Marikyan, D., Papagiannidis, S., F. Rana, O., & Ranjan, R. (2021). *An Application of Voice-based Digital Assistants in the Work Context.* Paper presented at MSP 2021 Conference, Newcastle, United Kingdom.

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An Application of Voice-based Digital Assistants in the Work Context

Extended Abstract

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1. Introduction

A voice-based digital assistant (VBDA) is an AI-powered technology that can refer to a stand-alone device, such as Alexa, Facebook and Google Home, as well as a voice-controlled application embedded in smart technology (e.g. mobile phones, personal computers, watches, TV), such as Siri and Cortana (Liao et al., 2019, Balakrishnan and Dwivedi, 2021). The uniqueness of digital assistants is human-like features supporting voice conversation with their users, and constantly evolving intelligence, enabling the technology to improve its services based on past interactions with users (McLean and Osei-Frimpong, 2019). The intuitive interface, voice control and intelligent capabilities of the technology have made it widely appealing for the general public, who seek to enjoy an unprecedented level of experience personalisation and the efficiency of tasks, such as grocery ordering, booking, appointment scheduling, digital content retrieval and management (McLean and Osei-Frimpong, 2019).

The application of the technology has recently gone beyond personal use. In light of the impact of the Coronavirus (COVID-19) pandemic, many organisations were forced to shift to the work-from-home pattern to ensure business continuity (Carroll and Conboy, 2020, Papagiannidis et al., 2020). This new reality encouraged utilizing information and communication technologies to support remote working. Given the availability of digital assistants in smart home settings (Marikyan et al., 2019), working from home meant that digital assistants could also be used for work-related tasks, such as arranging calls, meetings, retrieving information and other activities. Such a potential spillover application of voice-controlled digital assistants requires an empirical insight into the determinants and the outcomes of the use of the technology for work purposes.

Therefore, this study pursues two objectives. The first objective is to explore the factors affecting the utilisation of digital assistants for work purposes. The second objective is to

explore the work-related outcomes of the use of digital assistants. Specifically, the paper conceptualises and examines the correlation between use satisfaction, job engagement and productivity. A discussion of the relationships between variables is provided in the section that follows.

2. Theoretical Foundation and Hypothesis Development

Beliefs about technology utilisation include such factors as performance expectancy, effort expectancy and perceived enjoyment. Performance expectancy is defined as *"the degree to which an individual believes that using the system will help him or her to attain gains in job performance"* (Venkatesh et al., 2003). In the context of this study, performance expectancy refers to an individual's belief that the use of voice-based digital assistants improves their job performance. In technology utilisation research, it is well established that performance expectancy facilitates technology adoption (Jadil et al., 2021). Effort expectancy is defined as *"the degree of ease associated with the use of the system"* (Venkatesh et al., 2003). In the context of voice-based digital assistant applications, effort expectancy refers to individuals' belief as to how easy it is for them to operate the technology. There is evidence that the simplicity of an e-health mobile application contributes to the intention to adopt it (Seethamraju et al., 2018). Perceived enjoyment is defined as *"the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated"* (Davis et al., 1992). When it comes to voice-based digital assistants, perceived enjoyment captures individuals' perception of whether their use for work purposes is enjoyable and fun. Perceived enjoyment is an intrinsic motivation driving behaviour (Balog and Pribeanu, 2010). Similarly, in the information systems literature, the relationship between perceived enjoyment and behavioural intention is theoretically justified by the link between intrinsic motivation derived from enjoyable and pleasant use experience

and individuals' behavioural intention to use it again (Davis et al., 1992). Given the evidence in the literature, we hypothesise:

Hypothesis 1: There is a positive relationship between performance expectancy and satisfaction with voice-based digital assistants.

Hypothesis 2: There is a positive relationship between effort expectancy and satisfaction with voice-based digital assistants.

Hypothesis 3: There is a positive relationship between perceived enjoyment and satisfaction with voice-based digital assistants.

Based on the synthesis of the literature on digital assistants, the specific factors related to the use of devices include perceived anthropomorphism, perceived intelligence, social presence and trust towards technology (Moussawi et al., 2020, Fernandes and Oliveira, 2021). Perceived anthropomorphism concerns individuals' perception of how close a device is to a human being (Qiu and Benbasat, 2009). This perception arises when individuals assign human characteristics, behaviour, attributes or emotions to objects or to non-human agents (Qiu and Benbasat, 2009, Pfeuffer et al., 2019). Perceived intelligence refers to a system that is capable of aiding humans in solving complex tasks (Russell and Norvig, 2002). When it comes to voice-controlled assistants, perceived intelligence is defined as *"individuals' perception that the personal intelligent agent's behaviour is efficient and autonomous with the ability to process and produce natural language and deliver effectual output"* (Moussawi and Koufaris, 2019). Evidence from prior research suggests that the stronger the perception of system intelligence, the stronger the belief that the technology can be more effective and useful in delivering required services (Moussawi et al., 2020). Hence, it is assumed that the intelligence of digital assistants can help in delivering work-related tasks, thus positively contributing to satisfaction. Perceived social presence refers to the degree to which an individual feels the presence of the

technology. Due to the analytical advancements of information systems (e.g. robotics), individuals may develop a deeper connection with devices, which can form a positive perception and drive use behaviour (Fernandes and Oliveira, 2021, Qiu and Benbasat, 2009). Finally, trust is a critical factor when exploring technology adoption (Gefen et al., 2003, Patil et al., 2020, Arfi et al., 2021). When it comes to the adoption of AI-driven technology, such as voice assistants, trust plays a crucial role (Fernandes and Oliveira, 2021, Vimalkumar et al., 2021).

Hypothesis 4: There is a positive relationship between perceived anthropomorphism and satisfaction with voice-based digital assistants.

Hypothesis 5: There is a positive relationship between perceived intelligence and satisfaction with voice-based digital assistants.

Hypothesis 6: There is a positive relationship between perceived social presence and satisfaction with voice-based digital assistants.

Hypothesis 7: There is a positive relationship between trust towards voice-based digital assistants and satisfaction with voice-based digital assistants.

This study proposes a relationship between satisfaction with voice-based digital assistants, job engagement and productivity. The rationale for assuming a correlation between the factors is drawn from the research on information system management (Hammedi et al., 2021, Fuller and Dennis, 2009). Information systems adoption research has examined the functionality and the services of technology that facilitate the implementation of tasks, positively contributing to individuals' performance (Goodhue and Thompson, 1995, Fuller and Dennis, 2009). It has been shown that the use of technology that fits job requirements improves individuals' performance (Teo and Men, 2008, Fuller and Dennis, 2009). The functionality of voice-based assistants can

meet the needs of users in managing work-related activities, such as arranging calls, appointments and reminders. Hence, we propose that:

H8: There is a positive relationship between satisfaction with voice-based digital assistants and job engagement.

H9: There is a positive relationship between satisfaction with voice-based digital assistants and individuals' productivity.

3. Methodology and Results

To test the proposed model and the hypothesised paths, we collected data from 536 UK citizens, who confirmed their use of digital assistants, such as Amazon Alexa, Google Assistant or Siri. For the data collection, we employed an independent crowdsourcing company. 10 validated measurement scales were used. The items for performance expectancy and effort expectancy were derived from Venkatesh et al. (2003) and perceived enjoyment from Venkatesh and Bala (2008). To assess trust the items were borrowed from Chandra et al. (2010), while for measuring perceived social presence we used the scale proposed by Hassanein and Head (2007). When it comes to anthropomorphism and perceived intelligence, the items were adapted from Moussawi and Koufaris (2019) and Balakrishnan and Dwivedi (2021). The measurements for satisfaction, productivity and job engagement were borrowed from Bhattacherjee and Premkumar (2004), Tam and Oliveira (2016) and Schaufeli et al. (2006). The respondents were requested to recall their own experience when they used digital assistants for work purposes. All latent constructs were indirectly assessed by asking participants to rate relevant statements on a seven-point Likert scale.

SPSS v.26 and AMOS v.26 statistical packages were used to analyse the data. To produce descriptive statistics about a socio-demographic profile of the sample SPSS v.26 was utilised. To test the validity and reliability of the proposed model and investigate the hypothesised paths,

we conducted a confirmatory factor analysis, which produced satisfactory results: Model fit $\chi 2$ (934) = 2677.176, CMIN/DF = 3.285, CFI 0.922, RMSEA = 0.065. Average variance extracted (AVE>0.5) and construct reliability (C.R. > 0.7) were in line with the requirement (Hair et al., 2014). Table 3 presents the results of the convergent validity test, AVE and C.R. indices.

Table 3: Convergent validity test

	C.R	AVE	1	2	3	4	5	6	7	8	9	10
Job engagement	0.957	0.733	**0.856**									
Performance expectancy	0.939	0.794	0.644	**0.891**								
Effort expectancy	0.890	0.670	0.474	0.653	**0.819**							
Perceived enjoyment	0.943	0.846	0.631	0.727	0.706	**0.920**						
Trust	0.942	0.803	0.477	0.492	0.470	0.518	**0.896**					
Social presence	0.915	0.783	0.493	0.276	0.212	0.438	0.307	**0.885**				
Anthropomorphism	0.856	0.666	0.457	0.324	0.177	0.363	0.326	0.697	**0.816**			
Perceived Intelligence	0.765	0.521	0.454	0.459	0.436	0.578	0.433	0.429	0.426	**0.722**		
Productivity	0.953	0.771	0.694	0.829	0.568	0.679	0.576	0.318	0.337	0.561	**0.878**	
Satisfaction	0.947	0.782	0.757	0.729	0.635	0.786	0.612	0.470	0.424	0.627	0.803	**0.884**

Notes: Diagonal figures represent the square root of the average variance extracted (AVE) and the figures below represent the between-constructs correlations.

The model fit indices were satisfactory too: $\chi 2$ (830) = 2919.723, CMIN/DF = 3.518, CFI = 0.912, RMSEA = 0.069 (Hair et al., 2014). Table 4 demonstrates the results of path analysis. Out of 9 paths, 2 were non-significant (H2 and H6). The results showed that the model explains 77% of the variance in satisfaction with digital assistants, 60% of the variance in job engagement and 68% of the variance in productivity.

Table 4: The results of the tests of hypotheses

H	*Path*	*Coef.*	*t-test, sig*
H1	Performance expectancy → Satisfaction with digital assistants	0.327	(7.860***)
H2	Effort expectancy → Satisfaction with digital assistants	0.046	(1.142[ns])
H3	Perceived enjoyment → Satisfaction with digital assistants	0.276	(5.613***)
H4	Trust → satisfaction with digital assistants	0.184	(5.952***)
H5	Perceived social presence → Satisfaction with digital assistants	0.123	(3.093**)
H6	Anthropomorphism → Satisfaction with digital assistants	0.005	(0.129[ns])
H7	Intelligence → Satisfaction with digital assistants	0.167	(4.332***)
H8	Satisfaction with digital assistants → Job engagement	0.775	(17.830***)
H9	Satisfaction with digital assistants → Productivity	0.827	(19.180***)

4. Discussion

The analysis showed that all the antecedent factors, except effort expectancy and anthropomorphism, correlate with satisfaction with digital assistants. The positive correlation between performance expectancy and satisfaction supports evidence in prior literature which

uses the construct as a pillar in technology acceptance models to explain the underpinnings of use behaviour (Venkatesh et al., 2003). The relationship between effort expectancy and satisfaction with digital assistants was non-significant, in contrast to the findings of prior literature exploring the role of the factor in using innovative technologies (Arfi et al., 2021). Such a result could be because the sample consisted of users of digital assistants who had sufficient experience of interaction with the technology. The confirmed positive relationship between perceived enjoyment and satisfaction means that when individuals have a positive experience during the technology exploitation, such as joy and fun, they become intrinsically motivated to experience it again (Han, 2020). Although prior research empirically confirmed the positive effects of anthropomorphism on purchase intention (Guido and Peluso, 2015, Yen and Chiang, 2020), this study showed that this factor does not determine satisfaction when using the technology in the work context. A plausible explanation is that when voice-controlled devices are used by people to support them in work-related tasks, they are perceived as functional tools rather than human beings. The significant role of perceived social presence and perceived intelligence means that voice-based digital assistants have technical capabilities to provide voice responses and support conversations, which can induce a feeling of their presence. Finally, this study supported the role of trust, which is similar to evidence in prior research (Vimalkumar et al., 2021, Fernandes and Oliveira, 2021). This means that satisfaction with digital assistants increases with the increase of trust in the technology. Significant relationships between satisfaction, job engagement and productivity confirm the assumption that the utilisation of voice-based digital assistants has positive implications for work.

5. Contributions and Future Research Suggestions

The findings of the study offer two contributions to the theory. First, it contributes to the literature on voice-based digital assistants, which is still in its infancy (Bavaresco et al., 2020). This paper brings insights into the new application of voice-controlled devices in the work

context. The findings offer a new perspective, which is different from the current body of knowledge mainly exploring the technology in e-commerce (Balakrishnan and Dwivedi, 2021, Vimalkumar et al., 2021). The study complements the existing research by investigating how the benefits of using digital assistants spill over to the work settings. The second contribution of this study refers to the organisational literature. The findings add to the research on the implications of remote work by examining the role of innovative technology in facilitating positive job outcomes. While prior research mainly examined the use of technologies enabling virtual collaborations between employees (Drumea, 2020, Hafermalz and Riemer, 2021), this study demonstrates the work-related benefits of digital assistants, which was primarily considered as consumer technology. The exploration of the factors of satisfaction with voice-controlled devices provides knowledge of technology-enabled working conditions and features (e.g. social presence, intelligence) favouring productivity during work from home.

The paper has a number of limitations that future research can take into consideration. The first limitation refers to the inability to infer whether the results of the model testing will be different if comparing two samples of respondents from economically developed vs economically developing countries. Future studies could conduct comparative research to test whether the determinants and the outcomes of satisfaction with digital assistants are consistent across countries. Another avenue for future research is to understand the dependence of job-related outcomes on the types of task for which digital assistants were used. In the frame of such research, comparative sub-studies need to be carried out, each focusing on individuals mainly using devices for specific work-related tasks.

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