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Who are the (Non-)Adopters of Smart Speakers? A Cross-Sectional Survey Study of Dutch Families

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Samenvatting
Hoewel de literatuur over de adoptie en het gebruik van slimme speakers groeit, wordt de vraag wie de gezinnen met en zonder een apparaat zijn vaak verwaarloosd. Uit dit cross-sectioneel onderzoek onder Nederlandse ouders (N = 187) blijkt dat gezinnen met (34%) en zonder (66%) slimme speakers vooral in hun vertrouwen in technologie, internetgeletterdheid en voorkeursstijl van mediabemiddeling verschillen.

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Abstract

Smart speakers are becoming increasingly prevalent in the life of families with young children. While the body of literature on the adoption and use of smart speakers is growing, the question about *who* those families are that decide to adopt a device and how they differ from those who do not is often neglected. To fill this gap, we conducted a cross-sectional survey study and analysed $N = 187$ self-reports of Dutch parents. Families with (34%) and without (66%) a smart speaker differ along their trust in technology, internet literacy, and preferred media-mediation style. Findings show a clear tendency for second-digital-divide characteristics. Interestingly, children are not yet widely granted independent access at home. This study offers guidelines for industry in terms of families' adoption of future technologies, as well as inspiring future research on meaningful smart speaker interventions for families to ensure the technology remains at the service for them. (150 words)

Keywords: Families – second digital divide – smart speakers – survey research – technology adoption

Introduction

Smart speakers, such as Google Home and Alexa Echo, are becoming increasingly prevalent in everyday life, for instance to search the news, play music, or operate other smart household appliances (Goldenthal et al., 2021; Hoy, 2018). More specifically, market research shows that, especially for family households, the adoption rate is increasing and that children are becoming a key driver for parents to purchase a device for the family home (Tapper, 2020). This suggests that today's trending voice technology may have found a particular 'sweet spot' in families. Yet, empirical work on establishing *who* those families are that decide (not) to adopt a smart speaker remains limited and empirically problematic.

Firstly, previous research on families' adoption of new technologies, and smart speakers specifically, has focused on studying households that already have their own device, which primarily highlights perceptions of (early) adopters (Beneteau, Guan, et al., 2020; Bentley et al., 2018). Consequently, knowledge about the characteristics of families that have not (yet) purchased their own device remains scarce. Secondly, existing work on smart speaker adoption mainly looks at socio-demographic patterns to understand users

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(Beneteau, Boone, et al., 2020; Kowalczuk, 2018). In doing so, malleable factors such as technological attitude, skills, and knowledge, thought to play another important role in technology adoption (Bronfenbrenner & Morris, 1998; Valkenburg & Peter, 2013; van Deursen et al., 2021), are still often undervalued in research (see also Wald et al., 2023). This is problematic, since these factors offer an important opportunity for changing how people adopt new technology, making them particularly meaningful for further theorizing and intervention (e.g., Technology Acceptance Models by Davis, 1989; long-term technology use acceptance by de Graaf et al. 2018). Thirdly, the majority of conclusions about the increasing prevalence of smart speakers refers to the Anglo-American context (e.g., UK) (Beirl & Rogers, 2019; Foster, 2020). Little is known about the adoption level of families in markets where services and products are typically launched with a delay and are limited in language availability (i.e., Google Home) (Kinsella, 2019), such as the Netherlands – a Western European non-native English speaking country.

To overcome these research gaps, the present study explores whether and, if so, how 'Adopter-Families' (AFs) differ from 'Non-Adopter-Families' (NAFs) in a descriptive manner. To do so, we investigate a Dutch sample ($N = 187$) of parents with young children between the ages of three to eight years. Working with dispositional and contextual characteristics of these families, we investigate significant differences between AFs and NAFs (identified through device ownership) by describing profiles of these groups. Hereby, we utilize a combination of rather static demographics (e.g., age, gender, socio-economic status) as well as more malleable characteristics of families referring to their behaviour, attitude, and skills as this offers more meaningful pathways for behavioural change attempts moving forward. Moreover, we inspect the adoption rate of smart speakers within the Dutch context, and, specifically among AFs, we identify the dominant form of smart speaker usage at home (i.e., parent-usage, child-usage, co-usage). In doing so, this work paves the path for future research and practice related to smart speakers in families. More specifically, this study aims to highlight specific characteristics of families that help researchers and practitioners understand in which households the technology finds most acceptance and potential resistance. From that, we can learn what individual factors might be particularly crucial for smart speaker adoption. Such information can concretely inform intervention work and help shape the future development of smart speakers, particularly smart speakers developed with an eye towards family needs.

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Individual Differences in Families' Smart Speaker Adoption

Functioning via voice-control, a smart speaker device listens to and executes verbal commands, while allowing user interactions of multiple individuals independently (e.g., parent *or* child usage) as well as collectively (e.g., co-usage of parent *and* child) (Beirl & Rogers, 2019; Lee et al., 2020). This voice-control feature is what makes a smart speaker so suitable for families. But while families can be broadly defined, families with children between three to eight years form a particularly important context for investigation: On the one hand, it is not until about age three that a child can use a voice-controlled device on its own, as device use depends on verbal acuity, particularly the ability to speak in full sentences (Lovato & Piper, 2019). On the other hand, robustness of parental media-mediation begins to decline around the age of eight, as the desire of the child for (media) autonomy grows (Beyens et al., 2019). Inasmuch, observing smart speakers becoming part of today's family life calls for special attention during early childhood, as it is in that time-period when parents find themselves in the role of the main tech-gatekeeper for their child, deciding whether to make a smart speaker an addition to family life, and once adopted, how to involve the child in its usage.

To better make sense of smart speaker adoption for specific user groups, previous studies so far mainly considered socio-demographic patterns in their analyses (age, gender, socio-economic background). For instance, Kowalczuk (2018) proposed a conceptual model of smart speaker adoption among adults, considering age, gender, household size, and income to further describe the studied sample. Yet, when discussing the findings – that mainly showed enjoyment with the device to have the strongest influence on adoption intentions (similar to Wald et al., 2023) – the scholar lists as a limitation of the study that no statistical examination of individual differences of users' adoption intentions was conducted. Similarly, in a deployment study by Beneteau, Boone, or Guan, et al. (2020), families' usage of an Amazon Echo Dot device was analysed throughout the course of a month, yet with no further analytical attempts to uncover differences beyond age between the main users (i.e., adults). Consequently, we still do not know much about whether and, if so, how (Non-)Adopters of smart speakers differ from each other.

Literature on ecological models (Bronfenbrenner & Morris, 1998), media effect theories (Valkenburg & Peter, 2013), and the second digital divide

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(van Deursen et al., 2021; van Deursen & van Dijk, 2019) suggest that more malleable characteristics (e.g., attitude, skills, and knowledge) can provide a more comprehensive description of media users and are in fact needed for a robust understanding of technology adoption. Previous research building upon Appropriation Theory (van Deursen & van Dijk, 2019) here more concretely explains that certain characteristics of people can be indicative of certain technological disparities, including groups with different access to internet and technology. But such inequalities also stretch further to disparities in affordability, as well as perceived quality and self-efficacy to engage with technology (e.g., skills) (van Deursen et al., 2021). As such, going beyond rather static demographic characteristics and including these malleable characteristics in the present study is a step towards further improving our theorizing of technology acceptance as to *why* some people decide to adopt a smart speaker device while others do not. At the same time, they also open fruitful space for interventions aimed at safeguarding the process of technology adoption. That is narrowing down digital inequalities and ensuring that technology remains to be of service to its users.

Hence, in what follows, we present a selection of individual characteristics orientated along Bronfenbrenner and Morris (1998)'s ecological system theory, that encompasses a more holistic picture including factors from the child, parent, and family perspective. We start with characteristics of the child, continue with the ones of the parent, and conclude with the broader context of the family. Where justified, based on existing research, we present hypotheses. When existing evidence was found to be mixed or lacking, we pose open research questions (see also Table 1 in the supplemental materials on OSF).

Child Characteristics

There is an extensive history of *children's gender* influencing digital media access, especially during early childhood (Valkenburg & Piotrowski, 2017). For example, research has shown that young boys tend to prefer more game-oriented technology, while girls opt for technology that facilitates information search (Lorenz & Kapella, 2020). Yet, smart speakers are dynamic in that their use can be personalized – they can be easily game-oriented or instead pivot for a more information-based approach (Hoy, 2018) –, which makes the device potentially appealing for both genders. At the same time, smart speakers are not a kids-only device. In fact, parents are the ones who purchase these devices and can surely use them with(out)

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their children. Therefore, it may be that the children's gender is not even a crucial consideration for parents to adopt a smart speaker at home. Given those various possible predictions circling around questionable technology gender divides, we ask:

RQa: Do AFs and NAFs significantly differ in terms of their children's gender?

Second, *children's age* is also often acknowledged in literature on media technology use. As children's developmental skills (i.e., cognitive, and socio-emotional functioning) advance, research on age and media access makes clear that children prefer media that offer experiences which are moderately discrepant from what they know (Valkenburg & Piotrowski, 2017). And this changes with age. At this point, though, it is unclear how this discrepancy relates to smart speakers, which can simplify or complexify content per user demand. Additionally, the same argument for a potentially parent-only device – just like we raise for the child's gender – can be made. Given this mixed evidence on developmental differences in literature, we pose the following research question:

RQb: Do AFs and NAFs significantly differ in terms of their children's age?

Third, arising from parental mediation literature and Uses and Gratifications theory (Katz et al., 1973; Sundar & Limperos, 2013), parents select and utilize media to satisfy specific needs not only of themselves but also of their children (Broekman et al., 2016). It is, thus, likely that parents are differently attuned towards adopting a smart speaker in the family depending on specific behavioural characteristics of their children. As children differ in their sensitivity to external stimuli, which can interfere with their ability to manage their own (media) behaviour, we include *children's temperament* (Putnam et al., 2002) in this study as an important indicator of their behaviour. Existing work has established three main temperamental traits for children that conceptually resemble key dimensions of adults' Big Five: (1) extraverted, (2) negative affective, and (3) effortful controlled temperament traits (Sleddens et al., 2012). Given the lack of existing knowledge about how those three temperament traits might interfere with children's use of smart speakers, we ask:

RQc: Do AFs and NAFs significantly differ in terms of their children's temperament?

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Parent Characteristics

Socio-economic conditions, like the level of income and education, are known to influence the spread of new technologies (Goldenthal et al., 2021) and have long been considered meaningful digital divide variables. The digital divide, at its core, follows the premise that '[i]nternet access provides benefits and that not having access to the internet has negative consequences' (van Deursen & van Dijk, 2019, p. 355), ultimately opening a gap between people with and without access to modern technology. Research on Internet-of-Things use supports this assertion: namely, greater technology use is associated with mostly wealthy and higher educated households, while users of lower income and lower education express more worries and weaker use intentions (Lorenz & Kapella, 2020). Given that smart speakers are an emerging technology, we assume a similar gap between AFs and NAFs. We therefore expect the following:

H1: AF-parents report higher levels of income than NAF-parents.

H2: AF-parents report higher levels of education than NAF-parents.

This understanding about the digital divide is further extended by the proposition of a *second* level, which is characterized by malleable aspects that relate more to attitude, skills, and knowledge as opposed to variables facilitating access to technology (van Dijk, 2005). Technology optimism is an example of such malleable characteristics and has been successfully integrated by previous research in modified versions of Technology Acceptance Models (TAM) (Davis, 1989) when it comes to people's behavioural intentions to use smart speakers (Kowalczuk, 2018). Likewise, literature on human interaction with Artificial Intelligence systems argues that the closely related factor of *trust* can help to build more robust grounds for people's actual engagement with technology (Sundar, 2020). And indeed, existing work in this space shows that increased trust in technology is also associated with increased use of technology (van Deursen et al., 2021). Against this backdrop of literature, we consider *trust in technology* as an additional malleable characteristic of the parent and define it here as a dispositional belief towards a technology to perform as expected in a given situation with potential negative consequences following if not performing as expected (McKnight et al., 2011). We hypothesize:

H3: AF-parents report greater trust in technology than NAF-parents.

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Another related factor is the one of *privacy concerns*. Privacy concerns refer to people's beliefs that personal data that was shared is not kept safe and can suffer from undesirable consequences (Baruh et al., 2017). Such concerns have been found to be negatively associated with behavioural intentions to use online services (Baruh et al., 2017). And in terms of smart speakers, results are similar: privacy concerns seem to be a major motive for people's deliberate choice *not* to adopt a smart speaker in their home (Lau et al., 2018). Moreover, we know from existing research that parents' concerns about the effects media can have on children influences the types of media parents grant their children access to (Cingel & Krcmar, 2013). Taken together, we expect:

H4: AF-parents report lower levels of privacy concerns than NAF-parents.

A final variable that is further substantiated by the Theory of Planned Behaviour (Ajzen, 1991) – the antecedent theory of TAM with greater focus on behavioural intentions – and the second-digital-divide is *internet literacy*. Internet literacy is here defined as the skills and knowledge necessary to navigate through the internet and to comprehend online content in an appropriate and effective way (van Deursen et al., 2016). By reflecting aspects of behavioural control beliefs, previous research highlights that the lack of literacy can hinder technology acceptance and use (van Deursen & van Dijk, 2019). We therefore expect:

H5: AF-parents report higher internet literacy levels than NAF-parents.

Family Characteristics

Due to the important role of parent-child media-conversations during early childhood, we take into account how parents choose to monitor their child's media behaviour (Beyens & Beullens, 2017). Scientific literature understands this monitoring practice as *parental media-mediation* and distinguishes mostly between three different styles: restrictive, positive active, and negative active mediation. Restrictive mediation practices hereby refer to limitations of children's media access and use by parents (e.g., maximum amount of time). Positive or Negative Active mediation, in contrast, refers to practices where parents engage more in their children's media use, either in form of explanatory and stimulating (positive) efforts or in form of discouraging and warning (negative) ways (Beyens & Valkenburg, 2019).

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While parental interventions on children's media behaviour have been linked to different forms of technology use (e.g., use of positive active or restrictive mediation to face problematic mobile media use of adolescents) (Meeus et al., 2019), they are also found to impact parent-child relationships (e.g., Beyens & Valkenburg, 2019). Consequently, mediation practices form an essential linking element between technology use and family dynamics. Yet, since we lack clear empirical evidence for potential associations between media-mediation practices and smart speaker adoption, we openly ask:

RQd: Do AFs and NAFs significantly differ in terms of their parental media-mediation style (*restrictive, positive active, negative active*)*?*

Lastly, looking at the *space of* a family, we account for observable characteristics of the *household*, such as the size and composition of the family as well as the number of young children present. While one major functionality of smart speakers – especially for larger families – could be to help with coordination and organization tasks (Garg & Sengupta, 2020), existing work also reports that smaller households benefit from the social presence of the device that can, to a certain extent, replace missing human interaction (McLean & Osei-Frimpong, 2019). Given these mixed findings, we explore the role of household characteristics by asking:

RQ: Do AFs and NAFs significantly differ in terms of
e: household size?
f: household composition?
g: number of young children in the household?

Methods

Design

Data for this study stem from a large joint cross-sectional online survey about recent developments in the digital society, carried out by a group of researchers at the University of Amsterdam (osf.io/yu64r/). Participants for the entire research project were recruited through online channels between 19 November and 7 December 2020, through a large survey company (i.e., Ipsos) with approximately 130,000 active panel members. Those members were rewarded with points that could later be exchanged for money after completing the survey. Quota sampling (on age, region, and gender, interlocked with education) was used to arrive at a sample that

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approximates the adult Dutch population (18+). The study was approved by the university's ethics committee (2020-CC-12727), and respective data management guidelines were followed.

Procedure

After participants provided informed consent, they were asked to report on basic socio-demographic information before answering questions about their technology use, perceptions of smart speakers, technology-related beliefs, concerns, and competences. The survey continued with questions related to the joint research projects and ended with the assessment of child-specific characteristics and media-mediation style preferences. We asked each parent to think of their child between three and eight years in the family. If there were multiple children in the targeted age range present in the household, we asked each parent to think of the child with the next approaching birthday. In total, participation took about 30 minutes.

Participants

After excluding participants who did not give consent (N = 213), who failed both attention checks (N = 475, i.e., two questions requiring participants to select a specific answer), or who were identified as speeders (N = 31; detailed information about the recruitment and data-cleaning process can be found on the OSF-page of the joint research project), the total sample consisted of 1,994 valid responses. Of these, N = 187 matched our family criteria (i.e., parents with at least one child between three and eight years in the household) and formed the sample for this study. The distribution of mothers (N = 89) and fathers (N = 97) was relatively balanced. Parents were on average 38.85 (SD = 7.29) years old, with mothers being on average younger (M = 36.62, SD = 7.08) than fathers (M = 40.92, SD = 6.93). More than half of all parents (52%) completed higher education, i.e., the Dutch HBO or WO bachelor, or higher. The income of parents was relatively evenly distributed with the largest category being a yearly gross income between 39,500 and 66,000 EUR (28%). About half of the sample's family households (48%) were composed of four people, 27% held three members, 16% held 5 members, 5% indicated to be a single-parent household. Bigger households with six or more people were relatively rare (4%). The majority (70%) of parents reported to have one young child between the ages of three to eight years living in the household (26% for two, 3% for three, and less than 1% for four or more young children). An overview of demographic criteria of the final sample is provided again in Table 2 in the supplemental materials on OSF.

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Materials and Measures

An overview of the materials used for this study as well as the respective analysis code can be found on OSF (https://osf.io/7um4n/; see Measurements_DigSocSurvey_DescriptivePaper.pdf and R_script.Rmd). Confirmatory Factor Analyses were conducted on all pre-existing multi-item scales using R-package *lavaan* version 0.6–7 (Rosseel, 2012). To judge on model fit, advice by other scholars (Hooper, 2008; Hu & Bentler, 1999; Kline, 2015) to use fit indices such as Chi-Square (> 0.05), TLI (≥ 0.95), SRMR (< 0.08), RMSEA (< 0.08), and CFI (≥ 0.9) was used to judge model fit. Lowest weight was hereby given to the Chi-Square *p*-value statistic (Kenny, 2020). Cronbach's alpha coefficients served as indicators for internal consistency reliability for all multi-item measures (judged based on Kline, 1999). R-package *psych* version 2.0.12 (Revelle, 2020) was used for calculations.

Smart Speaker Ownership. Based on parents' answer to the question whether they own no, one, or multiple smart speaker(s) in the home (i.e., from Amazon, Apple, Google, another brand, or many different brands), we identified parents who indicated not to own a smart speaker as belonging to Non-Adopter-Families (i.e., NAFs), and parents who indicated to own at least one smart speaker as belonging to Adopter-Families (i.e., AFs).

Smart Speaker Usage. Three categorical answer options assessed the way the smart speaker is used in the family home: by the parent alone, together with the child, by the child alone. Single selections as well as a combination of answers were possible.

Child Gender. The child's gender was assessed by asking the parent to indicate whether their (selected) child is a boy or a girl.

Parent Education. We measured education level along seven categories of education in the Netherlands, which were incremental in the amount of education one has received, ranging from 1 'non-basic' to 7 'university master/postdoctoral education'.

Parent Income. Parents were asked to indicate their gross income along seven categories ranging from below modal income (26,500 EUR) up to two times modal or more (66,000 EUR or more). Parents who did not want to indicate their income were removed from subsequent analyses that included this variable.

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Parent Technology Trust. This variable was assessed via the adjusted three-items measurement by McKnight et al. (2011) (e.g., 'I usually trust information technology until it gives me a reason not to.') on a 7-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree'. Construct validity metrics revealed a just identified model (χ^2 = 0; TLI = 1; SRMR = 0; RMSEA = .00; CFI = 1). Internal reliability was high among all three items (α = .88).

Parent Privacy Concerns. This variable measured parents' concerns regarding their privacy online. Five previously modified items (e.g., 'When I am online, I am worried that my personal data (such as browsing behaviour, name or location) is being misused.') by Kruikemeier et al. (2020) (original scale used by Baek and Morimoto, 2012) were used and assessed on a 7-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree'. Construct validity metrics were appropriate except for the SRMR and RMSEA metric that lay both above the respective threshold (χ^2 = 0; TLI = .903; SRMR = .039; RMSEA = .192; CFI = .951). Internal reliability was high among all five items (α = .92).

Parent Internet Literacy. This variable was measured via the validated information-navigation subscale (van Deursen et al., 2016) on a 7-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree'. Due to the reversed item phrasing (e.g., 'I find it difficult to decide what the best keywords are to use for online searches.'), scores were recoded to facilitate analyses, whereby a score of 1 eventually represented a low and a score of 7 a high literacy level. Construct validity metrics were appropriate except for the RMSEA metric that lay above the threshold (χ^2 = 0; TLI = .917; SRMR = .043; RMSEA = .158; CFI = .959). Internal reliability of this scale was high (α = .90).

Child Temperament. Parents were asked to rate the fit of their child's behaviour to the three temperament types: extraversion, negative affectivity, and effortful control (Putnam, 2012). Consequently, each type was measured by one item (e.g., item for extraversion: 'This child has lots of energy, is easily excited, and often goes fast on the playground. This child enjoys meeting new people and going to new places.') on a scale ranging from -3 'my child behaves not at all like this description' to +3 'my child behaves exactly as described'. For analyses, this variable was recoded to responses ranging from 1 to 7, whereby 1 was recoded from -3 and 7 from +3.

Parental Media-Mediation Style. This variable was measured via an adjusted version of the previously developed and validated Parental Media-Mediation Style (PMMS) scale (Beyens et al., 2019). This scale

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originally includes four questions per style (i.e., positive active, negative active, restrictive mediation) for different media types. To minimize the survey's scope, we combined separately listed media formats into one item (e.g., 'How often do you prohibit your child from watching certain TV programmes/movies or playing a certain computer game?'). The resulting six items, two items per mediation style, were measured on a 4-point scale (1 = 'Never', 2 = 'Almost never', 3 = 'Sometimes', and 4 = 'Often'). Scores were mean-averaged per style, resulting in three final variable scores: one for restrictive PMMS, one for positive active PMMS, and one for negative active PMMS. Construct validity of this three-factor scale was given (χ^2 = .092; TLI = .939; SRMR = .042; RMSEA = .066; CFI = .975). Internal reliability was acceptable (α = .70).

Data Analysis

We performed MANOVA using R-function *manova* to test for significant differences between AFs and NAFs along all continuous individual characteristics considered in this study. Among the statistical assumptions for MANOVA, the one of multivariate normality was violated as indicated by a Q-Q plot (see R_sript.html file in the supplemental materials on OSF). To make inferences about effect size, partial eta-squared (η^2) and Cohen's d (d) were computed. To test for significant differences between NAFs and AFs along all categorical individual characteristics, we calculated Pearson χ^2 tests using R-function *chisq.test*.

Results

Distribution of Adopters and Non-Adopters

Out of the total 187 families, 63 (34%) had a smart speaker in their home, while 124 (66%) families did not. Among the ones who did, about half (55%) possessed a Google Home or Google Nest device. A quarter of AFs (25%) had a device of another brand in their home. Owners of devices from Amazon (10%) and Apple (10%) were relatively rare. Among all families with their own smart speaker device, the most common form of usage was the one by the parent (N = 43, 68%), co-usage with the child occurred less but still frequently (N = 33, 52%), child independent usage was rare (n = 6, 10%).

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Table 1. Descriptive means and standard deviations of all continuous variables per group (AFs and NAFs) plus results of Pearson χ2 tests

Individual characteristics	Overall (*N* = 187)	AFs (*n* = 63)	NAFs (*n* = 124)	*F* /χ²+	*p*
	M (SD)	*M (SD)*	*M (SD)*		
Child Gender	/	/	/	0.70558+	.4009+
Child Age	3.90 (1.69)	4.19 (1.52)	3.76 (1.76)	2.7449	.099
Income	/	/	/	7.9592+	.093+
Education	/	/	/	6.1569+	.406+
Technology Trust	4.51 (1.25)	4.94 (1.05)	4.28 (1.29)	12.158	**
Privacy Concerns	4.58 (1.29)	4.77 (1.18)	4.49 (1.33)	1.9137	.168
Internet Literacy	5.04 (1.40)	4.49 (1.64)	5.33 (1.17)	15.984	**
Child Temperament Extrav.	5.30 (1.61)	5.56 (1.53)	5.17 (1.63)	2.437	.120
Child Temperament Neg.Aff.	3.72 (1.80)	3.63 (1.89)	3.76 (1.75)	0.1949	.6594
Child Temperament Eff.Con.	4.94 (1.60)	5.03 (1.62)	4.89 (1.59)	0.3423	.5592
Restrictive Media-Mediation	3.11 (0.71)	3.26 (0.58)	3.03 (0.75)	4.6591	*
Negative Active Media-Mediation	2.98 (0.69)	3.10 (0.63)	2.92 (0.72)	2.9752	.08622
Positive Active Media-Mediation	3.10 (0.70)	3.32 (0.59)	3.00 (0.72)	9.2992	**
Household Size	3.88 (1.02)	3.92 (0.79)	3.86 (1.12)	0.1333	.7155
Household Composition	/	/	2.35 (0.52)	2.5836+	.108+
Number of Children	2.34 (0.57)	2.44 (0.62)	2.29 (0.54)	3.106	.07965

Note: * $p < .05$, ** $p \leq .01$, / not applicable for dichotomous variable, + shows Chi-square test results for all categorical characteristics. Overall MANOVA result: Pillai's Trace = 0.19309, $F(12, 174) = 3.4697$, $p < 0.001$, η2 = 0.19; d = .96.

Individual Differences between NAFs and AFs

An overview of all study variables including means and standard deviations is provided per group (AFs and NAFs) in Table 1. Overall, the MANOVA-model was significant showing a large effect (Pillai's Trace = 0.19309, $F(12, 174) = 3.4697$, $p < .001$; $\eta^2 = 0.19$; $d = .96$). Discriminant Function Analysis revealed higher accuracy for predicting NAF-parents based on the selection of individual characteristics than for AF-parents (see R_sript.html file in the supplemental materials on OSF).

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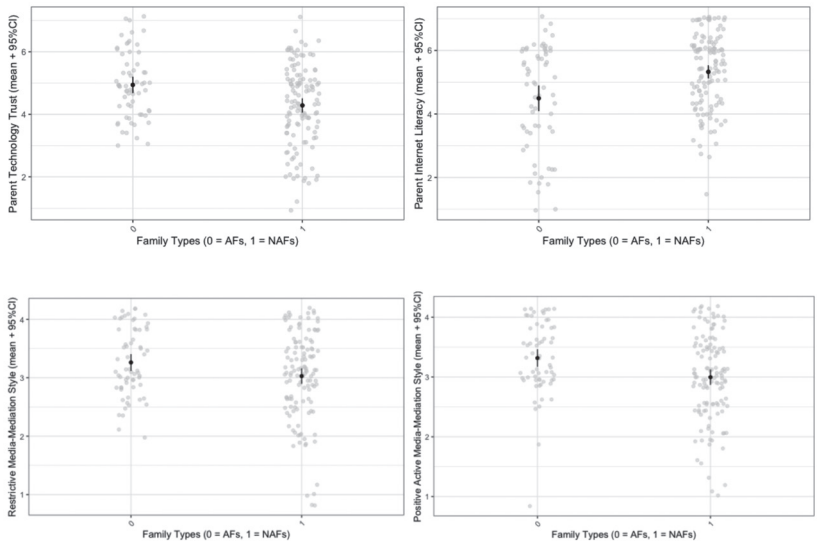

Figure 1. Scatterplots with means and confidence intervals showing significant differences between AFs and NAFs for variables Technology Trust (upper left), Internet Literacy (upper right), Restrictive Media-Mediation (lower left), and Positive Active Media-Mediation (lower right)

Child Characteristics

We found no significant differences among AFs and NAFs regarding children's gender (RQa; $\chi^2(1) = 0.706$, $p = 0.401$); children's age (RQb; $F = 2.745$, $p = .100$); and children's temperament (RQc; Extrav.: $F = 2.437$, $p = 0.120$; Neg. Aff: $F = 0.195$, $p = .659$; Eff.Con: $F = 0.342$, $p = .559$).

Parent Characteristics

We found non-significant results for parents' income (H1; $\chi^2(4) = 7.9592$, $p = .093$) and education (H2; $\chi^2(6) = 6.1569$, $p = .4058$). Post-hoc ANOVAs, however, provided support for H3 ($F = 12.158$, $< .01$) by showing AFs ($M = 4.94$, $SD = 1.05$) to report greater trust in technology than NAFs ($M = 4.28$, $SD = 1.29$; Figure 1). Results did not provide support for H4 regarding parents' privacy concerns, as means of the two groups did not significantly differ from each other ($F = 1.913$, $p = .168$). As for H5 regarding parents' internet literacy, we found again significant differences ($F = 15.984$, $p < .01$), yet in the opposite direction as was expected: AFs reported lower literacy levels ($M = 4.49$, $SD = 1.64$) than NAFs ($M = 5.33$, $SD = 1.17$).

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Family Characteristics

Results revealed significant differences between both groups with regards to restrictive ($F = 4.659$, $p < .05$) and positive active media-mediation style ($F = 9.299$, $p < .01$) in the family (Figure 1): AFs applied a restrictive ($M = 3.26$, $SD = 0.58$) and positive active ($M = 3.32$, $SD = 0.59$) media-mediation style to a greater degree than NAFs (restrictive: $M = 3.03$, $SD = 0.75$; positive active: $M = 3.00$, $SD = 0.72$). There were no significant differences among AFs and NAFs for the size of the household (RQ3e; $F = 0.133$, $p = .716$); the household composition (RQf; $\chi^2(1) = 2.584$, $p = .108$); and the number of young children (RQg; $F = 3.106$, $p = .080$).

Discussion

The recent trend of smart speakers becoming part of family life raises the important question as to how families with a smart speaker might differ from families without one. By specifically focusing on the Dutch context as a Western but non-English speaking country and on families with young children between three and eight years, this study establishes profiles of Adopter- and Non-Adopter-Families through the descriptive analysis of 187 parental self-reports. Taking into account theoretically motivated dispositional and contextual characteristics of these families, we detect (1) how widely adopted smart speaker devices are across family homes, (2) where the technology currently finds most resistance and acceptance, and (3) what implications arise for research and practice aimed at ensuring that smart speaker technology meets the needs of families in a safe and responsible manner.

Smart Speaker Adoption in Dutch Families

We discovered a 34% adoption rate across Dutch family households, with Google devices being the most popular. This updates earlier statistics from 2018 (KANTAR, 2019) and echoes findings of the Dutch National Voice Monitor (Direct Research, 2022). Interestingly, the rising adoption rate in the Netherlands is also similar to patterns observed in the Anglo-American context, where approximately one third of North-American homes are considered a 'smart home' by now (Jones, 2021). Although these numbers provide valuable insights into the current adoption process in the Dutch context, they are subject to temporal sensitivity. Furthermore, follow-up research of long-term practices and effects of smart speaker usage within family homes is needed, as this will help shedding light onto potential

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consequences of continued smart speaker usage for parents and children individually as well as for the collective dynamic of the family as a whole (similar to Garg & Sengupta, 2020).

Second Level Digital Divide Characteristics of (Non-)Adopters

To answer the main research question of this study – whether and, if so, how Adopters differ from Non-Adopters – we indeed confirm there are differences, but these are not always as expected from previous literature. Firstly, we find that socio-economic criteria do not significantly distinguish between AFs and NAFs. Even though smart speakers require relatively low purchase and maintenance costs and possess an intuitive operation mode via voice, we, based on existing research on technology access, hypothesized that higher financial and educational resources would still be associated with having a smart speaker device (Goldenthal et al., 2021; Lorenz & Kapella, 2020). Yet, we find no support for this assumption in the present investigation, which extends research on digital divides in that standard access indicators, such as income and education, may be less robust indicators when it comes to smart speaker adoption. In fact, as smart speakers become more accessible and increasingly more prevalent in the lives of people, the general notion of a digital divide may need to be updated.

Having said so, we find that there seem to be certain *second digital divide* characteristics that do distinguish between AFs and NAFs. Specifically, NAFs had lower trust in technology than AFs, meaning that parents in households with a smart speaker are more likely to show higher levels of trust in technology (H3) – an important finding that provides additional evidence for the crucial role of trust in the theoretical understanding of technology adoption (Glikson & Woolley, 2020). Next to trust, the level of internet literacy also emerges as a distinguishing factor: NAFs reported higher literacy levels than AFs. Yet, this is counter to previous work which suggests that the more literate you are the more likely you are to use new technologies (van Deursen et al., 2021).

At first glance, one possible explanation for this could be that higher digital literacy increases awareness for potential issues arising from using a smart speaker (e.g., security lacks, data usage), which might trigger reasons for concern and could be connected to the decision not to adopt a smart speaker after all. However, our data do not provide support for this explanation, since our MANOVA results neither revealed a significant role of privacy concerns (H4), nor was there a positive correlation between privacy concerns and

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internet literacy for our sample. In fact, the correlation was significantly negative (r = -0.329, p < .001), indicating that higher literacy levels are associated with lower privacy concerns, which is in line again with previous research.

Another alternative explanation may also be found in how we operationalized internet literacy in this study. The measure used in this study concerns mostly items about the conventional way of navigating the web via screen-based technology (e.g., 'I find it difficult to decide what the best keywords are to use for online searches.', 'I find the way in which many websites are designed confusing.'). One might therefore argue that smart speakers, which allow more intuitive information retrieval via voice control, serve as a tool for people that have difficulties with navigating the web in more traditional ways (e.g., via mouse, keyboard, and screen). In that regard, it is possible that people who are less proficient in conventional internet literacy as measured here, benefit from a conversational device like a smart speaker, and therefore show higher adoption rates for smart speakers compared to people with higher internet literacy levels.

To make full sense of this mixed picture of evidence, we call on future research to build upon these findings and extend in further empirical work. In case of replication, the connection between smart speaker adoption and low internet literacy could be – societally speaking – a sign for functional benefits of voice technology for low-literate users or it can be a sign of technological naivety. Resulting digital risks and benefits for specific groups would need further observation in order to prevent new digital divides from emerging. In fact, Adopter-Families who place high trust in technology although not being sufficiently literate might require specific attention as they may be *misusing* the device – that is blindly accepting technology without considering if it is in one's best interest (Glikson & Woolley, 2020). Specific device features (e.g., more explanatory, educative, transparent) as well as media literacy trainings could help to minimize such risks, but more field-research is needed first to better understand how usage in families with lower internet literacy levels exactly looks like.

At the same time, scientifically speaking, suppose this pattern also exists for other emerging (voice) technologies, the implications would be quite significant. In that regard, we suggest that scholars theoretically and methodologically account for aspects of internet literacy in future studies as it can help explain different effects across different people. Furthermore,

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from the perspective of NAFs, we see fruitful space here to investigate alternative reasons for Non-Adoption, since we saw that it is not necessarily a lack in ability to operate internet-powered devices that keeps families from acquiring a smart speaker.

The Role of Media-Mediation

Finding that parents are often still the most prominent users (N = 43, 68%), with co-usage occurring less but still frequently (N = 33, 52%), and child independent usage only rarely (N = 6, 10%), emphasizes the unique selling point of smart speakers – namely being suitable for individual and collective usage. However, it also shows that a rising presence of smart speaker devices in families does not always translate into granted independent usage for children. This might be an explanation for why we did not find significant results for any of the child characteristic variables (RQa: gender, RQb: age, RQc: temperament). Knowing that children are so far not regular independent smart speaker users implies that children's use practices remain subject to parental supervision and may be less of a focus when purchasing a device.

Having said that, we do see that parents who have adopted a smart speaker apply a combination of two mediation styles (RQd) and that those mediation styles are more crucial than any other characteristics of the household (RQe, f, g). They mediate more in a restrictive (e.g., limit children's access to certain content or the time spent on media) and positive active way (e.g., explanatory and stimulating efforts of parents to let their children engage with media content) (Beyens & Valkenburg, 2019), compared to parents who do not own a smart speaker. This could suggest that smart speakers are most accepted in families who work with clear media rules and/or strive to have encouraging media conversations; or alternatively, that having new technology at home stimulates the need for parental media mediation. Other recent findings have similarly shown that these parenting mediation styles are meaningful indicators to distinguish different types of families who already own a smart speaker (Wald et al., 2023). Yet, the extent to which these mediation styles are directly applied to smart speaker usage remains unknown (e.g., restrict child's smart speaker use time). Our measurement only listed traditional kids-media products of TV programmes, movies, and computer games to allow the same measure for AFs and NAFs likewise. Therefore, we suggest future research to ask how parents specifically mediate their children's smart speaker usage, and for what type of situations a smart speaker is found to be appropriate for co- as well as child independent-usage. This seems particularly important to investigate when considered in the context

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of our findings for literacy and trust, namely, how do high-trusting but low internet literate parents specifically mediate smart speakers in their homes?

In sum, our findings suggest that taking a wider perspective on dispositional and contextual characteristics of (potential) smart speaker users can meaningfully inform our scientific understanding of adoption decisions in specific population groups, such as families. Consequently, the technology adoption and acceptance literature might similarly benefit from approaches (e.g., ecological systems theory, media effects literature, and the study of digital divides) that aim for a balance between precision yet more holistic accounting of individual characteristics as well as proximal and distal environmental factors (e.g., other family members, space of the home).

Limitations and Future Research

Despite the novel insights of this study, findings should be interpreted through the lens of several limitations. First, in our study we utilized the measure of *ownership* to identify AFs from NAFs as an important physical indicator of adoption (i.e., appropriation) according to Silverstone (1993). But it is debatable whether ownership fully reflects adoption, because owning a device does not automatically mean using it too – phenomena of abandonment or de-domestication are also possible (e.g., Garg et al., 2021). This should be considered in future research to complement the present study and the field more generally.

Second, surveying one parent per family poses the risk of incomplete representativeness. If the surveyed parent significantly differs from their partner, our claims about differences between AFs and NAFs lose strength. Abrams et al. (2021) provide first arguments for situations in which accepting a new technology is not always necessarily something that occurs on a voluntary basis and instead might be 'forced'; here perhaps by the partner. Then again, if such differences occur within a family, issues of parental conflicts might further complicate technology adoption. Future research, which is able to include responses of all directly involved caretakers in a family, would be essential here.

Third, although building on established theoretical and empirical evidence for the selection of individual characteristics and the substantiation of our hypotheses, this study did not test concrete theoretical pathways (e.g., regarding the reasoning for [non-]adoption). Leaning on our description of Adopter and Non-Adopter family profiles in the Netherlands, future research

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can, however, continue with modelling out more concrete motivations for and against smart speaker (dis)use (similar to Wald et al., 2023).

Lastly, as a cross-sectional research design was employed, only correlational conclusions are possible. Looking at these patterns is a helpful first step to investigate the role of individual characteristics on smart speaker adoption decisions, but causal order is naturally not assumed.

Conclusion

In response to the emerging trend of smart speakers in family life, this study provides a descriptive analysis of profiles of (Non-)Adopter-Families with young children (3-8 years) in the Netherlands. While the current adoption rate (34%) indicates that smart speakers are indeed a growing phenomenon in Dutch families, children are not yet widely granted independent access. It will be interesting to follow this growth pattern, both in terms of general family adoption but also to see when and if children become more independent users of this technology. It is also interesting to see that Adopter-Families are indeed different than Non-Adopters in several ways not captured by traditional socio-demographic variables but rather by second-digital-divide characteristics. Specifically, Adopter-Families show higher technology trust, lower internet literacy levels, and a stronger preference for a restrictive as well as positive active media-mediation style. This pattern highlights an interesting tension: namely, a high trust in technology with a comparably weaker understanding of technology. Scholars suggest that such a pattern can lead to misuse of technology, leaving us with questions about what is happening *in* the family home. This pattern is a call for more work *in* the family home to better understand what (mediated) smart speaker use looks like and what we can do to minimize risks of potential misuse. New technology brings risks and rewards – science can help us identify both in ways that meaningfully contribute to the family home.

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