Abstract

Advances in intelligent technologies change the way consumers search and shop for products. Emerging is the trend of home-shopping devices such as Amazon’s Alexa and Google Home, which allow consumers to search or order products using voice commands. We study the impact of such artificial intelligence (AI) enabled devices on a brand’s channel strategy and its price discrimination across these channels. After making a theoretical breakdown of the functionalities of the AI-enabled shopping devices into (1) adding convenience in ordering procedure (“OC”) and (2) providing support in purchase decision-making (“DS”), we document via a set of experiments that consumers who have strong (weak) shopping preferences are less-inclined to shop through AI-enabled devices with the functionality of DS (OC) compared to their existing shopping heuristics. The hesitation of the group to adopt AI-enabled shopping devices makes it efficient for a brand operating in a competitive environment to price discriminate across distribution channels. In the second part of the paper, we build an analytical model and derive the equilibrium distribution and pricing strategies for competing brands conditional on the heterogeneity of consumers with respect to their willingness to adopt AI-enabled devices. We also analyze the welfare impact of the introduction of AI technology as a new possible distribution channel.

Keywords: Artificial intelligence (AI), AI aversion, channel design, price discrimination

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Introduction

Past few years have seen a quiet revolution in the number of artificial intelligence (AI) powered devices in use. By the end of 2019, an estimated 111.8 million people in the U.S. owned a voice-assisted device, most famously, Amazon’s Alexa or Google Home (Petrock, 2019). According to surveys, up to one third of those who own a smart device use it to shop for goods in Europe (Kinsella, 2018) where the sales through these devices reached $2.1 billion in 2018 (Thakker, 2019). In the U.S. too, shopping via such devices is growing, with tripled year-on-year growth between 2017 and 2018 for Amazon’s Alexa (Toplin, 2018). Consumer spending on Alexa mostly ranges between $25 and $199 per item (Edison Research, 2018) and common categories of shopping intention include groceries (45% of individuals), clothing (46%), and specialty products such as books or pet supplies (49%) (Capgemini, 2018). All these new devices and new purchasing options are duly noticed by retail executives. As a VP of e-commerce, digital marketing, and innovation at Lands’ End commented, “Given the explosive growth in voice search and equally explosive growth in shipments for Echo devices, it is the time to start to test and lean into this emerging channel” (Berthene, 2017). In this paper, we take a first rigorous look at a firm’s strategic entry decision on this emerging channel.

Smart devices interact with their users via voice-activated apps, which are called “skills” in Amazon’s Alexa. There are more than 70,000 skills available on Alexa (Martin, 2019), most of which are games and trivia. Out of these skills, 342 were shopping related at the time this paper was written¹, and the number is growing fast daily. Some of these skills are designed primarily to help consumers to obtain product information and make purchase decisions through AI-assisted recommendations. For example, “MySomm” is a skill which suggests the most suitable wine for its users, and “Kit” is a skill which gives product recommendations based on users’ queries such as “what is a good coffee maker” (Trotter, 2017). We refer to this category of skills as decision support (DS) devices or AI devices of DS functionality. There are also skills that primarily facilitate a consumer purchase by making ordering experience more convenient and pleasurable. For example, the skill “Ask Peapod” allows consumers to order groceries by voice (Thakker, 2019), “Grubhub Alexa” makes it possible for users to enjoy the convenience

¹Calculated by using the “shopping” filter on Amazon’s skills store web page (www.amazon.com, skills store).
of hands-free reordering\textsuperscript{2}. We refer to these skills as a device for order convenience (OC) or a device of OC functionality. This distinction between DS and OC functionalities for new retail technologies is common (Burke, 2002; Bucklin, Lehmann, & Little, 1998). Based on our classification, out of the top shopping skills which have been rated by at least 10 users, 38\% are primarily for DS, 50\% for OC, and the rest for both DS and OC. In this paper, we will investigate and show that consumers’ preferences for the device functionalities are actually related to their brand preferences.

A closer examination of the top retail AI skills also shows a curious fact: skills of different functionalities are either used exclusively as a proprietary channel or are shared as a platform where all competing vendors can use them. In the latter case, they are provided mostly by a third party. For instance, 86\% of the DS skills are used exclusively by a single vendor and they are there to help customers to decide what to buy at the vendor. In contrast, 67\% of the OC skills are not exclusive but are platforms, and they help consumers to complete their orders at any number of competing vendors on the platform. This contrast, if it holds going forward, suggests that a vendor’s decision to embrace a skill may depend on the functionalities of the skill, which in turn implies that the structure of the emerging channel may also depend on its functionalities as a result of vendors’ channel entry decisions. Although this emerging channel is still evolving and much of what lies ahead is uncertain, in this paper, we will make the first effort to peek into the future and investigate the channel entry decisions by competing vendors to see how the functionalities of AI devices can shape its structure. In doing so, we also investigate how the strategic incentives facing the vendors shape the provision of technology for the emerging channel.

The impact of AI devices on retailing is in its early stages and much of their vast potential is still unfolding. For instance, as competing retailers begin to reach their customers through AI devices such as Alexa, marketing scholars and practitioners alike begin to focus on the special importance of branding in a voice environment. Meyersohn (2018) suggests that voice ordering will make brand names more important because consumers will call by name when they purchase items. What is even more important, however, is to build trust between consumers and AI, as pointed out by Dawar (2018). As we shall discuss shortly, issues related to the interactions between consumers and AI devices and consumer buying behaviors in a machine-

\textsuperscript{2}See Grubhub’s official webpage \url{https://www.grubhub.com/alexa}.
assisted environment have now become timely and prominent research topics. In this paper, we add to this research from a different angle: we theoretically investigate which technologies and channel structure may emerge because of consumer preferences for AI devices of different functionalities and because of strategic choices by competing retailers as well as by technology providers.

In specific, our research focuses on a different set of questions that naturally arise with regard to AI devices. First, should firms always embrace a new AI device of any functionality for the purpose of “chasing after” consumers or securing the first mover advantage in the new channel? Some executives seem to think so (Berthene, 2017). Of course, a firm’s decision should depend on how consumers may embrace the technology. This brings up the second question. What kinds of consumers would prefer which kinds of AI devices? The answers to this question will shed light on the incentive environment in which retailers and technology providers would make their decisions. This brings up the third question. What incentives do competing retailers face in embracing an AI device of a certain functionality? Given retailers’ strategic incentives, the technology provider also plays a role in shaping the channel structure. In this context, we can ask the final question: what incentives do technology providers face? This last question, in fact, brings forth a cluster of other questions. Would a technology provider favor DS or OC functionality? For any given functionality she chooses to provide, does she have an incentive to make the functionality as good as feasible and make the technology broadly available to all the competing retailers? In a nutshell, can we trust the free market to provide the socially optimal retail technology? In this paper, we will develop a comprehensive analytical model to provide some preliminary answers to all these questions.

Our research starts with the empirical documentation that consumers’ technology preferences are related to their brand preferences. A consumer with a strong or weak preference for a brand may prefer an AI device of OC or DS functionality. By incorporating this preference structure into our game-theoretical modelling, it will become clear that competing retailers may or may not want to embrace the AI device of a certain functionality depending on which customers favor the new channel, how much competing retailers benefit from the price discrimination enabled by the new channel, and whether AI devices discourage competitive entry. The strategic interactions amongst downstream competing retailers will obviously affect their profitability, which in turn will affect how profitably a technology provider can sell access to an
AI channel and which functionality it has the most incentive to develop.

This research strategy has enabled us to generate a number of new insights into a new, evolving phenomenon where prospective insights are otherwise unavailable. We first show through experiments that consumers with stronger (weaker) brand preferences derive higher positive utility from an AI device of OC (DS) functionality and negative utility from DS (OC) functionality. This preference structure implies that competitive entry into an OC channel can benefit all retailers as they price-discriminate against consumers of strong brand preferences. However, with a DS channel favored by consumers of weak brand preferences, competitive entry will not occur and a unilateral entry can benefit both competing retailers. Given these incentives facing the downstream retailers, the technology provider, for its own profitability, prefers an AI device with the DS functionality over one with the OC functionality. Indeed, when both DS and OC functionalities can be incorporated into an AI device, the technology provider only has an incentive to provide the socially optimal level of DS functionality and to under-provide the OC functionality, even if cost is not an issue.

Our paper thus contributes to a growing literature in the human-AI interaction (Kleinberg, Lakkaraju, Leskovec, Ludwig, & Mullainathan, 2017) and implications of technology on firm strategy (Srinivasan, Lilien, & Rangaswamy, 2002; Ram & Sheth, 1989; Sriram, Chintagunta, & Agarwal, 2010). Our study contributes to the former by investigating the two dimensions cited by Burke (2002) in the context of AI adoption. We investigate this relationship from a unique perspective by extending it to the strength of brand preference and the desire to use AI. We contribute to the latter literature by investigating the implications of consumer attitudes towards technology for price discrimination and for technology choices.

Relevant Literature

Artificial Intelligence Aversion

With development of new technologies (e.g., AI) and their spread in people’s everyday life, researchers have been increasingly more interested in the interaction between customers and these new, advanced technologies. In the last few years, the literatures in marketing, operations, computer science, and psychology offer mixed findings about the reactions of consumers
to AI technologies and algorithmic judgments or recommendations. Scholars argue that AI can enhance consumer decision-making, as algorithms aggregate data and information across multiple individuals to reduce the error in decision making (e.g., Soll & Larrick, 2009; Surowiecki, 2004). However, the findings about how consumers respond to them diverge. A series of studies argue that consumers appreciate and trust algorithms (e.g., Logg, Minson, & Moore, 2019), studying examples such as predicting one’s weight or a song’s popularity ranking. Another series argue that consumers exhibit algorithm or AI aversion. For example, individuals feel less comfortable when making decisions based on machine recommendations after they see algorithms err (Dietvorst, Simmons, & Massey, 2016, 2015). In medical decision-making domain, consumer resistance to using algorithms has been documented (Chen, 2009; Longoni, Bonezzi, & Morewedge, 2019; Dzindolet, Pierce, Beck, & Dawe, 2002). Prior work also shows that people trust algorithms less if they themselves are experts in the decision task (Logg et al., 2019; Castelo, Bos, & Lehmann, 2019). Recruiters, for instance, trust their judgment more than they trust the algorithmic recommendations (Highhouse, 2008). Auditors are more likely to ignore the warnings from fraud detection systems (Boatsman, Moeckel, & Pei, 1997).

While there is no universal explanation for why individuals show aversion to using algorithms, seeing new technologies as a threat to humankind (George, 2014; Ferrari, Paladino, & Jetten, 2016; Conniff, 2011), in-group bias (Brewer, 1979), skepticism about the results provided by algorithms (Highhouse, 2008; Yeomans, Shah, Mullainathan, & Kleinberg, 2019), and the cost of learning to use these new technologies (e.g., Mick & Fournier, 1998; Goodman, 1988) are among explanations. Existing studies show that consumers would rather rely on their friends than algorithms for product recommendations (Sinha, Swearingen, et al., 2001; Önkal, Goodwin, Thomson, Gönül, & Pollock, 2009). This is because people not only care about the content of recommendations, but also want to understand the recommendation process (Yeomans et al., 2019). Mick and Fournier (1998) point out that new technologies do not by default save time for individuals, but may in fact result in some loss or waste of time due to having to learn about the new technology and whether it fits one’s needs (Goodman, 1988).

The literature, to our knowledge, has not yet provided insights about consumers’ desire to integrate algorithms in their shopping and product search process. We contribute to the literature by documenting how consumer brand preferences influence AI appreciation or resistance and by exploring the strategic implications for channel entry and pricing.
Sales Channels and Price Discrimination

Independently from AI adoption, our study also contributes to the literature on sales channels and price discrimination, two extensively studied areas in marketing and economics. In marketing, seminal papers on channel management typically focus on channel coordination (Gerstner & Hess, 1995; S. C. Choi, 1991; Lal, 1990), vertical integration (Jeuland & Shugan, 2008; Lee & Staelin, 1997), channel design and management (Moorthy, 1988; Coughlan & Wernerfelt, 1989). In this context, typical examinations focused on the models and pricing strategies which maximize downstream member, upstream member, or industry profits. Despite the richness of this literature (A Google scholar search of “channels, marketing” yields 1.7m journal articles), there has been little recent examinations in the intersection of technology and their impact on the channel structure.

The essential question we study is the channel strategy when consumers have heterogeneous preferences to use AI and when these preferences correlate with their brand preferences. We show further that preference for brands also influence consumers’ tendency to embrace AI-assisted channels, and hence firms’ channel entry decision. In a similar vein, as the online economy took off, empirical examinations demonstrated that consumer adoption of online stores depended on the geography of the consumer (Forman, Ghose, & Goldfarb, 2009; J. Choi & Bell, 2011).

In our study, the preference for a channel depends on the preference for the brands, and thus firms can use this information to price discriminate across channels (Bergemann, Brooks, & Morris, 2015). Price discrimination as a function of channel preference has been a cornerstone in economics (Gerstner, Hess, & Holthausen, 1994; Cavallo, 2017) and marketing research (Zettelmeyer, 2000; Besanko, Dubé, & Gupta, 2003; Liu & Zhang, 2006). However, there is, to our knowledge, no research demonstrating that consumers’ AI aversion can be a tool for price discrimination. We also fill this gap in the literature.
Brand & Technology Preferences: Experimental Evidence

Hypotheses Development: Reaction to AI-Enabled Shopping Devices

Consumers vary in their response to algorithms and thus to smart devices that use them (Dietvorst et al., 2016; Logg et al., 2019). While some consumers see a benefit from smart devices, others see little benefit and even purposefully refrain from using them. In this section, we narrow down the smart devices to smart shopping devices and investigate if consumers’ attitudes towards these technologies depend on a consumer’s preference for the brands that exist in the market. We anticipate that these differences will carry over to the context of shopping using such devices.

As Burke (2002) points out, “it is not the technology per se but how it is used to create value for customers that will determine its success.” Burke (2002) proposes two relevant dimensions of benefits that people seek when they buy utilitarian goods: (1) detailed product information that assists consumers in product selection when buying infrequently purchased goods such as appliances, consumer electronics, furniture, and lighting, and (2) a fast and convenient shopping experience when buying frequently purchased, nondurable goods such as groceries, health/beauty care items, and school/office supplies. We focus on these two dimensions as the main benefits offered by AI-enabled shopping devices. We allow these values to influence consumers differently as the latter or former may exist only for a subset of products.

How do AI-enabled devices impact consumers’ shopping experience? First, these devices can make purchase decision-making easier via product recommendations, lists, or additional product information that helps one’s search process when the customer is not sure of which product to buy. We will refer to this function as Decision Support (abbreviated as “DS”). Or, it can make ordering process more convenient via advanced human-computer interactions (e.g., voice command, shopping via camera, etc.) or auto-refilling functions. We will refer to this function as Ordering Convenience (abbreviated as “OC”).

Prior research shows some evidence that a consumer’s product familiarity/knowledge may affect how she benefits from “DS” and “OC” functions. Consumers familiar with a product category can easily retrieve information about brands and construct preferences for them (Coupey, Irwin, & Payne, 1998; Wright, 1975). Therefore, there is a positive relationship between one’s
product knowledge and brand preference. Prior research also shows that when consumers are familiar with products, it is easier for them to recall the brand names and reorder the same product among a set of alternative products (e.g., Park, Mothersbaugh, & Feick, 1994). The ease of retrieving a brand from memory is expected to make it easier for a consumer to use ordering convenience functions, such as a quick order confirmation via a voice command. Therefore we anticipate that consumers with stronger brand preferences are more likely to be familiar with the brands in the market, and have to exert less effort for recall and thus stand to benefit more from the “OC” function, compared to the consumers have weaker brand preferences.

**H1:** Consumers with stronger brand preferences benefit more from ordering convenience.

As argued above, consumers who hold a strong preference towards a brand should also be more familiar with its products (Coupey et al., 1998; Wright, 1975). They are therefore less likely to benefit from new information provided by the device’s “DS” function. Consumers with high product knowledge are familiar with the brands, so they tend to search less when considering existing alternatives (Johnson & Russo, 1984; Bettman & Park, 1980). So we anticipate that for these consumers, the value of recommendations and additional information will be lower compared to those who are less familiar with the product category.

**H2:** Consumers with weaker brand preferences benefit more from decision support.

Moreover, there is evidence that people exhibit some extent of AI/algorithm aversion (discussed on page 5), so we can extrapolate that consumers may feel negative about AI devices if they cannot provide them with enough benefit. Thus, we formulate **H3** and **H4**.

**H3:** Consumers with strong brand preferences may respond negatively to interacting with decision support features of AI devices.

**H4:** Consumers with weak brand preferences may respond negatively to interacting with the ordering convenience features of AI devices.

In following studies, we provide experimental evidence to test **H1** to **H4** about the correlation between the strength of a consumer’s brand preference and the benefit from DS or OC functions.
Study 1

The objective of Study 1 is to generate some preliminary evidence that there is a relationship between consumers’ brand preference and acceptance of an AI shopping device, moderated by the functionality of the device. A total of 161 subjects were recruited in a northeastern university’s behavioral lab and were paid for their participation in the study. The study used a $2 \times 2$ design (AI device functionality: ordering convenience (OC)/decision support (DS) $\times$ product knowledge: high/low). Each subject was randomly assigned to one of the two conditions describing the function of an AI-device. A randomly selected half of the subjects was told that the device was voice-activated and offered the convenience of easy reordering (“OC”), and the remaining half was told that the device assisted in the search and discovery of products by making recommendations or by listing criteria relevant for decision making (“DS”). We carried out a manipulation check at the end of the study by asking if the device assisted by making ordering a product more convenient or by helping to decide which brand to order.

Each subject was then asked to think of a product category she knew or did not know, based on the assignment to one of two random conditions (“high product knowledge” and “low product knowledge”). We anticipated that this manipulation would induce different levels of brand preference strength because prior research shows that a consumer familiar with a product category can easily retrieve product-relevant information but one who is not has to construct her preferences on the spot (Coupey et al., 1998; Wright, 1975).

Subsequently, the participants were asked to write down their favorite brand in the product category and if they had no favorite brand, they were instructed to put down “NA” as response. We then asked participants how strongly they preferred the brand that they listed on a 1-5 scale. Brand preference and ability to mention a favorite brand are highly correlated ($\rho = 0.84$). As the next step, participants were asked a question measuring how likely they are to use the AI-device that was described to shop for the product (for details, please see Online Appendix page A26). Responses ranged from “highly likely” to “highly unlikely,” which were converted to a numerical scale between -2 to 2 in empirical analysis. Subjects also answered to an open-ended question which asked them the reason for choosing (or not choosing) the AI-device.
Results

144 of the 161 participants passed the manipulation check and we used their data in the subsequent data analysis. There is a positive relationship between category knowledge and strength of brand preference. People who were assigned to the “high product knowledge” condition stated a stronger preference for the brand they listed in this product category ($M_{\text{high}} = 4.09$, $M_{\text{low}} = 1.92$; $p < 0.01$). To test the relationship between preference for AI-devices and strength of brand preference, we run the following regression:

$$\text{AI\_Acceptance} = \beta_0 + \beta_1 \times (\text{Preference\_Strength}) + \beta_2 \times (\text{AI\_Function\_DS})$$
$$+ \beta_3 \times (\text{Preference\_Strength}) \times (\text{AI\_Function\_DS}),$$

(1)

where $\text{AI\_Function\_DS}$ is a dummy taking the value 1 if a subject was told the device features decision support, and 0 otherwise. We care about the signs of $\beta_1$ and $\beta_1 + \beta_3$ to assess the relationship of interest.

Table 1 shows that consumers with stronger brand preferences are more likely to use AI-enabled shopping devices featuring OC (coefficient = 0.157, $p < 0.1$), and are less likely to use AI devices featuring DS (coefficient = 0.157 − 0.549 = −0.392, $p < 0.01$). A significant proportion of participants (69 out of 144, 47.9%) revealed a resistance to using AI shopping devices by stating that it is “unlikely” or “highly unlikely” that they would use the AI-device. More importantly, a device featuring ordering convenience (OC) (decision support (DS)) was more likely to be rejected by consumers with weaker (stronger) brand preferences.

These results are consistent with the expectation that consumers with stronger brand preferences are more likely to value a device offering OC functionality relative to those with weaker brand preferences. The opposite is true for a device offering DS functionality: Consumers with weak brand preferences are more likely to prefer devices with DS relative to consumers with strong brand preferences.

[Table 1 about here.]
Study 2

Study 1 provides suggestive evidence for the relationship between consumers’ brand preference strength and their acceptance of AI-enabled shopping devices featuring different functionalities. In Study 1, we manipulated the level of product knowledge of a participant by asking her to think of a product that she knew or didn’t know about. Asking subjects to think about a product that they know increases validity of our measurement, since subjects’ knowledge is authenticated.

In Study 2, we replicate Study 1, but this time we choose and fix the product category and brands. The limitation of this design is, product categories and the brands we chose may not be familiar to some individuals. To increase the likelihood that participants will be familiar with category and brands, we chose two of most commonly sold product categories on Amazon.com, and two comparable brands with high market shares in this category.

Study 2 was carried out with subjects on Amazon’s Mechanical Turk. 150 MTurkers participated in the study in exchange for money. Similar to Study 1, half of the subjects were given the description of an AI-device with OC features \(^3\) and the remaining half were told that the device featured DS.

Subjects were then asked to reveal their preferred brand between two headphone brands (Sony and Bose) as well as the strength of the preference. Specifically, one was asked “which headphone brand do you prefer?” with three options (Sony, Bose, or no preference). If the participant chose Sony or Bose, there was a follow-up question asking whether her preference was strong (Yes/No). Combining the two questions, we represented brand preferences using the following five levels: “Strongly prefer Sony,” “Prefer Sony,” “No preference,” “Prefer Bose,” and “Strongly prefer Bose,” which was converted to a numerical scale \((-2, -1, 0, 1, 2\) in the follow-up analysis. After revealing their preference over brands, their acceptance of AI-enabled shopping devices was measured on the same acceptance scale as in Study 1. Similar questions were asked for a second product category: cereals. We wanted to test our hypotheses for both expensive, less frequently bought products (headphone) and cheap, frequently bought products (cereals).

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\(^3\)There was a slight change in the description based on the feedback from Study 1 – they had concerns about whether shipping would cost them a lot or if they would incur other hidden fees. Thus some did not perceive ordering as convenient. Thus, in OC condition of Study 2, the subjects were told that they could learn the prices if they wanted to and the shipping cost was marginal.
We included a comprehension/attention check question in the survey which asked the function of the described device. 100 out of the 150 subjects answered the question correctly and we focused on these 100 participants in our analysis.

**Results**

We first provide model-free evidence supporting our hypotheses in Figures 1 for headphones and cereals. In each figure, consumers are located on the horizontal axis with those having stronger brand preferences for each brand on each end, and those who are indifferent between the brands in the middle. The vertical axis demonstrates the preference for AI. The relationship is a rough “V-shape” under the OC condition and an “inverse-V-shape” under DS, consistent with the expectation that for AI devices featuring OC (DS) function, those with stronger (weaker) brand preferences are more accepting of the AI device (corresponding to a higher value in the y-axis).

![Figure 1 about here.](image)

To test the relationship, we ran the specification given in Equation 1 and operationalized and measured the variables the same way as in Study 1. Table 2 shows the estimation results. For both products, $\beta_1$ (relationship between brand strength and acceptance of AI with OC) is positively significant, in line with our expectation. The coefficient of the interaction term is negative and significant. We can calculate the relationship between brand strength and acceptance of AI with DS ($\beta_1 + \beta_3$): for headphone, the coefficient is $0.716 - 1.200 = -0.484$, $p = 0.01$; for cereal, the coefficient is $0.574 - 0.813 = -0.239$, $p = 0.35$ (not significant). We can see that both point estimates are negative, which is consistent with what we expected. The effect of AI with DS for cereals is less precisely estimated, presumably because consumers are less likely to use decision support system for a cheap, frequently purchased product.

![Table 2 about here.](image)

**Summary and Discussion of the Empirical Results**

Studies 1 and 2 are consistent with the hypothesis that the value consumers place on shopping via an AI-channel is correlated with the strength of their brand preference. This correlation
can be positive or negative depending on the functionality of the retail technology. For some participants, the value from using the device is so negative that they avoid the device altogether. These participants are the customers with stronger brand preferences when the retail technology offers DS and those who with weaker brand preferences when the device features OC. Put differently, shopping with the new device may simply provide less utility to some consumers compared to the utility they receive from shopping in a traditional channel.

Here we provide a heuristic explanation for the main result. When one is familiar with a product category, she is more likely to hold a strong preference over brands. Thus, shopping devices featuring OC work better when one is familiar with the product category and has a preferred brand in mind, making ordering straightforward. However, devices featuring DS work better for consumers who are less familiar with a product category or brand and therefore need information.4

**Strategic Implications of Brand & Technology Preferences**

If consumers’ technology preference is related to their brand preference, as the previous section has shown, this will inevitably affect the choices of competing retailers in embracing the technology and in their pricing, and also the choice for the technology provider. In this section, we build a game-theoretic model incorporating the structure of consumer brand and technology preferences uncovered in the previous section to explore their strategic implications.

**Model**

The experimental results demonstrate that consumers are heterogeneous with respect to the strength of their brand preferences. To model brand preferences, we use a Hotelling model with consumers of mass 1 uniformly distributed on the line $[0, 1]$. Two competing brands are located at the ends of this line, Brand A at 0 and Brand B at 1. A customer located at $x \in [0, 1]$ incurs a transportation cost of $tx$ if shopping from Brand A and $t(1 - x)$ if shopping from Brand B, where $t$ is the unit transportation cost. In our framework, the distance to a brand indicates the

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4In the online Appendix page A26, we replicate what we have found in Study 1 and 2 in another experiment, and discuss explanations for the relationship between consumers’ brand preference and their acceptance of OC/DS AI-devices.
strength of the customer’s preference for the brand and the closer a customer is to a brand’s location, the stronger is her preference. A consumer at \( x \) gains a utility of \( V - p_A - tx \) if she purchases Brand A’s product and \( V - p_B - t(1-x) \), if she purchases Brand B’s product, where \( p_j \) is the price of Brand \( j \)’s product, \( j \in \{A, B\} \) and \( V \) is the reservation value which is assumed to be sufficiently larger than \( t \) such that the market is always covered.

Before adopting the AI-channel\(^5\), each brand sells its products in a traditional channel. A traditional channel, in our context, is a channel which does not integrate new AI-technology with DS or OC benefits that we study, such as a brick and mortar or a traditional online store. The brands make decisions about whether to also sell in an AI-channel when it becomes available and set the prices for products sold in each channel. We use the superscripts 0 and 1 to refer to the traditional and the AI-channel, respectively, and \( p^0_j \) represents the price of brand \( j \)’s product in the traditional channel and \( p^1_j \) represents the price of brand \( j \)’s product in the AI channel, where \( j \in \{A, B\} \). Let a proportion \( \alpha \in [0, 1] \) of customers have access to AI channel and choose to shop in this channel or in the traditional channel.\(^6\)

The experimental results also show that consumers’ brand preference strength correlates with their desire to shop for the product using an AI-device and this relationship depends on the main function of the AI-device (DS or OC). To incorporate these findings in the context of the Hotelling model, we assume that a customer located at \( x \) gains the added (negative or positive) utility of \( \Delta(x) \) when shopping in an AI-channel. This added utility will depend on the functionality of the AI-device, which we will elaborate shortly.

Thus, a consumer located at \( x \) can potentially have four (\( 2 \times 2 \)) shopping choices, consisting of buying the product of Brand A or B through the traditional channel or through the AI-channel. Table 3 provides the general payoff function for each choice, denoted respectively by \( V^0_A(x), V^1_A(x), V^0_B(x), \) and \( V^1_B(x) \).

[Table 3 about here.]

The timeline of the game is as follows. A technology provider develops an AI channel of a certain functionality and makes it available to competing retailers. Then, brands simultaneously

\(^5\)We will use the terms AI-based, AI-enabled, and technology-based interchangeably throughout the paper to refer to customers’ shopping using devices that use AI.

\(^6\)This difference in access to AI may be due to owning a device that allows shopping for products or not, or the geographical coverage of the market by the AI-channel.
decide whether or not to adopt the AI-enabled channel. After observing the competing brand’s channel adoption decision, they simultaneously set prices in each channel they sell in. Then the consumers decide which brand’s product to purchase and in which channel to purchase it. We adopt subgame perfection as the solution concept and solve the game using backward induction. To keep our analysis tractable, we assume that the unit transportation cost is high enough, or \( t > \frac{1}{2} \).

We bring in the following notations in the equilibrium analysis we discuss next. Superscript \((T, T)\) represents the case when both brands only sell through their traditional channel. When the AI-device offers DS functionality, superscript \((DS, DS)\) indicates both brands adopting the AI-channel with DS, and \((DS, T)\) indicates the case when Brand A adopts the AI-channel with DS function while Brand B does not. When the AI-device provides OC, we use superscripts \((OC, OC)\) and \((OC, T)\) in a similar manner to represent the strategic adoption decision of firms.

**Analysis**

Our analysis will unfold in two steps. We will first analyze firm decisions for pricing and distribution when the AI-device’s functionality is exclusively DS or exclusively OC. This will demonstrate that, based on the functionality that AI offers, the equilibrium market configuration and the resulting competition will look different. Then, in the Extensions section, we extend our analysis to an AI-device that has both functionalities. This two-step approach will allow us to isolate and highlight the mechanism through which the functionality of the retail technology can have competitive implications for a retailer.

Regardless of what functionality is available in the market, in the second stage of the game, there are three possible channel strategies that the brands can choose from: (1) both firms adopt the AI-channel, (2) one brand adopts the AI-channel and the other sells only in the traditional channel, and (3) both brands only sell in the traditional channel. In the last case where brands only sell in a traditional channel, we have the familiar equilibrium results as our benchmark where the prices of the brands are \( p_A^{(T,T)} = p_B^{(T,T)} = t \) and their profits are \( \pi_A^{(T,T)} = \pi_B^{(T,T)} = \frac{t}{2} \).

For the other two cases, we now take up DS and OC functionalities respectively.

---

7As it will become clear shortly, this assumption essentially rules out the case of \( t < \Delta \), where an equilibrium may not exist.
AI with Decision Support (DS) Functionality

DS technologies focus on making product recommendations and informational suggestions based on the preferences and purchase history of the customer. Our experiments show that consumers who do not show a strong loyalty to a particular brand in a product category are the ones with the highest desire to shop for products using AI. Moreover, such functionalities are considered a hassle by consumers who already formed their preferences and show a strong liking to any brand. We incorporate these experimental findings by specifying the added utility expression as:

$$\Delta^{DS}(x) = \xi - \tau |x - \frac{1}{2}|,$$  (2)

where $\xi$ is a constant indicating the highest additional benefit a consumer can gain from shopping in the AI channel featuring DS. A higher $\xi$ implies a higher positive benefit from using the AI-device on average and hence a better DS functionality. Here, $\tau$ is a scaling factor, and without loss of generality, we assume $\tau = 1$ to simplify our expressions.\(^8\) This function captures well the empirical findings from our experiments in that, first, consumers with weaker brand preferences – those located closer to the midpoint $\frac{1}{2}$ – gain an increasing benefit from using the AI-channel; second, $\xi \in (0, \frac{\tau}{2})$ implying that some consumers have disutility from shopping in the AI-channel. Figure 2 illustrates the shape of the $\Delta^{DS}(\cdot)$ function under this construction.

![Figure 2 about here.]

We are now ready to state the second stage equilibrium given that the AI-device features DS function. Proposition 1 summarizes the equilibrium adoption and pricing decisions in the DS case.

**Proposition 1. (Equilibrium with DS Functionality: Specialization in Distribution)**

The AI-channel that offers DS functionality strategically facilitates exclusive adoption. In equilibrium, competing brands follow an asymmetric distribution strategy such that only one brand adopts the AI-channel and the other one does not.

The proof for the proposition is in the online Appendix A. Figure 3 depicts the equilibrium market segmentation when Firm A adopts AI-channel, where “$A^0$”, “$A^1$”, and “$B^0$” denote the  

\(^8\)Note that the qualitative results in our paper can be achieved with variations of this function, however, this functional form allows us to describe the key insights while minimizing mathematical complexity.
consumer segments who buy Brand A from the traditional channel and from the AI-channel, and Brand B from the traditional channel, respectively. Equilibrium prices are

\[ p_A^{0, (DS,T)} = t \left( 1 + \frac{\alpha \left( t(9 - 2\xi) + 2(1 - \alpha)(3 - \xi) \right)}{6(1 - \alpha + t)(1 - \alpha + 2t)} \right), \]
\[ p_A^{1, (DS,T)} = p_A^{0, (DS,T)} + \frac{\xi}{2} - \frac{t}{4(1 - \alpha + t)}; \]
\[ p_B^{0, (DS,T)} = t \left( 1 + \frac{\alpha(3 - 2\xi)}{3(1 - \alpha + 2t)} \right) \]

and equilibrium profits are

\[ \pi_B^{(DS,T)} = \frac{t(3 - 2\alpha\xi + 6t)^2}{18(1 + 2t)(1 - \alpha + 2t)}, \quad \text{and} \quad \pi_A^{(DS,T)} = \pi_B^{(DS,T)} + \frac{\alpha(2\xi(1 - \alpha + t) + 3t)(6\xi(1 - \alpha + t) + t)}{24(1 - \alpha + t)(1 - \alpha + 2t)}. \]

[Figure 3 about here.]

To see the intuition for why an asymmetric distribution strategy is sustained, note that when AI-channel’s benefit is DS, it is the consumers with weaker brand preferences who are attracted to this channel. When both brands adopt the AI-channel, they would compete over the customers with the weakest brand preferences and cannot capture any added benefit of DS from them. However, if only one brand entered the AI segment, the adopting brand can take advantage of the added utility from the DS functions for the consumers with weak brand preferences and increase its price in the AI-channel for them. Indeed, the adopting brand’s price in the new channel can even be higher than that in the traditional channel when \( \xi \) is larger than \( \frac{t}{2(1 - \alpha + t)} \).\(^9\) In addition, as these weak preference customers move to the new channel, the adopting brand can set its price in the traditional channel higher than that of the non-adopting brand (Brand B), as it sells to customers of stronger brand preferences in this channel.\(^10\) The higher prices by the adopter due to channel differentiation, in turn, also benefits the non-adopter (B), i.e., \( \pi_B^{(DS,T)} > \pi_B^{(DS,DS)} \). This “differentiation-enhancing” effect is “washed out” if both brands adopt the AI-channel. Interestingly, this proposition does suggest that an AI channel with DS functionality should be “exclusively” used, as we noted earlier in the Introduction.

---

\(^9\) Based on \( p_A^{1, (DS,T)} - p_A^{0, (DS,T)} = \frac{\xi}{2} - \frac{t}{4(1 - \alpha + t)} > 0 \) iff \( 0 < \xi < \frac{t}{2(1 - \alpha + t)} \).

\(^10\) Based on \( p_A^{0, (DS,T)} - p_B^{0, (DS,T)} = \frac{\alpha t(2(1 - \alpha + t) + 3t)}{6(1 - \alpha + t)(1 - \alpha + 2t)} > 0 \).
Provision of DS Functionality If at any given DS functionality $\xi$, only one of the competing brands adopt the AI channel, does the technology provider have the incentive to make the functionality as advanced as possible? We can answer this question by going back one stage and examining how a technology provider may make a strategic decision about the quality of its AI, i.e., the benefit it provides to consumers ($\xi$), anticipating that this choice will have an impact on its own profitability\textsuperscript{11}. Here, we assume that the technology provider is a third party and it charges only a flat fee for using its technology $f$. The following proposition summarizes our analysis.

**Proposition 2. (AI Quality under DS Functionality)** When the AI-channel offers DS functionality, a third party technology provider offers the highest possible benefits to the consumer ($\xi^* = \frac{1}{2}$). In equilibrium, only one brand adopts the AI-device.

Proposition 2 suggests that, a third party developing the DS functionality of AI has its incentives aligned with that of the consumers. Both parties benefit from offering higher benefits from technology. This way, the developer can charge a fee equal to the added benefit to a brand from adopting the AI-technology and extract the added profit due to the new technology from the adopting brand so that the brand wants to be the adopter. Our analysis shows (please see Appendix ) that, if the technology provider also draws revenues from the traditional channel and charges a percentage of sales profit as its fees, our conclusions are qualitatively unaltered.

**AI with Ordering Convenience (OC) Functionality**

Next, we turn our attention to the AI-devices which offer the convenience of ordering (OC), but not DS, to demonstrate the sharp contrast in the equilibrium market configuration and prices under OC relative to the DS case. Recall that the experimental results show that, in contrast to the DS function, an AI-device featuring OC is more likely to be accepted by consumers with stronger brand preferences. A proportion of consumers with the weakest brand preferences state that they prefer to use the traditional channel over the AI-channel. So we model the added utility from shopping in an AI-channel with OC function incorporating these two findings as

\textsuperscript{11}To avoid some unnecessary technical complexity, we assume here and hereafter that Brand A is always the adopter if there is only a sole adopter, as it is the more tech-savvy retailer.
follows:
\[ \Delta^{OC}(x) = \tau |x - \frac{1}{2}| - \eta, \] (3)

where \( 0 < \eta < \frac{\tau}{2} \), \( \Delta^{OC}(0) = \Delta^{OC}(1) > 0 \) and \( \Delta^{OC}(\frac{1}{2}) < 0 \). Figure 4 illustrates how \( \Delta^{OC}(\cdot) \) varies with the heterogeneity in consumer preferences. In this function, \( \Delta(x) \) takes a negative value when \( x = \frac{1}{2} \), for the customers with the lowest brand strength. \( \eta \) calibrates OC functionality – a smaller \( \eta \) implies that more people enjoy a positive benefit from shopping in the AI-channel (i.e., a better OC functionality). Without loss of generality, we set the coefficient \( \tau = 1 \).

[Figure 4 about here.]

Proposition 3. (Equilibrium under OC Functionality: Uniformity in Distribution)

When the AI-channel offers OC functionality, in the subgame perfect equilibrium, both brands adopt the AI-channel. In equilibrium, the prices are \( p_A^{0,(OC,OC)} = p_B^{0,(OC,OC)} = t \) and \( p_A^{1,(OC,OC)} = p_B^{1,(OC,OC)} = t + \frac{1 - 2\eta}{4} \), and profits are \( \pi_A^{(OC,OC)} = \pi_B^{(OC,OC)} = \frac{t}{2} + \frac{\alpha}{4} (\frac{1}{2} - \eta)^2 \).

Proposition 3 points out to the sharp contrast in equilibrium market configuration and segmentation strategy of brands, when the main benefit of the technology is ordering convenience as opposed to decision support. In equilibrium, both brands choose to adopt a retail technology that provides ordering convenience, as these benefits are mostly enjoyed by the customers who are brand-loyal. Therefore, when brands adopt the new channel, they do not compete for these consumers.\(^{12}\) Figure 5 depicts the equilibrium market segmentation if the AI-enabled shopping device provides OC function, where “\( j^0 \)” and “\( j^1 \)” in the figure denotes the consumer segments who buy Brand \( j \) from the traditional channel and from the AI-channel, respectively, \( j = A, B \).

[Figure 5 about here.]

Since the OC functionality yields value to consumers with stronger brand preferences, a brand can sell to these consumers through the new channel and extract more surplus, with the traditional channel prices unaffected. Compared to the case where technology provides DS benefits, with ordering convenience, brands can internalize the added utility that the consumers

\(^{12}\)A summary of the equilibrium prices and profits are given in Table A2 in the online Appendix A page A1.
are experiencing when shopping in the AI-channel. This is because the marginal consumer in each AI-channel is indifferent between shopping in the AI or the traditional channel of the same brand. Since the AI-channels are not in direct competition, the brands can both open an AI channel and extract more surplus from the consumers shopping in this channel. As a result, the overall profits of the firms are higher as well.

A quick observation yields $p_{A}^{0}(OC,T) = p_{A}^{0}(OC,OC)$ and $\pi_{A}^{(OC,T)} = \pi_{A}^{(OC,OC)}$, as well as $p_{B}^{0}(OC,T) = p_{B}^{(T,T)}$ and $\pi_{B}^{(OC,T)} = \pi_{B}^{(T,T)}$. Thus, a brand’s pricing decision and equilibrium profit are independent of its competitor’s choice in the OC case. In other words, the introduction of the AI-channel only causes within-brand consumer switching and not between. Therefore, in the subgame perfect equilibrium, both brands adopt the AI-channel since it gives them the opportunity to extract more surplus from their “loyal” customers, as described in Proposition 3. Interestingly, the limited evidence as we noted in the Introduction section is consistent with OC devices being adopted by competing retailers.

**Provision of OC Functionality** Next, we solve for the technology provider’s problem of maximizing revenue from fees by choosing the quality of the technology ($\eta$) as the first stage of the game, similar to what we did under the DS case. The technology provider chooses the quality of AI, $\eta \in [0, \frac{1}{2}]$, as well as the transaction fee, $f$. Proposition 4 describes the third party’s optimal investment under OC.

**Proposition 4. (AI Quality under OC Functionality)** For an AI-device with OC functionality, a third party sets the quality $\eta^* = 0$, with a fee of $f^{OC} = \pi_{A}^{(OC,OC)}|_{\eta=0} - \frac{t}{2}$. In equilibrium, both brands adopt the AI-channel.

This proposition, along with Proposition 2, states that as long as the AI-device features only one functionality, either DS or OC, the technology provider will always provide the best possible quality, and charge a fee equal to the added benefit to a brand from adopting the AI-technology. However, what functionality is introduced in the market is not inconsequential both in terms of price competition at the retail level and also in influencing the market structure. This is because the functionality of a device determines which consumers self-select into using AI and which consumers do not, which in turn directly influences the ability of the firms to profitably price discriminate by offering these benefits in a channel. Optimal segmentation structure, as
a result, shows a sharp contrast between the cases when the primary benefit is DS and when it is OC. This also implies that if the technology provider has a choice of introducing one of the two functionalities, it will have definite preference, as we show next.

**Choice of AI Functionality: OC or DS?**

In the analysis of the DS and OC cases, we find that while the technology is always pushed towards the highest frontier, the adoption decisions in equilibrium are different. In the OC case, the technology provider can collect fees from both brands, but in the DS case, it can only collect money from one brand. A natural question is, which functionality, DS or OC, does a technology provider prefer to offer to maximize its profit? The following proposition gives the answer to the above question.

**Proposition 5. (AI Functionality and Technology Provider: DS or OC?)** If a third party could choose between offering DS vs OC functionality, it would choose to offer DS over OC since $\Pi_{DS}^* > \Pi_{OC}^*$.

Proposition 5 provides insights into how the functionalities offered by retail AI technology may evolve over time, given that the incentive of the third party shapes the provision of what is available to the retailers and to the consumers.

Denote the technology provider’s maximized profit as $\Pi_{DS}^* = f_{DS}^*$ if the AI-device features DS while as $\Pi_{OC}^* = 2f_{OC}^*$ if the AI-device features OC. Even though the third party sells to only one of the two brands when it offers DS (due to the asymmetry in adoption), it earns a higher profit relative to when it sells to both brands under OC functionality. The narrow profit margins that the brands have under the OC functionality restricts the profits of the third party as well.

DS function induces an asymmetric adoption, so consumers with weak preferences are “locked in” by the added utility, and thus the brand can charge a high price on the new channel to these customers with weak preferences. OC function, on the other hand, makes prices for “loyal” consumers higher while the competition for weak preference consumers is still high. Thus the traditional channel prices remain low, which implies that brands cannot charge too high a price for “loyal” customers on the new channel either, because they may switch to the traditional channel in that case.
In summary, our analysis in this section has provided a powerful insight into how technology can interact with strategic players in the marketplace to shape brand choices and evolution as well as the market structure. Our insight is fundamentally driven by the following economics. A new channel provides a new opportunity for price discrimination and the profitability of such an opportunity will depend on the intensity of price competition in the new channel. This intensity is mediated by the functionality of the new channel. Because of the fact that DS functionality is preferred by brand indifferent customers, whereas OC function is valued more by customers of strong brand preference, an AI channel based on DS functionality can either intensify price competition with competitive entry or reduce it through channel differentiation with a single adopter. In this case, a single adopter prevails as both price discrimination and channel differentiation benefit all competing retailers. In comparison, the OC functionality will only help with each retailer’s price discrimination without any possibility for channel differentiation. It is for this reason that the DS functionality is preferred by the technology provider over the OC functionality. In other words, when left to its own devices, the market favors the retail technology with DS functionality. This new insight may shed light on the apparent proliferation of recommendation systems in the marketplace.

Extensions

**AI Channel with DS and OC Functionalities Together**

In the main model, we intentionally divided our analyses into two parts, and assumed that the AI-channel provides one function and one function alone to point to the sharp contrast in the equilibrium outcomes in distribution strategy and pricing. Naturally, AI-channels may offer these functions together. In this section, we will provide the analysis of a channel serving these functions together and derive the equilibrium outcome.

When a channel offers both OC and DS benefits, a consumer who chooses to shop in this channel may benefit from (1) DS only, (2) OC only, or (3) both DS and OC. A consumer will choose to use these functions in a way to maximize her utility. Formally, when shopping in the
AI-channel, a consumer located at $x$ will receive the utility:

$$\Delta^{OC+DS}(x) := \max \{ \Delta^{DS}(x), \Delta^{OC}(x), \Delta^{DS}(x) + \Delta^{OC}(x) \}. \quad (4)$$

Using the formulas for $\Delta^{DS}(x)$ and $\Delta^{OC}(x)$ (given in Equations (2) and (3)) one can easily derive the expression for $\Delta^{OC+DS}(x)$ (for brevity, this expression is moved to the Appendix page A12). Figure 6 depicts how $\Delta^{OC+DS}$ varies with brand preferences, $x$. Part (a) corresponds to the case when $\xi \leq \eta$, where consumer utility is maximized by using only one of the two functions alone, and part (b) corresponds to the case when $\xi > \eta$, where utility is maximized by using both functions together.

[Figure 6 about here.]

Equilibrium market structure in this scenario depends on the relative benefit of each function, which is determined by the magnitudes of $\xi$ and $\eta$. A larger $\xi$ indicates a better DS functionality, while a smaller $\eta$ indicates a better OC functionality. The equilibrium outcomes are defined based on the relative magnitude of $\xi$ and $\eta$, a comparison of which results in the five cases given in Figure 7. The full expressions for the equilibrium decisions are given in Proposition A1 in Appendix page A11.

[Figure 7 about here.]

We solve for the full game, including a third party technology provider’s investment decision. Suppose that there is a technology provider who can choose both $\xi$ and $\eta$ for an AI-device which offers DS and OC functions together, as well as the fee $f$ that a brand has to pay to the provider if it wants to adopts the AI-channel.

**Proposition 6.** *(AI-channel with Combined OC and DS functions)* A third party which offers a combination of DS and OC functionalities strategically chooses to maximize the quality of DS technology, however, offers an imperfect OC quality ($\xi^* = \frac{1}{2}, \eta^* > 0$). In equilibrium, only one of the two brands adopts the AI-channel.

Proposition 6 provides a rather surprising finding. The technology provider maximizes its profit by strategically choosing to offer a perfect DS functionality while keeping the OC
functions less than perfect – even when technology is feasible and investment is costless. This is an important finding as it describes that the technology that consumers use in retail channels is not merely an outcome of technological advancements, but also an outcome of incentive-driven competition in the marketplace and purposeful interactions amongst retailers as well the third party technology developer. Even when a better technology is available, it may not be in the best interest of the retailers to adopt them in an effort to mitigate AI-adoption competition. Most importantly, the technology provider is not always driven to pursue the best technology. Rather, profit motives shape its preference for advanced technology!

Intuitively, the technology provider does not push both functions to the frontier, because it wants to leverage the heterogeneity in consumers’ attitudes toward AI, so that brands can carry out price discrimination effectively. The fact of the matter is that, the DS functionality favored by customers with weaker brand preferences is a more helpful technology, as we have shown previously, as it moderates retail competition. If both DS and OC functions are maximized, all consumers in the marketplace would prefer the AI-channel over the traditional channel. In turn, retailers can no longer use traditional and AI-channels for price discrimination purposes. As a result, the technology provider prefers to avoid offering all consumers very high benefits from using AI. Doing so is not beneficial for the retailers, and hence for itself.

**Consumer Welfare**

The fact that the technology provider may not provide the best feasible technology in an effort to mitigate a retail AI competition raises an interesting question: how does the market choice differ from the choice of a social planner who cares about social welfare? We address this question in the following proposition.

**Proposition 7. (AI and Welfare: When AI Provides Both Functions)** A social planner will optimally choose DS and OC functions at $\xi^{**} = \frac{1}{2}$ and $\eta^{**} = 0$, such that competing retailers both adopt the AI-channel.

Proposition 7 suggests two distortions resulting from the third party choice. First, there is a technology distortion. A central planner always prefers a “perfect” AI technology (both DS and OC functionalities yielding the highest utility to every consumer) which generates the highest social welfare. If the technology is provided by a third party, however, it will
strategically design the OC functionality to be less than perfect to obtain the highest profit. Second, there is an adoption distortion. In the socially optimal case, both brands would adopt the AI-device. However, if the technology is provided by a third party provider, it will only induce a monopolistic adopter to the detriment of consumers. These findings are informative for the policymakers who are thinking about the implications of technology in retail.

Conclusion

The technology with which consumers search and order products today is significantly different from that of yesterday’s. Advances in data analytics and artificial intelligence technologies provide a substitute for the physical legwork of searching and shopping for goods. Not surprisingly, an increasing number of devices integrate AI technology that assists in decision support and ordering convenience. Amazon’s Dash button automatically reorders the product for a consumer, Amazon’s Alexa allows consumers to receive product recommendations from Amazon. Google’s Home Assistant offers similar functionalities.

This paper, to our knowledge, is the first paper to test consumer attitudes towards using AI, conditional on their brand preference strength, and to use the underlying relationship to build a model of distribution and pricing strategy. By doing so, we theoretically explore the competitive implications of the new retailing technology and show how strategic interactions in the marketplace can shape the choice and implementation of the new technology.

Our experimental findings show that the acceptance of AI-based shopping devices depends on the functionality that the device offers and a consumer’s preference strength for the brand. Based on earlier research (Burke, 2002), we investigate two distinct functionalities: ordering convenience (OC) and decision support (DS). It is essential for managers to consider the primary functionality of the device to understand who stands to benefit more from it. When devices offer mainly ordering convenience or when products are ordered by consumers primarily using this function (similar to the dash buttons), those with established brand preferences are more likely to use these devices. In other words, consumers with stronger brand preferences derive more value from the OC functionality. When devices serve a search and discover function, it is the consumers with opposite traits, those with less established brand preferences who choose to use these devices. The two experiments we run uncover these preference structures.
We then take these empirical findings and incorporate them into a theoretical model to provide insights for marketing managers on how to sell and how to price products across these devices and traditional channels. This analysis yields a series of important findings. Most importantly, it demonstrates that the market structure, prices, and the profits of firms will look very different conditional on the functions the AI device offers.

The key findings of this study are as follows.

1. **AI-devices facilitate price discrimination.** AI-devices can facilitate price discrimination since consumers’ acceptance of the technology is correlated with their brand preference strength and the device functionality. Consumers self-select into the channel that yields a higher utility for them and firms can enhance profits due to better segmentation.

2. **AI-devices with OC function results in differentiation only in brand characteristics.** When the primary function of the devices is OC, both brands adopt the AI channel. Brand loyal consumers choose to shop from the new channel and pay higher prices to do so. The prices in the traditional channel remains unaffected, utilized by the consumers mostly with weaker brand preferences. For this reason, the OC function is not as effective in facilitating price discrimination or price moderation.

3. **AI-devices with DS function supports channel differentiation and price discrimination.** When the function of the device is DS, only one brand adopts the AI channel and the other does not. The consumers with less established brand preferences are more likely to adopt the new channel, thus managers should anticipate a price competition over the new channel. To mitigate competition, brands choose to differentiate in distribution channels. The traditional channel is utilized by the consumers with stronger brand preferences. The brand charges higher prices to these consumers relative to when it did not adopt the new channel.

4. **Brand-loyal consumers are more likely to face higher prices, even when they do not use the AI-channel.** Consumers who are more brand loyal are likely to face higher prices when AI devices are adopted by firms, regardless of the functionality of the device. Consumers with weaker preferences may face lower or unchanged prices.
5. **Consumer aversion to AI may not be a bad thing from the perspective of firms.** It may, on the surface, seem like elevating the benefits from shopping with AI-devices for all consumers is likely to benefit firms. In fact, this is true in a monopoly as the firm can charge a higher price to consumers. In a duopoly, however, elevating the utility to everyone can make firms worse off as it eliminates price discrimination ability and therefore enhances price competition. Put differently, the impact of AI technology is less predictable under competition and a higher heterogeneity in consumer benefits from AI is more conducive to firm profits.

6. **AI technology providers may refrain from a perfect technology.** While a perfect technology that benefits every consumer is socially optimal, such a technology is not preferred from the perspective of the technology provider. A provider prefers to limit the OC functionality while offering the perfect DS functionality.

In sum, the key insight our model offers is that firms can make use of some consumers’ aversion to the new, AI-enabled channel to price discriminate and thus gain a higher profit, given the fact that consumers’ channel preference is correlated with the strength of their brand preferences. Different functions induce different distribution strategies. AI-enabled shopping devices featuring OC will induce uniformity in distribution, while those featuring DS will induce specialization in distribution.

Our study offers, for the first time to our knowledge, an analysis of the AI-shopping devices using a combination of experimental and theoretical methods. While we think that the topic and the undertaking are important, our research is not without limits. In our analysis, we focus on the key benefits of technology defined by Burke (2002). There may be additional factors and benefits which are not considered in our research for reasons of keeping the research focused. Future research may want to focus on some of these additional benefits, for instance, the entertainment value of shopping or privacy as a consideration. Moreover, in our research we treat the device and channel interchangeably, and there may be additional agents in the market which are intermediaries that enable selling or offer the technology. We intentionally limit the number of players, but researchers who read this study (and make it this far) may find it valuable to think about the additional strategic considerations these intermediaries add to the problem we study.
References


Surowiecki, J. (2004). The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business. *Economies, Societies and Nations, 296*.


Figure 1: Study 2 Results: Headphone (Left), Cereal (Right)
Figure 2: The Additional Value from AI-Channel that Features DS

\[ \Delta DS(x) = \xi - |x - \frac{1}{2}| \]

Figure 3: The Equilibrium Market Configuration when AI provides DS Function

Figure 4: The Added Utility from Shopping in the AI-Channel that Features OC

\[ \Delta OC(x) = |x - \frac{1}{2}| - \eta \]

Figure 5: The Equilibrium Market Segmentation (OC Case)
Figure 6: The Added Value of Shopping in the AI-channel Featuring OC and DS

(a) When $\xi \leq \eta$

(b) When $\xi > \eta$

Figure 7: Equilibrium Configuration and Shape of $\Delta^{DS+OC}(\cdot)$ in 5 Scenarios
### Table 1: Study 1: Strength of Brand Preference and Acceptance of AI-device

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<td>Preference_Strength</td>
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Note: $N = 144$. *

$p<0.1$; **

$p<0.05$; ***

$p<0.01$
Table 2: Study 2: Strength of Brand Preference and Acceptance of AI-device

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</table>

Note: N = 100. *p<0.1; **p<0.05; ***p<0.01
Table 3: Payoffs from Shopping in the AI-channel vs. Traditional Channel

<table>
<thead>
<tr>
<th>Channel</th>
<th>Brand A</th>
<th>Brand B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional channel</td>
<td>$V^0_A(x) \equiv V - tx - p^0_A$</td>
<td>$V^0_B(x) \equiv V - t(1 - x) - p^0_B$</td>
</tr>
<tr>
<td>AI-channel</td>
<td>$V^1_A(x) \equiv V - tx - p^1_A + \Delta(x)$</td>
<td>$V^1_B(x) \equiv V - t(1 - x) - p^1_B + \Delta(x)$</td>
</tr>
</tbody>
</table>
Appendix A: Omitted Discussions, Expressions, and Proofs

Prices and Profits under Different Adoption Decisions

If the AI-channel features DS, see Table A1. If the AI-channel features OC, see Table A2.

Discussion: Technology Provider Charges a Percentage Fee (Commission)

Suppose now that both the traditional channel and the new channel are run by a single marketplace provider who charges percentage commissions based on sales from the channels. An example of such a marketplace is Amazon, which owns both its website and its AI-enabled channel, Alexa. The commission rates can be different across the two channels.

Suppose that the commission rate in the traditional channel, \( r^0 \), is exogenously given. It is determined by the opportunity cost of shopping through the traditional channel of the provider. The provider can choose the commission rate in the new channel, \( r^1 \), as well as the quality of the technology (\( \xi \) for DS and \( \eta \) for OC). The provider is maximizing its joint profit from both channels. The game is solved through backward induction.

**AI-Device with DS Only**   Suppose first that the AI-device provides only the DS functionality. For a given pair of \( \xi \) and \( r^1 \), again the possible subsequent subgames after the adoption decisions are \((DS, DS), (DS, T), (T, T)\), as we have seen in the main text. Again, we assume that \( A \) is the one who adopts if there is a sole adopter of the AI-channel.

Under subgame \((DS, DS)\), both brands \((j = A, B)\) solve the following problem:

\[
\max_{p_j^1, p_j^0} p_j^1 \alpha D_j^1 (1 - r^1) + p_j^0 (1 - \alpha) D_j^0 (1 - r^0),
\]

where \( D_j^0 \) and \( D_j^1 \) are the demand for Brand \( j \) in the traditional channel and the AI-channel, respectively. The solution would induce profits of firms \( \pi_j^{(DS, DS)} \), \( j = A, B \), which is a function of \( r^1, \xi \).

Similar setup can be applied to other subgames which induce profits \( \pi_j^{(DS, T)} \) and \( \pi_j^{(T, T)} \).
Note that a different pair of \((r, \xi)\) induces a different subsequent adoption equilibrium: \((DS, DS)\) is the subsequent equilibrium if \(\pi_{DS,DS}^{B} > \pi_{DS,T}^{B}\); \((DS, T)\) is the subsequent equilibrium if \(\pi_{A}^{DS,T} > \pi_{A}^{T,T}\) and \(\pi_{B}^{DS,T} > \pi_{B}^{DS,DS}\). \((T, T)\) is the equilibrium if \(\pi_{A}^{T,T} < \pi_{A}^{DS,T}\).

The provider then maximizes its profit by setting an optimal pair of \((r, \xi)\).

Analytical solutions are not tractable; we thus show the idea through a numerical example. We set \(\alpha = \frac{1}{3}\), \(r^0 = 0.15\), and \(t = 1\). We can solve numerically for the equilibrium, which is \(\xi^* = 0.5\) and \(r^1* = 0.4122\), when only one brand is induced to adopt the new channel and the provider’s profit is 0.2037. As a comparison, if the provider were to induce both brands to adopt, the maximum profit it can get is 0.1071 (when \(\xi = 0.5\) and \(r^1 = 0.0288\)); if the provider were to induce no brands to adopt, the profit it can get is 0.15.

**AI-Device with OC Only** Suppose now that the AI-device provides only the OC functionality, where the provider chooses \(\eta\) and \(r^1\). Following a similar procedure as the DS case, under the parameters \(\alpha = \frac{1}{3}\), \(r^0 = 0.15\), and \(t = 1\), the equilibrium is achieved when \(\eta^* = 0\) and \(r^1* = 0.3042\), when both brands are induced to adopt the new channel and the provider’s profit is 0.1720, which is higher compared to the profit when no brand adopts the new channel (0.15). It is not possible for the provider to induce only one brand to adopt in the OC case because an OC device cannot alter the competitive landscape. So the equilibrium must also be symmetric. Also, we see that the maximum profit the provider can obtain is higher in the DS case (0.2037) than that in the OC case (0.1720).

**AI-Device with DS and OC Together** Suppose now that the AI-device provides both the DS and OC functionalities. This time the provider chooses \(\xi, \eta\) and \(r^1\). Again, let \(\alpha = \frac{1}{3}\), \(r^0 = 0.15\), and \(t = 1\). In the equilibrium \(\xi^* = 0.5\) and \(\eta^* = 0.0189\) (perfect DS but imperfect OC functionality) and \(r^1* = 0.4180\), when only one brand is induced to adopt the new channel. In this case, the provider’s profit is 0.2427. As a comparison, if the provider makes both functionalities perfect, then it is optimal to set \(r^1 = 0.2897\), inducing both brands to adopt the new channel, and the profit of the provider becomes 0.2229 (< 0.2427).

**Proofs of the Propositions and Lemmas**

**Lemma A1.** If both brands adopt an AI-channel with DS function, in equilibrium, the prices are \(p_{A}^{0,DS,DS} = p_{B}^{0,DS,DS} = t\left(1 + \frac{\alpha(1-2\xi)}{1-\alpha+4t}\right)\) and \(p_{A}^{1,DS,DS} = p_{B}^{1,DS,DS} = t\left(1 - \frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t}\right)\), and

---

\(^{13}\)Because, as mentioned in the Introduction section, 111.8 million U.S. people, nearly one third of the population, owned a voice-assisted device by the end of 2019.

\(^{14}\)For most items sold on Amazon, the percentage commission is 15%.
the profits are \( \pi_A^{(DS,DS)} = \pi_B^{(DS,DS)} = \frac{t}{2} \left( 1 + \frac{\alpha(1-2\xi)^2(1-\alpha+2)}{(1-\alpha+4\xi)^2} \right). \)

**Proof of Lemma A1.** We first make the following observations about the equilibrium configuration:

1. If there are any consumers who shop in the AI-channel for a brand (without loss of generality, say Brand \( A \)), they must have a continuous mass. This is because the difference in the utility from shopping in one brand’s AI-channel and its traditional channel is a single peaked function in \( x \):
   \[ V_A^1(x) - V_A^0(x) = \xi - |x - \frac{1}{2}| - p_A^1 + p_A^0. \]

2. If \( V_A^1(x_1) > V_B^0(x_1) \) and \( x_1 > x_2 \), then \( V_A^1(x_2) > V_B^0(x_2) \) because
   \[
   V_A^1(x) - V_B^0(x) = (V - tx - p_A^1 + \xi - |x - \frac{1}{2}|) - (V - t(1 - x) - p_B^0)
   = -2tx - |x - \frac{1}{2}| - p_A^1 + p_B^0 + \xi
   = -(2t + 1)x + \frac{1}{2} - p_A^1 + p_B^0 + \xi
   
   
   is decreasing in \( x \) (since \( t > \frac{1}{2}, 2t + 1 > 0 \)). So if a consumer prefers buying in \( A \)’s AI-channel over buying in \( B \)’s traditional channel, then any consumer located to the left of this consumer should have the same preference order on \( A \)’s AI-channel and \( B \)’s traditional channel.

3. There cannot be an equilibrium where one brand serves all the consumers who have access to the AI-channel. If, for instance, Brand \( B \) did not sell to any consumers who have access to AI-channels, it would have an incentive to simply deviate to a price same as that of \( A \) in the new channel, because by doing so it can steal some consumers who shop in Brand \( A \)’s AI-channel and do strictly better.

Based on the three statements above, the only feasible equilibrium configurations are the two shown in Figure A1.

[Figure 8 about here.]

In Configuration 1 (Figure A1(a)), there exists a consumer indifferent between buying in \( A \)’s traditional channel and in \( B \)’s AI-channel (\( \tilde{x}_1^1 \)). The marginal consumers, \( \tilde{x}_A^1, \tilde{x}_0, \tilde{x}_1^1, \tilde{x}_2^1, \tilde{x}_B^1 \), are subject to the constraint that \( 0 \leq \tilde{x}_A^1 \leq \tilde{x}_0 \leq \tilde{x}_1^1 \leq \tilde{x}_2^1 \leq \tilde{x}_B^1 \) and are respectively defined by the following equations:

\[
V - t\tilde{x}_A^1 - p_A^0 = V - t\tilde{x}_A^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_A^1);
\]


\[ V - t\tilde{x}^0 - p_A^0 = V - t(1 - \tilde{x}^0) - p_B^0; \]
\[ V - t\tilde{x}_1^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_1^1) = V - t(1 - \tilde{x}_1^1) - p_B^0; \]
\[ V - t(1 - \tilde{x}_2^1) - p_B^0 = V - t(1 - \tilde{x}_2^1) - p_B^0 + \xi - (\frac{1}{2} - \tilde{x}_2^1); \]
\[ V - t(1 - \tilde{x}_B^1) - p_B^0 = V - t(1 - \tilde{x}_B^1) - p_B^0 + \xi - (\tilde{x}_B^1 - \frac{1}{2}). \]

The optimization problems of Brand A and Brand B become:

\[
\begin{align*}
\max_{p_A^0, p_A^1} p_A^0 \left( \tilde{x}_A^1 + (1 - \alpha)(\tilde{x}^0 - \tilde{x}_A^1) \right) + p_A^1 \alpha (\tilde{x}_1^1 - \tilde{x}_A^1), & \quad \text{and} \\
\max_{p_B^0, p_B^1} p_B^0 \alpha \left( (1 - \tilde{x}_B^1 + \tilde{x}_2^1 - \tilde{x}_1^1) + (1 - \alpha)(1 - \tilde{x}^0) \right) + p_B^1 \alpha (\tilde{x}_B^1 - \tilde{x}_2^1). & \quad \text{In solving these problems, we take advantage of the fact that the constraint } \tilde{x}_1^1 \leq \tilde{x}_2^1 \text{ always binds. Thus } \tilde{x}_1^1 = \tilde{x}_2^1 \text{ in the equilibrium, expressed by the consumer indifferent between } V_A^1 \text{ and } V_B^1. \text{ This implies that there exists no consumer indifferent between buying in } A \text{'s traditional channel and in } B \text{'s AI-channel (} \tilde{x}_1^1 \text{), or, Configuration 1 is infeasible.}
\end{align*}
\]

In Configuration 2 (Figure A1(b)), given a set of prices \((p_A^0, p_A^1, p_B^0, p_B^1)\), the equilibrium configuration is pinned down by the indifferent consumers \(\tilde{x}_A^1 \) and \(\tilde{x}_B^1 \) who are indifferent between purchasing in the traditional and in the AI-channel among all the consumers who buy from Brand A (B), and \(\tilde{x}^0 \) (\(\tilde{x}_1^1\)) as the consumer indifferent between the two brands if buying in the traditional (new) channel. In this configuration, \(0 \leq \tilde{x}_A^1 \leq \tilde{x}^0 \leq \tilde{x}_B^1 \leq 1 \) and \(\tilde{x}_A^1 \leq \tilde{x}_B^1 \leq \tilde{x}_B^1 \).

Since both brands have adopted an AI-channel featuring DS, by definition, we have

\[
\begin{align*}
V - t\tilde{x}^0 - p_A^0 = V - t(1 - \tilde{x}^0) - p_B^0 \Rightarrow \tilde{x}^0 = \frac{p_B^0 - p_A^0 + t}{2t}, \\
V - t\tilde{x}_1^1 - p_A^1 + \Delta(\tilde{x}_1^1) = V - t(1 - \tilde{x}_1^1) - p_B^1 + \Delta(\tilde{x}_1^1) \Rightarrow \tilde{x}_1^1 = \frac{p_B^1 - p_A^1 + t}{2t}, \\
V - t\tilde{x}_A^1 - p_A^0 = V - t\tilde{x}_A^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_A^1) \Rightarrow \tilde{x}_A^1 = \frac{1}{2} - (p_A^0 - p_A^1 + \xi), \\
V - t(1 - \tilde{x}_B^1) - p_B^0 = V - t(1 - \tilde{x}_B^1) - p_B^1 + \xi - (\tilde{x}_B^1 - \frac{1}{2}) \Rightarrow \tilde{x}_B^1 = \frac{1}{2} + (p_B^0 - p_B^1 + \xi).
\end{align*}
\]

We can thus find the demand for A and B and reformulate the brands’ maximization problems:

\[
\begin{align*}
\max_{p_A^0, p_A^1} p_A^0 \left( \tilde{x}_A^1 + (1 - \alpha)(\tilde{x}^0 - \tilde{x}_A^1) \right) + p_A^1 \alpha (\tilde{x}_1^1 - \tilde{x}_A^1), & \quad \text{and} \\
\max_{p_B^0, p_B^1} p_B^0 \left( (1 - \tilde{x}_B^1) + (1 - \alpha)(\tilde{x}_B^1 - \tilde{x}^0) \right) + p_B^1 \alpha (\tilde{x}_B^1 - \tilde{x}_1^1). & \quad \text{We can thus find the demand for A and B and reformulate the brands’ maximization problems:}
\end{align*}
\]

A4
Solving the FOC’s w.r.t. prices for the equilibrium prices yields:

\[ p_0^{(DS,DS)} = p_0^{(DS,DS)} = t \left( 1 + \frac{\alpha(1 - 2\xi)}{1 - \alpha + 4t} \right), \]
\[ p_A^{1,(DS,DS)} = p_B^{1,(DS,DS)} = t \left( 1 - \frac{(1 - \alpha)(1 - 2\xi)}{1 - \alpha + 4t} \right). \]

Plugging these prices back to get \( \tilde{x}_0^0, \tilde{x}_1^1, \tilde{x}_A^1, \) and \( \tilde{x}_B^1, \) we obtain:

\[ \tilde{x}_0^{0,(DS,DS)} = \tilde{x}_1^1 = \frac{1}{2}, \]
\[ \tilde{x}_A^{1,(DS,DS)} = \frac{(1 - 2\xi)(1 - \alpha + 2t)}{2(1 - \alpha + 4t)}, \]
\[ \tilde{x}_B^{1,(DS,DS)} = 1 - \frac{(1 - 2\xi)(1 - \alpha + 2t)}{2(1 - \alpha + 4t)}. \]

To make sure that the equilibrium is feasible, we check whether \( 0 < \tilde{x}_A^{1,(DS,DS)} < \tilde{x}_0^{0,(DS,DS)} (= \tilde{x}_1^{1,(DS,DS)} = 1/2 < \tilde{x}_B^{1,(DS,DS)} < 1 \) holds. Note that \( \tilde{x}_A^{1,(DS,DS)} < \frac{1}{2} < \tilde{x}_B^{1,(DS,DS)} \) is automatically satisfied under our parameter space. \( \tilde{x}_A^{1,(DS,DS)} > 0 \) and \( \tilde{x}_B^{1,(DS,DS)} < 1 \) are simultaneously satisfied due to the assumption that \( \xi < \frac{1}{2}. \)

We can now calculate the total profit of the two brands:

\[ \pi_A^{(DS,DS)} = \pi_B^{(DS,DS)} = \frac{t}{2} \left( 1 + \frac{\alpha(1 - 2\xi)^2(1 - \alpha + 2t)}{(1 - \alpha + 4t)^2} \right). \]

From these expressions, it is easy to see that \( \pi_A^{(DS,DS)} - \pi_A^{(T,T)} = \frac{ta(1-2\xi)^2(1-\alpha+2t)}{2(1-\alpha+4t)^2} > 0. \) This completes the proof. \( \square \)

**Proof of Proposition 1.** Suppose now that only Brand A opens the new channel. Based on the same three observations stated in the proof of Lemma A1, there are now three possible equilibrium configurations, as shown in Figure A2.

[Figure 9 about here.]

Consumers in the shaded region buy Brand A in the AI-channel. Consumers in the unshaded region to the left of \( \tilde{x}_0^0 \) buy Brand A in the traditional channel, while consumers in the unshaded region to the right of \( \tilde{x}_0^0 \) buy Brand B in the traditional channel. By a similar analysis as in the proof of Lemma A1, when \( t > 1/2, \) we can show that the first configuration is the only feasible configuration that can support an equilibrium. In this equilibrium, \( \tilde{x}_0^0, \tilde{x}_A^1 \) and \( \tilde{x}_A^2 \) are
determined by the following indifference conditions:

\[ V - t \tilde{x}^0 - p_A^0 = V - t(1 - \tilde{x}^0) - p_B^0 \quad \Rightarrow \quad \tilde{x}^0 = \frac{p_B^0 - p_A^0 + t}{2t}, \]

\[ V - t \tilde{x}_{A1}^1 - p_A^0 = V - t \tilde{x}_{A1}^1 - p_A^1 + \xi - \left( \frac{1}{2} - \tilde{x}_{A1}^1 \right) \quad \Rightarrow \quad \tilde{x}_{A1}^1 = \frac{1}{2} - (p_A^0 - p_A^1 + \xi), \]

\[ V - t(1 - \tilde{x}_{A2}^1) - p_B^0 = V - t \tilde{x}_{A2}^1 - p_A^1 + \xi - (\tilde{x}_{A2}^1 - \frac{1}{2}) \quad \Rightarrow \quad \tilde{x}_{A2}^1 = \frac{p_B^0 - p_A^1 + \xi + t + \frac{1}{2}}{2t + 1}. \]

The brands solve the following profit maximization problems:

\[ \max_{p_A^0, \tilde{p}_A} p_A^0 \left( \tilde{x}_{A1}^1 + (1 - \alpha)(\tilde{x}^0 - \tilde{x}_{A1}^1) \right) + p_A^1 \alpha (\tilde{x}_{A2}^1 - \tilde{x}_{A1}^1). \]

\[ \max_{p_B^0} \left( (1 - \tilde{x}_{A2}^1) + (1 - \alpha)(\tilde{x}_{A2}^1 - \tilde{x}^0) \right). \]

Solving the F.O.C's with respect to the equilibrium prices yields:

\[ p_A^{0,(DS,T)} = t \left( 1 + \frac{\alpha \left( t(9 - 2\xi) + 2(1 - \alpha)(3 - \xi) \right)}{6(1 - \alpha + t)(1 - \alpha + 2t)} \right), \]

\[ p_A^{1,(DS,T)} = p_A^{0,(DS,T)} + \frac{\xi}{2} - \frac{t}{4(1 - \alpha + t)}, \]

\[ p_B^{0,(DS,T)} = \frac{t(6t - 2\alpha \xi + 3)}{3(1 - \alpha + 2t)}. \]

We then plug the equilibrium prices back into the expressions for \( \tilde{x}^0, \tilde{x}_{A1}^1, \) and \( \tilde{x}_{A2}^1 \). To make sure that the equilibrium is feasible, we check that the conditions \( 0 < \tilde{x}_{A1}^1 < \tilde{x}^0 < \tilde{x}_{A2}^1 < 1 \) and \( \tilde{x}_{A1}^1 < 1/2 < \tilde{x}_{A2}^1 \) hold, which gives us the following equilibrium existence condition:

\[ 0 < \alpha < \min \left\{ \frac{7\xi + 10\xi t + 3t}{8\xi} - \frac{1}{8} \sqrt{(1 - 2t)^2 + \frac{3t(4\xi t + 6\xi + 3t)}{\xi^2}}, 1 \right\} \]

When \( t > 1/2 \), the inequality above is automatically satisfied.

Plugging in the above indifferent consumer locations and prices, the profit of the two brands become:

\[ \pi_B^{(DS,T)} = \frac{t(3 - 2\alpha \xi + 6t)^2}{18(1 + 2t)(1 - \alpha + 2t)}, \]

\[ \pi_A^{(DS,T)} = \pi_B^{(DS,T)} + \frac{\alpha(2\xi(1 - \alpha + t) + 3t)(6\xi(1 - \alpha + t) + t)}{24(1 - \alpha + t)(1 - \alpha + 2t)} > \pi_B^{(DS,T)}. \]

Now, let’s solve for the subgame perfect equilibrium, comparing the profit when both brands
adopt the AI-channel (provided in Lemma A1) and when only brand $A$ adopts.

\[
\pi_B^{(DS,T)} - \pi_B^{(DS,DS)} = \frac{t(3 - 2\alpha \xi + 6t)^2}{18(1 + 2t)(1 - \alpha + 2t)} - \frac{t}{2} \left( \frac{1 + \alpha(1 - 2\xi)^2(1 - \alpha + 2t)}{(1 - \alpha + 4t)^2} \right)
\]

\[
= \frac{t}{18(2t + 1)(1 - \alpha + 2t)(1 - \alpha + 4t)^2} \left[ 4 \alpha (1 - \alpha)^2 \xi ((\alpha - 9)\xi + 6) - 6 \left( 12\xi^2 + 4\xi - 9 \right) t^3 
+ t^2 \left( 2\alpha (44\xi^2 - 12\xi - 9) - 108\xi^2 + 12\xi + 45 \right) - (\alpha - 1)t \left( (26\alpha - 54)\xi^2 - 12(\alpha - 2)\xi + 9 \right) \right].
\]

Denote the term inside the square brackets as $h(t)$. Then one can easily calculate

\[
h'(t) = 4\alpha \left( (\alpha - 1) \left( (54 - 26\alpha)\xi^2 + 12(\alpha - 2)\xi - 9 \right) - 18(4\xi(3\xi + 1) - 9)t^2 
+ 2t(2\alpha (4\xi(11\xi - 3) - 9) + 12\xi(1 - 9\xi) + 45), \right.
\]

\[
h''(t) = 4\alpha (2(2\alpha (4\xi(11\xi - 3) - 9) + 12\xi(1 - 9\xi) + 45) - 36(4\xi(3\xi + 1) - 9)t).
\]

Note that $h''(t)$ is a linear function of $t$, and the slope is $-144\alpha(4\xi(3\xi + 1) - 9) > 0$ when $0 < \xi < 1/2$, so $h''(t)$ is increasing in $t$. Therefore, $h''(t) > h''(0) = 8\alpha(2\alpha (4\xi(11\xi - 3) - 9) + 12\xi(1 - 9\xi) + 45).

Also note that $2\alpha (4\xi(11\xi - 3) - 9) + 12\xi(1 - 9\xi) + 45$ is between $12\xi(1 - 9\xi) + 45$ and $2(4\xi(11\xi - 3) - 9) + 12\xi(1 - 9\xi) + 45$ and both are positive when $0 < \xi < 1/2$.

Thus we have $h''(t) > h''(0) > 0$, i.e. $h'(t)$ is increasing in $t$. Therefore $h'(t) > h'(0) = 4\alpha((\alpha - 1) ((54 - 26\alpha)\xi^2 + 12(\alpha - 2)\xi - 9))$ which can be shown similarly to be positive.

Following a similar procedure, one can show $h(t) > 0$, and thus $\pi_B^{(DS,T)} - \pi_B^{(DS,DS)} > 0$. This inequality, together with $\pi_A^{(DS,T)} > \pi_B^{(DS,T)}$ and $\pi_A^{(T,T)} < \pi_A^{(DS,DS)} = \pi_B^{(DS,DS)}$, implies $\pi_A^{(DS,T)} - \pi_A^{(T,T)} > 0$.

By definition of subgame perfection, we have finished the proof.

\[\square\]

**Lemma A2.** $\pi_A^{(DS,T)}$ is increasing and $\pi_B^{(DS,T)}$ is decreasing in $\xi$. In words, when the DS technology offers higher quality, the profit of the adopting brand increases and the profit of the other brand decreases.

**Proof of Lemma A2.** From the proof of Proposition 1

\[
\pi_A^{(DS,T)} = \frac{t(3 - 2\alpha \xi + 6t)^2}{18(1 + 2t)(1 - \alpha + 2t)} + \frac{\alpha(2\xi(1 - \alpha + t) + 3t)(6\xi(1 - \alpha + t) + t)}{24(1 - \alpha + 2t)(1 - \alpha + 4t)^2}.
\]

Taking the first derivative w.r.t. $\xi$ yields:

\[
\frac{\partial \pi_A^{(DS,T)}}{\partial \xi} = \frac{8\alpha(9(1 - \alpha) + t(14(1 - \alpha) + 18t + 13)) + 12\alpha t(2t + 1)}{72(2t + 1)(1 - \alpha + 2t)}.
\]
It is clear that this expression is positive, so \( \frac{\partial \pi^{(DS,T)}}{\partial \xi} > 0 \), i.e., \( \pi^{(DS,T)}_A \) is increasing in \( \xi \). Similarly, it is easy to see that \( \pi^{(DS,T)}_B = \frac{t(3-2\alpha\xi + 6t)}{18(1+2t)(1-\alpha+2t)} \) is decreasing in \( \xi \).

\[ \square \]

**Proof of Proposition 2.** If the AI-channel features DS, for any given \( \xi \) and \( f \), the profits of the firms are determined by their adoption decisions:

- If neither of them adopts, their profits are both \( \pi^{(T,T)}_A = \frac{t}{2} \).

- If both of them adopt, their profits are both \( \pi^{(DS,DS)}_A - f \).

- If only Brand A adopts, A’s profit is \( \pi^{(DS,T)}_A - f \), and B’s profit is \( \pi^{(DS,T)}_B \).

From the proof of Proposition 1, \( \pi^{(DS,T)}_B > \pi^{(DS,DS)}_B = \pi^{(DS,DS)}_A > \pi^{(DS,DS)}_A - f \). Thus, both firms adopting cannot be an equilibrium. Whether one or no brand adopts depends on \( f \). Specifically, the equilibrium in the adoption game should be characterized as follows:

If \( f \leq \pi^{(DS,T)}_A - \pi^{(T,T)}_A \), one brand adopts the AI-channel, and the AI provider earns \( f \); otherwise, no brand adopts the AI-channel, and the AI provider earns 0.

Therefore, for any fixed \( \xi \) the optimal \( f \) is \( \pi^{(DS,T)}_A - \pi^{(T,T)}_A = \pi^{(DS,T)}_A - \frac{t}{2} \).

By Lemma A2, we know that \( \pi^{(DS,T)}_A - \frac{t}{2} \) is also increasing in \( \xi \). Thus, the optimal level of \( \xi \) should reach the best possible (\( \xi^* = 1/2 \)), and the optimal fee is \( f^{DS*} = \pi^{(DS,T)}_A |_{\xi=1/2} - \frac{t}{2} \).

\[ \square \]

**Lemma A3.** If both brands adopt an AI-channel with the OC function, in equilibrium, the prices are \( p^{0,(OC,OC)}_A = p^{0,(OC,OC)}_B = t \) and \( p^{1,(OC,OC)}_A = p^{1,(OC,OC)}_B = t + \frac{1-2\eta}{4} \), and the equilibrium profits are \( \pi^{(OC,OC)}_A = \pi^{(OC,OC)}_B = \frac{t}{2} + \frac{\alpha(1/2 - \eta)^2}{4} \).

**Proof of Lemma A3.** Both brands adopt the AI-channel. Similar observations to those stated in the proof of Lemma A1 can be made also in the OC case:

1. The consumers who shop in the AI-channel for one brand must be a continuous mass.

2. If a consumer prefers buying in a brand’s AI-channel over this brand’s traditional channel, every consumer to its left should have the same preference ordering.

3. Not everyone who has access to the AI-channel buys from it. This is because if so, there is no interaction between the two channels, and thus the prices in the AI-channel can only be \( t \), which is the same as those in the traditional channel. However, if so, the middle consumer who is at \( x = \frac{1}{2} \) will actually prefer the traditional channel because she gets negative added utility from the AI-channel, which is a contradiction.
Given the statements above, the possible equilibrium configuration is shown in Figure A3.

By definition, $\tilde{x}_A$, $\tilde{x}_B$, and $\tilde{x}$ are given by

\[
V - t\tilde{x}_A - p^0_A = V - t\tilde{x}_A - p^1_A - \eta + \left(\frac{1}{2} - \tilde{x}_A\right) \Rightarrow \tilde{x}_A = p^0_A - p^1_A + \frac{1}{2} - \eta,
\]

\[
V - t(1 - \tilde{x}_B) - p^0_B = V - t(1 - \tilde{x}_B) - p^1_B - \eta + \left(\frac{1}{2} - \tilde{x}_B\right) \Rightarrow \tilde{x}_B = p^1_B - p^0_B + \frac{1}{2} + \eta,
\]

\[
V - t\tilde{x} - p^0_A = V - t(1 - \tilde{x}) - p^0_B \Rightarrow \tilde{x} = \frac{p^0_B - p^0_A + t}{2t}.
\]

The brands are solving for the following optimization problems to maximize their profits:

For Brand $A$,

\[
\max_{p^0_A, p^1_A} p^0_A ((1 - \alpha)\tilde{x}_A + (\tilde{x} - \tilde{x}_A)) + p^1_A \alpha \tilde{x}_A.
\]

For Brand $B$,

\[
\max_{p^0_B, p^1_B} p^0_B ((1 - \alpha) (1 - \tilde{x}_B) + (\tilde{x}_B - \tilde{x})) + p^1_B \alpha (1 - \tilde{x}_B).
\]

Solving for the first order conditions with respect to prices yields: $p^0_A(\text{OC,OC}) = p^0_B(\text{OC,OC}) = t$, and $p^1_A(\text{OC,OC}) = p^1_B(\text{OC,OC}) = t + \frac{1-2\eta}{4}$.

Plugging the prices in the expression for the indifferent consumers yields: $\tilde{x}_A^{\text{OC,OC}} = \frac{1}{4} - \frac{\eta}{2}$, $\tilde{x}_B^{\text{OC,OC}} = \frac{3}{4} + \frac{\eta}{2}$, and $\tilde{x}^{\text{OC,OC}} = \frac{1}{2}$, as well as the profit of the two brands: $\pi_A^{(\text{OC,OC})} = \pi_B^{(\text{OC,OC})} = t + \frac{\alpha}{4} (\frac{1}{2} - \eta)^2$. An equilibrium exists when $0 < \tilde{x}_A^{\text{OC,OC}} < \tilde{x}^{\text{OC,OC}} < \tilde{x}_B^{\text{OC,OC}} < 1$, which is guaranteed when $0 < \eta < 1/2$.

\[\square\]

**Proof of Proposition 3.** We first solve the other subgame when only one brand (say $A$) adopts the new channel, with the equilibrium configuration shown in Figure A4. The first two statements in the proof of Lemma A3 together with the fact that $\Delta(\frac{1}{2}) < 0$ ensure that this is the only possible equilibrium configuration.

Following a similar procedure to the one in the proof of Lemma A3, the maximization problem for Brand $A$ becomes:

\[
\max_{p^0_A, p^1_A} p^0_A ((1 - \alpha)\tilde{x}_A + (\tilde{x} - \tilde{x}_A)) + p^1_A \alpha \tilde{x}_A,
\]
and for Brand $B$, it becomes:

$$\max_{p_B^0} p_B^0 (1 - \tilde{x}).$$

Solving for the first order conditions with respect to prices yields: $p_A^{0,(OC,T)} = p_B^{0,(OC,T)} = t$, and $p_A^{1,(OC,T)} = t + \frac{1-2\eta}{4}$. The equilibrium profits are $\pi_A^{(OC,T)} = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$ and $\pi_B^{(OC,T)} = \frac{t}{2}$.

Comparing Equilibrium $(OC, OC)$ and Equilibrium $(OC, T)$ yields that $p_A^{0,(OC,T)} = p_A^{0,(OC,OC)}$ and $\pi_A^{(OC,T)} = \pi_A^{(OC,OC)}$, as well as $p_B^{0,(OC,T)} = p_B^{(T,T)}$ and $\pi_B^{(OC,T)} = \pi_B^{(T,T)}$. Thus, a brand’s pricing decision and equilibrium profit are independent of its competitor’s choice in the OC case. In other words, the introduction of the AI-channel only causes within-brand consumer switching and does not affect competition between brands, so adopting the AI-channel and charging a higher price in the new channel increases a brand’s profit. Therefore, both brands adopt the new channel in the subgame perfect equilibrium.

Lemma A4. $\pi_j^{(OC,OC)}$ is decreasing in $\eta$, $j = A, B$. In words, when the OC technology gets better, the profit of each brand increases.

Proof of Lemma A4. $\pi_j^{(OC,OC)} = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$, so $\frac{\partial \pi_j^{(OC,OC)}}{\partial \eta} < 0$ for $0 < \eta < 1/2$.

Proof of Proposition 4. If the AI-channel features OC, for any given $\eta$ and $f$, the profits of the firms are determined by their adoption decisions:

- If neither of them adopts, each brand’s profit is $\pi_A^{(T,T)} = \frac{t}{2}$.
- If both of them adopt, their profits are both $\pi_A^{(OC,OC)} = f$.
- If only Brand $A$ adopts, $A$’s profit is $\pi_A^{(OC,T)} = f$, and $B$’s profit is $\pi_B^{(OC,T)}$.

From the proof of Proposition 3, $\pi_A^{(OC,OC)} = \pi_A^{(OC,T)}$. Thus, a brand’s adoption decision is independent of its competitor’s decision, and only one brand adopting the AI-channel can never be an equilibrium. Whether two or no brands adopt depends on $f$. Specifically, if $f \leq \pi_A^{(OC,OC)} - \pi_A^{(T,T)}$, both brands adopt the AI-channel, and the provider earns $2f$. Otherwise, no brand adopts the AI-channel, and the technology provider earns 0 profit. Therefore, for any $\eta$, the optimal $f$ is defined by $\pi_A^{(OC,OC)} - \pi_A^{(T,T)} = (\frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2) - \frac{t}{2} = \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$.

By Lemma A4, we know that $\pi_A^{(DS,T)} - \frac{t}{2}$ is increasing in $\xi$. Thus, the optimal level of $\eta$ is 0. Remember that a small $\eta$ implies a better OC technology, so the the optimal $\eta^*$ represents the best possible technology. The optimal fee is thus $f^{OC*} = \pi_A^{(OC,OC)}|_{\eta=0} = \frac{t}{2} = \frac{\alpha}{16}$.

□
Proof of Proposition 5. The proposition compares $\Pi^{DS*}$ and $\Pi^{OC*}$. From the proofs of Propositions 2 and 4, if the technology provider provides DS, it will set the fee as $f^{DS*}$ and only one brand adopts the AI-channel; if the technology provider provides OC, it will set the fee as $f^{OC*}$ and both brands adopt the AI-channel. Thus,

$$\Pi^{DS*} = f^{DS*} = \pi_A^{(DS,T)}|_{\xi=\frac{1}{2}} - \frac{t}{2} = \frac{\alpha (9(1-\alpha)^2 + 120t^3 + 4(45 - 29\alpha)t^2 + 2(1-\alpha)(39 - 7\alpha)t)}{72(2t + 1)(1-\alpha + t)(1-\alpha + 2t)}.$$

$$\Pi^{OC*} = 2f^{OC*} = 2(\pi_A^{(OC,OC)}|_{\eta=0} - \frac{t}{2}) = \frac{\alpha}{8}.$$

With some algebra, we can calculate

$$\Pi^{DS*} - \Pi^{OC*} = \frac{\alpha t ((33 - 4\alpha^2 - 29\alpha) + (108 - 62\alpha)t + 84t^2)}{72(2t + 1)(1-\alpha + t)(1-\alpha + 2t)} > 0.$$

\[ \square \]

Proposition A1. (Equilibrium under Both DS and OC Functionalities) When the AI-channel offers both DS and OC functionalities, there are five scenarios in the $\xi - \eta$ space to define equilibria outcomes. Figure A5 graphically illustrates the parameter space $\eta, \xi)$ and the corresponding scenarios, where we fix $\alpha = \frac{1}{3}$ and $t = 1$ as an example. The full expressions of equilibrium solutions for price and profits are given as below:

- **(Scenario 1: Uniformity – AI Serves All)**
  If $0 < \eta < \frac{\alpha}{6(1-2\alpha)}$ and $\max\left\{\frac{3\eta(1+2\alpha)}{\alpha}, \frac{(1-\alpha)(10\eta+1)+12\alpha t}{8(1-\alpha)+12}\right\} < \xi < \frac{1}{2}$, both brands adopt the AI-enabled channel in the equilibrium with prices $p_A^0 = p_B^0 = p_A^1 = p_B^1 = t$ and profits $\pi_A = \pi_B = \frac{\xi}{2}$.

- **(Scenario 2: Uniformity – AI Serves Brand Loyal)**
  If $0 < \eta < \frac{1-\alpha}{4(1-2\alpha)}$ and $0 < \xi < \frac{(1-\alpha)(1-2\eta)-4\alpha t}{8(1-\alpha)+12}$, both brands adopt the AI-enabled channel in the equilibrium with prices $p_A^0 = p_B^0 = t$ and $p_A^1 = p_B^1 = t + \frac{1-2\eta}{4}$ and profits $\pi_A = \pi_B = \frac{\xi}{2} + \frac{\alpha}{4}\left(\frac{1}{2} - \eta\right)^2$.

- **(Scenario 3: Specialization – AI Serves Less Brand Loyal)**
  If $\frac{3(1-\alpha+2t)}{10(1-\alpha)+12t} < \eta < \frac{1}{2}$ and $\frac{5(1-\alpha)(1-2\eta)+t(8-12\eta)}{4(1-\alpha+t)} < \xi < \frac{1}{2}$, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = t\left(1 + \frac{\alpha t(9-2\xi+2(1-\alpha)(3-\xi))}{6(1-\alpha+2t)(1-\alpha+2t)}\right)$, $p_A^1 = p_B^0 + \frac{t - \xi}{4(1-\alpha+t)}$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$, $p_B^1 = \frac{t(3-2\alpha\xi+6)}{18(1+2t)(1-\alpha+2t)}$ and profits $\pi_A = \pi_B + \frac{\alpha(2\xi(1-\alpha+t)+3t)}{24(1-\alpha+t)(1-\alpha+2t)}$. 

A11
• **(Scenario 4: Specialization – AI Serves the most Brand Loyal and Less Loyal)**

If $\xi$ and $\eta$ do not satisfy the premises in Scenarios 1-3 and $0 < \xi < \frac{(1-\alpha)(10\eta+1)+12t}{8(1-\alpha)+12t}$, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = t\left(1 + \frac{\alpha(4t(3n+\xi+6)+3(1-\alpha)(2n+5))}{6(3-3\alpha+4t)(1-\alpha+2t)}\right)$, $p_A^1 = p_A^0 + \frac{\alpha(2t-4\xi+1-2\eta)(2t+1)+4\xi(t+1)+1}{4(3-3\alpha+4t)}$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$, $\pi_A = \pi_B + \frac{\alpha(8\xi(3(1-\alpha)^2(1-2\eta)+4(8-3n)(1-2\eta)(3-2\eta)))+3(1-\alpha)(2t-4\xi)+48\xi^2(1-\alpha+t)^2}{48(3-3\alpha+4t)(1-\alpha+2t)}$.

• **(Scenario 5– Specialization – AI Serves All Customers of One Brand)**

Otherwise, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = \frac{t(2\alpha(3\eta-2\xi)+3(1+2t))}{3(1-\alpha+2t)}$, $p_A^1 = p_A^0 + \xi - \eta$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$, $\pi_A = \pi_B + \frac{3(1-\alpha)(1+2\eta)(\xi-\eta)+8\alpha\xi^2}{6(1-\alpha+2t)}$.

[Figure 12 about here.]

**Proof of Proposition A1.** Suppose that both brands adopt the AI-channel. If, in equilibrium, each consumer who has access to AI-channel chooses to shop in this channel, then brands’ pricing decisions for the AI-channel is made independently of the pricing decisions made for the traditional channel. In this case, the equilibrium prices both in the traditional and new channels are $t$ and the equilibrium profits are $t/2$ for each brand.

Next, consider the case when some of the consumers who have access to AI-devices shop in this channel. Since $\Delta^{OC}(x) = |x - \frac{1}{2}| - \eta$, $\Delta^{DS}(x) = \xi - |x - \frac{1}{2}|$, and $\Delta^{OC+DS}(x) = \max\{\Delta^{OC}(x), \Delta^{DS}(x), \Delta^{OC}(x) + \Delta^{DS}(x)\}$, with some basic algebra it is easy to derive that:

if $\xi \leq \eta$,

$$\Delta^{OC+DS}(x) = \begin{cases} 
\frac{1}{2} - x - \eta & \text{if } 0 \leq x \leq \frac{1-(\xi+\eta)}{2} \\
\xi - \frac{1}{2} - x & \text{if } \frac{1-(\xi+\eta)}{2} < x \leq \frac{1}{2} \\
\xi - \left(x - \frac{1}{2}\right) & \text{if } \frac{1}{2} < x \leq \frac{1+(\xi+\eta)}{2} \\
x - \frac{1}{2} - \eta & \text{if } \frac{1+(\xi+\eta)}{2} < x \leq 1;
\end{cases}$$

if $\xi > \eta$,

$$\Delta^{OC+DS}(x) = \begin{cases} 
\frac{1}{2} - x - \eta & \text{if } 0 \leq x \leq \frac{1-2\xi}{2} \\
\xi - \eta & \text{if } \frac{1-2\xi}{2} < x \leq \frac{1-2\eta}{2} \\
\xi - \frac{1}{2} - x & \text{if } \frac{1-2\eta}{2} < x \leq \frac{1}{2} \\
\xi - \left(x - \frac{1}{2}\right) & \text{if } \frac{1}{2} < x \leq \frac{1+2\eta}{2} \\
\xi - \eta & \text{if } \frac{1+2\eta}{2} < x \leq \frac{1+2\xi}{2} \\
x - \frac{1}{2} - \eta & \text{if } \frac{1+2\xi}{2} < x \leq 1.
\end{cases}$$
Each brand can set a high price in the AI-channel to extract more surplus from its loyal customers or to set a low price in the AI-channel to compete for the consumers with weak brand preferences. Thus, there are two possible equilibrium configurations (where consumers in the shaded region buy from the AI-channel), as shown in Figure A6.

One may think that there can be other configurations when the middle (weakest preference) consumers buy in the AI-channel. However this is not the case. This is because we have the same configuration as in Lemma A1 and we know that in that case \( p_A^1 < p_A^0 \) holds. So loyal consumers will also switch to the AI-channel because they also gain a positive added utility from the new channel. This creates a contradiction. Also, asymmetric cases when one brand sets a low price in the AI-channel while the other one sets a high price are not possible equilibria.

One can show that the brand who charges a higher price in the AI-channel will always have the incentive to charge a lower price so that they deviate from the configuration.

Similar to the proof of Propositions 1 and 3, we can find out the indifferent customers and then solve for the equilibrium. When both brands set a high price (case (1)), the equilibrium prices are \( p_A^0 = p_B^0 = t \) and \( p_A^1 = p_B^1 = t + \frac{1-2\eta}{2} \), and the equilibrium profits are \( \pi_A = \pi_B = \frac{t}{\frac{1}{2} + \frac{\alpha}{3} (1-\frac{\eta}{2})^2} \). When both brands set a low price (case (2)), the equilibrium prices are \( p_A^0 = p_B^0 = \frac{t(\alpha(2\eta-2\xi-1)+8t+1)}{-\alpha+8t+1} \) and \( p_A^1 = p_B^1 = \frac{t((\alpha-1)(2\eta-2\xi-1)+8t)}{-\alpha+8t+1} \), and the equilibrium profits are \( \pi_A = \pi_B = \frac{t((1-\alpha)(\alpha(4\eta-\xi)^2-1)+1)+64t^2+16(\alpha((\eta-\xi)^2-1)+1)}{2(\alpha-8t-1)^2} \).

Now, suppose only Brand A adopts the new channel. Consider the following configuration specified in Figure A7.

Again, defining indifferent consumers \( x_{A1}, x_{A2}, x_0, x_1 \) as shown in the figure above and solving for the equilibrium as we did before, we get equilibrium prices \( p_A^0 = \frac{t(3-\alpha)(6-\alpha(1-2\eta)+48\xi^2+4(\alpha(3\eta+\xi-9)+15))}{6(3-3\alpha+4\eta)(1-\alpha+2\xi)} \), \( p_A^1 = p_B^0 + \frac{\alpha(t(3-\alpha)(6-\alpha(1-2\eta)+48\xi^2+4(\alpha(3\eta+\xi-9)+15))}{6(3-3\alpha+4\eta)(1-\alpha+2\xi)} \), \( p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2\xi)} \), and profits \( \pi_A = \pi_B \) \( = \frac{t(3-2\alpha\xi+6\xi^2)}{18(1+2\xi)(1-\alpha+2\xi)} \), \( \pi_A = \pi_B + \frac{\alpha(3(1-\alpha)^2(1-2\eta)+4(8-3\eta)t^2+9(1-\alpha)(3-2\eta)t+3(\alpha(1-2\eta)+\eta(4t+2)-1)^2+48\xi^2(1-\alpha+2\xi)^2)}{48(3-3\alpha+4\eta)(1-\alpha+2\xi)} \).

One can check that the profit of \( B \) is higher than any possible profit it could earn if both \( A \) and \( B \) adopt the AI-channel (similar to the proof of Proposition 1). Thus, as long as the equilibrium above holds, in the subgame perfect equilibrium, it must be the case that only one brand adopts the new channel.

However, there are several conditions that \( x_{A1}, x_{A2}, x_0, x_1 \) need to satisfy to make the equilibrium hold: (1) \( x_{A1} > 0 \), (2) \( x_{A2} < \frac{1}{2} < x_1 \), and (3) \( x_{A1} < \frac{1-\xi-\eta}{2} < x_{A2} \) when \( \xi < \eta \); \( x_{A1} < \frac{1-2\eta}{2} < \frac{1-2\eta}{2} < x_{A2} \) when \( \xi > \eta \).
When all these 3 conditions are satisfied, it is the SPE (subgame perfect equilibrium) – only A adopting, prices and profits listed above (Scenario 4).

When (1) is violated, \( x_{A1} \) should always equal to 0, i.e. not serving loyal consumers. The equilibrium looks identical to the DS-only case (Scenario 3).

When (2) is violated, no consumer is served in the middle, which becomes identical to the OC-only case. Thus only A adopting is not a SPE. Both brands will adopt the AI-channel (Scenario 2).

When (3) is violated, everyone to the left of \( x_1 \) buys from the new channel as long as she has the access.

There are two subcases under the case when (3) is violated:

(a) If \( x_1 < \frac{1+2q}{2} \), then \( x_1 = \frac{2t-2p_1^0+2p_0^0+2t+1}{2(2t+1)} \). A is solving the following maximization problem: \( \max_p p_1^0 \alpha x_1 + p_0^0 (1-\alpha) x_0 \) subject to the constraint that \( p_1^0 \leq p_0^0 + \xi - \eta \) in order to make sure everyone to the left of \( x_0 \) uses AI-channel. Solving this, we have \( p_0^0 = \frac{t(2t+2t-2+3(1+2t))}{3(1-\alpha+2t)} \), \( p_1^0 = p_0^0 + \xi - \eta \), \( p_B^0 = \frac{t(6t-2t+3)}{3(1-\alpha+2t)} \). One can check this is still subgame perfect (Scenario 5).

(b) If \( x_1 \geq \frac{1+2q}{2} \), then \( x_1 = \frac{-\eta+\xi-p_1^0+p_0^0+\pi}{2t} \). Following a similar procedure, we have \( p_0^0 = \frac{1}{6} \alpha(\eta - \xi) + t, p_1^0 = \frac{1}{6} (\alpha - 3)(\eta - \xi) + t, p_B^0 = \frac{1}{3} \alpha(\eta - \xi) + t, \) and \( \pi_B = \frac{(3t-\alpha(\xi-\eta))^2}{18t} < t/2 \), which is not subgame perfect, so both adopting and let the new channel cover everyone who has the access with price \( t \) is the only SPE (Scenario 1).

\[ \square \]

**Proof of Proposition 6.** Refer to Proposition A1 for the 5 scenarios. We will first prove that within each scenario, the profit of the third party provider is (weakly) increasing in \( \xi \) and (weakly) decreasing in \( \eta \). Then we can just compare the highest profit within each scenario to obtain the global maximum.

Consider Scenario 1 first. If \( f = 0 \), both brands adopt the AI-channel. The technology developer can either set a lower fee \( \bar{f} = \pi_{B,S1}^{(AI,AI)} - \pi_{B,S1}^{(AI,T)} = t/2 - \frac{(3t-\alpha(\xi-\eta))^2}{18t} = \frac{a(\xi-\eta)(6t-\alpha(\xi-\eta))}{18t} \) such that both brands want to adopt the AI-channel (provider’s profit= \( 2\bar{f} \)) \(^{15}\), or set a higher fee \( \bar{\bar{f}} = \pi_{B,S1}^{(AI,T)} - \pi_{B,S1}^{(T,T)} = \frac{1}{3} \alpha(\xi - \eta) + \frac{a(\xi - \eta)(5a-\xi)(\xi-\eta)}{72t} \) such that only one brand wants to do so (provider’s profit= \( \bar{\bar{f}} \)). \( \pi_{B,S1}^{(AI,AI)}, \pi_{B,S1}^{(AI,T)}, \pi_{A,S1}^{(AI,T)}, \pi_{A,S1}^{(T,T)} \) are calculated based on expressions in the proof of Proposition A1. The technology provider’s profit is then \( \Pi = \max\{2\bar{f}, \bar{\bar{f}}\} \). \( 2\bar{f} - \bar{\bar{f}} = \frac{a(\xi - \eta)(8t-(\alpha+3)(\xi-\eta))}{24t} > 0 \). Thus \( \Pi = 2\bar{f} \), which is increasing in \( \xi - \eta \) when \( \xi - \eta \leq 1/2 \).

Therefore, the optimal quality of AI in Scenario 1 is with \( \xi_{S1} = 1/2 \) and \( \eta_{S1} = 0 \), and the

\(^{15}\)The superscript “\((AI,T)\)” means the case when \( A \) adopts the AI channel while \( B \) does not (traditional channel only). Similarly we have \((AI,AI)\) and \((T,T)\). Subscript “\(S1\)” means in Scenario 1. Similarly we have “\(S2-5\)” meaning across Scenarios 2-5.
provider’s profit is
\[ \Pi^*_{s_1} = 2f(\xi=1/2, \eta=0) = \frac{\alpha(\xi - \eta)(6t - \alpha(\xi - \eta))}{9t} \bigg|_{\xi=1/2, \eta=0} = \frac{\alpha(12t - \alpha)}{72t}. \]

Scenarios 2-5 are similar to that in Proposition 2. Through similar procedures to what we have done in the proofs of Lemmas A2 and A4 (taking first derivatives w.r.t. \( \xi \) and \( \eta \)), we can show that across Scenarios 2-5, the provider’s profit is non-decreasing in \( \xi \) and non-increasing in \( \eta \). Thus, the optimal quality of AI across Scenarios 2-5 is set at \( \xi^*_{s_2-5} = 1/2 \) and \( \eta^*_{s_2-5} = \frac{\alpha}{6(1+2t)} \), and the provider’s profit is
\[
\Pi^*_{s_2-5} = \left\{ \frac{t(3 - 2\alpha\xi + 6t)^2}{18(1 + 2t)(1 - \alpha + 2t)} + \frac{3\alpha(1 - \alpha)(1 + 2\eta)(\xi - \eta) + 8\alpha\xi t - t^2}{6(1 - \alpha + 2t)} \right\} \bigg|_{\xi=1/2, \eta=\frac{\alpha}{6(1+2t)}}
= \alpha \left( \frac{\alpha^3 - \alpha^2 - 2(\alpha^2 + 1)(16t + 9) + 3(2t + 1)^2(10t + 3)}{36(2t + 1)^2(1 - \alpha + 2t)} \right).
\]

With some algebra, we can show that \( \Pi^*_{s_2-5} - \Pi^*_{s_1} \) is positive since every term is positive.

The global maximum profit \( \Pi^* = \max\{\Pi^*_{s_1}, \Pi^*_{s_2-5}\} = \Pi^*_{s_2-5} \), when \( \xi^* = 1/2 \) and \( \eta^* = \frac{\alpha}{6(1+2t)} > 0 \). This is at Scenario 5, where only one brand adopts the new channel in the equilibrium.

**Proof of Proposition 7.** To calculate social welfare, we need to sum up the consumer surplus, the firms’ profits, and the profit of the technology provider:

Social welfare = Consumer surplus + Firms’ profit + Provider’s profit
\[
= \left( \alpha \left( \int_{x \in \mathcal{X}} V - t^1(x) - p^1(x) + \Delta^{OC+DS}(x) \right) dx + \int_{x \in \overline{\mathcal{X}}} V - t^0(x) - p^0(x) dx \right)
+ (1 - \alpha) \left( \int_{0}^{t^1} V - t^0(x) - p^0(x) dx \right) + \left( \alpha \left( \int_{x \in \mathcal{X}} p^1(x) dx + \int_{x \in \overline{\mathcal{X}}} p^0(x) dx \right) \right)
+ (1 - \alpha) \left( \int_{0}^{t^0} p^0(x) dx - f_A - f_B \right) + \left( f_A + f_B \right)
= V - T + \alpha \int_{x \in \mathcal{X}} \Delta^{OC+DS}(x) dx.
\]
where \( t^0(x) \) and \( t^1(x) \) denote the transportation cost for a consumer at \( x \) who buys from the traditional channel and AI-channel, respectively, which is \( tx \) if this consumer buys from Brand A, \( t(1-x) \) if she buys from B; \( T = \alpha \left( \int_{x \in \mathcal{X}} t^1(x) dx + \int_{x \in \overline{\mathcal{X}}} t^0(x) dx \right) + (1 - \alpha) \int_{0}^{t^0} t^0(x) dx \) denotes the total transportation cost across all consumers; \( p^0(x) \) and \( p^1(x) \) denotes the price a consumer at \( x \) who buys from the traditional channel and AI-channel, respectively, pays; \( \mathcal{X} \) represents the consumer segment who has the access and uses the AI-device, while \( \overline{\mathcal{X}} = [0, 1] \setminus \mathcal{X} \) represents
the segment who has the access to the AI-channel but buys from the traditional channel; \( f_j \) \((j = A, B)\) denotes the fee a brand pays to the technology provider.

As we see from the equation above, the transfer between brands and the technology provider (fees) and between brands and consumers (prices) are cancelled out when calculating the social welfare. \( V \) is fixed, so a social planner cares about the sum of the following two factors:

1. How much additional utility consumers enjoy from using AI \((\alpha \int_{x \in \mathcal{X}} \Delta^{OC+DS}(x)dx)\).

2. The total transportation cost \((T)\), which is minimized when everyone to the left of \( \frac{1}{2} \) buys Brand A and everyone to the right of \( \frac{1}{2} \) buys Brand B.

Note that when \( \xi^{**} = 1/2, \eta^{**} = 0 \), \( \Delta^{OC+DS}(x) \) reaches its highest value for any \( x \), and \( \mathcal{X} = [0, 1] \) covers all consumers with access to an AI-device. This implies that the total additional utility consumers enjoy from using AI is maximized, because the integrant is point-wise maximized and the integration region is the largest.

Also, since both brands adopt the AI-device, the equilibrium is symmetric, so everyone to the left of \( \frac{1}{2} \) buys Brand A and everyone to the right of \( \frac{1}{2} \) buys Brand B, and the total transportation cost is minimized.

Thus, social welfare is maximized when \( \xi^{**} = 1/2, \eta^{**} = 0 \), i.e., both OC and DS functionalities are offered at their highest possible quality. Consumer surplus is the difference between social welfare and the total price consumers pay. When both functions are “perfect” the AI-channel is competitive, the price drop to \( t \), which is the lowest possible price in any equilibrium. Thus, this is also the point that maximizes consumer surplus.
Figure A1: Possible Equilibrium Configurations

(a) Configuration 1

(b) Configuration 2
Figure A2: Possible Equilibrium Configurations

(a) Configuration 1

(b) Configuration 2

(c) Configuration 3
Figure A3: OC Case; Both Firms Adopt AI-Channel
Figure A4: OC Case; Only $A$ Adopts the AI-Channel

0 \quad \bar{x} \quad 1

$\alpha$

$1 - \alpha$

$\tilde{x}_A$

$A^1$

$A^0$

$B^0$
Figure A5: Scenarios and Parameter Space \((\eta, \xi)\) when \(\alpha = \frac{1}{3}, t = 1\)
Figure A6: Possible Equilibrium Configurations

(a) Case (1)

(b) Case (2)
Figure A7: Only $A$ Adopts the AI-Channel

\[ x_{A1} \quad x_{A2} \quad x_1 \]

\[ \alpha \quad A^1 \quad A^1 \quad B^0 \]

\[ 1 - \alpha \quad A^0 \quad x_0 \quad \]
<table>
<thead>
<tr>
<th></th>
<th>Only $A$ adopts AI channel</th>
<th>Both adopt AI channel</th>
<th>No AI channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_A^0$</td>
<td>$t \left( 1 + \frac{\alpha \left( 9 - 2\xi + 2(1-\alpha)(3-\xi) \right)}{6(1-\alpha+t)(1-\alpha+2t)} \right)$ &gt; $t \left( 1 + \frac{\alpha(1-2\xi)}{1-\alpha+4t} \right)$ &gt; $t$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p_B^0$</td>
<td>$t \left( 1 + \frac{\alpha(3-2\xi)}{3(1-\alpha+2t)} \right)$ &gt; $t \left( 1 + \frac{\alpha(1-2\xi)}{1-\alpha+4t} \right)$ &gt; $t$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p_A^1$</td>
<td>$p_A^0 + \frac{\xi}{2} - \frac{t}{4(1-\alpha+t)}$ &gt; $t \left( 1 - \frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t} \right)$ &lt; $(t)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p_B^1$</td>
<td>NA &gt; $t \left( 1 - \frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t} \right)$ &lt; $(t)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi_A$</td>
<td>$\pi_B + \frac{\alpha(2\xi(1-\alpha+t)+3t)(6\xi(1-\alpha+t)+t)}{24(1-\alpha+t)(1-\alpha+2t)}$ &gt; $t \left( \frac{1 + \alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2} \right)$ &gt; $t$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi_B$</td>
<td>$\frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$ &gt; $t \left( \frac{1 + \alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2} \right)$ &gt; $t$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table A2: OC Case: Prices and Profits under Different Adoption Decisions

<table>
<thead>
<tr>
<th></th>
<th>One Brand (A) Adopts AI channel</th>
<th>Both Brands channel Adopt AI channel</th>
<th>Neither Brand Adopts AI channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p^0_A$</td>
<td>$t$ = $t$</td>
<td>$t$ = $t$</td>
<td>$t$ = $t$</td>
</tr>
<tr>
<td>$p^0_B$</td>
<td>$t$ = $t$</td>
<td>$t$ = $t$</td>
<td>$t$ = $t$</td>
</tr>
<tr>
<td>$p^1_A$</td>
<td>$t + \frac{1-2\eta}{4}$ = $t + \frac{1-2\eta}{4}$ &gt; $(t)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p^1_B$</td>
<td>NA</td>
<td>$t + \frac{1-2\eta}{4}$ = $(t)$</td>
<td></td>
</tr>
<tr>
<td>$\pi_A$</td>
<td>$\frac{t}{2} + \frac{\alpha}{4} \left(\frac{1}{2} - \eta\right)^2$ = $\frac{t}{2} + \frac{\alpha}{4} \left(\frac{1}{2} - \eta\right)^2$ &gt; $\frac{t}{2}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi_B$</td>
<td>$\frac{t}{2}$ &lt; $\frac{t}{2} + \frac{\alpha}{4} \left(\frac{1}{2} - \eta\right)^2$ &gt; $\frac{t}{2}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Online Appendix B – Experimental Materials

Supplemental Study

In this study, we let participants make forced-choices between AI-enabled shopping devices with DS and OC functions. Based on our hypotheses, it must be that consumers who have stronger brand preferences will be more likely to prefer OC to DS. The following study tests this corollary.

170 MTurkers participated in the study. They were first randomly assigned to one of the two conditions: high/low product knowledge. The manipulation is the same as that in Study 1 (“think of a product category that you know/do not know about”). Then the participants were asked whether they had a preferred brand in this product category (brand preference strength), at a scale of 1 (weak preference) to 5 (strong preference). Finally, they were described the two functionalities of AI-devices (DS/OC), and were asked which functionality they liked between DS and OC when they buy the product they just mentioned (functionality preference), at a scale of 1 (strongly prefer DS) to 5 (strongly prefer OC).

If we regress functionality preference on (1) brand preference strength, (2) product knowledge, (3) brand preference strength and product knowledge, we find the results in Table B1.

[Table 6 about here.]

First, (1) show that consumers who have stronger brand preferences will be more likely to prefer OC to DS, which goes in line with our hypotheses and replicates what we have found in Study 1 and 2. (2) and (3) partly reveal the possible mechanism behind this phenomenon. We see the positive relationship between product knowledge and OC functionality preference in (2), and the level of product knowledge is what we have manipulated. Thus we conclude a causal relationship between product knowledge and AI functionality acceptance. Also, in (3) we find that if we include both product knowledge and brand preference strength, all the effect of brand preference strength is absorbed by product knowledge. Actually, higher product knowledge will induce stronger brand preference (See Table B2), and the high $R^2$ indicates the relationship is strong.

[Table 7 about here.]

Experiment Scripts

Study 1: Instructions and Figures

For the “OC” Condition: “Shopbot” is a smart shopping device using artificial intelligence (AI). This device can be used to shop with voice commands.
When you need to buy, for example, a toothpaste, you can say to Shopbot: “Shopbot, buy me [brand name] toothpaste”, and Shopbot will order it for you. The next time you want toothpaste, you can just say: “Shopbot, buy me toothpaste”, and Shopbot will order the same toothpaste you bought the last time.

For the “DS” Condition: “Shopbot” is a smart shopping-support device using artificial intelligence (AI). This device can help you make purchase decisions when you need it.

When you need, for example, a toothpaste, you can turn to Shopbot and ask which brand to buy. Based on its understanding of your past purchase behavior and online product information, Shopbot can suggest you a toothpaste brand. If you want, it can also give you tips on how to choose among different brands.

Question for the High Product Knowledge Condition: Think of a product category (e.g. shampoo, motor oil, etc.) you know a lot about. Please write down the product category: [ ________ ]

Question for the Low Product Knowledge Condition: Think of a product category (e.g. shampoo, motor oil, etc.) you do NOT know a lot about. Please write down the product category: [ ________ ]

Common Questions for All Participants: Do you have a preferred brand in this product category?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not
What’s your favorite brand in this product category? (If no favorite brand, just write “NA”) [________]  
When you need to buy this product, how likely will you use Shopbot?  
- Highly likely  
- Likely  
- Not sure  
- Unlikely  
- Highly unlikely  
Why or why not do you want to use Shopbot when purchasing this product? [________]

MANIPULATION CHECK QUESTIONS
Do you think Shopbot makes it easier to choose between brands?  
- Definitely yes  
- Probably yes  
- Might or might not  
- Probably not  
- Definitely not  
Do you think Shopbot makes it easier to order products?  
- Definitely yes  
- Probably yes  
- Might or might not  
- Probably not  
- Definitely not

Study 2: Instructions and Figures
For the “DS” Condition: “Shopbot” is a smart shopping device using artificial intelligence (AI). This device can be used to shop with voice commands.  
When you need to buy, for example, a detergent, you can simply say to Shopbot: “Shopbot, buy me [brand name] detergent”, and Shopbot will order it for you. The next time you want detergent, you can just say: “Shopbot, buy me detergent”, and Shopbot will order the same detergent you bought the last time. You can review the prices if you want. The shipping cost is marginal.
For the “DS” Condition:

“Shopbot” is a smart shopping-support device using artificial intelligence (AI). This device can help you make purchase decisions when you need it.

When you need, for example, a detergent, you can turn to Shopbot and ask which brand to buy. Based on its understanding of your past purchase behavior and online product information, Shopbot can suggest you a detergent brand. If you want, it can also give you shopping tips on how to choose among different brands.

Common Questions for All Participants:

Which headphone brand do you prefer?

- Sony
- Bose
- I am indifferent between the two brands above

Is your preference over the brand you chose in the previous question strong?

- Yes, my brand preference is strong
- No, my brand preference is weak

Which cereals brand do you prefer?

- Cheerios
- Frosted Flakes
- I am indifferent between the two brands above

Is your preference over the brand you chose in the previous question strong?

A29
• Yes, my brand preference is strong
• No, my brand preference is weak

Which of the functions below does Shopbot have? [Select all that apply]
• With Shopbot, you can shop using your voice
• Shopbot can help you find used items being sold nearby
• Shopbot can provide you with shopping tips when you need

When you need to buy a headphone (Sony or Bose), how likely will you use Shopbot?
• Highly likely
• Likely
• Not sure
• Unlikely
• Highly unlikely

How much do you think you know about headphones?
• Very much
• Much
• Not sure
• Little
• Very little

When you need to buy cereals (Cheerios or Frosted Flakes), how likely will you use Shopbot?
• Highly likely
• Likely
• Not sure
• Unlikely
• Highly unlikely

How much do you think you know about cereals?
• Very much
• Much
• Not sure
• Little
• Very little

Supplemental Study

**Question for the High Product Knowledge Condition:** Think of a product category (e.g. cereals, headphone, etc.) you know a lot about. Please write down the product category: 

**Question for the Low Product Knowledge Condition:** Think of a product category (e.g. cereals, headphone, etc.) you do NOT know a lot about. Please write down the product category:

**Questions Common to All:**

Do you have a preferred brand in this product category?

• Definitely yes
• Probably yes
• Might or might not
• Probably not
• Definitely not

Suppose now you can use a smart shopping device, which is enabled by artificial intelligence (AI), to purchase the product you just wrote. There are two possible functionalities that the device can provide:

1. **[Decision Support]** Help you decide which brand to buy (providing product recommendations, lists, or additional product information)
2. **[Ordering Convenience]** Make your ordering more convenient (ordering through voice command, shopping via camera, or auto-refilling functions)

Which functionality do you prefer the shopping device to have?

• Strongly prefer Decision Support
• Prefer Decision Support
• Indifferent between Decision Support and Ordering Convenience

• Prefer Ordering Convenience

• Strongly prefer Ordering Convenience
<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>functionally preference (larger means preferring OC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>brand preference strength</td>
<td>0.193***</td>
<td>−0.008</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
<td>(0.079)</td>
<td></td>
</tr>
<tr>
<td>product knowledge</td>
<td></td>
<td>0.988***</td>
<td>1.003***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.191)</td>
<td>(0.246)</td>
</tr>
<tr>
<td>(Constant)</td>
<td>1.850***</td>
<td>1.976***</td>
<td>1.994***</td>
</tr>
<tr>
<td></td>
<td>(0.229)</td>
<td>(0.135)</td>
<td>(0.222)</td>
</tr>
<tr>
<td>R²</td>
<td>0.051</td>
<td>0.137</td>
<td>0.137</td>
</tr>
<tr>
<td></td>
<td>(df = 1; 168)</td>
<td>(df = 1; 168)</td>
<td>(df = 2; 167)</td>
</tr>
</tbody>
</table>

Note: N = 170. *p<0.1; **p<0.05; ***p<0.01
Table B2: Product Knowledge and Brand Preference

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable:</th>
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<tbody>
<tr>
<td></td>
<td>brand preference strength</td>
</tr>
<tr>
<td>product knowledge</td>
<td>1.953***</td>
</tr>
<tr>
<td></td>
<td>(0.188)</td>
</tr>
<tr>
<td>(Constant)</td>
<td>2.235***</td>
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<tr>
<td></td>
<td>(0.133)</td>
</tr>
<tr>
<td>R²</td>
<td>0.391</td>
</tr>
<tr>
<td>F Statistic</td>
<td>107.942*** (df = 1; 168)</td>
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</tbody>
</table>

Note: N = 170. *p < 0.1; **p < 0.05; ***p < 0.01