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ORIGINAL EMPIRICAL RESEARCH

Hey, Alexa! What attributes of Skills affect firm value?

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Abstract

Anthropomorphic voice assistants (e.g., Amazon Alexa) enable users to use natural-language voice commands to control "smart" objects and access the internet for information, shopping, and entertainment. Most manufacturers of voice assistants allow other firms to develop software (i.e., voice assistant functions, VAFs) related to their products and services that add new capabilities to voice assistants. To measure the value of different types of capabilities of VAFs, we empirically study the impact of announcements of VAFs on firm value. We show that informational capabilities and VAFs announced by product firms have a positive moderating effect on firm value. On the other hand, object-control capabilities have no moderating impact on firm value, while transactional capabilities have a negative impact. Theoretical and managerial implications are discussed. Additionally, necessary avenues for future research within the voice assistant domain are proposed.

Keywords Voice assistant functions · Internet of Things · Smart speakers · Event study · Firm value

Introduction

Advancements in technology often disrupt existing distribution systems by introducing new, better marketing channels. The modernization of postal technology led to the creation of catalogs, radio to telemarketing, television to home shopping networks, Internet to online marketing, and smartphones to mobile marketing. Currently, a cutting-edge technological revolution offering many new possibilities to the business world is the Internet of Things (IoT). The most widely adopted IoT device is smart speakers (e.g., Amazon Echo, Google Home), with 55% of U.S. households expected to own one by 2022 (Braiker, 2018). Smart speakers have built-in voice assistants, such as Amazon Alexa and Google Assistant, which permit natural-language voice interactions between users and smart speakers. Voice assistants allow users to verbally issue intuitive commands to perform a variety of tasks, such as setting an alarm or timer, playing music, and controlling other Wi-Fi-connected smart objects. The artificial intelligence (AI)-based software (Davenport et al., 2020) that runs voice assistants can even anticipate users' requests through "hunches" and ask appropriate questions (Priest, 2020); the verbal interaction mimics real-time conversation.

Most manufacturers of voice assistants allow other firms to create software related to their products and services that can be downloaded onto their voice assistants. Amazon and Google refer to such software as Skills and Actions, respectively, which we hereafter refer to as voice assistant functions (or VAFs in short). VAFs expand the capabilities of voice assistants to a point where smart speakers become an additional channel that consumers can use to interact with a company, its products, and services (Ratchford & Ratchford, 2021). For example, users can research appliances before purchase with the Consumer Reports VAF, check their credit card balance with the Capital One VAF, and reorder their favorite meals with the Chipotle VAF. According to Vijay Sankaran, Chief Information Officer, TD Ameritrade, *"Voice-enabled technology is the future, and with the rollout of support for the Google Assistant, we've added another major piece in our reach across the voice technology ecosystem. Now, nearly any client, on nearly any smart device, has the ability to*

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connect with us seamlessly in a way that feels natural to their lifestyle and doesn't ask them to leave their current platform or routine."

The addition of a channel naturally causes disruption to existing business structures, and thereby poses many questions to managers and academics, such as how to model competition and cooperation with older channels (Deleersnyder et al., 2002), coordinate marketing activities across channels (Ofek et al., 2011), and ascertain cross-channel elasticities (Avery et al., 2012). A perennial research question is "Does addition of a new channel create value for a firm?" Researchers have studied this question in the context of Internet channels (Geyskens et al., 2002), mobile apps (Boyd et al., 2019; Cao et al., 2018), and channel competition across countries (Homburg et al., 2014). As the voice channel is the latest channel connecting consumers and firms, this question needs to be answered for VAFs as well. To do so, we apply the event study methodology to examine the impact of VAF announcements on the stock market returns of publicly traded firms that announced a VAF between 2016 and 2020. We further identify key VAF- and firm-related characteristics that moderate the impact of a firm's VAF announcement on firm value.

Our work makes three primary contributions to the marketing literature. First, we contribute to the emerging research area of IoT (see Table 1). A few studies have examined smart speakers and other smart objects and uncovered interesting findings. For example, Kowalczuk (2018) found that perceived ease of use, usefulness, system quality and diversity, enjoyment, technology optimism, and risk have a strong impact on consumers' intention to use smart speakers. Mulcahy et al. (2019) analyzed how general perceptions regarding technology affect opinions and imagined experiences with smart home technology, which in turn impact consumers' adoption intention. Through semi-structured interviews, Foehr and Germelmann (2020) learned how smart speaker users build and maintain trust in their devices. The extant research has focused on (1) the consumer perspective and (2) IoT technologies at a broad, general level. No research has specifically studied VAFs and the voice-activated technology. This research theorizes how investors perceive VAF announcements and their impact on firm outcomes. Complementing Shankar (2018) who recognizes the different benefits that artificial intelligence technologies can provide, we empirically verify whether investors recognize these benefits. We find that the effect of a VAF announcement on firm value is positive—a .32% increase on average.

Second, we draw from assemblage theory (Novak & Hoffman, 2019) to theorize how VAFs may impact consumers' experience. Assemblage theory was developed to understand consumers' experience in the Internet of Things; it essentially moves away from a human-centric approach and argues that both consumers' experience and objects' experience should be jointly considered. The resulting assemblage in which consumers and smart speakers interact can both enable or constrain consumers' experience. We propose that certain features of VAFs may enable (i.e., positively impact) or constrain (i.e., negatively impact) consumers' experience, which may lead investors to reward (or penalize) firms to different extents. Our empirical analysis finds that VAFs that include informational capabilities (e.g., news briefings, information

Table 1 Relevant Internet of Things (IoT) literature

Paper	Area of focus	Type of work	Contribution
Shankar (2018)	Artificial Intelligence (AI)	Conceptual	Discusses how AI can be leveraged by retailers to provide benefits on the supply and demand side, and draws attention to future AI developments that may warrant further examination
Davenport et al. (2020)	Artificial Intelligence (AI)	Conceptual	Proposes a multidimensional framework to understand the impact of AI based on intelligence levels, task types, and whether AI is embedded in a robot, with implications for customer behavior and firms' marketing strategies
Guha et al. (2021)	Artificial Intelligence (AI)	Conceptual	Proposes a framework for how retailing firms' managers should think about adopting AI, based on interview data which reveals customer-facing and non-customer-facing AI applications
Kowalczuk (2018)	Smart speakers	Empirical	Analyzes customer review data and assesses which types of perceptual dimensions (e.g., ease of use, usefulness) affect consumer acceptance (use intention) of smart speakers
Mulcahy et al. (2019)	Smart objects	Empirical	Analyzes survey data to assess the intertwined relationships between consumers' technology readiness, engagement, perceived risk and trust, and adoption intention
Foehr and Germelmann (2020)	Smart speakers	Empirical	Conducts qualitative studies to understand how trust is developed as consumers interact with smart speakers
Our paper (2022)	Smart speakers' voice assistant functions (VAFs)	Empirical	Analyzes whether firms have gained financial value from developing and announcing voice assistant functions, and which factors (capability type, firm type) have a moderating impact

search) are more positively received by investors since such capabilities allow users to self-extend parts of their identity and, in turn, self-expand as they absorb and trust the content provided to them. VAFs that include object-control capabilities (e.g., change the channel on a smart TV, preheat a smart oven) are not received any differently by investors than VAFs that do not, in light of the fact that such capabilities limit consumers' ability to use the smart objects they own to their fullest extent. VAFs that include transactional capabilities (e.g., pay a bill, make a purchase) are received less positively by investors as consumers are typically restricted to repurchasing a product that they already bought (rather than being able to purchase new products). Consumers must also have a pre-existing relationship (e.g., existing account) with firms to use other forms of transactional capabilities, thereby limiting the ability of firms to attract new customers. Finally, we find that product firms witness a larger positive effect from announcing a VAF than service firms. This may be because, while VAFs of product firms allow them to add a new dimension to the physical nature of their products, VAFs of service firms provide services similar to what is available through existing channels and therefore do not enhance consumers' experience.

Third, since our research is the first study to specifically analyze VAFs, we propose several important directions for future research. Such research could help scholars and managers further understand the implications of VAF technology, to prepare for a channel that will likely undergo significant changes in the coming years.

In the following sections, we outline the conceptual framework driving our hypotheses, explain the event study methodology and our data collection process, review the results of the event study and moderation analysis, and conclude with a discussion of important managerial implications and directions for future research.

Conceptual framework

The value of voice assistant functions (VAFs)

To understand how a VAF might affect firm value, we review prior literature on channel additions (Cao et al., 2018; Geyskens et al., 2002; Homburg et al., 2014) to identify different factors that might influence investors' perceptions. VAFs allow firms to provide value to existing and new customers (Kim et al., 2015), an essential contributor to firm value (Gupta, 2013). VAFs also provide convenience to consumers as they can interact with a firm from wherever they happen to be in their home. VAFs also make it much easier to multitask, as they allow consumers to research products, book tickets, etc., while engaged in other activities such as cooking. Existing research has found that the quality and number of features incorporated in smart speakers has a positive effect on their adoption (Kowalczuk, 2018), suggesting that firms' VAFs may be able to enhance adoption by introducing new features. Lee and Cho (2020) found that many consumers use smart speakers as they perceive a social relationship with them, a relationship which is aided and fostered by direct vocal feedback from smart speakers in response to consumers' voice commands. Such an interaction provides a sense of socializing or having a conversation. Therefore, through their VAFs, firms can establish meaningful social connections with their customers.

Considering the different benefits of VAFs, we expect many firms to use announcements of VAFs to not only signal to the market that they have a strategic interest in engaging with consumers through a new, innovative medium (Boyd et al., 2019), but are also agile enough to adopt the latest technological innovations (Kalaignanam et al., 2021). As investors collect new information surrounding firms and their activities, they update their expectations through their stock market reactions (i.e., buying or selling stock), which dictates firm value (Raassens et al., 2012). Accordingly, we posit the following:

H1 A VAF announcement by a firm has a positive impact on the firm's value

Our discussion to this point has focused on the direct, main effect of VAF announcements on firm value. Investors typically investigate additional cues from such announcements to form a more accurate estimate of the potential benefits to firms, which can lead certain firms to witness more positive financial effects than others (Bhagwat et al., 2020). Since VAFs are specifically designed by firms to provide new forms of value to consumers who own smart speakers, we refer to assemblage theory to theoretically understand how consumers' experience may be influenced (i.e., enabled or constrained) by VAFs.

Assemblage theory

As consumers (i.e., human actors) interact with smart speakers (i.e., nonhuman actors), an assemblage emerges that is defined by the properties and capacities that arise from the interactions among its component parts (Hoffman & Novak, 2018). Consumers and smart speakers express both agentic roles since they can each affect the assemblage, and communal roles since they can each be affected by the assemblage. These expressive roles, in turn, define the experience of the consumer, which can be positive or negative. Positive experiences result when a consumer enables (or is enabled by) the assemblage. For example, self-extension experiences (Belk, 2013) occur when a consumer extends part of their identity into the assemblage; self-expansion experiences (Aron et al., 1991) occur when a consumer absorbs aspects of the identity

of the assemblage into themselves (Novak & Hoffman, 2019). On the other hand, negative experiences result when a consumer constrains (or is constrained by) the assemblage. For example, self-restriction experiences occur when a consumer limits what the assemblage can do, and self-reduction experiences occur when a consumer is limited by what the assemblage does (Novak & Hoffman, 2019).

By developing VAFs and allowing consumers to download them, firms affect the assemblage by modifying smart speakers and what they are able to do. VAFs add a variety of new types of functional capabilities that consumers can utilize, which subsequently affect consumers' experience and relationship with brands (Keller, 2012). The assemblage that results from the modified smart speakers may implicitly enable or constrain consumers' experience (DeLanda, 2016), which, as discussed earlier, can have positive or negative effects and which, in turn, may be rewarded or penalized by investors. In the following sections, we extend the work of Boyd et al. (2019) to the voice channel context and theorize how different types of VAF capabilities have different implications for consumers' experience. Firms include informational, object-control, and transactional capabilities in their VAFs (see Table 2 for examples) and can even include multiple types of capabilities if desired. Understanding the implications of each type of capability is important, as investors may reward (or penalize) firms in different ways. In addition, we extend the work of Cao et al. (2018) to the current context and theorize how firm type (product versus service firms) may moderate the impact of a VAF announcement on firm value. Our full conceptual model is provided in Fig. 1. Table 3 summarizes our hypotheses and key underlying rationale.

Informational capabilities provide consumers with novel ways to access various types of information. Firms such as CNN and CNBC have developed VAFs with "flash briefings" that automatically procure the day's top news stories and read them aloud to consumers—all following a simple command such as "What's the latest news?" or "How are the markets doing?" Rather than having to wait for a specific time of day (e.g., evening news reports on TV) or search online and read several news articles one by one, consumers can conveniently have the news procured and presented to them on demand,

Table 2 Voice assistant function (VAF) capability types and examples

Capability type	Operationalization	Announcement examples
Informational	VAF enables the user to have information procured and presented with minimal effort required, allows the user to ask questions, ask for personal or account-related information	"…you can ask Alexa about any news story CNN is currently covering, like the U.S. elections or other breaking news…for example, say "the latest on the election" or more generally, just "the latest news" "TripIt users can now ask Google Assistant for their flight summary, information about the weather, aircraft and much more" "After linking their Expedia accounts to the Action…travelers can check Expedia Rewards balances"
Object-control	VAF enables the user to control other Wi-Fi-connected smart objects	"If you have DirectTV and you're fed up of having to use an old-fashioned remote to get to the content you want to watch… it's then a matter of using your voice to play, rewind and record shows, or change the channel" "Users can ask (their HP home printer) to print games like sudoku puzzles or bingo cards, their to-do or shopping lists, coloring pages and even graph paper, blank calendars or notebook paper" "Moen is adding Alexa voice control capability; with the new skill, you can tell Alexa to turn on your shower at a desired temperature or to a customized setting"
Transactional	VAF enables the user to make a payment or make a full purchase of a product or service	"Domino's customers with a Pizza Profile can place an order with the Google Assistant…the customer can order their saved Easy Order or recent order, and can also ask Google to track their order progress" "Customers just say 'Alexa, ask 1–800-FLOWERS.COM to order a dozen roses' and (Alexa) will process the order and arrange for delivery" "…you'll be able to buy items from Walmart with your voice through Google Home and then have your purchase delivered to your home"

Table 3 Hypotheses and underlying rationale

Hypothesis	Rationale
H1: A VAF announcement by a firm has a positive impact on the firm's value	VAFs may produce benefits that firms can derive on the supply side (e.g., greater economies of scale, lower transaction costs) and demand side (e.g., new forms of value enjoyed by existing and new customers).
H2a: Informational capabilities included in the VAF announcement by a firm positively moderate the impact of the announcement on firm value	Informational capabilities allow consumers to self-extend their identities, which permits VAFs to incorporate personalized information that enables consumers' experience. Self-expansion may also occur, as consumers' relationship with smart speakers is strengthened.
H2b: Object-control capabilities included in the VAF announcement by a firm negatively moderate the impact of the announcement on firm value	Object-control capabilities limit consumers' ability to use the smart objects they already own to their fullest extent, as such capabilities carry fewer features than the physical interfaces of smart objects. Self-reduction and weaker engagement may result, thereby constraining consumers' experience.
H2c: Transactional capabilities included in the VAF announcement by a firm negatively moderate the impact of the announcement on firm value	Transactional capabilities lock consumers into a repetitive cycle, as they typically only allow repurchase of a product purchased in the past. Such capabilities also alienate consumers who do not have a pre-existing relationship with the firm. Consumers' experience may be constrained as a result.
H3: Firm type moderates the impact of a VAF announcement on firm value, such that product firms witness a stronger positive impact than service firms	Product firms may have a stronger opportunity to enable consumers' experience than service firms, since they can use VAFs to add a new dimension to the physical nature of their products and offer new forms of value to consumers.

based upon a brief one-time setup where consumers indicate which news briefings should be included and what should be the order of presentation. In addition, many firms have developed VAFs that make it easy for consumers to search for information. For example, Allrecipes's VAF allows consumers to discover new meal recipes with their voice and reads aloud step-by-step instructions; Clairol's VAF works with consumers to identify their personal hair color treatment plan and provides instructions on the application process; the United Parcel Service (UPS) VAF allows consumers to check the status of their incoming shipments; and WebMD's VAF offers health and personal wellness advice in response to questions such as "What should I eat after my workout?" or "How can I treat my runny nose?" Therefore, consumers can efficiently access the information that they need by asking questions aloud and engaging in a realistic conversation with voice assistants. Since informational capabilities allow consumers to self-extend part of their identity (Hoffman & Novak, 2018) by indicating their preferences (e.g., preferred news organizations, favorite cuisines) and sharing personal information (e.g., health concerns, account-related data) with their smart speakers, VAFs that include these capabilities actively incorporate personalized information when responding to consumers and likely have enabling effects on consumers' experience. In addition, as informational capabilities enhance social presence and strengthen the relationship between consumers and their smart speakers, consumers may self-expand as they begin to "treat others' resources, perspectives, and identities as if these were their own" (Aron et al., 1992). We believe that investors may reward firms for including

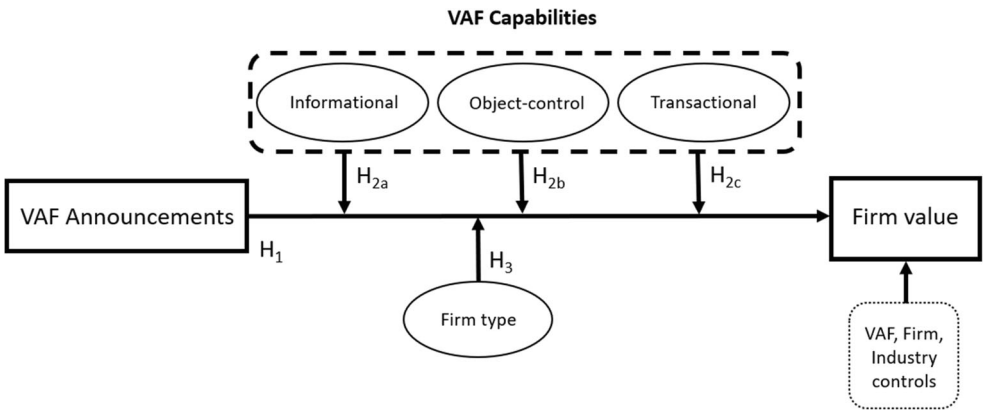

Fig. 1 Conceptual model

informational capabilities in their VAFs, as consumers' experience may be positively affected. Therefore, we posit:

H2a Informational capabilities included in the VAF announcement by a firm positively moderate the impact of the announcement on firm value

Object-control capabilities allow consumers to control other smart objects that are linked wirelessly to smart speakers through Wi-Fi connections. For example, consumers can adjust the temperature of their homes with Honeywell's VAF, which communicates with its smart thermostats; change the channel or volume on their smart DVR with TiVo's VAF; and preheat their smart oven or start, pause, or resume the laundry cycle on their smart washing machine with the Whirlpool VAF. Although object-control capabilities can provide convenience and efficiency benefits, it is important to note that they carry a limited range of features when compared to the physical interfaces of the smart objects they control. For example, Honeywell's VAF does not allow consumers to control the temperatures of different zones within their home (the firm's smart thermostats do), TiVo's VAF does not allow consumers to search for movies and television shows or access recorded content (the firm's smart DVRs do), and Whirlpool's VAF does not allow consumers to use their oven's broil function or change the type of laundry cycle (the firm's smart appliances do). As object-control capabilities limit consumers' ability to use the smart objects they already own to their fullest potential, we believe they may have a constraining effect on consumers' experience. Self-reduction may occur, as consumers "exercise their capacities during interaction with a given assemblage in ways that are 'less than' how those same capacities may be exercised in other contexts" (Hoffman & Novak, 2018). This could lead consumers to become less engaged with the object being controlled (Mick & Fournier, 1998). As a result, investors may not be receptive to object-control capabilities. Formally, we propose the following:

H2b Object-control capabilities included in the VAF announcement by a firm negatively moderate the impact of the announcement on firm value

Transactional capabilities allow consumers to pay a bill, make a purchase, or place an order by voice command. For example, the Avis VAF allows consumers to reserve a rental car, the Starbucks VAF allows consumers to reorder their favorite drink, and the Capital One VAF allows consumers to pay their credit card bill. These capabilities focus on the purchase phase of the consumer journey (Boyd et al., 2019) and may enhance customer spending (Kushwaha & Shankar, 2013), reflecting why firms choose to include them in their VAFs. However, assemblage literature suggests that consumers' experience may be constrained by transactional capabilities, as they lock consumers into a repetitive and stagnant assemblage that limits what is possible going forward (Hoffman & Novak, 2018). Transactional capabilities constrain consumers to repurchasing products they purchased in the past rather than enabling them to discover and purchase new products. Such limitations constrain the variety-seeking tendencies on the part of the consumer. In addition, while transactional capabilities may provide convenience benefits to existing customers, they alienate consumers who do not have a pre-existing relationship with the firm (e.g., an existing account). Therefore, transactional capabilities have a limited ability to attract new customers, as firms that incorporate these capabilities into their VAFs cannot simply target any smart speaker owner. In summary, we believe investors may penalize firms for including transactional capabilities in their VAFs, as they may lead to a self-reduced consumer experience by emphasizing habitual use (Murray & Haubl, 2007) and also inhibiting new customers from enjoying a richer assemblage.

H2c Transactional capabilities included in the VAF announcement by a firm negatively moderate the impact of the announcement on firm value

Firm type (product versus service firms) may also affect investors' perceptions of the value of a VAF. In the context of mobile channel addition, Cao et al. (2018) found that firms that primarily sell products (as opposed to services) are rewarded more positively by investors when announcing the release of a mobile app since these firms can leverage their existing assets (e.g., physical inventory, distribution network) to reach consumers more efficiently. In the current context of voice channel additions, assemblage theory suggests that product firms may have a greater potential to enable consumers' experience than service firms. We believe this to be the case since product firms often use their VAFs to add a new dimension to the physical nature of their products, thereby offering new forms of value that can lead to deeper customer engagement (Grewal et al., 2017). For example, Clairol, which for decades has focused on designing and distributing its various hair-care products, now is able to speak directly to its customers in their own bathrooms, guiding them through their hair-coloring process with a variety of information, which customers previously had to read on small-print instructional packets or search for online. Quaker, whose food products have been well-known American staples for more than 140 years, has capitalized on a growing consumer trend for overnight oatmeal (a preparation method from the 1800s) by developing a VAF that guides customers through the cooking process, allowing the firm to add a new dimension to its relationship with its customers. Service firms such as United Airlines (e.g., ask for flight information and amenities) and American Express (e.g., review recent account charges) have VAFs that often provide services similar to what is available through their online, mobile, and even telephone channels. Therefore, we hypothesize that investors may reward product firms more positively than service firms for their VAFs, as

consumers' experience becomes further enabled in ways that were previously not possible. Thus,

H3 Firm type moderates the impact of a VAF announcement on firm value, such that product firms witness a stronger positive impact than service firms

Methodology

Data collection

To study the effect of a VAF announcement on firm value, we searched the Amazon Alexa and Google Assistant VAF marketplaces to compile an inclusive list of all Skills (Amazon's VAFs) and Actions (Google's VAFs) that are offered by publicly traded firms (as opposed to independent, third-party developers). Next, we searched for the earliest public announcement of each VAF by using ProQuest and Lexis-Nexis, a comprehensive database of business news publications. We also searched for online articles and news releases by firms on their respective websites. In total, we found 112 VAF announcements. To eliminate any confounding effects, we removed announcements that were made in close time proximity to announcements related to firms' earnings releases (Borah & Tellis, 2014; Sorescu et al., 2017). The final dataset consists of 96 VAF announcements; the sample size is similar to that of many other event studies (e.g., Boyd et al., 2010; Gao et al., 2015; Raassens et al., 2012).

Dependent variable

Event study methodology is best suited for our research questions, as it provides an accurate measure of the change in a firm's value due to the announcement of its VAF. Financial theory holds that a firm's current stock price reflects the market's expectations regarding the discounted value of all future cash flows that are expected to be accrued by the firm (Rappaport, 1987). Therefore, the effect of a firm's VAF announcement on its (firm) value is expected to be captured in an immediate manner by the market through the firm's stock price as soon as the information is made publicly available. Formally, this effect is referred to as abnormal return (AR) and is measured as:

$$AR_{it} = \frac{P_{it} - E(P_{it})}{P_{it-1}} = R_{it} - E(R_{it})$$

P_{it} and P_{it-1} are the actual dividend-adjusted prices of the stock of firm i at time t and t-1, respectively, and $E(P_{it})$ is the expected dividend-adjusted price of stock i if the announcement had not been made. R_{it} is the realized rate of return of the stock of firm i at period t, and $E(R_{it})$ is the expected return of stock i at period t that would have been obtained had the event not occurred (Sorescu et al., 2017). To estimate the expected return $E(R_{it})$ of stock i at period t and subsequently abnormal return, we utilize the market-adjusted model (Brown & Warner, 1985). This model calculates $E(R_{it})$ as the average rate of return of all stocks that are traded in the stock market at period t and is recommended to be used for short-term event studies such as ours (Sorescu et al., 2017, pp. 195). Expected returns were estimated over a period of 250 trading days, ending 50 days before the event day.

Abnormal return reflects the change in stock price above or below the expected price on a *specific day*. However, since an event's effect on the firm's stock price may persist beyond the event day, abnormal return is often estimated over a measurement window spanning several days by aggregating the abnormal returns for each day within that window. This aggregated value is referred to as cumulative abnormal return (CAR) and mathematically expressed as follows:

$$CAR_{it} = \sum_{t-a}^{t+b} AR_{it}$$

AR_{it} is the abnormal return of stock i on day t (the event day itself), and a and b are the number of days before and after the event day, respectively, which are chosen as the endpoints of the event window. Abnormal returns may also occur before the event due to leakage of information that investors may have received before the announcement (Fama, 1970). Event windows can be as short as the event day itself (Fornell et al., 2006) or as many as five days (Kalaignanam & Bahadir, 2013). In practice, CAR is estimated across various windows spanning many days before and after a firm's announcement. Following prior event studies, we selected the window with the most significant t-statistic for subsequent analysis (Sorescu et al., 2017). We obtained all financial data from the Center for Research in Securities Prices (CRSP) database.

Independent variables

Details regarding the independent variables were collected from the VAF announcements and Compustat. First, the content of the announcements was manually analyzed by two independent, undergraduate student raters to identify values for the variables relating to VAF capability types. We ensured that these raters had no prior knowledge of the VAF announcements or any personal experience using VAFs. We provided the 96 VAF announcements to the raters and instructed them to read each announcement and assign a value of 1 to the informational capabilities variable, if the VAF announcement mentioned such capabilities, and 0 otherwise. The same process was carried out for the object-control and

transactional capabilities variables. Inter-rater reliability of the two raters was excellent (informational capabilities α >93%, object-control capabilities α >98%, transactional capabilities α >96%) and any strong uncertainties were discussed with the research team. For the fourth independent variable – firm type – we used Compustat to denote whether the firm announcing a VAF primarily sells services (0) or products (1). Cao et al. (2018) used a similar approach. Table 4 summarizes data details.

Control variables

Following prior event studies that included additional factors that may influence stock returns, we included several control variables. At the firm level, firm size is calculated as the natural logarithm of a firm's total assets (Cao et al., 2018; Sorescu et al., 2017). Time period controls for time-related effects, as firms that announced VAFs earlier (as opposed to later) may have been rewarded more positively by investors (Boyd et al., 2019) or less (Geyskens et al., 2002). This variable was developed by arranging the dataset of 96 VAF announcements by announcement date and then splitting the announcements into two equal groups, following the approach taken by Boyd et al. (2019). Time period is measured as 0 for VAFs announced between 2016 (January) and 2017 (December), and 1 for those announced between 2018 (January) and 2020 (January).

At the industry level, competitive intensity represents the inverse Herfindahl-Hirschman index for industry concentration (Homburg et al., 2014), which accounts for the number of competitors within a firm's industry and their respective market shares. Product demand growth is assessed as the percent change in industry sales from the previous year's sales (Geyskens et al., 2002). Industry advertising is evaluated as the average five-year advertising-to-sales ratio within a firm's industry (Boyd et al., 2010). Finally, we include a VAF-level dummy variable, Platform, which controls for potential effects relating to platform popularity, as investors may reward VAFs announced for Google Assistant (0) or Amazon Alexa (1) differentially. Full information regarding variable measurement and sources is provided in Table 4. Correlations and descriptive statistics of all variables are presented in Table 5 About 80% of VAFs incorporate informational capabilities, 24% incorporate object-control capabilities, and 22% incorporate transactional capabilities.

Selection bias correction

As systematic differences may exist between firms that decide to announce a VAF and those that do not, potential selection bias may confound model estimation results. The decision to announce a VAF may be the outcome of unobserved factors that may affect the abnormal return for a firm. Therefore, following prior event studies in marketing (see Sorescu

Table 4 Measurement variables and data sources

Variable	Description	Source
Abnormal stock return (dependent variable)	Difference between actual and expected returns during the event window, as calculated by the market-adjusted model	Center for Research in Security Prices (CRSP)
Moderating variables		
Informational capabilities	Dummy variable identifying if a VAF includes informational capabilities (1) or not (0)	VAF announcement
Object-control capabilities	Dummy variable identifying if a VAF includes object-control capabilities (1) or not (0)	VAF announcement
Transactional capabilities	Dummy variable identifying if a VAF includes transactional capabilities (1) or not (0)	VAF announcement
Firm type	Dummy variable for firms primarily selling services (0) or products (1)	Compustat
Control variables		
Firm size	The natural log of a firm's total assets	Compustat
Time period	Dummy variable identifying whether a VAF was announced between 2016 and 2018 (0) or 2018 and 2020 (1)	VAF announcement
Competitive intensity	Inverse Herfindahl-Hirschman index for industry concentration (industry SIC code)	Compustat
Product demand growth	The percent change in a firm's total industry sales from the previous year's sales (industry SIC code)	Compustat
Industry advertising	The average five-year advertising-to-sales ratio for a firm's industry (industry SIC code)	Compustat
Platform	Dummy variable identifying whether a VAF was announced for Google Assistant (0) or for Amazon Alexa (1)	VAF announcement

Table 5 Correlations and descriptive statistics

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10
1. Informational capabilities	.80	.40	1									
2. Object-control capabilities	.24	.43	−.27**	1								
3. Transactional capabilities	.22	.42	.19	−.23*	1							
4. Firm type	.39	.49	−.39**	.44**	.03	1						
5. Firm size	10.43	1.93	.10	.02	.01	.05	1					
6. Time period	.50	.50	−.07	.02	−.12	−.08	−.02	1				
7. Competitive intensity	6.82	5.77	.16	−.15	.08	−.22*	.27**	−.01	1			
8. Product demand growth	0.03	.12	−.02	−.13	.28**	−.10	−.02	.06	.12	1		
9. Industry advertising	.02	.02	.20*	−.27**	.10	−.14	−.09	.16	−.13	.26**	1	
10. Platform	.73	.45	−.06	−.09	−.07	−.08	.05	−.14	.01	−.08	−.03	1

Note: *p value < .05, **p value < .01

et al., 2017 for examples), we adopt the two-stage Heckman procedure (Heckman, 1979) to control for these potentially confounding effects. In the first stage, we use a probit model to estimate a firm's propensity to announce a VAF based on specific firm characteristics. We began by collecting a matched sample of firms that have not announced a VAF but are similar in size (±25%; Fang et al., 2015; Cao et al., 2018; Ertekin et al., 2018) to those in our sample and are within the same industry (SIC code). To allow for model identification, we used several variables as instruments within the first stage that are excluded from the second stage. First, we included a dummy variable that takes on a value of 1 if a firm has released a mobile app and 0 otherwise. Since developing a mobile app reflects a high level of knowledge and experience in the realm of channel additions, this likely has an impact on whether a firm has enough of an innovative technological background to approach the voice channel. Next, following Bhagwat et al. (2020), we included several firm-specific financial characteristics (return on assets, leverage, book-to-market ratio, sales growth) since performance may affect whether firms are able to justify adoption of the voice channel, as it may pose uncertainty to investors.

After the first-stage model was estimated, its coefficient estimates were used to calculate the inverse Mills ratio, which takes the form of an additional regressor in the second-stage model to control for potential selection bias. The following second-stage model includes this component, in addition to the hypothesized regressors and control variables, to assess their impact on the abnormal stock return that firm i witnesses from announcing VAF j:

$$\begin{aligned} CAR_i = {} & \beta_0 + \beta_1 Informational_{j,i} + \beta_2 Objectcontrol_{j,i} \\ & + \beta_3 Transactional_{j,i} + \beta_4 Firmtype_i \\ & + \beta_{5-10} Controls_i + \beta_{11} Inversemills_i + \varepsilon_i \end{aligned} \quad (1)$$

Results

Table 6 shows the results of the first-stage probit selection model ($\chi^2 = 35.86, p < .01$). Two instrumental variables were found to be significant: mobile app release ($p < .01$) and return on assets ($p < .01$). The model is properly identified and allows us to calculate the inverse Mills ratio, which we include in the second-stage model. To ensure that the exclusion restriction of the Heckman procedure is met, we assessed whether the inverse Mills ratio is significantly correlated with any of the independent variables in the second-stage model (Bhagwat et al., 2020; Certo et al., 2016). All correlations are less than .07 and insignificant (each $p > .49$), therefore allowing us to proceed with the results of the second-stage model.

Main effect of a VAF announcement on firm value

We ran several alternative models, and the results of these analyses are reported in Table 7. Model 1 has VAF-specific variables and control variables, Model 2 has firm type and

Table 6 Heckman first-stage probit selection model results

Variable	Estimate	Chi-Square
Intercept	−1.771	5.246**
Mobile app	1.330	7.672***
Firm size	.028	.279
ROA	7.506	7.348***
Leverage	.414	.283
Book-to-market	−0.059	.083
Sales growth	.139	.055
Model Chi-Square: 35.86***		

Note: *p value < .10, **p value < .05, ***p value < .01

Table 7 Model results

Variable	Model 1 Estimate(SE)	Model 2 Estimate(SE)	Model 3 Estimate(SE)	Model 4 Estimate(SE)
Intercept	.022** (.008)	.023*** (.008)	.001 (.004)	.022*** (.008)
Informational capabilities	.005 (.003)	–	.007* (.004)	.010** (.004)
Object-control capabilities	−.001 (.003)	–	−.004 (.003)	−.004 (.003)
Transactional capabilities	−.009** (.003)	–	−.010*** (.003)	−.012*** (.003)
Firm type	–	.001 (.001)	.003** (.001)	.004** (.001)
Firm size	−.001** (.000)	−.001** (.000)	–	−.002*** (.000)
Time period	−.000 (.003)	.000 (.003)	–	.000 (.002)
Competitive intensity	−.000 (.000)	.000 (.000)	–	.000 (.000)
Product demand growth	.009 (.015)	−.001 (.014)	–	.014 (.014)
Industry advertising	−.040 (.108)	.015 (.106)	–	−.052 (.105)
Platform	−.000 (.001)	.000 (.001)	–	.000 (.001)
Inverse Mills	−.000 (.000)	−.000 (.000)	–	−.000 (.000)
F-statistic	1.48	1.03	2.63	2.06
R-squared (adjusted R-squared)	.148 (.048)	.086 (.002)	.103 (.064)	.212 (.109)
Observations	96	96	96	96

Note: *p value < .10, **p value < .05, ***p value < .01. The numbers in brackets are standard errors

control variables, Model 3 has all the moderating variables but no control variables, and Model 4 is the full model with all variables. No intolerable multicollinearity was found among the variables, as all variance inflation factors were below 2. The full model has the highest adjusted R-square and, therefore, the rest of the discussion is limited to the full model (Model 4). The F-statistic of Model 4 is also statistically significant and rejects the null hypothesis that all regression coefficients are zero.

The main effect of a VAF announcement on firm value (t = 2.2, p < .03) is found to be significant. This supports H1. In line with the most statistically significant event window (Sorescu et al., 2017), the effect begins four days before the event day (−4,0) and the average firm witnesses a .32% increase in firm value from announcing a VAF. The magnitude of this positive effect is similar to that of the effect estimated after the announcement of a mobile app (0.30% in Cao et al., 2018; 0.37% in Boyd et al., 2019), but is lower than that reported after the announcement of an internet channel addition (0.71% in Geyskens et al., 2002). Multiplying the CAR by the average market value of firms in our dataset suggests that $296 million in firm value is created on average when a firm announces a VAF. Next, we review our analysis of moderating factors to evaluate H2a-c and H3 and to identify the factors that affect the gain in firm value from a VAF announcement.

Analysis of moderating variables

To assess the moderating effects of the hypothesized variables on the impact of a VAF announcement on firm value, we estimated Eq. 1. This included the inverse Mills ratio, which was found to be statistically insignificant (p > .38), thereby revealing no selection bias.

In support of H2a, the mention of informational capabilities in a firm's VAF announcement is found to positively moderate the impact of the announcement on firm value (t = 2.41, p < .02), suggesting that investors reward firms that release VAFs that provide easy access to information. H2b is not supported, as the mention of object-control capabilities in a firm's VAF announcement is found to have an insignificant moderating impact (t = −1.2, p > .23). Next, support for H2c is found, as the mention of transactional capabilities in a firm's VAF announcement is found to have a significantly negative moderating impact on firm value (t = −3.16, p < .01), suggesting that investors penalize firms that release VAFs that provide payment or repurchase abilities. Finally, in evaluation of H3, support is found, as firm type is significant (t = 2.61, p < .01), revealing that VAF announcements made by product firms are rewarded more positively than those of service firms.

Robustness checks

We checked the robustness of our results in three ways. First, we employed several alternative asset pricing models that have been used in past finance and marketing event studies (Sorescu et al., 2017): the market model (Brown & Warner, 1985), Fama-French three-factor model (Fama & French, 1993), and Carhart's four-factor model (Carhart, 1997). Thereafter, we repeated our event study and re-estimated Eq. 1 for each of the models. In summary, we were able to substantiate the results of the main study with no notable

differences with regard to our hypotheses. The Carhart four-factor model was found to have the highest adjusted R-square amongst the three alternative models but was still less than the market-adjusted model that was used in the main study. In the second robustness test, we wanted to ensure that outliers did not influence our results; we performed a 90% winsorization of the data, which caps observations below the 5th percentile and above the 95th percentile at a fixed level (Boyd et al., 2019; Wies et al., 2019). We then re-estimated the main model and the three alternative asset-pricing models and found that all hypotheses continue to be supported. Finally, since emerging research has suggested that user enjoyment has a strong impact on smart speaker usage intention (Cha et al., 2021), we included an additional moderating variable in our main study to test whether the mention of hedonic capabilities in a firm's VAF announcement has an impact on investors' reactions. Hedonic capabilities included in VAFs typically focus on user entertainment. For example, the Jeopardy VAF quizzes users on a wide range of subjects, the Huggies VAF provides music and games to children, and the Wild 'N Out VAF allows users to freestyle rap following a short set of lyrics. After re-estimating Eq. 1, we found no significant moderating effect of hedonic capabilities on firm value ($t = .59$, $p > .56$), while all of our original results held. The nonsignificant effect could be because the overall experience of using a VAF, regardless of what it is being used for, is already perceived by investors to be enjoyable to users, and additional hedonic capabilities do not further enable consumers' experience.

Additional study: Number of VAF capabilities

Although we studied the different types of VAF capabilities, it should be noted that Kowalczuk (2018) suggests that the *number* of capabilities a smart speaker has can impact consumers' adoption likelihood—a factor which could ultimately affect investors' belief of the extent to which VAFs enable consumers' experience. As firms have ultimate flexibility in deciding how many capabilities to include in their VAFs, the question that naturally arises is whether investors prefer VAFs that have a focused (i.e., lower) number of capabilities or ones that maximize this number to provide consumers with a more expansive experience. To answer this, we asked our independent raters (α >94%) to reread each of the 96 VAF announcements and code the total number of capabilities that each announcement mentions. This resulted in a quantitative measure termed as Totalnumber (M = 2.69, SD = 1.66), which we then used in re-estimating Eq. 1 from our main study. The results of the model estimation are provided in the first column of Table 8 (Model 5), which reveal that the total number of capabilities mentioned in a VAF announcement has no significant ($t = .16$, $p > .16$) moderating impact on firm value. Next, we ran a second model that includes a quadratic term ($Totalnumber^2$) since it may be possible that investors appreciate a larger number of capabilities until a threshold is reached (i.e., inverted-U), a consideration also made in recent research of digital capabilities (Wielgos et al., 2021). The results of this nonlinear model are provided in the second column of Table 8 (Model 6) and reveal no significant ($t = .86$, $p > .39$) nonlinear relationship. In summary, investors do not seem to be concerned with the overall number of capabilities a VAF includes.

We next tested if investors' reactions to VAFs are contingent upon the number of capabilities belonging to each *specific type* of capability. In other words, perhaps VAF announcements that mention a larger number of informational capabilities are rewarded more positively than those with a smaller number. Or, perhaps the negative moderating impact of transactional capabilities (as found in the main study) is more severe for firms that develop and announce a large number of these capabilities. To address these questions, we again asked our independent raters to reread the VAF announcements, and this time code the total number of capabilities mentioned belonging to each of the three capability types. This produced three quantitative measures: Numberinformational (M = 1.73, SD = 1.26), Numberobjectcontrol (M = .72, SD = 1.48), and Numbertransactional (M = .22, SD = .44). Inter-rater reliability was excellent (α >90%, α >94%, α >97%, respective to each measure). Again, we re-estimated Eq. 1 with the inclusion of these measures, and the results are shown in the third column of Table 8 (Model 7). Numberinformational ($t = 2.81$, $p < .007$) and Numbertransactional ($t = -2.49$, $p < .02$) are each significant, which reveals that the moderating effects of the mention of informational capabilities and transactional capabilities (as found in the main study) each are further moderated by capability quantity. Therefore, investors not only reward firms for simply including informational capabilities in their VAFs, but also for making efforts to include more of these capabilities, thereby expanding consumers' easy access to information and further enabling consumers' experience. With regard to transactional capabilities, investors not only penalize firms for including such capabilities in their VAFs, but also for emphasizing these features further (in greater quantity). To understand whether either of these moderating effects reaches a breaking point, we ran a nonlinear model by including quadratic terms of each of the variables (i.e., $Numberinformational^2$ and $Numbertransactional^2$). The results are illustrated in the final column of Table 8 (Model 8), revealing that the number of informational capabilities ($t = -.25$, $p > .80$) and number of transactional capabilities ($t = .01$, $p > .99$) each have no significant nonlinear moderating effects on firm value. Therefore, dependent on capability type, investors reward (penalize) firms for the number of capabilities they mention in their VAF announcement in a linear fashion.

Table 8 VAF capability quantity models

Variable	Model 5 Estimate(SE)	Model 6 Estimate(SE)	Model 7 Estimate(SE)	Model 8 Estimate(SE)
Intercept	.018** (.007)	.019** (.007)	.019** (.007)	.019** (.007)
Totalnumber	.001 (.000)	−.000 (.002)	–	–
Totalnumber^2	–	.000 (.000)	–	–
Numberinformational	–	–	.003*** (.001)	.004 (.003)
Numberinformational^2	–	–	–	−.000 (.000)
Numberobjectcontrol	–	–	.000 (.000)	.000 (.001)
Numbertransactional	–	–	−.008** (.003)	−.008 (.009)
Numbertransactional^2	–	–	–	.000 (.008)
Firm type	.002** (.001)	.002* (.001)	.004*** (.001)	.004*** (.001)
Firm size	−.002*** (.000)	−.001*** (.000)	−.002*** (.000)	−.002*** (.000)
Time period	.001 (.002)	.000 (.002)	.001 (.002)	.001 (.002)
Competitive intensity	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Product demand growth	−.002 (.013)	−.003 (.013)	.008 (.013)	.008 (.014)
Industry advertising	.041 (.093)	.046 (.094)	.046 (.092)	.041 (.103)
Platform	.001 (.001)	.000 (.001)	.000 (.001)	.000 (.001)
Inverse Mills	−.000 (.000)	−.000 (.000)	−.000 (.000)	−.000 (.000)
F-statistic	1.40	1.33	2.10	1.74
R-squared (adjusted R-squared)	.128 (.037)	.136 (.034)	.216 (.113)	.217 (.092)
Observations	96	96	96	96

Note: *p value < .10, **p value < .05, ***p value < .01. The numbers in brackets are standard errors

Discussion

With the advent of Internet of Things (IoT) technology, billions of devices are now connected to the internet. Such proliferation of IoT devices is changing how individuals think, learn, and perform various activities in their day-to-day lives. Tech giants such as Amazon and Google have introduced extremely user-friendly voice assistants for smart speakers, which consumers can access by simple voice commands. Furthermore, these companies allow independent developers to create their own software that expands the capabilities of voice assistants and allows smart speaker users to enjoy additional benefits. Many firms have invested in developing this software (i.e., voice assistant functions, VAFs) to provide value to current and potential new customers. Just as the addition of the internet (Geyskens et al., 2002) and mobile (Cao et al., 2018) channels enhanced firm value, firms expect to reap financial benefits from their investments in the voice channel (through VAFs), but no research has explored this issue. Rather, extant research has focused on IoT technologies (e.g., smart objects, smart speakers) at a broad level, often from the consumer perspective by focusing on consumer use (Kowalczuk, 2018) and adoption intention (Mulcahy et al., 2019). To address this gap, our research explores the value of VAFs from the investor point of view, as investors consider the potential benefits and costs involved in developing such innovations (Boyd et al., 2019) and directly influence firm value through their stock investment actions (Sorescu et al., 2017). We conduct an event study of VAFs launched by publicly traded firms between 2016 and 2020 to learn whether investors perceive this new channel to be a valuable business endeavor, and which types of factors may lead investors to reward certain firms more positively than others. In the following sections, we discuss the theoretical and managerial implications of our findings, in addition to directions for future research. As our research is the first to specifically study VAFs, we believe it can be a catalyst for research into a domain that is likely to undergo changes in the coming years, with a variety of implications for consumers and firms.

Implications

With our event study, we find that VAF announcements are positively received by investors, leading to an average .32% increase in firm value. From a theoretical perspective, this positive effect is likely due to investors appreciating the fact that the voice channel provides an additional channel to firms to reach and deliver value to existing and new customers (Kim et al., 2015). The benefits to consumers include not only factors such as convenience and multi-tasking, which marketing scholars have studied in the context of internet and mobile channels, but also socialization which is new to the voice channel. We contribute to the marketing literature by studying the IoT, or the "third digital revolution" (Novak & Hoffman,

2019). From a managerial perspective, we recommend that firms that have not yet developed a VAF to seriously consider it. As we found no time-varying effects, our results suggest that investors continue to value VAFs in a market that has been in existence for over five years. Of course, firms should carefully weigh all possible implications of VAFs for their business, as investors are only one type of stakeholder that a firm considers.

With our analysis of moderating variables, we find that the overall positive impact of VAF announcements on firm value is dependent on several factors. From a theoretical perspective, our results support the assemblage theory of Novak and Hoffman (2019). As both consumers and smart speakers affect, and in turn are affected, by the assemblage that emerges from their interactions, positive and negative consumer experiences can result. When firms develop VAFs and allow consumers to download them, they modify smart speakers and their contributions to the assemblage. The new, resulting assemblage may implicitly enable or constrain consumers' experience (DeLanda, 2016), depending on how consumers' expressive or communal role is affected. By extending the work of Boyd et al. (2019) and Cao et al. (2018) to the voice channel, we theorize that different types of VAF capabilities, along with firm type, may have different effects on consumers' experience—investors may therefore reward firms for factors that enable consumers' experience and penalize firms for factors that constrain consumers' experience. First, we find that investors reward firms that mention informational capabilities in their VAF announcement, since these capabilities allow consumers to self-extend (Hoffman & Novak, 2018) parts of their identity by indicating their preferences and providing other forms of personal information to their smart speakers, which can enable consumers' experience as consumers begin to self-expand as well (Aron et al., 1991). Second, although we expected investors to penalize firms that mention object-control capabilities in their VAF announcement, since self-reduction (Hoffman & Novak, 2018) may occur as consumers' ability to use the smart objects they already own may be hampered, we found that no such effect exists. This could be because investors may be satisfied with the quality of the functionalities that object-control capabilities provide and may not worry that the omission of other functionalities could lead to lower consumer engagement. For example, investors may believe that the object-control capabilities included in VAFs match the most popular functions that exist in the firms' smart objects that are being controlled, and therefore neither have enabling nor constraining effects on consumers' experience. Third, we discover that firms that mention transactional capabilities in their VAF announcement are penalized by investors, likely due to the fact that consumers' experience is constrained since they are locked into a repetitive assemblage where they mainly repurchase orders made in the past. In addition, transactional capabilities can alienate consumers who do not have a pre-existing relationship (e.g., account) with the firm, which could impede new customers from enjoying a richer assemblage. Finally, we learn that investors emphasize whether a firm offers products or services when determining the value of a firm's VAF. More specifically, firms that primarily sell products are rewarded more positively for their VAFs than those that primarily sell services. Since product firms are able to add a new dimension to the physical nature of their products by engaging with customers in their homes, investors seem to appreciate the enabling benefits that can result from their VAFs.

While we have referred to assemblage theory to explain our empirical findings, there may be an alternative explanation. The different types of VAF capabilities can be classified in terms of their consequences for consumers. Less consequential VAF capabilities (e.g., information provision) should lead to positive results for firms, but more consequential VAF capabilities (e.g., purchase or payment) should not. Performing less consequential actions via voice has speed benefits for consumers with a limited downside if there are errors (voice control increases the probability of error in message transmission), whereas controlling more consequential actions via voice may increase risks, as there is much downside if there are errors.

From a managerial perspective, our analysis of moderating variables (and additional study) provides evidence that investors do not reward firms for their VAFs in a uniform fashion. The specific capabilities that firms choose to include in their VAFs, in addition to the underlying type of business that defines a firm, are important factors that influence the extent to which investors reward firms. This fact leads to a number of managerial implications. First, as informational capabilities have a positive moderating impact on firm value, we recommend managers to strongly consider including features that provide consumers with easy access to information, whether it is presented automatically or can be accessed through question-and-answer format. Informational capabilities provide users with extremely personalized feedback from their voice assistants, which enhances their experience and is rewarded by investors. Second, as object-control capabilities do not have a significant moderating impact on firm value, this signifies that investors are indifferent to their inclusion within firms' VAFs. Therefore, we recommend managers to not worry about whether including object-control capabilities in their VAFs may hurt consumers' experience through lower engagement with the smart objects they are controlling. Third, as transactional capabilities have a negative moderating impact on firm value, we recommend that managers be cautious regarding the inclusion of such features within VAFs. While these capabilities at surface level may enhance customer spending (Kushwaha & Shankar, 2013), they mainly focus on customers who have a pre-existing relationship with the

firm, and rarely allow existing customers to purchase new (as opposed to previously purchased) products. We recommend that managers be aware of the penalty that investors place on transactional capabilities, and perhaps consider expanding consumers' experience in the future by making infrastructural changes which (1) allow consumers to purchase a wider variety of products and services, and (2) make VAFs more directly accessible to new customers who do not have an existing account. For example, rather than requiring customers to link their existing account to a VAF through external platforms (e.g., website, mobile app) as is currently the case, firms could begin to build capabilities that allow new customers to open an account directly through VAFs. Fourth, based on the findings of our additional study, we recommend that managers be aware that not only does the mere inclusion of informational and transactional capabilities in a VAF have a moderating impact on firm value, but also the number of each type of capability. Firms whose VAFs have a larger number of informational capabilities are rewarded more by investors, while firms whose VAFs have a larger number of transactional capabilities are penalized more. Therefore, managers should begin with our main study's guidance regarding the directional effects of these types of capabilities and be aware that our additional study further validates the suggestions we make. Finally, as we find that firm type has a significant moderating impact on firm value, we advise the managers of product firms to be cognizant of the distinct value that investors place on their VAFs. Since product firms suffer from the fact that their offerings are not consumed immediately at the point of purchase (unlike service firms), their ability to follow up with their customers is weakened. VAFs provide a unique opportunity to such firms, who now have the ability to engage with their customers in their homes and provide them with new forms of value and experiences.

Directions for future research

As our research makes one of the first attempts to analyze VAFs specifically – as opposed to prior work that focused on broader domains, such as smart objects and smart speakers – we believe a plethora of opportunities exist for research that could help scholars and managers understand the implications of this technology. We collected data on a narrow time window, and our findings may not be representative of all firms releasing VAFs subsequently. Therefore, future researchers should collect more data over a longer period of time and try to corroborate our findings as the voice channel grows in popularity and adoption. More research is needed in this space, as digital business transformation is not always easy for firms to accomplish (Wielgos et al., 2021). Additionally, since our research is primarily empirical in nature, we suggest that future scholars conduct experiments or qualitative studies to uncover other phenomena which may be underlying our results. We next outline several topics that warrant further examination in the VAF domain. Table 9 illustrates these directions for future research.

Privacy concerns Consumers, firms, and regulators have become increasingly concerned about privacy and the ways in which online data are handled (Thomaz et al., 2019). In the past couple of years alone, firms such as Microsoft, Estée Lauder, Walgreens, and Marriott have suffered data breaches in which tens of millions of customer records were exposed. As news reports about such data breaches occur with increasing frequency, consumers get more and more sensitive about the effect of new technologies on the privacy of their data. VAFs require consumers to use a radically new technology (the voice channel) to share a wide variety of personal and interactional data, and this may add an additional layer of nervousness about privacy and data security in their minds.

Cross-channel effects VAFs make available another channel for consumers to seek information and make purchases. It will be interesting to explore the effects that VAF usage has on consumers' use of other channels (e.g., internet, mobile, offline). Are the effects cannibalistic or complementary? Are the effects symmetrical? Which channel gains more? Researchers can study the effects on business outcomes, such as purchase frequency and quantity (Shankar, 2018).

Recommendations and advertising Firms use algorithms and tracking methods (e.g., cookies) to make product recommendations that can assist consumer decisions (Gai & Klesse, 2019; Tsekouras et al., 2020). In addition, advertising (paid, owned, or earned) is used to keep customers informed of firms' activities and offerings (Srinivasan et al., 2016). Currently, firms do not have the ability to initiate communications, such as recommendations or advertisements, on voice assistants. Nevertheless, emerging research has begun to study the effects of hypothetical advertisements on voice assistant platforms (Lee & Cho, 2020; Smith, 2020) with the expectation that someday Amazon and Google may change their policies to allow firm-initiated communications. Hence, we recommend that researchers follow this topic closely and try to determine the consequences of recommendations and advertisements through VAFs.

Social capabilities Although mobile apps have a variety of social capabilities that allow peer-to-peer interaction (Boyd et al., 2019), no VAF currently allows a consumer to interact remotely with other consumers, publish or read product reviews, or participate in discussion forums. This could change, as the growth of social media may spill over into the VAF

Table 9 Directions for future research

Topic	Research question	Suggested reading
Privacy concerns	Does consumer confidence in firms' ability to ensure privacy and handling of data affect the success of firms' VAFs?	Kassel (2018), Stevens (2018), Morris (2019)
Cross-channel effects	How does VAF usage affect consumers' use of and purchases through other channels (e.g., online, mobile, offline)?	Xu et al. (2016), Sun et al. (2019), Gu and Kannan (2021)
Recommendations and advertising	Will Amazon and Google allow firms to make firm-initiated communications through VAFs in the future? How will consumers and firms be affected?	Koksal (2018), Lee and Cho (2020), Smith (2020)
Social capabilities	Will social media capabilities (e.g., interact with other users, conduct product reviews) spill over to the VAF domain and subsequently affect firm outcomes?	Ziles (2016), Mourey et al. (2017), Boyd et al. (2019)
Anthropomorphism of VAFs	How can firms anthropomorphize their VAFs to enhance consumers' experience?	Wilson et al. (2017), Blut et al. (2021), Parrish (2021)
First versus third parties	As first parties (i.e., Amazon, Google) develop and prioritize their own VAFs, what implications does this pose for third parties? As Amazon and Google's own operations and strategies shift, will adopting Alexa versus Assistant become an important strategic decision for third parties?	Nicas and Collins (2019), Albergotti (2019), Grant (2021),
Monetization	What are consumers' perceptions of microtransactions within the VAF domain, and how can firms design in-VAF consumables to capture value?	Perez (2018), Kinsella (2019)

domain and allow firms to further modify the assemblage by letting consumers interact with others. Thus, we recommend that researchers be aware of this potential shift, as it could be interesting to study how VAFs affect consumers' use of social media. In addition, future research could study whether the experiential (i.e., hedonic) benefits resulting from social capabilities differ from that of existing hedonic offerings such as games, quizzes, and music.

Anthropomorphism of VAFs In the context of human-robot interactions, recent research has shown that anthropomorphism of robots exerts a strong positive effect on consumers' intention to use a robot (Blut et al., 2021). Extrapolating this to VAFs, greater anthropomorphization of VAFs should lead to greater use of VAFs. One way to increase anthropomorphization is to further personalize the voice assistant. For example, Amazon recently added the ability to change the voice of Alexa to that of Samuel L. Jackson, the Hollywood actor (Parrish, 2021). However, while Mr. Jackson can tell users a joke or story, check the weather, and set an alarm (among other capabilities), he cannot help users make purchases or use Skills (i.e., VAFs). This presents a clear opportunity that firms can capitalize on. For example, firms with famous spokespeople (e.g., GEICO's gecko), characters (e.g., Disney's Mickey Mouse), or other pop culture icons could anthropomorphize their VAFs further by personalizing the voice used to communicate with consumers. Researchers could study this phenomenon and its impact on consumers and firms.

First versus third parties Although Amazon and Google allow third-party firms to develop VAFs for their voice assistants, two inherent challenges exist which firms must face. The first is that Amazon and Google, as first-party developers, are constantly innovating their own VAFs which are often subsequently included as default (i.e., built-in) VAFs and do not require consumers to search for them. This poses concerns to third parties, whose VAFs may become overlooked or even less prioritized by search algorithms (Nicas & Collins, 2019). Second, Amazon and Google themselves may begin to compete strongly with one another, as their operations change over time. Amazon has rapidly expanded its physical retail operations for several years, while Google has just recently entered this domain (Grant, 2021). This could lead to changes across the Alexa and Assistant platforms, as Amazon and Google develop innovative VAFs that complement their respective growth strategies. Third parties may therefore have to become cognizant of which voice assistant platform is more optimal for them.

Monetization Prior literature in the area of mobile apps has recognized that free apps can reduce consumer uncertainty regarding the quality and fit of apps, although their free nature can also damage the adoption speed of paid apps (Arora et al., 2017). While most VAFs are presently free for users to download, VAF developers can earn revenue by allowing consumers to purchase in-VAF consumables. Although Amazon charges a 30% fee from these transactions, it only earned $1.4 million in the first ten months of 2019, well short of its $5.5 million projection (Kinsella, 2019). This could be due to the fact that very few VAFs have been built with in-VAF purchase options. We recommend that researchers explore this issue further to understand consumers' perceptions of microtransactions within the voice channel domain, and subsequently produce strategic insights that could be used by firms to influence the development of in-VAF purchases.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

Albergotti, R. (2019). How Apple uses its App store to copy the best ideas. Retrieved November 11, 2021 from https://www.washingtonpost.com/technology/2019/09/05/how-apple-uses-its-app-store-copy-best-ideas/

Aron, A., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close relationships as including other in the self. *Journal of Personality and Social Psychology, 60*(2), 241–253.

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology, 63*(4), 596–612.

Arora, S., Hofstede, F. T., & Mahajan, V. (2017). The implications of offering free versions for the performance of paid mobile apps. *Journal of Marketing, 81*(6), 62–78.

Avery, J., Steenburgh, T. J., Deighton, J., & Caravella, M. (2012). Adding bricks to clicks: Predicting the patterns of cross-channel elasticities over time. *Journal of Marketing, 76*(3), 96–111.

Belk, R. W. (2013). Extended self in a digital world. *Journal of Consumer Research, 40*(3), 477–500.

Bhagwat, Y., Warren, N. L., Beck, J. T., & Watson IV, G. F. (2020). Corporate sociopolitical activism and firm value. *Journal of Marketing, 84*(5), 1–21.

Blut, M., Wang, C., Wunderlich, N. V., & Brock, C. (2021). Understanding anthropomorphism in service provision: A meta-analysis of physical robots, chatbots, and other AI. *Journal of the Academy of Marketing Science, 49*, 632–658.

Borah, A., & Tellis, G. J. (2014). Make, buy, or ally? Choice of and payoff from announcements of alternate strategies for innovations. *Marketing Science, 33*(1), 114–133.

Boyd, D. E., Chandy, R. K., & Cunha, M. (2010). When do chief marketing officers affect firm value? A customer power explanation. *Journal of Marketing Research, 47*(6), 1162–1176.

Boyd, D. E., Kannan, P. K., & Slotegraaf, R. J. (2019). Branded apps and their impact on firm value: A design perspective. *Journal of Marketing Research, 56*(1), 76–88.

Braiker, B. (2018). Ad lib: What really works in voice – and why Google is smarter than Amazon. Retrieved March 22, 2021 from http://adage.com/article/podcasts/ad-lib-fresh-digital-s-doug-robinson-works-voice/311928/

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics, 14*(1), 3–31.

Cao, L., Liu, X., & Cao, W. (2018). The effects of search-related and purchase-related mobile app additions on retailers' shareholder wealth: The roles of firm size, product category, and customer segment. *Journal of Retailing, 94*(4), 343–351.

Carhart, M. M. (1997). On persistence in mutual fund performance. *Journal of Finance, 52*(1), 57–82.

Certo, S. T., Busenbark, J. R., Woo, H. S., & Semadeni, M. (2016). Sample selection bias and Heckman models in strategic management research. *Strategic Management Journal, 37*(13), 2639–2657.

Cha, H. S., Wi, J. H., Park, C., & Kim, T. (2021). Sustainability calculus in adopting smart speakers – Personalized services and privacy risks. *Sustainability, 13*(2), 602.

Davenport, T., Guha, A., Grewal, D., & Bressgott, T. (2020). How artificial intelligence will change the future of marketing. *Journal of the Academy of Marketing Science, 48*, 24–42.

DeLanda, M. (2016). *Assemblage theory*. Edinburgh University Press.

Deleersnyder, B., Geyskens, I., Gielens, K., & Dekimpe, M. G. (2002). How cannibalistic is the internet channel? A study of the newspaper industry in the United Kingdom and the Netherlands. *International Journal of Research in Marketing, 19*(4), 337–348.

Ertekin, L., Sorescu, A., & Houston, M. B. (2018). Hands off my brand! The financial consequences of protecting brands through trademark infringement lawsuits. *Journal of Marketing, 82*(5), 45–65.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25*(2), 383–417.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*(1), 3–56.

Fang, E., Lee, J., & Yang, Z. (2015). The timing of codevelopment alliances in new product development processes: Returns for upstream and downstream partners. *Journal of Marketing, 79*(1), 64–82.

Foehr, J., & Germelmann, C. C. (2020). Alexa, can I trust you? Exploring consumer paths to trust in smart voice-interaction technologies. *Journal of the Association for Consumer Research, 5*(2), 181–205.

Fornell, C., Mithas, S., Morgeson III, F. V., & Krishnan, M. S. (2006). Customer satisfaction and stock prices: High returns, low risk. *Journal of Marketing, 70*(1), 3–14.

Gai, P. J., & Klesse, A. K. (2019). Making recommendations more effective through framings: Impacts of user- versus item-based framings on recommendation click-throughs. *Journal of Marketing, 83*(6), 61–75.

Gao, H., Xie, J., Wang, Q., & Wilbur, K. C. (2015). Should ad spending increase or decrease before a recall announcement? The marketing-finance interface in product-harm crisis management. *Journal of Marketing, 79*(5), 80–99.

Geyskens, I., Gielens, K., & Dekimpe, M. G. (2002). The market valuation of internet channel additions. *Journal of Marketing, 66*(2), 102–119.

Grant, N. (2021). Google to open first retail store steps away from Apple in NYC. Retrieved November 11, 2021 from https://www.bloomberg.com/news/articles/2021-06-16/google-to-open-first-retail-store-steps-away-from-apple-in-nyc

Grewal, D., Roggeveen, A. L., & Nordfält, J. (2017). The future of retailing. *Journal of Retailing, 93*(1), 1–6.

Gu, X., & Kannan, P. K. (2021). The dark side of mobile app adoption: Examining the impact on customers' multichannel purchase. *Journal of Marketing Research, 58*(2), 246–264.

Guha, A., Grewal, D., Kopalle, P. K., Haenlein, M., Schneider, M. J., Jung, H., Moustafa, R., Hegde, D. R., & Hawkins, G. (2021). How artificial intelligence will affect the future of retailing. *Journal of Retailing, 97*(1), 28–41.

Gupta, S. (2013). For mobile devices, think apps, not ads. *Harvard Business Review, 91*(3), 70–75.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica, 47*(1), 153–161.

Hoffman, D. L., & Novak, T. P. (2018). Consumer and object experience in the internet of things: An assemblage theory approach. *Journal of Consumer Research, 44*, 1178–1204.

Homburg, C., Vollmayr, J., & Hahn, A. (2014). Firm value creation through major channel expansions: Evidence from an event study in the United States, Germany, and China. *Journal of Marketing, 78*(3), 38–61.

Kalaignanam, K., & Bahadir, S. C. (2013). Corporate brand name changes and business restructuring: Is the relationship complementary or substitutive? *Journal of the Academy of Marketing Science, 41*(4), 456–472.

Kalaignanam, K., Tuli, K. R., Kushwaha, T., Lee, L., & Gal, D. (2021). Marketing agility: The concept, antecedents, and a research agenda. *Journal of Marketing, 85*(1), 35–58.

Kassel, M. (2018). Alexa, just how secure are you? Retrieved November 11, 2021 from https://www.wsj.com/articles/alexa-just-how-secure-are-you-1527271565.

Keller, K. L. (2012). Understanding the richness of brand relationships: Research dialogue on brands as intentional agents. *Journal of Consumer Psychology, 22*(2), 186–190.

Kim, S. J., Wang, R. J. H., & Malthouse, E. C. (2015). The effects of adopting and using a brand's mobile application on customers' subsequent purchase behavior. *Journal of Interactive Marketing, 31*, 28–41.

Kinsella, B. (2019). Amazon brings in $1.4 million in 2019 of Alexa skill revenue so far – Well short of the $5.5 million target according to the information. Retrieved July 22, 2021 from https://voicebot.ai/2019/12/16/amazon-brings-in-1-4-million-in-2019-of-alexa-skill-revenue-so-far-well-short-of-the-5-5-million-target-according-to-the-information/

Koksal, I. (2018). How Alexa is changing the future of advertising. Retrieved November 11, 2021 from https://www.forbes.com/sites/ilkerkoksal/2018/12/11/how-alexa-is-changing-the-future-of-advertising/?sh=2ec13bd01d4d

Kowalczuk, P. (2018). Consumer acceptance of smart speakers: A mixed methods approach. *Journal of Research in Interactive Marketing, 12*(4), 418–431.

Kushwaha, T., & Shankar, V. (2013). Are multichannel customers really more valuable? The moderating role of product category characteristics. *Journal of Marketing, 77*(4), 67–85.

Lee, H., & Cho, C. H. (2020). Uses and gratifications of smart speakers: Modelling the effectiveness of smart speaker advertising. *International Journal of Advertising, 39*(7), 1150–1171.

Mick, D. G., & Fournier, S. (1998). Paradoxes of technology: Consumer cognizance, emotions, and coping strategies. *Journal of Consumer Research, 25*(2), 123–143.

Morris, B. (2019). Amazon is accused of violating kids' privacy with smart speakers. Retrieved November 11, 2021 from https://www.wsj.com/articles/amazon-is-accused-of-violating-kids-privacy-with-smart-speakers-11557374460

Mourey, J. A., Olson, J. G., & Yoon, C. (2017). Products as pals: Engaging with anthropomorphic products mitigates the effects of social exclusion. *Journal of Consumer Research, 44*(2), 414–431.

Mulcahy, R., Letheren, K., McAndrew, R., Glavas, C., & Russell-Bennett, R. (2019). Are households ready to engage with smart home technology. *Journal of Marketing Management, 35*(15/16), 1370–1400.

Murray, K. B., & Haubl, G. (2007). Explaining cognitive lock-in: The role of skill-based habits of use in consumer choice. *Journal of Consumer Research, 34*(1), 77–88.

Nicas, J. & Collins, K. (2019). How Apple's apps topped rivals in the App store it controls. Retrieved November 11, 2021 from https://www.nytimes.com/interactive/2019/09/09/technology/apple-app-store-competition.html

Novak, T. P., & Hoffman, D. L. (2019). Relationship journeys in the internet of things: A new framework for understanding interactions between consumers and smart objects. *Journal of the Academy of Marketing Science, 47*(2), 216–237.

Ofek, E., Katona, Z., & Sarvary, M. (2011). "Bricks and clicks": The impact of product returns on the strategies of multichannel retailers. *Marketing Science, 30*(1), 42–60.

Parrish, K. (2021). How to talk to Samuel L. Jackson using Alexa. Retrieved July 22, 2021 from https://www.digitaltrends.com/home/how-to-talk-to-samuel-l-jackson-using-alexa/

Perez, S. (2018). Amazon opens up in-skill purchasing to all Alexa developers. Retrieved November 11, 2021 from https://techcrunch.com/2018/05/03/amazon-opens-up-in-skill-purchases-to-all-alexa-developers/

Priest, D. (2020). Alexa is starting to ask questions. How should we respond? Retrieved March 22, 2021 from https://www.msn.com/en-us/news/technology/buckle-in-alexa-is-asking-the-questions-now/ar-BB178ID6

Raassens, N., Wuyts, S., & Geyskens, I. (2012). The market valuation of outsourcing new product development. *Journal of Marketing Research, 49*(5), 682–695.

Rappaport, A. (1987). Stock market signals to managers. *Harvard Business Review, 65*(6), 57–62.

Ratchford, M., & Ratchford, B. T. (2021). A cross-category analysis of dispositional drivers of technology adoption. *Journal of Business Research, 127*, 300–311.

Shankar, V. (2018). How artificial intelligence (AI) is reshaping retailing. *Journal of Retailing, 94*(4), vi–xi.

Smith, K. T. (2020). Marketing via smart speakers: What should Alexa say? *Journal of Strategic Marketing, 28*(4), 350–365.

Sorescu, A., Warren, N. L., & Ertekin, L. (2017). Event study methodology in the marketing literature: An overview. *Journal of the Academy of Marketing Science, 45*, 186–207.

Srinivasan, S., Rutz, O. J., & Pauwels, K. (2016). Paths to and off purchase: Quantifying the impact of traditional marketing and online consumer activity. *Journal of the Academy of Marketing Science, 44*, 440–453.

Stevens, L. (2018). Amazon Alexa-powered device recorded and shared user's conversation without permission. Retrieved November 11, 2021 from https://www.wsj.com/articles/amazon-alexa-powered-device-recorded-and-shared-users-conversation-without-permission-1527203250

Sun, C., Shi, Z., Liu, X., Ghose, A., Li, X., & Xiong, F. (2019). The effect of voice AI on consumer purchase and search behavior. *NYU Stern School of Business*. https://doi.org/10.2139/ssrn.3480877

Thomaz, F., Salge, C., Karahanna, E., & Hulland, J. (2019). Learning from the dark web: Leveraging conversational agents in the era of hyper-privacy to enhance marketing. *Journal of the Academy of Marketing Science, 48*, 43–63.

Tsekouras, D., Dellaert, B. G. C., Donkers, B., & Haubl, G. (2020). Product set granularity and consumer response to recommendations. *Journal of the Academy of Marketing Science, 48*, 186–202.

Wielgos, D. M., Homburg, C., & Kuehnl, C. (2021). Digital business capability: Its impact on firm and customer performance. *Journal of the Academy of Marketing Science, 49*, 762–789.

Wies, S., Hoffmann, A. O. I., Aspara, J., & Pennings, J. M. E. (2019). Can advertising investments counter the negative impact of shareholder complaints on firm value? *Journal of Marketing, 83*(4), 58–80.

Wilson, H. J., Daugherty, P. R., & Bianzino, N. M. (2017). When AI becomes the new face of your brand. Harvard Business Review, Web. Retrieved November 11, 2021, fromhttps://hbr.org/2017/06/when-ai-becomes-the-new-face-of-your-brand

Xu, K., Chan, J., Ghose, A., & Han, S. P. (2016). Battle of the channels: The impact of tablets on digital commerce. *Management Science, 63*(5), 1469–1492.

Ziles, C. (2016). Why Amazon echo could be the next great social media platform. Retrieved November 11, 2021 from https://socialmediahq.com/amazon-echo-next-great-social-media-platform/