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THOUGHT LEADERSHIP

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Trust: The Essential Element in Mobility Technologies

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Building and maintaining consumer trust is rapidly becoming the dividing line between winners and losers for mobility products. Getting into a car with a stranger, turning over your driving responsibilities to a series of mechanical sensors and algorithms, and giving a distant corporation access to your financial information all require trust. Digital platforms, crowd-sourced assessment ratings, and the immediate airing of both good and bad consumer experiences mean that car manufacturers are not selling automated vehicles, nor are rideshare companies selling mobility—they are both selling trust.[1]

Current trends in the transportation industry indicate that the number of Americans using ride-sharing services increased from 15% in 2015 to 36% in 2018.[2] The SEC filings of many of the companies in this segment have identified access to automated vehicle (AV) technology as an important, if not key, enabler to their long-term business strategy (see, for example, the Uber[3] and Lyft[4] filings). AAA[5] has conducted yearly surveys on consumer acceptance of AVs for the past 5 years, and the percentage of drivers who report they are afraid to ride in a fully self-driving vehicle has always been 60% or greater. Putting these three ideas together, it is our observation that new transportation technologies and mobility services share a common ingredient: the expanding role of trust in consumers' mobility-related decision-making.

However, trust is a challenging concept to measure and influence through product design. It reflects an attitude or belief that an agent will "help achieve an individual's goals in a situation characterized by uncertainty and vulnerability."[6] Levels of trust are inherently flexible, and earned trust can be lost quickly in response to new information[7] – a phenomenon seen recently as the media and the public have reacted to high-profile crashes involving fatalities with advanced driver assistance systems (ADAS) and AVs.[8] Thus, maintaining trust when adverse roadway incidents threaten it can be just as important as building it in the first place.

So how can mobility companies build and maintain trust? What are the specific features of new transportation technologies that contribute to trust? What makes an AV or ride-share experience seem accurate, behave consistently, and feel transparent? For ADAS and AVs, there are a multitude of product features that could potentially influence trust, including marketing messages; website descriptions and videos; product names and descriptions; instruction manuals and videos describing system functions, capabilities, and limitations; and the human-machine interface. Critically, how can we

[1] Henderson, M.T. & Churi, S. (2019). The trust revolution: How the digitization of trust will revolutionize business and government. Cambridge, United Kingdom: Cambridge University Press.
[2] Jiang, J. (2019). More Americans are using ride-hailing apps. (Pew Research Center, Survey conducted Sep-Oct 2018). https://www.pewresearch.org/fact-tank/2019/01/04/more-americans-are-using-ride-hailing-apps/
[3] Uber SEC Filings (Quarterly Report, 11-05-19; https://investor.uber.com/financials/default.aspx)
[4] Lyft SEC Filings (Quarterly Report, 11-04-19; https://investor.lyft.com/sec-filings/sec-filing/10-q/0001564590-19-039781)
[5] AAA (2018) American Trust in Autonomous Vehicles Slips. https://newsroom.aaa.com/2018/05/aaa-american-trust-autonomous-vehicles-slips/ & https://publicaffairsresources.aaa.biz/download/10980/
[6] Lee, J. D., & See, K. A. (2004). Trust in automation: designing for appropriate reliance. Human Factors, 46(1), 50–80.
[7] Hoff, K.A., & Bashir, M. (2015). Trust in automation: integrating empirical evidence on factors that influence trust. Human Factors, 57(3), 407–434.
[8] Reuters (2019) Americans still don't trust self-driving cars, Reuters/Ipsos poll finds. https://www.reuters.com/article/us-autos-selfdriving-poll-idUSKCN1RD2QS

characterize the relationships between such features and customer perceptions to provide product designers with guidance that leads to enduring levels of consumer trust?

In response to these challenges, experts at Exponent have developed and utilized a rigorous scientific approach to obtaining valid and reliable customer preference data that can be applied to product design, engineering, and evaluations for AVs and ADAS. The technique reflects a powerful blend of methods from the consumer research, psychometric, and human factors domains. It results in quantitative descriptions of the relationships between specific product features and a variety of concepts related to customer preference, including trust. The technique has been used successfully to support the design of a range of new automotive technologies, including head-up displays, adaptive cruise control, in-vehicle information systems, and advanced visibility systems.

Three research steps are involved:

1. **Identify the Product Features that Most Impact User Trust**. The critical first step is to comprehensively define the features and feature options associated with the product and identify those "high payoff" features that have the greatest impact on perceived trust. Discussions with design staff and product walk-throughs are conducted during this step, as are small-group sessions with representative consumers to explore the basic relationships between product features and perceived trust. Given the challenges of assessing a construct such as trust, it is crucial that the consumer assessments broadly address attitudes and beliefs associated with adjacent constructs such as ease-of-use, reliability, quality, and safety.
2. **Test a Range of Product Options with Users**. Next, consumer testing is conducted with product exemplars representing a range of options of the "high-payoff" features from Step 1. The goal is to study an adequate representation of the product space with a consumer sample large enough to provide enough statistical power for subsequent analyses. The product exemplars should provide a range of feature options to clearly differentiate between "losers" and "winners." A key determination at this step is the fidelity of the product options tested, which can range from "paper prototypes," to static mock-ups, to more dynamic and realistic representations of the product, including actual vehicles. Lower-fidelity stimuli are sufficient for gathering more general impressions and attitudes; greater fidelity is required when more specific information (e.g., purchasing decisions, frequency of use) is needed.
3. **Determine the Optimal Combinations of Product Features**. The data from Step 2 are analyzed using multiple regression techniques to develop predictive, quantitative models of consumer attitudes and beliefs. Depending on the nature of the assessment, model validation activities can be conducted, either through collecting additional data with a new consumer sample or analyzing "holdout" data from the previous step. The data from the consumer testing are used to determine the specific combinations of product features that predict optimal levels of trust.

Overall, this research technique offers a means to systematically assess how and to what degree different AV and ADAS features affect customer trust and other attitudes. It can support the development of successful transportation products that inspire and retain high levels of consumer trust, even in the aftermath of adverse incidents. Critically, this approach supports the iterative design approach used in product development. The insights provided by this research technique can be used to determine the acceptability, perceived usefulness, and perceived value of new transportation technologies; determine high-payoff design features in terms of trust; substantiate trade-offs among design options; evaluate/refine product designs; determine consumers' "pain points" and "showstoppers"; and identify a customer vocabulary to help market the product.

Exponent's Expertise

Exponent understands the importance of trust and has been a reliable and productive partner in the development of advanced transportation technologies for over a decade. Today, we are actively investigating ADAS, as well as connected vehicle and AV design.[9,10] Our experts have refined this rigorous scientific approach to quantifying the determinants of consumer trust, preference, and acceptance across a range of transportation technologies. What sets Exponent apart is our ability to offer a multi-disciplinary team of Ph.D.-level engineers, scientists, and human factors experts to quickly and seamlessly integrate with in-house teams to address a client's human factors needs throughout the design and development of advanced vehicle technologies, including AVs.

[9] Crump C., Cades D., Rauschenberger R., Hildebrand E.A., Young D.E., (2014). Dynamic on-road method for evaluation of Advanced Driver Assistance System (ADAS). Proceedings, 3rd Annual World Conference of the Society for Industrial and Systems Engineering, pp. 77–81, San Antonio, TX, October 20–22, 2014.

[10] Hoyos C., Lester B.D., Crump C., Cades D.M., and Young, D.E. (2018). Consumer perceptions, understanding, and expectations of Advanced Driver Assistance Systems (ADAS) and vehicle automation. In, Proceedings of the Human Factors and Ergonomics Society Annual Meeting 2018 Sept; 62(1):1888–1892, Los Angeles, CA: SAGE Publications.

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