Examining Extremes

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Examining Extremes

Anyone who's spent significant time in consumer insights, decision science, or behavioral science has probably executed or commissioned a Choice-Based Conjoint (CBC) research project. But no one currently working in these fields (or any other, for that matter) has ever seen anything like COVID-19. Or the current global George Floyd protests against police violence toward African Americans. You may be surprised at how these apparently disparate topics relate to one of the most important sources of scientific breakthroughs and commercial innovations alike: the study of extreme conditions.

Examining Extremes

Whether you're sizing a market opportunity, investigating price elasticity in an existing category, or optimizing a new product design, CBC allows us to tease apart the various features (or attributes) of a product or brand, and understand how much each attribute contributes to its perceived value. The predictive accuracy of properly designed CBC studies can be bested only by more sophisticated versions of CBC itself, e.g. the Proportion-of-Emotion-CBC model that explicitly integrates both non-conscious emotional responses, and deliberate or rational consideration of choices.

In a CBC study, the value of each product attribute—from price to the amounts or qualities of other attributes–is estimated by varying the levels of each attribute. By analyzing respondent choice behavior over a well-balanced set of combinations of attribute levels, we can identify, for each attribute, where the amount of that attribute is perceived as "too little to matter" at the low end, and "too much to pay for" at the high end. Many consumers won't be interested in a car with less than four cylinders or more than eight cylinders. Sometimes, a price that's too low drives some consumers away due to suspicions about quality, while a too-high price can't be justified by consumers' perceptions of the value of a product's attributes–things like the number of seats in a car, the interest rate and member rewards bundled with a credit card, or the amount of value your brand's reputation adds to a product that competitors might also claim to offer (if only consumers trusted those brands as much as they trust you).

Attributes are the key independent variables in a CBC experiment. By presenting a properly balanced set of trade-offs among choices, and measuring respondents' choice behavior (the dependent variable), we can produce a mathematically-precise model of how new or modified products or brands–with specific combinations of attributes and levels–will perform in-market.

While other units of value can be substituted in place of dollar cost, the most common type of CBC uses willingness-to-pay as the basic measure of utility. A well-structured CBC can identify the features that consumers are willing to pay for, and those that aren't really driving purchase decisions, by varying price across a range that is at least somewhat wider than might be realistic in the real world. We can then accurately model how well or poorly a product with a specific combination of features will perform in the market, across a range of prices, and determine e.g. whether that product will be successful at a sustainable price point.

Product Behave as Expected by Brand When Price is Systematically Varied

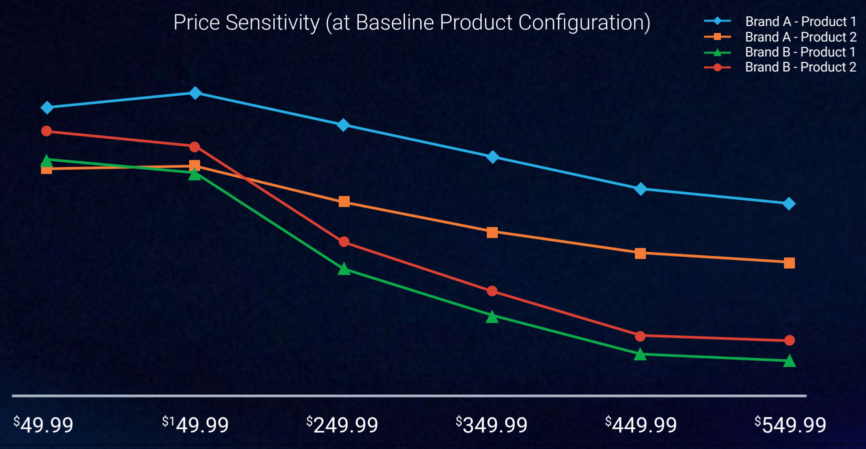


Figure: A Sentient Decision Science PoE-weighted CBC study, determining consumers' willingness-to-pay for specific products across a very wide range of price points, is a familiar example of a *parametric* study.

IF YOU'VE FOLLOWED ALONG SO FAR, CONGRATULATIONS!

You understand the rarified concept of *parametric studies*. Parametric studies map the full range of potential responses to the full range of possible values of an independent variable, from the lowest possible value to the highest. Such studies allow us to 'map the response curve' as it relates to a particular variable or driver—especially those parts of the curve that are outside what you might think of as the 'normal' range.

Parametric studies map the full range of potential responses to an expanded range of values of an independent variable, like price, from the lowest feasible value to the highest, to see what will *really* happen if we push things further than we normally would. Parametric studies allow us to 'map the response curve' as it relates to a particular variable or choice driver—especially those parts of the curve that are outside what you might think of as the 'normal' range.

We don’t hear much about parametric studies of real-world human behavior outside of academic laboratories, but *parametric studies* across many fields have produced discoveries that impact your life and your mission in profound ways. Parametric studies tell you how much things can actually change in response to extreme situations; how to recognize real inflection points (vs. temporary changes that will quickly revert to normal); how quickly things can really change; the ranges of independent variables over which the response might not change in a meaningful or relevant way; and where the optimal and extreme points on the curve are really located.

Often, these include optimal and/or worst-case scenarios you didn’t expect to find, regardless of how much data you’ve already collected. For example, parametric studies of choice set size, assortment, and variety have demonstrated changes in purchase behavior that can amount to multiples of your usual velocity.

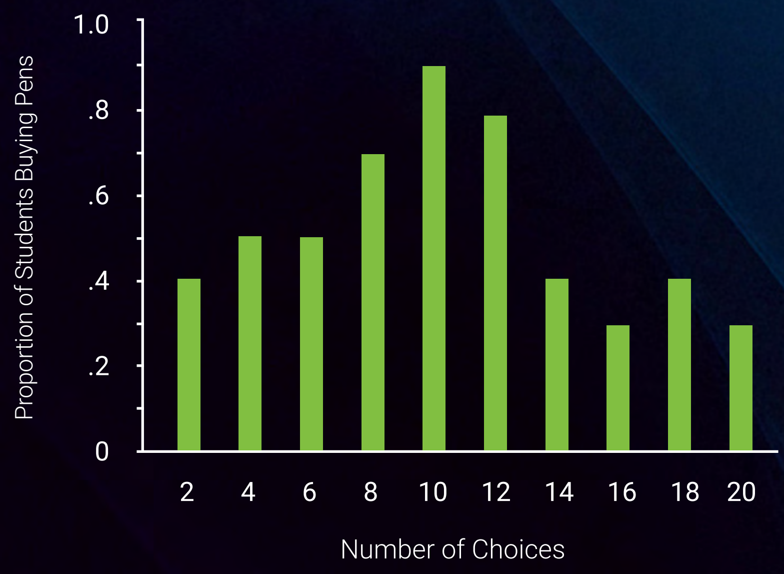


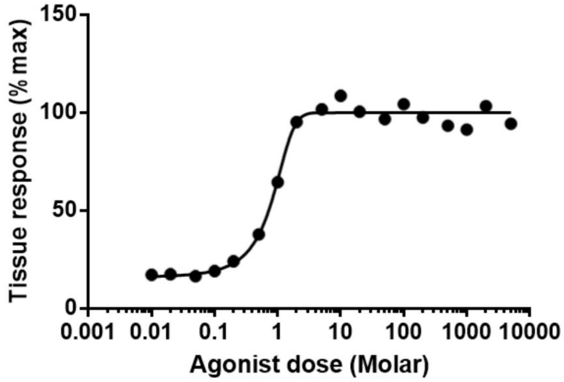
Figure: The proportion of shoppers at a 'pop-up pen sale' who bought pens (y-axis) as a function of the variety of pens available for sale (x-axis). (*Shah and Wolford, 2007*) This parametric study both identified an optimal choice set size for this kind of sale display, and–by studying responses to a much wider range of values of the independent variable (variety)–made a critically important contribution to the field. Earlier research suggested buying would peak at some point, then drop to zero in a smooth, linear fashion as the number of choices available increased to 'overwhelming' levels (see, e.g., the work of Barry Schwartz). However, as we can see here, buying behavior can in many cases 'level off' at some level lower than its peak, even when the number of choices continues to increase. If you're in a 'crowded' category where consumers have lots of choices, you'll appreciate the dynamics in play here.

Without parametric studies, we can't *fully* understand 'typical' conditions. We can't say for sure whether 'typical' stimuli are the only ones that produce 'typical' responses, or if there is a limit to how much people will notice or respond to extreme conditions, or how behaviors might change in new and unexpected ways when we're pushed beyond our 'comfort zone' by events beyond our control. Most importantly, the value of *projections* much beyond the range we've studied should always be regarded as suspect: If we continue to change the value of an independent variable well above or below the 'normal' range, we may find that responses max out, or that they drop to zero at some point. But we may also find that if we keep moving along the curve, the response may come back up to some 'typical' range, return in a different form, or suddenly ramp up, down, or sideways in some unexpected but important way we've never seen before.

Figures: [*Dose-response curves*]() chart the response to increasing doses of medications, and are essential for developing treatment guidelines and obtaining approval for new medicines. While some dose-response curves (**A.**) follow a familiar sigmoid or s-shaped pattern, others (**B.**) show a small or even negative response at low doses, followed by increasing improvements in outcomes up to some higher dose, then return again to produce undesirable or even harmful effects as doses go still higher. (**C.**) Highly complex systems or living organisms (like humans) often respond optimally to specific amounts of drugs, foods, lighting levels, stress, or choice set sizes, in ways that indicate the presence of a '*sweet spot*'–a range of quantities that are neither too small nor too large, but 'just right.' Biological and behavioral responses that help us manage our body temperature, or consume the right amount of various nutrients, or engage with the 'just right' amount of choices, or buy the right vehicle for our needs, all help to keep us in that 'sweet spot,' and are examples of **homeostasis**.

Drug dosages, air temperatures, and food are all beneficial in the right range, but become deadly at extremely low or high values. But things like stress, widespread illness or unemployment, social distancing, or just having too many TVs to choose from across too many online and brick-

A



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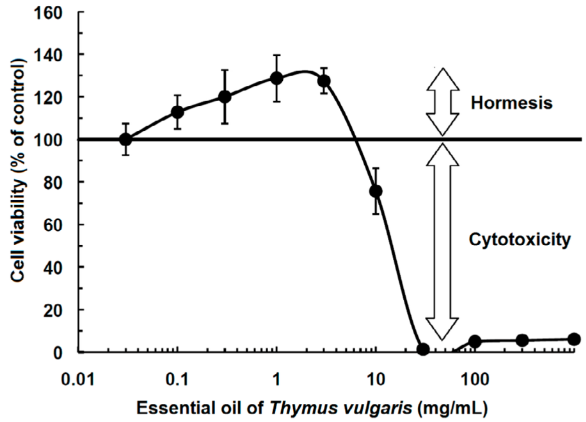

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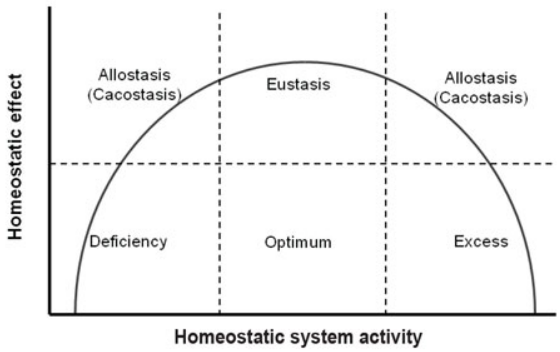

and-mortar retailers, don't usually harm us–instead, our incredibly flexible and adaptable cognitive and behavioral abilities find some way to cope with stress, or muddle through our lousy day, or avoid getting sick, or save time by focusing on what we know and ignoring many of the choices available when shopping. As we've been pushed further out along the x-axis of social disruption by the coronavirus, and hit degrees or kinds of changes that we haven't seen before, we've seen consumers adapt and change in new and surprising ways that were impossible to predict simply because we've never been here before. By conducting research during these extreme times and bringing an informed perspective to interpreting the results, we can eliminate uncertainty when the next large-scale disruption hits, learn to make better predictions about how consumers will adapt to such events and understand how and when new behaviors, habits and ways of thinking will emerge. And if we invest in data and insights during unusual or extreme circumstances, we'll be far better equipped to anticipate exactly what will and won't be different when things 'go back to normal.'

If understanding how consumers change under extreme conditions, and knowing how to change with them, is critical to the long-term survival of our business, but parametric data isn't available (pandemics, stock market crashes, and other calamities are real and terrible events that we'd all do best to avoid entirely), then it's imperative that we collect as much data and develop as much insight as we possibly can, whenever extreme circumstances happen to arise..

ABOUT THE AUTHOR

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Dr. McCandless is the recipient of four competitive federal awards to support his research into the neurophysiology of behavior and cognition. Winner of the EXPLOR Award and the IBM LEAD Award for Shopper Engagement. He has published in major peer-reviewed journals, presented his work at international conferences, and designed the algorithms behind the facial coding platform Sentient Expression®.

Since 1995, Dr. McCandless has specialized in Neuroethology—the study of brain function during natural behavior and stimulation—with a focus on motivation, goal-directed behavior, navigation and spatial orientation, gaining extensive experience in the direct investigation and analysis of the neurophysiological systems underlying the structure and causes of behavior, as well as non-invasive brain imaging methods such as fMRI.

Dr. McCandless earned his M.S. in Neuroscience and his Ph.D. in Neurobiology from the University of Pittsburgh. He also holds a Certification in Cognitive Neuroscience from the National Science Foundation's Center for the Neural Basis of Cognition.

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REFERENCES

The Proportion of Emotion Model. *Emotion as a tradeable quantity*. Aaron A. Reid and Claudia González-Vallejo, 2008

Buying Behavior as a Function of Parametric Variation of Number of Choices. Shah and Wolford, 2007

Dose–response relationship: https://en.wikipedia.org/wiki/Dose–response_relationship

Hormesis: Decoding Two Sides of the Same Coin. Dipita Bhakta-Guha and Thomas Efferth, 2015

Recent advances in the molecular mechanisms causing primary generalized glucocorticoid resistance. Nicolas C. Nicolaides, Agaristi Lamprokostopoulou, Amalia Sertedaki, Evangelia Charmandari, 2002