"Hey, voice assistant!" How do users perceive you? An exploratory study[1]

Received
8th July 2020
Revised
13th November 2020
Accepted
1st February 2021

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Abstract

Purpose of the paper: *The increasing consumer adoption of voice-based artificial intelligence technologies is starting to catch the attention of researchers. This study fits into the nascent marketing literature on user perceptions of interactions with voice assistants (VAs) by exploring perceived VA anthropomorphism and benefits. We also seek to identify millennial clusters based on perceptual differences.*

Methodology*: Quantitative exploratory research was conducted based on questionnaires (N=337) administered to millennials. The data were analysed through exploratory factor analysis. Subsequently, to identify clusters, we performed K-means cluster analysis.*

Findings*: The EFA indicated a four-factor solution: "utilitarian and hedonic benefits", "symbolic benefits", "human-like voice" and "human-like presence". The K-means cluster analysis identified three clusters: "useful and pleasant", "human" and "status symbol".*

Research limits*: This paper is not exempt from limitations, especially those related to the exploratory nature of the analysis techniques adopted.*

Practical implications: *Indicating the main perceptual dimensions of VA anthropomorphism and the benefits associated with user-VA interaction, our results provide marketers with important strategic implications for designing the VA interaction experience. The cluster analysis offers companies the possibility of selecting a target and addressing it by creating a specific value proposition.*

Originality of the paper: *This study contributes to the existing partial and fragmented knowledge by offering an overall integrated interpretation of consumer perceptions related to VA interactions. Our findings are the first to jointly reveal user perceptions of the human voice and of the VA as a human interlocutor. Moreover, we contribute to the literature on anthropomorphism by conceptualising the human-like voice construct.*

Key words: voice assistants; anthropomorphism; human-like voice; benefits; EFA; cluster analysis

1. Introduction

Voice assistants (VAs) are artificial intelligence (AI) technologies that simulate the human understanding of language through voice interaction

[1] This paper is the result of the joint effort of the three authors. In the final draft, however, paragraphs 2, 3, 4, 5.1 and 5.3 may be attributed to Michela Patrizi, the introduction may be attributed to Maria Vernuccio, and paragraph 5.2 may be attributed to Alberto Pastore.

(Fivesight Research, 2017). VA usage data are starting to become particularly relevant, with 90 million users in the US alone querying their VAs on smartphones at least once a month and 56 million users using a smart speaker (Voicebot, 2018). Globally, smartphones are confirmed to be the most popular device for interacting with a VA (Juniper Research, 2019), and millennials are the segment most accustomed to VA usage (Voicebot, 2018). Their interactions are characterised both by informative requests (e.g., generic questions, traffic and weather information) and ludic requests (e.g., playing music or games, taking quizzes), and they are more inclined to use VAs for product purchases than other users' generations (Voicebot, 2019a). Currently, the VA market is dominated by large players (technology providers): Google (Google Assistant), Amazon (Alexa), Apple (Siri), and Microsoft (Cortana) (Voicebot, 2018). In addition, name-brand VAs (Vernuccio *et al.*, 2018; 2020a), which are VAs that are developed in-house, speak with a specific brand voice and are activated by the user saying the brand name (e.g., "Hey Mercedes!"), are emerging.

In the academic literature, studies on VAs are starting to emerge in a variety of disciplines, including marketing and computer science. Among these, only a few began to investigate the perceptions of consumers arising from interactions with VAs and their effects on attitudinal and behavioural outcomes (e.g., attitude towards the VA, use intention, engagement and loyalty towards the VA). Regarding consumer perceptions, early studies have focused on VAs' ease of use (Moriuchi, 2019; Wagner *et al.*, 2019; Smith, 2020), perceived privacy risks (PPRs) (Lau *et al.*, 2018; Cho, 2019; McLean and Osei-Frimpong, 2019), opportunities (e.g., convenience) and challenges (e.g., lack of control) (Tuzovic and Paluch, 2018; Monsurrò and Querci, 2019) associated with interacting with VAs. Moreover, some researchers have begun to examine the anthropomorphic perceptions of VAs by referring to the human-like voice (HLV) as opposed to a synthetic/robotic voice (Chérif and Lemoine, 2019). Other scholars analysed VA humanity, which is the overall perception of the VA as a human interlocutor (Chérif and Lemoine, 2019; Cho, 2019; Cho *et al.*, 2019; McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021). In VA humanity studies, perceptions of benefits related to user-VA interactions have also been investigated. In particular, attention has been mainly paid to usefulness (Moriuchi, 2019; Fernandes and Oliveira, 2021), while hedonic and symbolic benefits have only been considered by McLean and Osei-Frimpong (2019).

The literature on these topics in the VA field appears disjointed, since the HLV has been investigated only in the experimental study of Chérif and Lemoine (2019) and has been treated as a stimulus; consequently, no conceptualisation has been found. Moreover, VA humanity has been analysed by adopting different measurement scales (i.e., social presence, human-likeness and perceived humanness) and theoretical perspectives (i.e., uses & gratification theory and service robot acceptance model) in specific interaction contexts (e.g., smart speaker - Alexa; laptop vs. smartphone - Cortana). In addition, utilitarian, hedonic and symbolic benefits have been examined in an integrated manner only in the smart speaker field by McLean and Osei-Frimpong (2019). Finally, regarding the

joint analysis of VA anthropomorphism and benefits, the human-like voice as well as the smartphone interaction context have not been considered.

Therefore, despite the nascent interest in VA anthropomorphism and benefits, the literature appears partial and fragmented, demonstrating the need for an overall integrated interpretation of these heterogeneous perceptions when users dialogue with VAs on smartphones. For this reason, our study intends to jointly explore the main dimensions of VA anthropomorphic perceptions (i.e., human-like voice and VA humanity) and heterogeneous perceived benefits (i.e., utilitarian, hedonic and symbolic) related to user-VA interactions on smartphones. As millennials use VAs in a more advanced way (i.e., utilitarian, ludic and purchasing activities) compared to other generations of consumers, we chose to focus on users between 18 and 34 years old (e.g., Nassivera *et al.*, 2020), who use a VA on their smartphone at least once a month. Moreover, since no study has investigated the presence of perceptual differences between user groups and Millennials segment is composed by consumers with a varied range age, we set a second objective: to identify Millennials clusters based on perceptual differences. In this way, we respond to the calls by Belk and Kniazeva (2018) for more studies on VA anthropomorphism and by McLean and Osei-Frimpong (2019) for further research on perceived benefits in the VA field. Moreover, our findings provide managers with important cues for designing the user-VA interaction experience and planning communication campaigns on VAs.

To achieve our aims, the data collected through a web survey were analysed through exploratory factor analysis (EFA), followed by K-means cluster analysis.

This paper is structured as follows: In the next section (§ 2), we describe the literature on anthropomorphism and perceived benefits in the VA field, ending the section with the purpose of this study. Then, the method is described (§ 3), and the main findings are presented (§ 4). This article ends with the academic (§ 5.1) and managerial implications (§ 5.2) of the results, followed by the limitations and directions for future research (§ 5.3).

2. VA anthropomorphism and benefits perceptions

The term "anthropomorphism" refers to consumers' tendency to attribute human physical characteristics, emotions, intentions and motivations to nonhuman agents and objects (Epley *et al.*, 2007). In the academic marketing literature, anthropomorphism has long been related to physical aspects and product design aspects, such as facial features (Aggarwal and McGill, 2007; Kim and McGill, 2011; Landwehr *et al.*, 2011; Guido and Peluso, 2015; Kwak *et al.*, 2015) and human anatomical features (Guido and Peluso, 2015). With the spread of VAs, research on the anthropomorphic perceptions of VAs has begun with regard to two emerging concepts: human-like voice (Chérif and Lemoine, 2019) and VA humanity (Whang and Im, 2018; Cho, 2019; Cho *et al.*, 2019; McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021).

HLV has mostly been analysed in the human-computer field through experimental studies that place such a voice in opposition to a voice perceived as more synthetic/robotic. These contributions show that compared to a synthetic voice, consumers are more likely to attribute anthropomorphic characteristics to a "computerised agent" when it has a HLV (Nass and Brave, 2005; Takayama and Nass, 2008; Waytz *et al.*, 2014; Schroeder and Epley 2016). To the best of our knowledge, the only study provided by Chérif and Lemoine (2019) confirmed these results in the VA context. They highlight how the perception of VA humanity increases in the minds of users when they interact with a VA endowed with a human-like (vs. synthetic) voice (Table 1). However, since the voice has been treated as a stimulus, no conceptualisations or scales that could represent the main dimensions of HLV have been developed. In addition, the anthropomorphism literature has focused on only physical and design attributes, not considering the role of voice characteristics (Guido and Peluso, 2015; Golossenko *et al.*, 2020). In this regard, some studies in the advertising and political marketing fields have identified some voice characteristics that can stimulate the perception of traits related to the human dimension (i.e., warmth and competence), such as pitch (Morales *et al.*, 2012), accent (Zoghaib, 2017; Zoghaib, 2019) and quality (Wiener and Chartrand, 2014).

The VAs humanity finds its origins in social psychology, as applied to telecommunications, with scholars defining social presence as "the degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions" (Short *et al.*, 1976, p. 65). With the digital revolution, alongside interpersonal interaction mediated by a technological interface ("interactivity through the medium"), interaction between a subject and the medium itself ("interactivity with the medium") has increasingly developed. In this context, the construct of social presence has been used in the human-computer interaction field to indicate the perception of the humanity of different technological communication interfaces, such as websites (Hassanein and Head, 2007; Tung and Deng, 2007; Cioppi *et al.*, 2016), social media (Shen and Khalifa, 2009) and robots (Lee *et al.*, 2006). Concerning individual-VA interaction, VA humanity has been measured with heterogeneous scales: social presence (Chérif and Lemoine, 2019; Cho, 2019; McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021), human-likeness (Cho *et al.*, 2019) and perceived humanness (Fernandes and Oliveira, 2021). Moreover, the results appear fragmented since they have also been obtained by adopting different theoretical perspectives (i.e., uses & gratification theory and service robot acceptance model) in diverse interaction contexts (i.e., laptops, smartphones and smart speakers) (Table 1).

The term "utilitarian benefits" has been used with regard to functional, practical and instrumental benefits. In the experiential context of VAs, the ability to interact hands-free, with little effort and without the need to look at or touch a physical interface (e.g., the smartphone screen) are important utilitarian benefits that no other technology can offer (Hoy, 2018). Hedonic benefits refer to attributes of the user's aesthetic and emotional experience, such as pleasure and fun (Schuitema *et al.*, 2013). Finally, symbolic

benefits refer to users' social identity and image, which may arise from their interaction with technology (Schuitema *et al.*, 2013). Concerning VA interactions, Moriuchi (2019) examined the perceived usefulness of Google Assistants on websites by using the technology acceptance model, while Fernandes and Oliveira (2021) considered VA perceived usefulness by following the service robot acceptance model. Only McLean and Osei-Frimpong (2019) have jointly investigated utilitarian, hedonic and symbolic benefits related to user-VA interactions on smart speakers, highlighting how utilitarian and symbolic benefits motivate individuals to use Alexa, while no significant causal relationship between hedonic benefits and usage has been noted (Table 1).

Finally, concerning the joint study of VA anthropomorphism and benefit perceptions, a few studies have proposed partial contributions (McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021). In particular, in the first study, benefits (i.e., utilitarian, hedonic and symbolic) and social presence were analysed as independent antecedents of in-home VA usage. In the second category, scholars have considered VA humanness, social presence and only usefulness as benefits to analyse their effects on VA acceptance. Therefore, in these contributions, not only the smartphone as a context of interaction but also human-like voice perception has not been studied.

The overview of the main empirical studies on perceived VA anthropomorphism and benefits in Table 1 reassumes the extant results in terms of theoretical perspective, methodology, main findings, context and sample.

In sum, the literature appears partial and fragmented, since on the one hand, no conceptualisation of human-like voice has been proposed, and on the other hand, VA humanity has been measured by using heterogeneous scales and theoretical perspectives in diverse interaction contexts. Moreover, concerning perceived benefits related to interactions with VAs, early studies have mainly focused on utility, and only the contribution of McLean and Osei-Frimpong (2019) has analysed even hedonic and symbolic benefits in the smart speaker context. Therefore, perceptions of utilitarian, hedonic and symbolic benefits have not yet been examined in an integrated manner in the smartphone interaction context. Finally, when perceptions of VA anthropomorphism and benefits were jointly investigated (McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021), the humanity of the voice was not considered, nor was the smartphone interaction context. Therefore, no study has aimed to obtain an overall view of perceptions in terms of VA anthropomorphism and benefits related to user-VA interaction on smartphones. Consequently, we formulate the following research question:

RQ1: What are the main perceptual dimensions of VA anthropomorphism and benefits associated with user-VA interactions on smartphones?

Tab. 1: Overview of the main empirical studies on perceived VA anthropomorphism and benefits

Author(s)	Theoretical perspective	Methodology	Main findings	Context	Sample
Whang and Im, 2018	N/A	Experiment + regression models	- Website (vs. VA) is perceived as more humanlike. - Consumers engaging in task-oriented interactions (vs. socially oriented) with VAs are more likely to accept VAs' recommendations.	Website vs smart speaker (Alexa)	Millennials (N=66)
Chérif and Lemoine, 2019	N/A	Experiment + regression models	- Human-like voice (vs. synthetic) create a stronger VA social presence perception	Website (Prosper)	Internet users (N=640)
Cho, 2019	N/A	Experiment + regression models	- Voice (vs. text) enhances the VA social presence perception and leads to a more favourable VA attitude. - Device difference (smartphone vs. smart speaker) did not exert perceptual impact on users.	Smartphone vs smart speaker (Google Assistant)	Undergraduate students (N=53)
Cho *et al.*, 2019	N/A	Experiment + regression models	- Voice (vs. text) increases perceived VA human likeness. - Laptop (vs. mobile phone) increases perceived VA human likeness. - Voice (vs. text) enhances perceived VA human likeness, but only in the utilitarian (vs. hedonic) task condition.	Laptop vs. smartphone (Cortana)	Undergraduate students (N=82)
McLean and Osei-Frimpong, 2019	Uses & Gratification Theory (U&GT)	Online survey + SEM	- Utilitarian and symbolic benefits motivate individuals to use in-home VAs. - Hedonic benefits do not motivate individual to use in-home VAs. - Social benefits (social presence and social attraction) motivate individuals to use in-home VAs.	Smart speaker (Alexa)	Market research firm's panel (N=724)
Mourichi, 2019	Technology Acceptance Model (TAM)	Online survey + SEM	- In transactional and nontransactional activities perceived ease of use of VA has a positive effect on VA attitude. - In transactional and nontransactional activities perceived usefulness of VA has a positive effect on VA attitude and VA engagement	Website (Google Assistant)	Participants recruited by MTurk (N=368)
Fernandes and Oliveira, 2021	Service Robot Acceptance Model (sRAM)	Cross-sectional survey + PLS-SEM	- Perceived usefulness of VA has a positive effect on VA acceptance. - Perceived humanness of VA does not affect VA acceptance. - Perceived VA social presence affects VA acceptance.	N/A	Millennials (N=238)

Source: our elaboration

Furthermore, in the VA field, no contribution has proposed a segmentation of users based on the perceptual dimensions investigated in this study. In addition, millennials, which is the segment most inclined to use VAs (Voicebot, 2018: e-Marketer, 2019), are made up of users born between 1986 and 2002 (Nassivera *et al.*, 2020). In this context, different ages match different modalities of use, since the younger subgroup has adopted VAs at a faster pace, while older millennials use them more frequently (e-Marketer, 2017). Consequently, diverse usages may correspond with

differences in perceptions. In the face of this variety, it seems appropriate to perform a cluster analysis with the aim of determining the perceptual differences between user groups. Therefore, the following research question is formulated:

RQ2: Which clusters of millennials can be identified based on the differences in perceptual dimensions of VA anthropomorphism and benefits?

3. Methodology

In light of the literature's partiality and fragmented nature and the research questions, we adopted an exploratory approach. In particular, we conducted a web survey focused on millennials, i.e., those aged 18-34 years old (Nassivera *et al.*, 2020), who use VAs four times more often than baby boomers (Tuzovic and Paluch, 2018). Moreover, they are the most prone to advanced use of VA technologies since their interactions are not merely characterised by both utilitarian and playful requests but also aimed at product purchases (Voicebot, 2019b). In addition, we concentrated on interactions through a smartphone (Voicebot, 2018) because, on the one hand, the smartphone is the most used device for dialoguing with VAs, and on the other hand, no study has conjointly analysed perceptions of VA anthropomorphism and benefits in this interaction context. The survey was conducted at an academic research centre in Italy, and the respondents were selected, first, by involving bachelor's- and master's-level university students and, subsequently, through snowball sampling (Robinson, 2014). Moreover, the survey included screening questions to select users who were born between 1986 and 2002 and who are accustomed to interacting with VAs on their smartphone at least once a month. Therefore, the final sample is composed of 337 target respondents (86.4% of the total respondents). As a preliminary step, a pilot study was conducted with 10 respondents to test the survey in terms of linguistic expression and completion time. Based on the results, some minor revisions were made to the questionnaire. The sample is composed of 56.2% women (Table 2) and has an average age of 24 years.

Tab. 2: Profile of the Respondents (N = 337)

Category	(%)
Gender	
Female	56.2
Male	43.8
Education	
High School Graduate	13.6
Bachelor's Degree	70.6
Master's Degree	14.8
Other	0.9

Source: our elaboration

The questionnaire, administered through the SurveyMonkey® online platform, consists of four sections. First, anthropomorphic perceptions of VAs were measured by two constructs, HLV and HLP. HLV was measured by adapting the Human Facial Physiognomy scale (Guido and Peluso, 2015) and using the dimensions of the "humanity" of the voice, i.e., pitch, accent and quality, that emerged from the studies of Morales *et al.* (2012), Zoghaib, (2017; 2019) and Wiener and Chartrand (2014). HLP was measured by adapting the four-item scale of McLean and Osei-Frimpong (2019). In the second section, perceived benefits, i.e., utilitarian, hedonic and symbolic, were measured using the scales developed by McLean and Osei-Frimpong (2019), and attitudes towards the VA (ATT) were measured using Moriuchi's five-item scale (2019). In the third section, focused on descriptive variables, the level of expertise was measured using a seven-point scale (from 1=decisively nonexpert to 7=decisively expert), perceived privacy risk (PPR) was measured through the four-item scale developed by McLean and Osei-Frimpong (2019), and personal innovativeness (PI) was measured through the four-item scale developed by Agarwal and Prasad (1998) (Table 3). Respondents were asked to rate their agreement with items using a Likert scale ranging from (1) totally disagree to (7) totally agree. Finally, in the fourth section, structural data (gender and educational qualifications) were obtained.

4. Findings

To analyse the perceptual dimensions of VA anthropomorphism and the benefits associated with user-VA interaction, we conducted EFA through SPSS 25 software using the main components as a criterion for factor extraction and varimax rotation. The following criteria were used to identify the number of factors to be extracted: 1) eigenvalue>1 (SPSS default); 2) the scree plot; and 3) parallel analysis (Patil *et al.*, 2008). Subsequently, to identify groups of consumers based on perceptual differences, we performed K-means cluster analysis based on the factor scores.

4.1 Exploratory factor analysis results

The EFA results indicated a four-factor solution (24 items, Table 4), with all factor loadings above 0.40 (minimum value 0.603; maximum value 0.876) and no cross-loading above 0.30. These results are satisfactory according to Costello and Osborne (2005). The four factors extracted accounted for 65.31% of the total variance. In addition, the Kaiser-Meyer-Olkin (KMO) index equalled 0.896 (significant at $p < 0.001$) and confirmed the sampling adequacy, and Bartlett's test of sphericity ($\chi 2 = 5145.12$ (276), $p < 0.001$) indicated that the variables used were appropriate for the factor analysis (Hair *et al.*, 1998). Finally, Cronbach's alpha (factor 1: $\alpha = 0.919$; factor 2: $\alpha = 0.913$; factor 3: $\alpha = 0.864$; factor 4: $\alpha = 0.880$) confirmed the internal consistency of the items in each factor (Malhotra *et al.*, 2010). The extracted factors can be classified as 1) utilitarian and hedonic benefits, 2) symbolic benefits, 3) HLV and 4) HLP.

Tab. 3: Measurement Scales

	Item	Source
HLV1	My voice assistant's voice seems to be human	Adapted from Guido and Peluso (2015)
HLV2	My voice assistant's pitch seems to be human	
HLV3	My voice assistant's accent seems to be human	
HLV4	My voice assistant's voice quality seems to be human	
HLP1	When I communicate with my voice assistant, it feels like someone is near me	Adapted from McLean and Osei-Frimpong (2019)
HLP2	The interaction experience with my voice assistant is close to that with a human being	
HLP3	During interactions with my voice assistant, I feel like I am communicating with a human	
HLP4	I interact with my voice assistant in a way similar to how I interact with people	
UB1	Using my voice assistant is a convenient way to manage my time	McLean and Osei-Frimpong (2019)
UB2	Completing tasks with my voice assistant makes my life easier	
UB3	Completing tasks with my voice assistant fits with my schedule	
UB4	Completing tasks with my voice assistant is an efficient use of my time	
HB1	Ifind using my voice assistant to be enjoyable	
HB2	The actual process of using my voice assistant is entertaining	
HB3	I have fun using my voice assistant to complete tasks	
SB1	Using my voice assistant enhances my image among my peers	
SB2	Using my voice assistant makes me seem more valuable among my peers	
SB3	Using my voice assistant is a status symbol for me	
SB4	Using my voice assistant makes me seem more prestigious than those who do not use a voice assistant	
ATT1	I think my voice assistant is useful	Moriuchi (2019)
ATT2	I think my voice assistant is realistic	
ATT3	I think my voice assistant is informative	
ATT4	I think my voice assistant is specific	
ATT5	I think my voice assistant is logical	
PPR1	I have doubts over the confidentiality of my interactions with my voice assistant	McLean and Osei-Frimpong (2019)
PPR2	I am concerned about performing financial transactions via my voice assistant	
PPR3	I am concerned that my personal details stored with my voice assistant could be stolen	
PPR4	I am concerned that my voice assistant collects too much information about me	
PI1	If I heard about a new information technology, I would look for ways to experiment with it	Agarwal and Prasad (1998)
PI2	Among my peers, I am usually the first to try out new information technologies	
PI3	In general, I am hesitant to try out new information technologies	
PI4	I like to experiment with new information technologies	

Notes: HLV=human-like voice; HLP=human-like presence; UB=utilitarian benefits; HE=hedonic benefits; SB=symbolic benefits; ATT=attitude towards the VA; PPR=perceived privacy risk; PI=personal innovativeness.

Source: our elaboration

Tab. 4: Exploratory Factor Analysis (EFA) Results

Factor	Item	Factor Loading			
Factor 1 -Utilitarian and hedonic benefits (α = 0.919)	I think my voice assistant is useful	0.822			
	Completing tasks with my voice assistant makes my life easier	0.777			
	Using my voice assistant is a convenient way to manage my time	0.760			
	Completing tasks with my voice assistant is an efficient use of my time	0.746			
	I think my voice assistant is informative	0.728			
	The actual process of using my voice assistant is entertaining	0.716			
	I find using my voice assistant to be enjoyable	0.713			
	I have fun using my voice assistant to complete tasks	0.657			
	I think my voice assistant is logical	0.656			
	Completing tasks my voice assistant fits with my schedule	0.650			
	I think my voice assistant is realistic	0.608			
	I think my voice assistant is specific	0.603			
Factor 2 -Symbolic benefits (α = 0.913)	Using my voice assistant makes me seem more valuable among my peers		0.876		
	Using my voice assistant makes me seem more prestigious than those who do not use a voice assistant		0.862		
	Using my voice assistant is a status symbol for me		0.848		
	Using my voice assistant enhances my image among my peers		0.829		
Factor 3 - Human-like voice (α = 0.864)	My voice assistant's voice quality seems to be human			0.829	
	My voice assistant's pitch seems to be human			0.818	
	My voice assistant's voice seems to be human			0.798	
	My voice assistant's accent seems to be human			0.789	
Factor 4 -Human-like presence (α = 0.880)	During interactions with my voice assistant, I feel like I am communicating with a human				0.833
	The interaction experience with my voice assistant is close to that with a human being				0.829
	I interact with my voice assistant in a way similar to how I interact with people				0.779
	When I communicate with my voice assistant, it feels like someone is near me				0.652

Notes: Total variance extracted = 65.31%; KMO = 0.896; Bartlett's $\chi 2 = 5145.12$ (276), $p < 0.001$.

Source: our elaboration

4.2 Cluster analysis results

The four factors extracted from the EFA became the starting point for the non-hierarchical K-means cluster analysis (Ward's method) conducted to explore the existence of VA perceptions among similar users. To define the final number of clusters, we considered the following criteria: 1) the statistical properties in terms of the relationship between within-cluster and between-cluster variance (F-test); 2) the interpretability of the data; 3) the number of users per cluster; and 4) the pseudo F-test (62.44) (Caliński and Harabasz, 1974). These criteria yielded a three-cluster solution (Table 5) whose generalisability to the entire population is confirmed by the Rand index (0.778) (Rand, 1971).

Tab. 5: K-means Cluster Analysis Results

	F-statistic	Cluster		
		1. Useful and pleasant	2. Human	3. Status symbol
Factor 1 - Utilitarian and hedonic benefits	101.821*	0.61	0.18	-0.91
Factor 2 - Symbolic benefits	29.424*	-0.49	0.06	0.49
Factor 3 - Human-like voice	114.412*	-0.43	0.86	-0.55
Factor 4 - Human-like presence	30.138*	-0.46	0.48	-0.05
N	337	115	121	101
% of sample	100%	34.26%	35.80%	29.94%

Notes: *p<0.001.

Source: our elaboration

The first cluster, which we designate "useful and pleasant", is composed of 115 respondents and represents 34.26% of the sample (N=337). These users show a high level of sensitivity to utilitarian and hedonistic benefits (positive standardised score 0.61, thus above average and the highest value among the three clusters). They are not interested in symbolic benefits (-0.46, thus lower than average and the lowest value among the three clusters), nor are they interested in HLV (-0.43) or HLP (-0.46, the lowest value among the three clusters) (Table 5).

The second cluster is composed of 121 respondents (35.80% of the sample) and is designated "human" because it is particularly sensitive to HLV (0.86, the highest value among the three clusters) and the HLP of the VA (0.48, the highest value among the three clusters). These users show a reduced perception of utilitarian and hedonic benefits (0.18) and symbolic benefits (0.06).

Finally, the third cluster, designated the "status symbol", consists of 101 respondents (29.94% of the sample). This segment shows a high level of sensitivity to symbolic benefits (0.49, the highest value among the three clusters) but is not interested in utilitarian and hedonic benefits (-0.91, the lowest value among the three clusters). Moreover, it does not perceive HLV (-0.55, the lowest value among the 3 clusters) or HLP (-0.05).

To highlight the differences, the three clusters were compared based on the descriptive variables measured in the third and fourth sections of

the questionnaire. The analysis of the relationships between the qualitative descriptive variables and cluster membership was conducted through the contingency table (or connection analysis) using the chi-square test. Moreover, we ran a series of one-way ANOVAs considering cluster membership as the independent variable and the quantitative descriptive variables as the dependent variables. The results show a significant association between cluster membership and gender ($\chi 2 = 5.924$ (2), $p = 0.052$) and significant differences across the three clusters in terms of age ($F(2, 321) = 6.621$, $p = 0.002$), expertise ($F(2, 321) = 6.949$, $p = 0.001$), PPR ($F(2, 321) = 2.736$, $p = 0.066$) and PI ($F(2, 321) = 5.796$, $p = 0.003$) (Table 6).

Tab. 6: One-way ANOVA Cluster Means and Significance Levels

Key dependent variables	Cluster Mean			F-statistic	P-value
	1. Useful and pleasant	2. Human	3. Status symbol		
Age	23.32	24.24	23.35	6.621	p = 0.002
Expertise	3.89	4.08	3.31	6.949	p = 0.001
Perceived privacy risk	4.59	4.01	4.27	2.736	p = 0.066
Personal innovativeness	4.8	4.91	4.3	5.796	p = 0.003

Source: our elaboration

Regarding gender, the "useful and pleasant" and "status symbol" clusters are characterised by a prevalence of female users, representing 62% and 64% of the cluster, respectively, while the "human" cluster is characterised by a slight majority of male users (51% of the cluster).

With regard to the quantitative descriptive variables (Table 7), the "useful and pleasant" cluster shows above average levels of PPR ($M_{Useful\&Pleasant} = 4.59$ vs. $M_{Human} = 4.01$; $p = 0.004$) compared to the "human" cluster, while there is no significant difference with the average of the "status symbol" cluster ($M_{Useful\&Pleasant} = 4.59$ vs. $M_{StatusSymbol} = 4.27$; $p = 0.449$NS). Moreover, the users belonging to the "human" cluster have the highest average age compared to those belonging to the "useful and pleasant" cluster ($M_{Human} = 24.24$ vs. $M_{Useful\&Pleasant} = 23.32$; $p = 0.004$) and the "status symbol" cluster ($M_{Human} = 24.24$ vs. $M_{StatusSymbol} = 23.35$; $p = 0.009$). Finally, the "status symbol" cluster has the lowest average level of expertise compared to the other two clusters ($M_{StatusSymbol} = 3.31$ vs. $M_{Useful\&Pleasant} = 3.89$; $p = 0.021$ and $MS_{tatusSymbol} = 3.31$ vs. $M_{Human} = 4.08$; $p = 0.001$), as well as the lower average PI value ($M_{StatusSymbol} = 4.3$ vs. $M_{Useful\&Pleasant} = 4.8$; $p = 0.028$ e $M_{StatusSymbol} = 4.3$ vs. $M_{Human} = 4.91$; $p = 0.004$).

In conclusion, Figure 1 summarises the findings of EFA and K-means cluster analysis by showing the integrated interpretation of the main perceptual dimensions of VA anthropomorphism and the benefits associated with user-VA interaction, as well as the millennial clusters based on these perceptual differences.

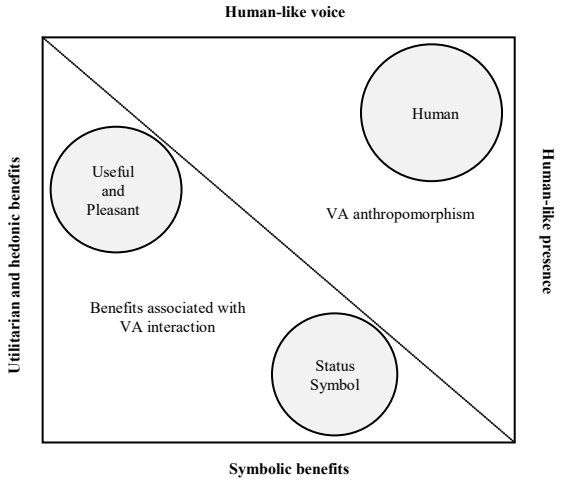
Tab. 7: One-way ANOVA Cluster Means and Significance Levels

Key dependent variables	Cluster		Mean difference	P-value
Age	2	1	0.93	p=0.004
		3	0.89	p=0.009
Expertise	3	1	-0.58	p=0.021
		2	-0.77	p=0.001
Perceived privacy risk	1	2	0.49	p=0.064
		3	0.32	p=0.449*
Personal innovativeness	3	1	-0.50	p=0.028
		2	-0.62	p=0.004

Notes: *p>0.1 NS.

Source: our elaboration

Fig. 1: Integrated interpretation of VA anthropomorphism, benefits and millennial clusters



Source: our elaboration

5. Conclusion

5.1 Discussion and academic implications

This study is part of the nascent marketing literature on VAs, identifying and interpreting in an integrated way the main perceptual dimensions of VA anthropomorphism and the benefits associated with user-VA interaction (RQ1). The EFA reveals a satisfactory structure with four conceptually clear and reliable dimensions: utilitarian and hedonic benefits, symbolic benefits, HLV and HLP. The first dimension is composed of 12 items related to functional benefits (e.g., "*Completing tasks with my voice assistant makes my life easier*"), hedonic benefits (e.g., "*I have fun using my voice assistant to complete tasks*") and VA attitude perception (e.g., "*I think my voice assistant*

is useful"). The symbolic benefits are based on four items concerning users' image and social status (e.g., "*Using my voice assistant makes me seem more valuable among my peers*"). Concerning VA anthropomorphism, HLV is based on the perception of specific voice characteristics, such as pitch, accent and quality. Finally, the HLP factor, which is composed of four items (e.g., "*When I communicate with my voice assistant, it feels like someone is near me*"), is related to the perception of the VA as a human interlocutor.

Moreover, conducting K-means cluster analysis (RQ2), we categorise three user clusters ("useful and pleasant", "human", "status symbol") that are identified based on the factor scores and that are described in terms of PPR, PI, expertise, gender and age. The users belonging to the first cluster, "useful and pleasant", show a high level of sensitivity to utilitarian and hedonistic benefits, and they are particularly concerned about data security. Moreover, this cluster mainly consists of women, and the users in this cluster are younger than those in the other two clusters. In the "human" cluster, users are predominantly men and are older than the users associated with the other two clusters, and they have the highest perceptions of the HLV and HLP of VAs. These consumers are the most experienced in using VAs and are the most inclined to use new technologies. Finally, the "status symbol" cluster is mostly composed of women who are particularly attracted by the symbolic benefits of VA usage. These users are also characterised by the lowest levels of expertise and PI among the three clusters.

In terms of academic implications, the proposed conceptualisation of HLV (i.e., human voice, human voice quality, human pitch and human accent) contributes to both the literature on VA perceptions, in which the human-like voice has been treated only as a stimulus in an experimental research design (Chérif and Lemoine, 2019), and the literature on anthropomorphism, which to date has focused on only physical and design attributes and has not considered the role played by the vocal stimulus (Guido and Peluso, 2015; Golossenko *et al.*, 2020). Moreover, our findings jointly reveal human-like voice and human-like presence perceptions, thus responding to the call by Belk and Kniazeva (2018) for further research on VA anthropomorphic perceptions.

Concerning perceived benefits, our contribution is the first to examine utilitarian, hedonic and symbolic benefits in an integrated manner in the smartphone context. In this way, we address the call by McLean and Osei-Frimpong (2019) for more studies on benefit perceptions in the VA field. In particular, our findings show the holistic perception of utilitarian and hedonic benefits related to user-VA interactions on a smartphone. This unexpected hybrid factor, on the one hand, has indirect evidence in the concept of "utilitarism", which reflects "both hedonic and utilitarian dimensions" (Babin *et al.*, 1994, p. 645), and on the other hand, could find support in VA use for both functional and ludic purposes by Millennials (Voicebot, 2019a).

Therefore, this research fits into the partial and fragmented studies on perceptions regarding interactions with VAs (e.g., Chérif and Lemoine, 2019; McLean and Osei-Frimpong, 2019; Fernandes and Oliveira, 2021) by proposing, for the first time, an overall integrated interpretation of the main dimensions of VA anthropomorphism, which are related to both

human-like voice and human-like presence, and heterogeneous benefits perceptions (i.e., utilitarian and hedonic benefits, symbolic benefits) in the smartphone context.

Finally, this is the first study to highlight millennials' perceptual differences related to interactions with VAs, identifying three user clusters (i.e., "useful and pleasant", "human", "status symbol").

5.2 Managerial implications

The results of this study provide marketers interested in new voice-based AI technologies with important insights for understanding consumers.

Specifically, the EFA results (RQ1) indicate the main dimensions of VA anthropomorphism and benefits. Concerning benefits, marketers should bear in mind that utility and hedonism are perceived as being inseparable from each other, while symbolic benefits remain a separate category. Consequently, they will have to design an interaction experience that is both playful and useful. To date, this tendency is only observed with reference to large technology providers, such as Amazon and Microsoft. In addition, marketers aiming to activate the perception of anthropomorphism in the consumer's mind must create a user-VA dialogue experience based on a human-like voice to favour the human-like presence of voice assistants. Regarding this point, interesting strategic implications emerge since the voice of a technology provider's VA cannot be changed by a brand deciding to enter the provider's ecosystem (Vernuccio *et al.*, 2020b). Therefore, companies interested in pursuing an anthropomorphisation strategy will have to consider developing a VA in-house and designing an ad hoc voice with specific characteristics (pitch, accent, quality). To date, only two international companies have chosen to pursue this strategy and build their voice assistant in-house, i.e., Mercedes and BMW.

Moreover, the cluster analysis results (RQ2) provide marketing experts with information about the demographic and attitudinal characteristics of millennial groups using VAs. Therefore, companies are offered the possibility of selecting a target segment ("useful and pleasant", "human", "status symbol") and addressing it by creating a specific value proposition. To address the "useful and pleasant" cluster, marketers will have to design an interactive experience that is both informative and ludic with both types of requests and, consequently, direct communication towards both benefits. For example, Microsoft's marketing communication on Cortana emphasises the utilitarian (e.g., check schedule, obtain weather information) and hedonic benefits (e.g., finds cinema and place to eat) that users can gain from interaction (e.g., https://www.youtube.com/watch?v=G5fa0voNxw8). Similarly, focused on user-Alexa dialogues through Amazon Echo smart speakers, both utilitarian and hedonic benefits are stressed (e.g., https://www.youtube.com/watch?v=__lAYgAYvgc). Moreover, as this cluster is the one most concerned about personal data breaches, practitioners will need to focus their marketing communication even on data security and safety. If a brand/company decides to address the "human" cluster, it will have to develop an ad hoc voice with specific characteristics (pitch, accent and quality) and endow its own VA with an HLP by working on its ability

to interact (e.g., predicting a response time of the VA that is similar to that of a human interlocutor), i.e., Mercedes with MBUX and BMW with Intelligent Personal Assistant. Concerning large players, Google decided to focus its communication on the Google Assistant's ability to dialogue as a human being. As you can see in the video at the following link (https://www.youtube.com/watch?v=-qCanuYrR0g), Google Assistant, like a human, calls a restaurant to make a reservation and introduces himself "Hi! I'm the Google Assistant" and interacts exposing the day, time and number of people at the table. Finally, if the target is the "status symbol" cluster, a company will need to be able to highlight the symbolic benefits of interaction (e.g., improving the user's image among his or her friends/colleagues) in its communication campaigns related to the VA. In this case, an example is represented by Apple's marketing communication on Siri, which stresses the symbolic benefits arising from interaction by engaging the actor Dwayne Johnson (aka "The Rock"), who is known for his superhero roles (https://www.youtube.com/watch?v=fhLGBY5_0zU). Because this cluster has the lowest levels of expertise and PI among the three clusters, as Apple has done, the interaction experience should be designed to be simple and intuitive.

5.3 Limitations and future research

The limitations of the present work suggest fruitful lines of future research.

First, our study is focused on Italian millennials who interact with VAs through a smartphone. Thus, the research design could be carried out in other countries, users (i.e., Generation Z, Generation Y, Baby Boomers and Silent Generation) and devices (i.e., smart speakers and multimedia systems installed in cars).

Second, clusters are described in terms of gender, age, expertise, perceived privacy risk and personal innovativeness. Thus, other users' data, such as the structure of households, occupation and income, should be detected and used as descriptive variables.

Additional limitations of this work lie in the exploratory nature of the analysis techniques adopted for factor extraction and K-means cluster analysis. Specifically, the number of factors, as well as the number of clusters and their size, are influenced by the choices we made with regard to the extraction criterion and the rotation of factors as well as the clustering technique. To overcome these limitations, future studies collecting data characterised by a normal distribution might use maximum likelihood as a factor extraction criterion and opt for Promax rotation. Concerning the choices made with regard to cluster analysis, other clustering techniques should be adopted in future works (e.g., two-step clustering and hierarchical clustering).

In addition, as our research has exploratory value, future studies could investigate the antecedents of VA anthropomorphism and perceived benefits, as well as the consequences of these constructs for consumer behaviour, by applying specific theoretical perspectives (e.g., TAM).

Fifth, we did not consider the type of task performed by the user.

Since the previous literature (Cho, 2019) has shown that the execution of utilitarian or hedonic tasks influences VA usefulness perception, other studies could also verify effects on VA anthropomorphism perceptions and benefits.

Finally, the humanity of the voice was measured through four items based on adapting the Human Facial Physiognomy scale developed by Guido and Peluso (2015). Therefore, future research should test the validity and reliability of the scale adopted.

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sinergie
italian journal of management

ISSN 0393-5108
DOI 10.7433/s114.2021.10
pp. 173-192