To disable the complexity-reducing property of the CvSS architecture, all 128 (2 x 4 x 16) possible earring configurations were presented as candidate starting solutions. Thus, in the CvSS condition, participants first chose one of 128 fully specified earrings as a starting solution, which they were then able to modify to create their final customized earring.

**Measurement**

At the beginning of the experiment, consumers’ expertise in the domain of earrings was measured (using the same items as in Study 4; α = .94). After the product customization task, participants completed a survey that included measures of their mental simulation of product use (α = .81), of the perceived complexity of the customization process (α = .90), and of how satisfied they were with the pair of earrings they had chosen (α = .86). Confirmatory factor analyses indicate discriminant validity among the mental simulation and process complexity constructs (χ<sup>2</sup>(1) = 9.554, p < .001; AVEs > .5 vs. r<sup>2</sup> = .091; CIs of correlation coefficient [5,000 iterations] do not include –1; CI<sub>95%</sub> = [–.50, –.11]).

**Results**

As we intended, expanding the set of starting solutions under CvSS to include all possible product configurations eliminated any difference between the two conditions in terms of perceived process complexity (M<sub>CvSS</sub> = 3.39, M<sub>AbAC</sub> = 3.36; t(98) = .202, p > .84). However, even with its complexity-reducing property stripped away, CvSS still caused not only increased mental simulation of product use (M<sub>CvSS</sub> = 6.26, M<sub>AbAC</sub> = 5.53; t(98) = 3.051, p < .01) but also greater choice satisfaction with the customized product (M<sub>CvSS</sub> = 6.33, M<sub>AbAC</sub> = 5.92; t(98) = 2.577, p < .05) relative to the attribute-by-attribute format. Critically, the enhanced mental simulation fully mediated the positive effect of CvSS on choice satisfaction (CI<sub>95%,MentSim</sub> = [.10, .39]; z = 2.593, p < .01), whereas the path via perceived process complexity was disabled (CI<sub>95%,ProcComp</sub> = [–.09, .08]; z = .186, p > .85). The effect of CvSS on satisfaction with the chosen product is not moderated by consumer expertise, but the latter does have a positive main effect on mental simulation of product use (β<sub>Expertise</sub> = .31, t(96) = 2.564, p < .05).

Approximately one-quarter (26%) of participants in the CvSS condition selected their starting solution as their final product without modification. On average, participants in the CvSS condition altered 74% of the options prespecified in their chosen starting solution (M<sub>DS</sub> = .74, tested against 0: t(45) = 31.104, p < .001). The number of these alterations had no effect on choice satisfaction (β<sub>DS</sub> = .17, t(44) = .291, p > .77), perceived process complexity (β<sub>P</sub> = –1.55, t(44) = 1.167, p > .25), or mental simulation of product use (β<sub>DS</sub> = .37, t(44) = .472, p > .63).

**Discussion**

In this study, we were able to isolate one of the two psychological processes that underlie the positive effect of the CvSS architecture on consumers’ satisfaction with their customized products. The findings show that the mediational path via enhanced mental simulation of product use is clearly active even when the complexity-reducing property of CvSS (relative to the attribute-by-attribute format) is removed. This study also demonstrates an important boundary condition for the mediational path via reduced process complexity, which sheds further light on the nature of this psychological mechanism. In particular, the findings of Study 5 show that the complexity-reducing effect of CvSS hinges on the presentation of a small set of starting solutions from which consumers can quickly select one that approximates what they are looking for and that this effect cannot be obtained by merely partitioning (or interrupting) the customization process without effective simplification.

**STUDY 6: ISOLATING COMPLEXITY REDUCTION (FINANCIAL PRODUCTS)**

Whereas Study 5 isolates the indirect effect of CvSS on choice satisfaction via enhanced mental simulation, Study 6 focuses on the second hypothesized mediational path—that via reduced process complexity. In particular, we examine whether the latter path is active even when consumers’ opportunity to engage in mental simulation of product use is inhibited. To that end, we used investment portfolios as the product domain in Study 6.
Design and Procedure

A total of 166 private investors (M\text{age} = 32 years) recruited from an online research panel completed the study. Their task was to customize a personal investment portfolio. Investors were randomly assigned to either a CvSS or an attribute-by-attribute condition. Those in the latter condition were able to choose any combination of funds from a total of 120, which were grouped into 10 asset classes (10 money market funds; 10 high-yield fixed income funds; 10 short-term fixed income funds; 10 long-term fixed income funds; 10 small- and mid-cap growth funds; 10 small- and mid-cap value funds; 10 large-cap growth funds; 10 large-cap value funds; 20 commodity funds; and 20 specialty funds investing in real estate, health care, biotechnology, and utilities). Investors in the CvSS condition first chose one of three fully specified starting solutions. These three portfolios varied in their asset class structure from conservative (i.e., predominantly money market funds) to intermediate (i.e., balanced across asset classes with a focus on fixed income funds) to aggressive (i.e., mostly commodities and equity funds), while the number of preselected funds was constant (10 out of 120). Investors then had the opportunity to refine their chosen starting solution by modifying it arbitrarily (i.e., by both adding and removing individual funds from the portfolio). They were free to include as many of the 120 funds as they wanted in their final customized portfolio.

Measurement

At the outset, participants’ expertise in the domain of investments was measured using the four-item scale from Study 4 (α = .91). After configuring their final investment portfolio, participants completed a survey that included measures (using the same items as in the previous studies) of their mental simulation in connection with this portfolio (α = .70), of the perceived complexity of the customization process (α = .83), and of how satisfied they were with the portfolio they had created (α = .87). Confirmatory factor analyses indicate discriminant validity among the mental simulation and process complexity constructs (χ^2(Δ1) = 23.416, p < .001; AVEs > .5 vs. r^2 = .12; CIs of correlation coefficient [5,000 iterations] do not include –1; Cl_{95%} = [−.50, −.19]).

Results

As we expected, the CvSS architecture did not affect investors’ mental simulation regarding the customized portfolio (M_{CvSS} = 4.43, M_{AbAC} = 4.39; t(164) = 1.219, p > .22). However, even in the absence of a difference in mental simulation, CvSS still caused not only a reduction in perceived process complexity (M_{CvSS} = 4.22, M_{AbAC} = 4.72; t(164) = 2.31, p < .05) but also an increase in satisfaction with the chosen portfolio (M_{CvSS} = 5.52, M_{AbAC} = 5.22; t(164) = 2.07, p < .05) relative to the attribute-by-attribute format. Critically, the reduced complexity of the customization process fully mediated the positive effect of CvSS on investors’ satisfaction with their portfolio (CI_{95%}, ProcComp = [0.3, .20]; z = 1.981, p < .05). The feature richness of the customized portfolio did not have a significant effect on satisfaction (β = .01, t(164) = .717, p > .47). The effect of CvSS on choice satisfaction is not moderated by expertise.

Only 5% of participants in the CvSS condition selected their starting solution as their final portfolio without modification. On average, investors in this condition altered 16% of the funds prespecified in their chosen starting solution (M_{DSS} = .16, tested against 0: t(81) = 5.802, p < .001). The number of such alterations made by an investor had no effect on satisfaction with the customized portfolio (β_{DSS} = .36, t(80) = .914, p > .36), on perceived process complexity (β_{DSS} = −.71, t(80) = 1.157, p > .25), or on mental simulation (β_{DSS} = .72, t(80) = 1.299, p > .20).

Finally, participants in the CvSS condition included a significantly greater number of funds in their customized portfolios than those in the attribute-by-attribute condition (M_{CvSS} = 18.13, M_{AbAC} = 14.64; t(164) = 2.606, p < .01) and also a greater number of funds than had been prespecified in the starting solutions (tested against 10: t(81) = 8.779, p < .001). These findings indicate that the positive effect of CvSS on the feature richness of the customized portfolios cannot be due to investors’ reluctance to deselect funds included in their chosen starting solutions.

Discussion

The results of this study show that the indirect effect of the CvSS architecture on choice satisfaction via a reduction in perceived process complexity holds even in the absence of an opportunity to engage in mental simulation of product use, suggesting that the favorable impact of CvSS on satisfaction generalizes across a wide range of product domains. Whereas Study 5 isolated the mediational path via enhanced mental simulation, Study 6 did so for the path via reduced process complexity. Taken together, these findings provide clear evidence of the two distinct psychological processes that underlie the positive effect of the CvSS architecture on consumers’ satisfaction with their customized products.

STUDY 7: OVERALL MODEL TEST (AUTOMOBILES)

Studies 1–6 provide converging evidence in support of our conceptual model of how the CvSS architecture influences consumers’ product customization decisions, the feature richness of their final customized product, and their satisfaction with the latter. We designed Study 7 to examine all of the hypothesized effects jointly in an overall test of this model.

Design and Procedure

A total of 237 consumers (M\text{age} = 31 years) were recruited through a market research company and participated in the experiment for a monetary reward. Participants were prescreened to be in the market for a new car (planning to purchase one within six months) and to be seriously considering the particular model used in this study. Their task was to configure an Audi A4 for themselves. At the outset, participants in both conditions were presented with the images of two fully configured sample automobiles. As in the previous studies, participants were randomly assigned to either a CvSS format or an attribute-by-attribute format. In the CvSS condition, participants first chose one of three fully specified starting solutions, which they were then able to refine by modifying any of its attributes. By contrast, those in the attribute-by-attribute condition configured their vehicle by making individual decisions about each of 17 attribute categories.
Measurement

At the beginning of the experiment, participants’ expertise in connection with automobiles was measured using the same four-item scale as in the previous studies (α = .92). After the customization task, they completed a survey that included measures of the extent of their mental simulation of using the car they were customizing (α = .81), of process complexity (α = .91), and of how satisfied they were with their customized car (α = .91).

Confirmatory factor analyses indicate discriminant validity among the mental simulation and process complexity constructs ($\chi^2(1) = 19.808, p < .001$; AVEs $>.5$ vs. $r^2 = .09$; CIs of correlation coefficient [5,000 iterations] do not include $–1$; CI$_{95\%} = [-.43, -.16]$). We operationalized the feature richness of the customized car as the total number of optional (i.e., nonessential) features included.

Results

For an overall test of the conceptual model depicted in Figure 2, we estimated a structural equation model (using the SEM package in R) with the experimental manipulation (CvSS vs. attribute-by-attribute) as the exogenous variable, feature richness of the customized car, and satisfaction with the car as endogenous variables. Figure 5 provides an overview of the estimation results for this model.

As we hypothesized, CvSS reduced the perceived complexity of the customization process ($H_1$: $\beta = -.14, t = 2.052, p < .05$), enhanced the mental simulation of product use ($H_2$: $\beta = .18, t = 2.598, p < .01$), promoted the choice of more feature-rich cars ($H_3$: $\beta_{\text{total}} = .22, t = 3.480, p < .001$), and increased car buyers’ satisfaction with their customized products ($H_4$: $\beta_{\text{total}} = .17, t = 2.605, p < .01$). The positive total effect of CvSS on the feature richness of the customized vehicle consists of a positive direct effect ($\beta_{\text{direct}} = .19, t = 2.898, p < .01$) and, in line with $H_7$, a significant indirect path via mental simulation, with the latter having a positive effect on the chosen product’s feature richness ($\beta_{\text{MentSim}} = .20, t = 2.817, p < .01$). Finally, the positive total effect of CvSS on satisfaction with the customized car consists of two significant indirect paths, one via reduced process complexity ($H_3$) and the other via enhanced mental simulation ($H_4$), with each of these mediating constructs having a strong impact on product satisfaction ($\beta_{\text{ProcComp}} = -.31, t = 5.024, p < .001$; $\beta_{\text{MentSim}} = .47, t = 6.795, p < .001$). These two indirect paths fully account for the overall impact of CvSS on satisfaction with the customized product: the direct effect is nonsignificant given that the indirect effects are included in the model ($\beta_{\text{direct}} = .05, t = .826, p > .4$).

As a test of overall model fit, we compare the hypothesized model with a more parsimonious alternative model that does not include any indirect (mediational) paths. The hypothesized model uses five more degrees of freedom, but the corresponding gain in model fit more than offsets this reduction in parsimony, as indicated by a chi-square difference test ($\chi^2(5) = 16.889, p < .01$).

Additional analyses (i.e., alternative models) reveal that the feature richness of the chosen car had a positive effect on consumers’ satisfaction with it ($\beta = .14, t(235) = 4.371, p < .001$). However, estimation of the less parsimonious model that includes the additional path from feature richness to product satisfaction only marginally improves model fit ($\chi^2(1) = 3.238, p = .07$), and the Bayesian information criterion (BIC) actually favors the model that does not include this additional path (BIC$_{\text{without}} = 226.84$, BIC$_{\text{with}} = 229.08$). Moreover, consumer expertise did not moderate the effects of CvSS on the feature richness of the customized product ($\beta = .13, t = 1.139, p > .25$) or on satisfaction ($\beta = .08, t = 1.466, p > .14$). Finally, expertise had a positive effect on mental simulation of product use ($\beta = .24, t = 4.586, p < .001$).

Figure 5
GLOBAL MODEL TEST (STUDY 7)
Discussion

Study 7 provides an overall test of our conceptual model, examining all of its hypotheses concurrently. The results corroborate those of Studies 1–6, and they demonstrate how the psychological processes involved operate in concert. Study 7 shows that the beneficial effects of CvSS are caused by the two predicted meditational paths—one via reduced complexity of the customization process and the other via enhanced mental simulation of product use.

STUDY 8: THE EFFECT OF THE NUMBER OF STARTING SOLUTIONS (AUTOMOBILES)

The number of starting solutions provided in the CvSS conditions of Studies 1–7 varied substantially. Although the consistency of our findings across these studies suggests that the hypothesized effects are robust, the evidence presented thus far provides little insight into how the effectiveness of the CvSS architecture might depend on how many starting solutions are presented to consumers. Study 8 fills this gap by experimentally manipulating the number of starting solutions in connection with consumers’ customization of an automobile.

Our expectation was that the optimal number of starting solutions, in terms of maximizing the positive effects of the CvSS architecture—such as reducing process complexity, promoting mental simulation of product use, and increasing consumer satisfaction with a customized product—would be somewhere between two (the minimum number required to give consumers a choice) and all possible feature combinations (as in Study 5). The advantage of providing more than two candidate starting solutions is a reduction of the risk that no solutions even remotely resemble what a consumer is looking for. However, as the number of presented starting solutions increases, the complexity-reducing property of the CvSS architecture will eventually be undermined. Thus, given these competing forces, we predicted that the “sweet spot” at which the greatest overall benefits arise would be at an intermediate number of candidate starting solutions.

Design and Procedure

A total of 336 prospective car buyers (M_age = 30 years) prescreened to be in the market for a new car (as in Study 7) participated in the experiment for a monetary reward. Participants’ task was to configure an Audi Q3 for themselves with their customized car (α = .81), and of how satisfied they were with their customized car (α = .88).

Confirmatory factor analyses indicate discriminant validity among the mental simulation and process complexity constructs (χ²(1) = 57.261, p < .001; AVEs > .5 vs. r² = .15; CIs of correlation coefficient [5,000 iterations] do not include −1; CI_{95%} = [−.51, −.27]). We operationalized the feature richness of consumers’ final customized car as the total number of selected options.

Results

Relative to the attribute-by-attribute format, CvSS caused consumers to be more satisfied with their customized vehicles, irrespective of the number of candidate starting solutions (nested analysis of variance model with number of starting solutions nested within the CvSS condition; F(1, 334) = 19.22, p < .001). However, the magnitude of the positive effect of CvSS on product satisfaction diminished considerably between 16 and 32 candidate starting solutions, with 32 being less beneficial than all other CvSS conditions (F(1, 276) = 5.553, p < .01; see Figure 6, Panel A). A similar pattern emerged for the feature richness of the final customized vehicle (see Figure 6, Panel B), with a greater number of selected options under CvSS, irrespective of the number of starting solutions, than under the attribute-by-attribute format (nested analysis of variance; F(1, 334) = 17.73, p < .001), and with this effect tapering off as the number of presented starting solutions increased beyond 8. (However, feature richness was lower for 4 than for either 2 or 8 starting solutions.)

These results are corroborated by the patterns observed for mental simulation and process complexity. First, across the board, participants in all CvSS conditions engaged in greater mental simulation of product use than did those in the attribute-by-attribute condition (F(5, 330) = 5.047, p < .001), and a set of 8 candidate starting solutions caused the highest level of mental simulation (M = 6.12, M_{2, 4, 16, 32} = 5.68; F(1, 276) = 8.200, p < .01; see Figure 6, Panel C). Finally, the presentation of 2, 4, or 8 candidate starting solutions resulted in a significant reduction in process complexity relative to both attribute-by-attribute customization (F(1, 218) = 18.260, p < .001) and the presentation of either 16 or 32 starting solutions (F(1, 276) = 9.092, p < .01; see Figure 6, Panel D).

Consistent with the findings of Studies 4–7, the effect of CvSS on product satisfaction is not moderated by consumer expertise (F(5, 323) = 1.141, p > .33), but the latter did have a positive main effect on mental simulation of product use (β_{expertise} = .14, t(334) = 3.733, p < .001). Participants in the CvSS conditions included significantly more options in their customized vehicle than the four that were prespecified in the starting solutions (M = 10.24; t(277) = 27.335, p < .001). Moreover, only 5% of them selected their starting solution as their final customized car without modification. Overall, prospective car buyers in the CvSS conditions deviated significantly from the chosen starting solution (M_DSS = .32, tested against 0: t(277) = 32.405, p < .001). The extent of these deviations had no effect on satisfaction with the customized car (β_{DSS} = .29, t(276) = 1.308, p > .19), perceived process complexity (β_{DSS} = −.14, t(276) = −.352, p > .72), or mental simulation of product use (β_{DSS} = −.16, t(276) = .454, p > .65).
Discussion

The results of Study 8 show that, although the effects of the CvSS architecture on consumers’ satisfaction with their customized product are robust in that they do not hinge on a carefully chosen set of candidate starting solutions, the number of the presented starting solutions does have a significant impact on consumer satisfaction with a customized product as well as on other key variables. In particular, in
the domain of automobiles, the key benefits of CvSS begin to taper off as the number of candidate starting solutions goes beyond 16 and, in some respects, when it exceeds 8. These findings indicate that, as we predicted, there exists a sweet spot—or, more appropriately, a range—that such the greatest overall benefits arise with an intermediate number of candidate starting solutions.

**STUDY 9: CONSUMER PREFERENCE FOR THE CvSS ARCHITECTURE**

Although the converging evidence from Studies 1–8 suggests that the CvSS architecture is beneficial for consumers, the question remains to what extent consumers are able to anticipate these benefits and how likely they are to use a CvSS format, rather than an attribute-by-attribute customization format, if given the choice. Indeed, the small proportion of shirt buyers who used CvSS in Study 1 suggests that consumers might not be accurate in forecasting the benefits of this customization format. Moreover, it is important to examine whether there are significant differences across products in consumers’ inclination to use CvSS and what properties of a product domain might determine consumer preference for CvSS relative to the attribute-by-attribute customization format. Study 9 addresses these questions.

**Design and Procedure**

Participants were 100 consumers recruited from an online panel ($M_{\text{age}} = 35$ years). First, they read generic descriptions of both the attribute-by-attribute customization format and the CvSS format. Next, they were asked to indicate which of these two formats they would prefer to use for customizing a product for themselves in each of 36 product domains, one at a time. After that, participants expressed, for each of the 36 products, (1) how easy they thought it would be for them to mentally simulate using or consuming the product, (2) how complex they expected the customization process to be, and (3) how many starting solutions they would like to be presented with if the format were CvSS.

**Results**

Overall, consumers chose the CvSS architecture in 43.3% of all instances and the attribute-by-attribute format 56.7% of the time ($\chi^2(1) = 9.000, p < .001$). However, preference for CvSS varied considerably across products. Figure 7 shows the proportion of participants who chose the CvSS architecture in each of the 36 product domains. To shed light on what underlies this variation in preference, we estimated a linear mixed effects model with ease of mental simulation of product use and anticipated complexity of the customization process as predictors of the choice of a customization format. The results revealed that consumers were more likely to choose the CvSS architecture when they thought that mental simulation of product use would be difficult ($\beta_{\text{MensSim}} = - .25; z(3,600) = 4.951, p < .001$) and when they expected the customization process to be complex ($\beta_{\text{ProcComp}} = .10; z(3,600) = 1.680, p = .09$). To illustrate the effect of anticipated ease of mental simulation on preference for CvSS, bars in Figure 7 are black (white) for those product domains that are below (above) the median in terms of how easy consumers thought it would be to mentally simulate product use in that domain. Finally, when

**Discussion**

The first eight studies in this article demonstrate the significant benefits to consumers of using the CvSS architecture rather than an attribute-by-attribute customization format. The findings of Study 9 show that consumers seem to generally underestimate these benefits, as indicated by the low overall choice share of CvSS. However, consumers’ preference for customization formats does vary across product domains in a manner that is consistent with our theory: they are more inclined to choose CvSS when mental simulation of product use is difficult and when they anticipate the complexity of the customization process to be high.

**GENERAL DISCUSSION**

**Theoretical Implications**

This research makes several theoretical contributions. First, it bridges the gap between the domain of product customization and the emerging field of choice architecture (Goldstein et al. 2008; Johnson et al. 2012; Lamberton and Diehl 2013; Thaler and Sunstein 2008) while advancing prior work on option framing (Herrmann et al. 2013; Park, Jun, and MacInnis 2000). Specifically, we introduce a novel choice architecture for consumers’ product customization decisions—CvSS—as an alternative to the standard attribute-by-attribute format. The essential property of the CvSS architecture is that it partitions the consumer’s task of customizing a product into two stages—selecting one from a set of fully specified multiattribute alternatives and subsequently refining this starting solution by modifying any of its attributes. Evidence from nine studies shows that (relative to attribute-by-attribute customization) CvSS has a strong impact on (1) how consumers experience the product customization process, (2) what product they ultimately choose, and (3) how satisfied they are with their customized product. In line with our conceptual model, the findings indicate that CvSS reduces the perceived complexity of the customization process and enhances mental simulation of product use, in turn promoting the choice of more feature-rich products and increasing consumers’ satisfaction with their customized products. These findings show high convergence across the nine studies and across the various product domains used, lending confidence to the validity of the overall body of insight. The CvSS architecture is an effective remedy for the customization paradox (i.e., the consumer benefits that arise from the opportunity to configure products in line with their preferences are offset by the inherently onerous process of attribute-by-attribute customization; Dellaert and Stremersch 2005) and also for the “mixed blessing” nature of subtractive option framing, in which promoting the choice of more feature-rich products seems to go hand in hand with an increase in both perceived process complexity and consumer regret (Park, Jun, and MacInnis 2000).

The present work also contributes to the literature on mental simulation (Elder and Krishna 2012; Escalas 2004; Zhao, Hoeffler, and Zauberman 2011) by showing that, rela-
tive to attribute-by-attribute format, the CvSS architecture causes consumers to envision using products more extensively during the purchase decision process, which in turn has important downstream consequences for consumers. In particular, the enhanced mental simulation of product use during the customization process, as a consequence of the presentation of a set of holistically characterized products under CvSS, influences consumers to configure more feature-rich products and renders them more satisfied with their customized products.

The sets of candidate starting solutions used in the studies presented in this article were designed to be representative of the array of possible product configurations. This need not be the case in an application of CvSS. Further research might examine consumer behavior in connection with sets of prespecified alternatives that are (overtly or covertly) biased with the intention of influencing product choice. Another fruitful avenue for additional work on the CvSS architecture would be to examine how the starting solutions themselves affect consumers’ perceptions of a company’s assortment variety or of the brand or company in general. More research is needed to examine the temporal dynamics of some of the effects we uncovered in the present work. In particular, it would be worthwhile to examine the extent to which the favorable effect of using the CvSS architecture on satisfaction with the customized product persists after consumers use it, and whether the particular customization format used has a systematic influence on consumers’ product usage experience (e.g., how frequently they use the product, how much they enjoy using it). Finally, although attribute-by-attribute customization is a natural standard of comparison for the CvSS architecture, further research might examine the latter in contrast to other formats—for example, formats in which candidate starting solutions are personalized using prior information about a consumer’s prefer-
ences, or noncustomization formats such as choice from a (large) set of prespecified alternatives.

**Practical Implications**

Apart from making a theoretical contribution by advancing understanding of the psychology of product customization decisions, the current article also has important practical implications for the design of customer interfaces that companies provide to enable consumers to configure their own products. First, the present research shows that a firm can achieve desirable outcomes—such as increased customer satisfaction and greater revenue as a result of the sale of more feature-rich products—without any change to its product assortment, pricing, or any other marketing variable. These effects demonstrated in this article are driven entirely by a modification of the customization *interface* that the firm provides to its customers. The CvSS architecture is inspired by insights from behavioral science and designed with the cognitive limitations of the human decision-making system in mind. Thus, it illustrates the array of opportunities that the science-driven design of choice architectures holds for firms aiming to create more engaging customer experiences, increase customer satisfaction, and nudge purchase decisions in directions that are beneficial to the firm (as well as its customers).

Second, our findings indicate that not all companies can be expected to benefit equally from implementing a CvSS architecture relative to a standard attribute-by-attribute customization format. In particular, firms selling products for which it is difficult to mentally simulate what it would be like to use them, and for which the customization process is complex, should benefit the most (Study 9), including some of the rising customization domains such as customizable food, beverages, cosmetics, or even complex products and services in both consumer and business-to-business markets.

Third, both consumers and companies are likely to benefit the most from a moderate number of candidate starting solutions. As Study 8 reveals, there seems to be a sweet spot—or, more appropriately, a range—that the greatest overall benefits from the CvSS architecture arise with an intermediate number of candidate starting solutions. In particular, the results of that study show that, in the domain of cars, the benefits of CvSS begin to taper off as the number of candidate starting solutions exceeds eight. Although this finding regarding the most effective number of starting solutions under CvSS is likely to generalize across a wide range of circumstances, we must not assume that it holds universally; the optimal number of starting solutions in a particular setting is a function of additional variables such as product or assortment characteristics (e.g., assortment size, number of customizable features) and market characteristics (e.g., similarity to competitors’ products).

Fourth, the current results suggest that the desirable effects of the CvSS architecture are independent of the specific nature of the candidate starting solutions. The body of evidence in this article shows that the CvSS architecture has consistently positive effects on consumers’ satisfaction with their customized products irrespective of whether the sets of candidate starting solutions were chosen strategically (as they presumably were in Studies 1–3) or at random (as they were in Studies 4–8). Thus, we can be confident that our conclusions generalize across a wide range of implementa-

**REFERENCES**


Web Appendix

Product Customization via Starting Solutions

CHRISTIAN HILDEBRAND, GERALD HÄUBL, and ANDREAS HERRMANN

Choice Satisfaction Scale (Studies 3 to 8)

7-point scales (1: do not agree at all, 7: fully agree)
\[ \alpha_{\text{Study 3}} = .76, \alpha_{\text{Study 4}} = .91, \alpha_{\text{Study 5}} = .86, \alpha_{\text{Study 6}} = .87, \alpha_{\text{Study 7}} = .91, \alpha_{\text{Study 8}} = .88 \]

All in all, I am satisfied with my customized product.

My customized product corresponds to what I want.

If I had to decide among the same features once again, I would decide the same way.

I feel good about having made my customization decisions.

Process Complexity Scale (Studies 4 to 8)

7-point scales (1: do not agree at all, 7: fully agree)
\[ \alpha_{\text{Study 4}} = .84, \alpha_{\text{Study 5}} = .90, \alpha_{\text{Study 6}} = .83, \alpha_{\text{Study 7}} = .91, \alpha_{\text{Study 8}} = .81 \]

I found the customization process …

… difficult.

… effortful.

… complicated.
Mental Simulation Scale (Studies 4 to 8)

7-point scales
\( \alpha_{\text{Study}4} = .93, \alpha_{\text{Study}5} = .81, \alpha_{\text{Study}6} = .70, \alpha_{\text{Study}7} = .81, \alpha_{\text{Study}8} = .79 \)

How easy/difficult was it for you imagine your product during the customization task?
(imagining was difficult / imagining was easy)

How many images of the product went through your mind while customizing?
(few mental images / many mental images)

How well could you imagine yourself using your customized product?
(not at all / very well)

Product Knowledge Scale (Studies 4 to 8)

7-point scales (1: do not agree at all, 7: fully agree)
\( \alpha_{\text{Study}4} = .84, \alpha_{\text{Study}5} = .94, \alpha_{\text{Study}6} = .91, \alpha_{\text{Study}7} = .92, \alpha_{\text{Study}8} = .94 \)

I know a lot about _____.

When it comes to _____, I really don’t know a lot. (reverse item)

I do not feel very knowledgeable about _____. (reverse item)

Compared to most other people, I know less about _____. (reverse item)

Regret Scale (Study 4)

7-point scales (1: do not agree at all, 7: fully agree)
\( \alpha_{\text{Study}4} = .80 \)

If I could customize my product one more time, I would change my feature choices.

I would be much happier if I would have made different feature choices.

I regret my feature choices.
Figure A-1

Presentation of Fully Configured Products Prior to Customization Task
(Studies 4 and 5)

On the following page, you can customize your own earring.

- Below this textbox you see some typical earring configurations based on our earring configurator. Take a minute to look at the provided example configurations.
- Click "Next" to proceed with the study and to customize your own earring.

Note: The presentation of fully configured products prior to the customization task was identical in the attribute-by-attribute and CvSS conditions.
Note: A total of 12 earring configurations were presented as candidate starting solutions in Study 4.
Figure A-3

Example Stimuli: CvSS Condition (Study 5)

Note: A total of 128 (2×4×16) earring configurations were presented as candidate starting solutions in Study 5.
**Figure A-4**

**Example Stimuli: CvSS Condition (Study 6)**

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**Note:** All funds were linked to bloomberg.com, allowing investors to review fund performance.
Figure A-5
Example Stimuli: CvSS Condition (Study 7)

Choose Your Preferred Car

Features:
- 1.8 TFSI (86 HP)
- 6-arm wheels
- Multifunction Navigation
- 2 Year Warranty

Features:
- 2.0 TFSI
- 10 multi-spoke design wheels
- Sport interior package
- Multifunction Steering Wheel

Features:
- 1.8 TFSI (86 HP)
- 10-arm wheels
- Heated front seats
- Automatic Climate Control
Figure A-6

Example Stimuli: CvSS Condition (Study 8)

>> Choose Your Preferred Car
>> You can modify your choice on the next page if you wish.

Features:
- 1.4 TFSI S tronic
- 5-arm spoke wheels
- Sport exterior package
- Driver information system

Features:
- 2.0 TFSI Quattro S tronic
- 5-arm rotor design titan look wheels
- Three-zone automatic climate control
- Judith side awash

Features:
- 1.4 TFSI
- 5-arm offroad design
- Driver seat memory
- Parking system with rear view camera

Features:
- 2.0 TFSI
- 5-arm Audi offroad exclusive design
- Three-zone automatic climate control
- Extended 2 Year Warranty