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How the number of options and perceived variety influence choice satisfaction: An experiment with prescription drug plans

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Abstract

This study measures the perceived costs, perceived benefits, choice outcome satisfaction, and choice process satisfaction from consumers making hypothetical choices amongst prescription drug plans. I juxtapose the number of options the consumer is choosing between and his/her perceived variety of the choice set to understand which contributes more to explaining these outcomes. I find that once perceived variety is included in the model, the number of options (i) has no effect on perceived benefits and choice outcome satisfaction, (ii) increases perceived costs, and (iii) decreases choice process satisfaction. Furthermore, the concave relationship that has been shown to occur when the number of options increases is a function of the subjective perception of variety. Overall, these results contribute to our understanding of how assortment structure and the number of options affect choice outcome and process satisfaction. Additionally, this study provides some evidence that can inform U.S. national heath insurance policy and the current debate on choice in health care in the United States and other countries.

Keywords: consumer choice, perceived variety, choice overload, choice satisfaction, prescription drug plans, Medicare Part D

1 Introduction

A number of studies document "choice overload", the phenomenon that leads individuals to delay decision-making, report lower choice satisfaction, and make poorer decisions when faced with a large number of choice options (Iyengar & Lepper, 2000; Schwartz, 2004). Not all studies, however, find evidence for the choice overload effect, and most recently, there has been a call to understand how strong and universal the effect is, as well as to identify some of the boundary conditions for too much choice (Chernev, Bockenholt & Goodman, 2015; Scheibehenne, Greifeneder & Todd, 2010).

Demonstrations of the choice overload effect suggest that, as we increase the number of options, choice satisfaction initially improves but after a certain point begins to decrease (in the shape of a concave function). We can ask if this effect depends not only on the number of alternatives in the choice set but also on how much variety the alternatives in the choice set provide. This is a relevant question for marketing managers that must decide how many options and how much heterogeneity to include in a product line, for retailers that must decide how many products to place on the shelf and whether to include products that cover a range of different attributes, and for public policy architects who must decide how many alternatives (e.g., health plans) and of what types to offer citizens. In this paper, I juxtapose the level of perceived variety against the number of options to see which of these variables is more important in explaining consumers' perceived benefits, perceived costs, and perceived net benefits of prescription health plans. The primary hypothesis I test is that perceived variety is more important than the number of options that a person has in influencing choice satisfaction. The secondary hypothesis is that perceived variety mediates the relationship between the number of options and choice satisfaction.

Although the majority of studies in the choice overload literature consider the number of options only in their analyses, there is a reason to suspect that this type of model is too simplistic: the relationship between the different options may also affect choice satisfaction. In practice, some choice sets cover a wider product line and some a narrower one even when both choice sets have the same number of products. Empirically, it may be important to account for such differences between choice sets.

For this reason and possibly others, researchers have considered the roles of other attributes of choice sets, besides assortment size, in models that explain how individuals select between alternatives. The simple model has been enriched with the consideration of *information structure*, the number of attribute levels for each attribute and the distribution of

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attribute levels across alternatives (Lurie, 2004); *assortment structure* which depends on the relative attractiveness of the options, attribute complementarity, and pricing (Chernev, 2012); and by *choice complexity*, the number of alternatives and number of attributes on which they are described (Greifeneder, Scheibehenne & Kleber, 2010). That these additions are critical to understanding consumer choice is evidenced by the fact that complexity of the choice set arises as one of the factors that moderates the choice overload effect (Chernev et al., 2015).

This research has been complemented by studies in the marketing literature that explore customer motivations for seeking variety. Firstly, consumers care about the variety of the choice set because they are more likely to find products they like from more varied choice sets (Hoch, Bradlow & Wansink, 1999; Lancaster, 1990). Even for a single consumer, variety seeking can be explained by the multiple needs that a product may serve for a consumer, desire to maintain choice flexibility over time, and intra- and inter-personal motives such as desiring varied consumption (McAlister & Pessemier, 1982; Kahn & Lehmann, 1991; Kahn, 1998). These motivations for wanting variety in choice sets parallel the benefits that consumers seek from having more options in a choice set: having more choice may increase the availability of heterogeneous products at a single point in time and over time (see for example Bundorf & Szrek, 2010, for a discussion of this point in the context of health plan choice).

One difference between the number of options and variety is that, while number of options is relatively easy to discern, the actual level of variety of an assortment may not be easy for consumers to perceive correctly. Perceived variety is apparently more closely related to anticipated consumption utility than to actual variety, because of structural factors such as assortment organization or complexity, which may make it harder for consumers to discern actual assortment variety (Broniarczyk & Hoyer, 2010; Broniarczyk, Hoyer & McAlister, 1998; Hoch et al., 1999; Kahn & Wansink, 2004; Kahn, Weingarten & Townsend, 2013; van Herpen & Pieters, 2002). This, and the lack of data on perceived variety, may be two reasons why more studies in the choice overload literature ignore the perceived variety of the choice set or the assortment structure in their models.

However, a handful of studies incorporate both the number of options and perceived variety (or actual variety) in their models. First, one study analyzes the relationship between the number of choices and the attribute distribution amongst twelve product categories in two popular stores in Germany: Fasolo, Hertwig, Huber and Ludwig (2009) found that larger supermarkets actually do have more variety (density and entropy) than smaller supermarkets, and their simulations of consumer choice strategies show that choice is more difficult but not necessarily better from larger stores. In the context of speed dating, Lenton and Francesconi (2011) consider the number of potential mates and the actual variety of different mate options, and their results suggest that increased variety (but not increased options) created increased confusion amongst choosers, leading them to defer choices and make poorer quality decisions. In another study, Mogilner, Rudnick and Iyengar (2008) found that the presence of categories influenced perceptions of variety and explained consumer satisfaction better than the actual number of options of magazines. A different study that estimates choice deferral finds that choice complexity, rather than perceived variety, mediates the interaction between presentation type and number of options (Townsend & Kahn, 2014). In related work, Chernev and Hamilton (2009) show that consumers tend to prefer stores or assortments with fewer alternatives when the options are relatively attractive but prefer stores or assortments with more alternatives when the options are less attractive.

Of these studies, Lenton and Francesconi (2011) is closest to the current research. I take a different approach than Lenton and Francesconi (2011) by building on an existing model in the literature that considers the final outcome (outcome and process satisfaction) and also separates the final outcome into benefits and costs. In this model, costs and benefits increase with the number of options, and the benefits increase more than the costs at first but the costs increase at a faster rate, leading to a concave function (Reutskaja & Hogarth, 2009). In the present study, I add perceived variety to the original Reutskaja-Hogarth model, thus testing whether it is the effect of the number of options or whether it is the effect of perceived variety that explains the concave function characteristic of choice overload.

The present study directly builds on previous work in this context that considers the effects of choice set size on decision making (Bundorf and Szrek, 2010), the effects of choice set size on anticipated enrollment (Szrek & Bundorf, 2011), and the mediating roles of costs and benefits in explaining decision quality (Szrek & Bundorf, 2014). The question asked in this study is also closely related to other research that fundamentally questions whether choice is desired in and of itself (Iyengar & Lepper, 1999; Bown, Read & Summers, 2003; Szrek & Baron, 2007) by considering whether individuals are seeking more options or more variety.

2 Method

2.1 Participants

The analysis is from a survey fielded in December 2007 to a sample of adults aged 65 years and older drawn from an internet-enabled panel developed and maintained by Knowledge Networks. In total, 534 eligible panel members were contacted, and 294 unique respondents completed the study, answering the key dependent and independent variables, for a response rate of 55%. Respondents were given a fixed fee for participating. Because the sample was restricted to in-

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ternet users, the study population is not representative of the US population aged 65 and older, however it is a diverse population both in geographical and socio-demographic terms (Bundorf and Szrek, 2010). Of the 294 respondents that completed the survey, 251 gave responses to both choice scenarios. Forty-three respondents answered one scenario only. The main analysis uses all 545 observations ((2*251) + 43 = 545), whereas a sub-analysis considers the 251 respondents that answered both scenarios.

2.2 Procedure

Knowledge Networks sent an email to participants to visit the study website. The link is available at http://www.stanford.edu/group/health_surveys/cgi-bin/ex/mkb1.htm. Before entering the site, respondents were asked to provide informed consent. Once agreed, they continued onto the website. First, they were asked to assume a hypothetical scenario: they were not able to obtain prescription drug coverage from any other source and needed to make a decision amongst the prescription drug plans that would be presented to them. They were asked to answer carefully, as if they were making real decisions. Participants were then shown some information about Medicare Drug Plans, and they were given the option to open this information in another window for the duration of the experiment. Respondents then entered the experiment and were immediately randomized to one of two experimental conditions. The experimental condition varied the level of differentiation in the characteristics of the plans in their choice set.[1] Within that experimental condition, they were randomized to a set of 2, 5, 10, or 16 drug plan options. Respondents were asked to select a prescription drug plan from the set shown to them. After choosing, respondents were asked a series of questions about the plan that they chose and the choice set they were shown. After answering these questions, respondents were randomized to a different number of drug plans within the same experimental condition. Respondents repeated the procedure of choosing a drug plan and responding to the same post-choice questions.

2.3 Materials

The scenario was designed to be as real as possible. Descriptions of the plan attributes were assembled from currently available materials on the Medicare web site. Plan characteristics were selected to resemble those currently available in the market and were devised from data on plan offerings publicly available from the Centers for Medicaid and Medicare Services. In addition, so that prices reflected the attributes of each drug plan and to ensure that respondents were choosing between plans of similar expected value, a premium for each plan was calculated based on a model of the relationship between observed premiums and plan characteristics at the time of data collection (Simon & Lucarelli, 2006). With the attribute and price information for each plan, we formed the master sets of drug plans, which we used as a basis for the randomization (Bundorf & Szrek, 2010).

[1]The intent of dividing the participants into two conditions with different levels of differentiation of characteristics was to experimentally create conditions with higher and lower perceived variety. However, the manipulation did not work - participants did not distinguish between the two experimental conditions. For this reason I do not distinguish between experimental condition in the analysis, nor discuss this further. See Appendix A for more detail.

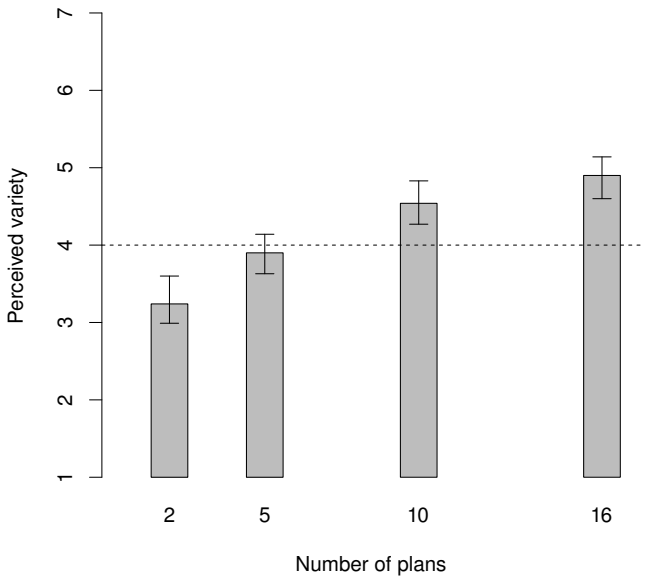

FIGURE 1: Mean perceived variety by number of plans: An anova shows significant differences across the distribution of variety by number of plans. Means were, respectively, 3.24, 3.90, 4.54, and 4.90 on a scale from 1 to 7. Error bars show standard deviations.

2.4 Measures

Respondents were questioned about the perceived variety of the choice set, choice outcome and choice process satisfaction, perceived benefits of the chosen item, perceived costs of the choice process, and desire for choice of multiple items. Additionally, extensive information was available about the respondents' demographic characteristics and the following characteristics were included in the models: age, gender, education level, race, marital status, household income, and a 5-category self-perceived health status variable. Sample means for these variables are listed in Appendix B, Table B1.

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3 Results

3.1 Summary statistics

Table 1 shows the means of the variables with their associated correlations. Frequency distributions (not shown in table) highlight that many people found the choice very difficult (61% responded with 5, 6, or 7) and many did not enjoy the choice at all (58% responded with 1, 2, or 3). On the other hand, close to half of the respondents claimed to have chosen a plan close to their ideal plan (45% responded with 5, 6, or 7) and said they liked the plan they chose (46% responded with 5, 6, or 7).

Number of options has a significant correlation with perceived variety and choice difficulty. Perceived variety is also significantly correlated with choice outcome satisfaction, perceived benefits, and perceived costs (but not with choice process satisfaction which shows a moderate correlation with desire for variety). Choice outcome satisfaction exhibits strong positive correlations with choice process satisfaction and perceived benefits, and a negative correlation with perceived costs. Choice process satisfaction also has a positive correlation with benefits and a negative correlation with costs. Costs and benefits show a negative correlation.

Figure 1 (previous page) displays how perceived variety varies with the number of options. An anova reveals that perceived variety is significantly different across the distribution of number of options (n=545, F=24.55, Prob>F=0.00). Four (4) on the perceived variety scale corresponds to the respondent having the right amount of variety, and with 2 or 5 plans, the respondents on average perceived variety being less than they wanted and with 10 or 16 plans, the respondents on average perceived variety being more than they wanted.

3.2 Regressions

I tested for a concave relationship between the number of options and perceived benefits, costs, net benefits (choice outcome satisfaction and choice process satisfaction), following Reutskaja and Hogarth (2009). My model initially estimated each of these four dependent variables with the number of options and number of options squared as the explanatory variables (with the squared term to allow for a non-linear relationship) plus the demographic control variables. I then estimated a second model in which I added perceived variety and perceived variety squared. I also included a control measure for desire for variety in the models to improve the precision of the perceived variety measure. All regressions use clustering to control for up to two observations per individual and robust standard errors to correct for homoscedasticity in the data. I analyzed the joint significance of the linear and quadratic predictor variables. This tests the main hypothesis through a comparison of the size and significance of perceived variety and number of options.

Choice outcome satisfaction. Table 2 shows how the net benefits (choice outcome and choice process satisfaction) relate to the number of options and perceived variety. I find that the number of options has a statistically significant concave relationship with choice outcome satisfaction when I do not include perceived variety (as in Model 1). One interpretation from this model is that an increase from five to six options increases choice outcome satisfaction by 1% while an increase from five to ten options increases choice outcome satisfaction by 3%. However, as shown in Model 2, as soon as perceived variety is included in the model, the joint effect of number of options is no longer significant. The joint effect of perceived variety and perceived variety squared, in contrast, is significant and concave; choice outcome satisfaction peaks when perceived variety is 5 on a 1 to 7 scale (Table 4). Since the interpretation of "4" on the scale for perceived variety is "I had the right amount of variety", this suggests that choice outcome satisfaction is highest when perceived variety is one level higher than "the right amount". A change in perceived variety from 3 to 4 will increase choice outcome satisfaction by 5.3 percentage points, while a change from 2 to 4 will increase choice outcome satisfaction by 15 percentage points.

Choice process satisfaction. The number of options and number of options squared does not show a significant effect on choice process satisfaction when perceived variety is not in the model (Table 2, Model 3). However, a joint significance test suggests that number of options and number of options squared are jointly significant when perceived variety is included (Model 4). When perceived variety is fixed at 3, an increase from 5 to 10 plans reduces choice process satisfaction by 2.7%. The joint effect of the perceived variety variables is also significant and concave in this model, with choice process satisfaction at its peak when perceived variety is 4 on a 1 to 7 scale (Table 4) – that is, when perceived variety is at the "right amount". Furthermore, increases in perceived variety from 3 to 4 will increase choice process satisfaction by 4.3 percentage points, while a change from 2 to 4 will increase choice process satisfaction by 15 percentage points.

Perceived benefits. The number of options and number of options squared exhibit a significant concave relationship with perceived benefits when perceived variety is not included (Table 3, Model 1), with perceived benefits peaking at 14 plans. However, once perceived variety is included in the model (Table 3, Model 2), the joint effect of number of options and number of options squared is no longer significant. The joint effect of the perceived variety coefficients, in contrast, is significant, and exhibits a concave relationship with perceived benefits. Perceived benefits peak when perceived variety is at 5 on a scale of 1 to 7 (Table 4), when perceived variety is one level higher than the "right amount".

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TABLE 1: Key variable definitions, means, and correlations.

Name	Definition
Number of plans	Respondent randomized to 2, 5, 10, or 16 plans
Perceived variety	Do you think that the selection should have included a greater variety of plans? Scale 1–7, (1) I had too little variety, (4) I had the right amount of variety, (7) I had too much variety
Outcome satisfaction	How much do you like the plan you decided to pick? Scale 1–7, (1) Not at all, (7) Extremely
Process satisfaction	How much did you enjoy making the choice? Scale 1–7, (1) Not at all, (7) Extremely
Perceived benefits	How different/similar is the plan you chose from the 'ideal' plan you would like to purchase for yourself? Scale 1–7, (1) Ideal plan would be very different from the plan I chose now, (7) The plan I chose now is the ideal one
Perceived costs	Did you find it difficult to make your decision? Scale 1–7, (1) Not at all, (7) Extremely
Desire for choice	Would you prefer to choose your own Medicare drug plan from a variety of plans or would you rather be automatically enrolled into a single standard plan? Scale 1–7, (1) I would prefer to NOT choose my own plan, (4) I am indifferent, (7) I would prefer to choose my own plan.

			Correlations					
Variable	Mean	S.D.	Number of Plans	Perceived variety	Outcome satisfaction	Process satisfaction	Perceived benefits	Perceived costs
Number of plans	8.18	5.19	1					
Perceived variety	4.15	1.78	0.33*	1				
Outcome satisfaction	4.29	1.38	0.07	0.22*	1			
Process satisfaction	3.11	1.68	−0.07	0	0.56*	1		
Perceived benefits	4.09	1.64	0.11	0.24*	0.63*	0.41*	1	
Perceived costs	4.72	1.80	0.15*	0.18*	−0.19*	−0.40*	−0.11*	1
Desire for choice	5.68	1.61	0.02	−0.09	0.09	0.13*	0.06	−0.01

Note: All correlations are Spearman. N= 545 with up to 2 responses per individual, * reflects p<.01.

A change in perceived variety from 3 to 4 increases perceived benefits by 7 percentage points, while a change in perceived variety from 2 to 4 increases perceived benefits by 19 percentage points.

Perceived costs. The number of options and number of options squared show a significant effect on perceived costs – increasing perceived costs with increases in the number of options — regardless of whether perceived variety is included in the regression (Models 3 and 4 in Table 3). Linear and squared terms of perceived variety are jointly statistically significant displaying a convex relationship with perceived costs. Perceived costs are lowest when perceived variety is 3 or 4 (Table 4). In other words, perceived costs are lowest when perceived variety is at "the right amount" or one level lower. When perceived variety decreases or increases by one level (down to 2 or up to 5), perceived costs increase by 4 percentage points. Additionally, when perceived variety is 4, an increase from 5 to 10 plans increases perceived costs by 10%.

Individual characteristics. I then tested whether the effects of perceived variety on the dependent variables differ by the age, gender, and education level of the respondent. I reran the regressions as before with interactions for each of these demographic variables with perceived variety and perceived variety squared.

Post-regression statistical tests in Table 5 highlight the effect of interactions between education, age, gender, and perceived variety on the dependent variables. For individuals in the lowest education group (less than high school), perceived variety did not significantly affect either choice outcome satisfaction or perceived benefits, however desire for variety did – with individuals with higher desire for variety showing lower choice outcome satisfaction and perceived benefits (supported by further analysis).

The oldest age group (Age 75+) showed differences vis-à-vis the other groups in how variety affected their assessment of net benefits. In particular, perceived variety had a larger effect on their assessments of both choice outcome and process satisfaction when perceived variety was either very low

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TABLE 2: Net benefits.

	Choice outcome satisfaction	Choice outcome satisfaction	Choice process satisfaction	Choice process satisfaction
Number of plans	0.147 [0.046, 0.248]**	0.060 [–0.040, 0.161]	0.026 [–0.088, 0.140]	–0.047 [–0.155, 0.061]
Number of plans squared	–0.007 [–0.012, –0.002]**	–0.004 [–0.009, 0.001]	–0.003 [–0.009, 0.004]	0.001 [–0.005, 0.006]
Perceived variety		1.185 [0.918, 1.451]**		1.611 [1.299, 1.923]**
Perceived variety squared		–0.122 [–0.154, –0.091]**		–0.193 [–0.231, –0.155]**
Desire for variety		0.068 [–0.021, 0.157]		0.128 [0.015, 0.240]*
Constant	6.422 [3.835, 9.008]**	3.394 [0.823, 5.966]**	6.905 [3.373, 10.437]**	2.658 [–0.794, 6.111]
N	545	545	545	545
R^2	0.09	0.22	0.08	0.24
F	1.35	5.95	2.08	7.93
Root MSE	1.36	1.26	1.66	1.51
Joint significance test (number of plans, number of plans squared)				
F test	4.35	1.52	1.63	3.46
Prob>F	0.014*	0.220	0.198	0.033*
Joint significance test (perceived variety, perceived variety squared)				
F test		42.94		51.6
Prob>F		0.000**		0.000**

Note: Models show coefficients and 95% confidence intervals for key variables. The following demographic control variables were included in the regression but are not displayed in the table: education, health status, household income, gender, age, race, and marital status: * p<0.05; ** p<0.01.

or very high, lowering their satisfaction (supported by further analysis). The middle age group (Age 70–74) also had lower endpoints for choice outcome satisfaction than the youngest age group (Age 65-69).

I did not find that men and women exhibited differences in how variety affected perceived benefits, costs, and net benefits.

Within subject analysis. Next, I complement the analysis with a within-subject analysis that considers how differences in perceived variety and number of plans across the two choices made by the respondent affect differences in perceived benefits, costs, and net benefits. This analysis addresses the concern that an omitted variable that relates to perceived variety and the dependent variables could be affecting the results.

I find that choice outcome satisfaction, choice process satisfaction, and perceived benefits all show a concave relationship with perceived variety and that choice difficulty shows a convex relationship with perceived variety (Appendix B, Table B2). Number of plans shows a significant and a concave relationship for choice outcome satisfaction.

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TABLE 3: Perceived benefits and costs.

	Perceived benefits	Perceived benefits	Perceived costs	Perceived costs
Number of plans	0.113 [–0.006, 0.231]	0.000 [–0.110, 0.110]	0.018 [–0.098, 0.133]	0.009 [–0.104, 0.122]
Number of plans squared	–0.004 [–0.010, 0.002]	0.000 [–0.006, 0.006]	0.002 [–0.004, 0.008]	0.002 [–0.004, 0.008]
Perceived variety		1.495 [1.180, 1.809]**		–0.832 [–1.250, –0.414]**
Perceived variety squared		–0.153 [–0.191, –0.115]**		–0.119 [0.071, 0.167]**
Desire for variety		0.088 [–0.021, 0.196]		0.038 [–0.095, 0.172]*
Constant	5.774 [3.140, 8.409]**	1.931 [–0.643, 4.505]	1.687 [–1.390, 4.764]	3.112 [–0.274, 6.498]
N	545	545	545	545
R2	0.08	0.23	0.09	0.16
F	1.34	12.14	6.61	7.06
Root MSE	1.62	1.48	1.76	1.7
Joint significance test (number of plans, number of plans squared)				
F test	4.53	0.03	7.89	4.64
Prob>F	0.012*	0.973	0.001**	0.010*
Joint significance test (perceived variety, perceived variety squared)				
F test		54.85		18.69
Prob>F		0.000**		0.000**

Note: Models show coefficients and 95% confidence intervals for key variables. The following demographic control variables were included in the regression but are not displayed in the table: education, health status, household income, gender, age, race, and marital status: * p<0.05; ** p<0.01.

3.3 Mediation models

From recent advances in research on mediation (Hayes, 2013; Preacher & Hayes, 2008; Zhao, Lynch & Chen, 2010), we know that, in addition to its direct effect (or even if there is no direct effect), a variable may exert an (important) influence on another variable indirectly. Hence, to complete the analysis, I ran mediation models to test for whether perceived variety mediated the relationship between number of options and the dependent variables. This tests the second hypothesis by testing a path through which number of options operates. I estimated mediation models that preserved the non-linear relationships between the number of options (perceived variety) and the dependent variables. I then used Medcurve to compute unbiased bootstrapped confidence intervals (Hayes & Preacher, 2010).

In Tables 2 and 3, the joint effect of number of options and number of options squared tests whether the direct effect of number of options on the dependent variable is significant. Table 6 shows the indirect effects of number of options on the different dependent variables, measured at each number of options (2, 5, 10, or 16 health plans).

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TABLE 4: Margins calculated at each level of perceived variety.

	Choice outcome satisfaction			Choice process satisfaction		
	Estimate	95% CI		Estimate	95% CI	
Level		Lower bound	Upper bound		Lower bound	Upper bound
1	2.937	2.622	3.252	1.784	1.458	2.110
2	3.755	3.560	3.950	2.816	2.599	3.032
3	4.327	4.165	4.489	3.461	3.250	3.671
4	4.654	4.492	4.817	3.719	3.501	3.938
5	4.737	4.579	4.895	3.591	3.389	3.793
6	4.575	4.398	4.751	3.077	2.871	3.283
7	4.167	3.888	4.447	2.176	1.851	2.502
	Perceived benefits			Perceived costs		
	Estimate	95% CI		Estimate	95% CI	
Level		Lower bound	Upper bound		Lower bound	Upper bound
1	2.340	1.988	2.691	5.030	4.520	5.540
2	3.377	3.163	3.590	4.555	4.251	4.859
3	4.108	3.927	4.289	4.319	4.082	4.555
4	4.534	4.350	4.717	4.320	4.086	4.554
5	4.654	4.478	4.831	4.559	4.339	4.779
6	4.469	4.262	4.676	5.036	4.811	5.262
7	3.979	3.631	4.327	5.752	5.391	6.112

Note: Margins were calculated post-regression (Tables 2 and 3). They show the average estimated value of the dependent variable when all observations are as if they took on the value of perceived variety at that point. Control variables are left unchanged. Post-estimation tests show that the values of the margins at each level are significantly different from the margins at adjacent values in all regressions, except for choice difficulty in which they are the same for values 3 and 4.

Choice outcome and process satisfaction. The indirect effect of number of options through perceived variety on choice outcome satisfaction is positive and significant when the number of options is 2, 5, and 10. This effect is highest when the number of options is 2 and decreases as the number of options increases, becoming insignificantly different from 0 for the highest level of options in the experiment (16). The interpretation is that an increase in three options at the level of 2 plans will increase choice outcome satisfaction through perceived variety by 0.12(=3 x 0.04), a 2 percentage point increase.

The indirect effect of number of options through perceived variety on choice process satisfaction is positive and significant when there are 2 or 5 options, zero for 10 options, and negative and significant when there are 16 options. In other words, as the number of options increases the effect of the number of options through perceived variety on choice process satisfaction goes from being positive to being negative. At 16 options, a three option increase indirectly decreases choice process satisfaction by 0.09 (or 1.5 percentage points).

Costs and Benefits. The number of options also has a positive and significant indirect effect through perceived variety on the benefits of choice when the number of options is 2, 5, or 10. The effect is largest for the smallest set size (2), where the effect of an increase in three options increases perceived benefits by .15 points (2.50 percentage points). The number of options has an indirect effect on the perceived costs when the number of options is 10 or 16. An increase in three options increases perceived costs at 16 plans by 0.12 (2 percentage points).

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TABLE 5: Joint significance tests of age groups, education groups, and gender.

	Choice outcome satisfaction	Choice process satisfaction	Perceived benefits	Perceived costs
Omitted Age Group (65-69)				
Age Group (70-74)				
F test	4.15	0.68	0.18	0.11
Prob>F	0.042*	0.410	0.675	0.742
Age Group (75+)				
F test	20.69	11.27	2.46	1.56
Prob>F	0.000**	0.000**	0.119	0.213
Omitted Education Group (Some College)				
Education Group (Less than High School)				
F test	9.20	1.19	5.87	0.56
Prob>F	0.003**	0.276	0.016*	0.456
Education Group (High School)				
F test	0.14	0.57	0.66	4.13
Prob>F	0.713	0.453	0.417	0.043*
Education Group (Bachelor's degree or higher)				
F test	0.66	0.45	1.41	2.85
Prob>F	0.418	0.504	0.236	0.092
Female				
F test	2.37	0.42	1.22	0.35
Prob>F	0.125	0.518	0.271	0.554

Note: Tests show the joint significance of the category listed, its interactions with perceived variety, and its interactions with perceived variety squared relative to the omitted group. All tests are run following regressions that estimate the dependent variable on the number of plans, number of plans squared, perceived variety, perceived variety squared, desire for variety, interactions with (perceived variety, perceived variety squared, and education group/age group/gender), and individual characteristics (education group, age group, gender, household income, self-assessed health status, race, and marital status).

4 Discussion

Many studies document a concave relationship between the number of options and consumer satisfaction (Lenton, Fasolo & Todd, 2010; Reutskaja & Hogarth, 2009; Shah & Wolford, 2007; Soyer & Hogarth, 2011). I also find such a relationship between the number of options and both choice outcome satisfaction and perceived benefits. However, because the literature points to the importance of assortment structure and the variety of the choice set in influencing behavior, I also include perceived variety in my models. Once I do this, I find support for the primary hypothesis that perceived variety is more important than the number of options that a person has: perceived variety displays a concave relationship with choice outcome satisfaction, choice process satisfaction, and perceived benefits and a concave relationship with perceived costs (see Models 2 and 4 in Tables 2 and 3). In contrast, after I include perceived variety in the models, number of options did not improve any outcomes, but on average reduced choice process satisfaction and increased perceived costs.

This finding is consistent with the notion that having more options is desirable if they are perceived as differentiated options. In fact, the results support the secondary hypothesis that having more options does improve outcomes through its effect on perceived variety. While I found (Tables 2 and 3) that, on average, the direct effect of number of options was to decrease choice process satisfaction and increase perceived costs, the mediation results (Table 6) suggest additional ways

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TABLE 6: Mediation analysis: Indirect effects of number of plans through perceived variety.

	Choice outcome satisfaction			Choice process satisfaction		
a*b at X values	Estimate	95% BC CI		Estimate	95% BC CI	
2	**0.039**	**0.024**	**0.058**	**0.031**	**0.016**	**0.051**
5	**0.030**	**0.019**	**0.043**	**0.018**	**0.007**	**0.032**
10	**0.015**	**0.007**	**0.024**	–0.000	–0.016	0.006
16	–0.000	–0.016	0.008	**–0.031**	**–0.054**	**–0.013**
	Benefits			Costs		
a*b at X values	Estimate	95% BC CI		Estimate	95% BC CI	
2	**0.047**	**0.027**	**0.069**	–0.000	–0.018	0.011
5	**0.037**	**0.023**	**0.054**	0.006	–0.006	0.017
10	**0.020**	**0.008**	**0.031**	**0.020**	**0.010**	**0.036**
16	–0.000	–0.018	0.011	**0.037**	**0.022**	**0.062**

Note: Indirect effects (of the number of plans through perceived variety on the dependent variable) in four mediation models are shown. Models preserved the non-linear relationships between number of plans and the outcome variables and perceived variety and the outcome variables. Models also include demographic control variables. Estimates and 95% bias-corrected confidence intervals are shown for 1000 bootstrapped samples. Bolded values highlight confidence intervals that do not include 0.

in which number of options affects the dependent variables through perceived variety. For small choice sets, having more options increases perceived variety and consequently boosts choice outcome satisfaction, choice process satisfaction, and perceived benefits. For large choice sets, having more options increases perceived variety but consequently reduces choice process satisfaction and increases perceived costs. These findings suggest a theoretical mechanism underlying the relationship between number of options and choice outcomes.

The paper also builds on earlier studies in the literature. I was able to replicate the results by Reutskaja and Hogarth (2009) before illustrating the role of perceived variety in a similar model. The findings regarding perceived variety can also be fit into the taxonomy that Chernev (2012) offers for assortment structure, where perceived variety relates to attribute complementarity. Furthermore, the results provide additional support that perceptions of variety positively influence consumer satisfaction (Broniarczyk et al., 1998; Hoch et al., 1999; Mogilner et al., 2008). In summary, the study addresses research on perceived variety and research on choice overload to show that the same concave relationship that was previously attributed to the number of options, is qualified by perceived variety and that the peak of this inverted U shaped function is when perceived variety is 'just right'.

This study is not without limitations. Most critically, the measures are simple and consist of single items. They were based on previous papers in the literature (Iyengar & Lepper, 2000; Reutskaja & Hogarth, 2009), but some authors have used more robust measures. Actual variety has been measured in more robust ways by other researchers (e.g., Fasolo et al., 2009; Lurie, 2004), but may not always be a good replacement for perceived variety (Broniarczyk et al., 1998; Hoch et al., 1999; Kahn & Wansink, 2004). In this study, respondents did not discern the actual variety manipulation (Appendix A), and future research should consider whether complexity of the choice task was the main reason for this. Future research should also explore the heterogeneity amongst respondents in their preferences for more options and more variety, examining the extent of that heterogeneity and its effects on choice satisfaction.

The data are, of course, from a specific context, but the experiments, despite being hypothetical, use stimuli that closely resemble the true stimuli and respondents are seniors that make these decisions in real life. The results from non-hypothetical studies with other consumer goods reinforce the findings. For example, Mogilner et al. 2008 show, using magazines and coffee as stimuli, that perceived variety affects choice satisfaction. Greifender et al. 2010 suggest, using pens and MP3 players as stimuli, that the too-much choice effect is stimulated by choice complexity, which is a function of the number of options as well as other features of the choice set. Still, not all of the results will necessarily be affected in the same way from using hypothetical measures. Perceived variety and choice process satisfaction, as in the

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previous two examples, may not differ as much as choice outcome satisfaction does in a real scenario. Nevertheless, I expect that the results will generalize reasonably well in contexts where decisions are less consequential and not as complex, such as in these two studies. Moreover, although the study was run with older adults, related prior work has shown that numeracy is a more relevant characteristic than age when it comes to choice overload. For example, older adults with lower numeracy made poorer quality decisions in extensive choice environments than their higher numeracy counterparts[2] (Szrek & Bundorf, 2014) and were more likely to report positive willingness to pay for choice than those with higher numeracy even when choice did not improve their outcomes (Szrek & Bundorf, 2011). Elsewhere I have found positive willingness to pay for choice amongst younger subject pools (Szrek & Baron, 2007), implying that the results in this paper should generalize to younger populations. Nevertheless, there is no doubt that populations with lower socioeconomic status and lower numeracy levels, including populations of older adults, have difficulty with decisions involving extensive choice and may be especially "lured" by the illusion of choice; these groups need more assistance with these decisions especially when the decisions can affect their welfare.

The relationship between perceived variety, choice satisfaction, and individual utility or welfare has not been discussed in this paper, however it is especially important in contexts that affect the health and/or financial welfare of citizens. I caution that when interpreting the results, optimizing the relationship between perceived variety and consumer satisfaction should not be an objective in and of itself, but need be related to other potential goals, like improving the welfare of decision makers by helping them make better decisions (see for example Kling et al. 2012 and Ketcham et al. 2012 for studies that measure welfare in this context). I briefly explored the relationship between decision quality (as in Szrek and Bundorf, 2014), perceived variety, perceived benefits, perceived costs, and net benefits of choice in the data. I found that perceived variety mediates the relationship between perceived benefits and net benefits (both outcome and process satisfaction) and decision quality, although it has no direct effect on decision quality. These results are noteworthy as they help to position these results in the broader context; in both the health care context and in other financial contexts with important consequences, a complete analysis should give some consideration to decision quality.

The current health insurance exchanges in the United States are similar to Medicare Part D in that choice is provided through an internet platform that requires potential consumers to sort through different choices and make a decision. Many of the difficulties that researchers identify parallel those that have been discussed for Medicare Part D (Wong et al., 2014) suggesting that the results discussed in this paper are relevant to improving the current platform for Affordable Care Act coverage in the U.S. In other countries, health care choice is also a key policy issue. In Switzerland, for example, individuals have to choose between many different private health insurance plans (Frank & Lamiraud, 2009). Maintaining patient choice of hospital (for example in England, Denmark, Norway, Sweden) or choice of provider (for example in France or Germany) has been a key policy issue – and regulatory mechanisms have tried not to sacrifice choice for efficiency (Jost, Dawson & den Exter, 2006). Understanding how the number of options, perceived variety, choice satisfaction, and decision quality relate may lead to a better appreciation for when and how individuals benefit from more choice in health care and other contexts.

[2]We showed that numeracy moderated the choice overload effect and that increases in decision costs mediated it: more numerate adults made better decisions than less numerate adults when choosing among a small number of alternatives but when choice set size increased their advantage dissipated. Here I find corroborating results for choice difficulty — escalations in choice difficulty arising from increases in perceived variety are most highly concentrated in the most numerate respondents.

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Appendix A: Description of the variety manipulation

The experiment manipulated actual variety by randomizing respondents to choice sets with more or less differentiation amongst product attributes. This was accomplished by having one high differentiation condition and another low differentiation condition. The variety manipulation did not "work" in the sense that respondents did not perceive a large or significant difference in the two conditions. The correlation of actual variety and perceived variety is 0.0158 (Prob>t=0.7070).

I believe that the lack of a relationship between actual and perceived variety has to do with the complexity of the task that was asked of respondents, as reflected by the similarity to the real task. In other papers, Bundorf and I document the difficulty of the task (Szrek and Bundorf, 2011, Szrek and Bundorf, 2014) as do other researchers (Ketcham, Lucarelli & Miravete, 2012; Kling et al., 2012). Because this study elicited perceived variety, I do not discuss actual variety further in the paper and focus instead on perceived variety which has received as much attention as actual variety by consumer behavior researchers. Here I summarize, for interested readers, how actual variety (differentiation) was manipulated and illustrate with some tables how the attributes in the high and low differentiation choice sets compared to each other.

Implementing low and high differentiation. The objective in creating low and high differentiation conditions was to construct choice sets such that within set variation in plan attributes would be greater in high differentiation than in low differentiation sets. However, it was also desirable for the mean characteristics of plans to be similar among respondents in the low and high differentiation arms to ensure that the characteristics of offered plans did not differ in systematic ways between the arms. This was accomplished by first defining a set of 16 highly differentiated plans (and then 16 sets of 16 low differentiated plans) that were described on 5 attributes and then by setting monthly premiums (the sixth attribute) in such a way that choice sets were equivalent in terms of expected value. I describe how this was done.

The high differentiation choice set was constructed by varying the ranges of the plan characteristics (except monthly premium) as much as possible but keeping them within the range of existing plans in the market. Each of the 16 different plans in this highly differentiated choice set was then used to define a low differentiation choice set. So, for example, the 3rd plan in the high differentiation choice set was the first plan in the 3rd set of (16) low differentiation plans. The plan characteristics of the other 15 plans of the low differentiation set were created by varying the characteristics

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of each plan within pre-defined relatively narrow limits for the choice set. Up to three characteristics were changed at a time for each plan. The range for each of the attributes and the number of levels of each attribute was restricted to vary from 3 or 4 levels to 2 or 3 levels. For example, the plans in the high differentiation condition had a deductible of either 0, 100, or 250 (3 levels). In the low differentiation choice sets, the possible deductibles are either 0 and 100 or 100 and 250 (2 levels). To use another example, the number of drugs with a $20 or less copay has 4 levels in the high differentiation choice set, spanning the range of 20 to 95. In the low differentiation choice sets, the range is set by the original plan from the choice set +/- 5, so the range spans 10 (for example, 15 to 25 or 35 to 45). For another example, see plan B of the high variety choice set in Table A1 (at the end of Appendix A). For each of the 15 plans in the low differentiation set modeled after plan B, only three characteristics were modified at a time (and these were modified within the limits shown). For example, all plans in this low differentiation choice set have coverage in the gap, although some have coverage in the gap for generic and branded drugs, while some plans have coverage in the gap for generic drugs only.

Then, to make sure that the characteristics of offered plans did not differ in systematic ways between the arms, the monthly premium was determined using the relationship between observed premium and plan characteristics from the market (Simon and Lucarelli, 2006): monthly premium = 4 + 0.4 * Formulary Breadth – 0.12 * Prior Authorization + 0.05 * Copayment + 10.0 * Generic Gap + 25 * Brand and Generic Gap – 10 * $100 Deductible – 25 * $250 Deductible. This equation, by valuing the characteristics in dollar terms allows us to say that respondents in all choice sets saw options with similar expected value. This ensured that all respondents, regardless of the variety of the choice set or number of options (plans) that they were randomized to, would be choosing between plans that were actuarially equivalent. In the set of plans shown in Table A1, the monthly premium ranged from $38.15 to $65.25.

Randomization. In the study, individuals were randomized to a level of differentiation (high, low) and number of drug plans (2, 5, 10, 16). If they were randomized to the high differentiation choice set, the plans presented to them were randomly chosen from the original differentiated choice set (the high differentiation choice set). If they were randomized to the low differentiation choice set, they were randomized to one of the 16 low differentiation choice sets that were created from the highly differentiated choice set. Plans presented to them were then randomly chosen from this low variety choice set. The order of presentation of the plans was also randomized.

Comparisons between the high and low differentiation choice sets. Tables A2 and A3 present comparisons of the low and high differentiation choice sets. The high differentiation choice set has higher maximum value and lower minimum value for all attributes compared to the averages for the low variety choice sets (Table A2). Similarly, the number of attribute levels, density, and range are higher for the high differentiation choice set than for the average of the low differentiation choice sets. (The number of attribute levels for the monthly premium is an exception – this was always 16 because of the equation used to calculate monthly premium.) An examination of each of the low variety choice sets (not shown in table) shows that the number of attribute levels, density, and range are always lower in the low differentiation choice sets with the exception of number of attribute levels for monthly premium (as mentioned) and for the density of the deductible which is sometimes higher in the low differentiation choice sets. The maximum values for all attributes are higher (or equal) in the high differentiation set than the individual low differentiation sets and the minimum values are lower (or equal) for all attributes with the exception of the monthly premium which is slightly higher in 4 low differentiation choice sets and slightly lower in 1 low differentiation choice set (not shown in table). The density was calculated by dividing the range by the number of attribute levels minus 1. For example, in the high differentiation choice set, the out of pocket maximum ranged from 2500 to 6350 and there were 7 unique attribute levels, yielding a density of 641.7=(6350-2500)/(7-1).

The variances are shown for all choice sets in Table A3, and the variances for each attribute are always lower for the low differentiation choice sets compared to the high differentiation choice set.

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TABLE A1: Example of a Low Variety Choice Set.

	Monthly premium	Deductible	Number of top 100 Medicare drugs on formulary	Number of drugs requiring prior authorization	Number of drugs with a $20 or less copay	Availability of coverage in the gap
Plan B from the high variety set	63,75	0	75	0	75	Yes, Generics and Branded drugs
Possible characteristics of the set of plans modeled after Plan B	Ranged from 38.15 to 65.25	0, 100	70, 75, 80	0, 5	65, 75, 85	Yes, Generics and Branded drugs Yes, Generics drugs

TABLE A2: Comparison of high and low differentiation choice sets.

	Monthly premium	Deductible	Number of top 100 Medicare drugs on formulary	Number of drugs requiring prior authorization	Number of drugs with a $20 or less copay	Availability of coverage in the gap
HIGH						
Maximum value	63.75	250	99	40	95	10
Minimum value	6.2	0	75	0	20	0
Number of attribute levels	16	3	4	4	4	3
Density	3.837	125	8	13.333	25	5
Range	57.55	250	24	40	75	10
LOW						
Maximum value	55.313	156.25	92	21.563	68.5	7.188
Minimum value	28.138	37.5	83.688	13.438	50	2.188
Number of attribute levels	16	2	2.875	2.625	3	2
Density	1.812	118.75	4.479	5	9.25	5
Range	27.175	118.75	8.313	8.125	18.5	5

Note: The table shows the characteristics of the full (16 item) high differentiation choice set and averages for each characteristic across the full 16 low differentiation choice sets. Availability of coverage in the gap was converted to numeric, for the purposes of this table, where 10=Yes, Generics and branded drugs, 7=Yes, Generics only, and 0=No. Density is calculated as (Maximum value – Minimum value)/(Number of attribute levels – 1). The Range is calculate as (Maximum value – Minimum value).

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TABLE A3: Variances of the attributes in the different choice sets.

	Monthly premium	Deductible	Number of top 100 Medicare drugs on formulary	Number of drugs requiring prior authorization	Number of drugs with a $20 or less copay
High differentiation choice set	214.424	9545.455	34.618	200	920.455
Low differentiation choice set 1	81.971	5906.25	11.563	14.896	59.583
Low differentiation choice set 2	88.068	2500	11.563	6.563	53.333
Low differentiation choice set 3	62.394	2625	11.563	14.896	53.333
Low differentiation choice set 4	108.783	5906.25	11.563	6.563	28.533
Low differentiation choice set 5	84.259	2625	11.563	6.563	53.333
Low differentiation choice set 6	78.859	5906.25	11.563	14.896	53.333
Low differentiation choice set 7	57.875	2625	11.563	14.896	53.333
Low differentiation choice set 8	89.095	2625	11.563	14.896	53.333
Low differentiation choice set 9	89.630	5906.25	9.6	14.896	30.517
Low differentiation choice set 10	74.08	5625	9.6	6.563	51.667
Low differentiation choice set 11	82.037	2625	9.6	14.896	53.333
Low differentiation choice set 12	95.112	2625	9.6	6.563	28.533
Low differentiation choice set 13	115.087	5906.25	4.2	14.896	28.533
Low differentiation choice set 14	49.839	2625	4.733	14.896	53.333
Low differentiation choice set 15	58.613	2625	4.2	14.896	53.333
Low differentiation choice set 16	92.592	2625	4.2	6.563	53.333

Note: The table shows the variances for each 16-item choice set. There was one high differentiation choice set and 16 low differentiation choice sets.

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Appendix B: Supplementary tables

TABLE B1: Variances of the attributes in the different choice sets.

	Mean	Standard Deviation
Education		
Less than High School	0.097	0.297
High School	0.316	0.465
Some college	0.264	0.441
Bachelor's degree or higher	0.323	0.468
Self-reported health		
Excellent	0.097	0.297
Very good	0.378	0.485
Good	0.369	0.483
Fair	0.139	0.347
Poor	0.017	0.128
Female	0.488	0.500
White Race	0.853	0.354
Married	0.716	0.452
Age (Range 65–89)	70.722	4.900
Annual Household Income		
$5.000–$7.499	0.024	0.153
$7.500–$9.999	0.007	0.085
$10.000–$12.499	0.015	0.120
$12.500–14.999	0.018	0.134
$15.000–$19.999	0.050	0.217
$20.000–$24.999	0.084	0.278
$25.000–$29.999	0.068	0.252
$30.000–$34.999	0.083	0.275
$35.000–$39.999	0.073	0.261
$40.000 –$49.999	0.134	0.341
$50.000–$59.999	0.119	0.324
$60.000–$74.999	0.116	0.320
$75.000–$84.999	0.061	0.239
$85.000–$99.999	0.051	0.221
$100.000–$124.999	0.055	0.228
$125.000–$149.999	0.015	0.120
$150.000–$174.999	0.013	0.113
$175.000 or more	0.015	0.120

Note: N=545.

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TABLE B2: Joint significance tests of age groups, education groups, and gender.

	Change in choice outcome satisfaction	Change in choice process satisfaction	Change in perceived benefits	Change in perceived costs
Change in number of plans	0.129	0.032	0.032	0.089
	[0.017, 0.240]*	[–0.082, 0.146]	[–0.095, 0.160]	[–0.021, 0.199]
Change in number of plans squared	–0.006	–0.002	–0.001	–0.002
	[–0.012, –0.000]*	[–0.008, 0.004]	[–0.007, 0.006]	[–0.008, 0.003]
Change in perceived variety	0.835	1.042	1.118	–0.796
	[0.419, 1.250]**	[0.580, 1.504]**	[0.565, –1.672]**	[–1.345, –0.248]**
Change in perceived variety squared	–0.095	–0.132	–0.113	0.102
	[–0.141, –0.049]**	[–0.184, –0.079]**	[–0.175, –0.052]**	[0.042, 0.161]**
Constant	0.099	0.183	–0.096	–0.195
	[–0.066, 0.264]	[0.006, 0.360]*	[–0.329, 0.137]	[–0.400, 0.010]
N	251	251	251	251
R2	0.14	0.14	0.12	0.11
F	8.19	7.26	6.39	7.93
Root MSE	1.32	1.4	1.79	1.64

Note: Regressions use two responses per individual and estimate the change in the dependent variable, regressing it on changes in the main independent variables. Other independent measures are constant within the individual and are not included in the model. * p<0.05; ** p<0.01

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