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# Virtual assistants in the family home. Understanding parents' motivations to use virtual assistants with their Child(dren)<sup>☆</sup>

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## ABSTRACT

Virtual assistants (VA) like Siri, Alexa, or Google Assistant are becoming household names - especially for families with young children. Scientific inquiry studying this user population and their intention to use VAs at home, however, remains scarce. By bridging the Technology Acceptance Model, Uses and Gratifications theory, and the first proposition of the Differential Susceptibility to Media Effects Model, this study disentangles (1) different *types of families* with (2) different *motivations* for (3) different *forms of VA-usage* (i.e., parent only, child only, co-use). Cross-sectional survey data ( $N = 305$ ) from Dutch parents with at least one child between 3 and 8 years and a Google Assistant-powered smart speaker in their home show that (1) families mostly differ along parents' digital literacy skills, frequency of VA-use, trust in technology, and preferred degree of child media-mediation. (2) Hedonic motivation is key for parents to (3) co-use the VA together with their child(ren). New pathways for the methodological and theoretical study of technology use in families are highlighted. Developers can best anchor VA-application among families in aspects of enjoyment while scholars and policy makers might wish to consider additional meaningful intervention criteria for the future study and guidance of family VA-use practices. (197 words).

## 1. Introduction

Virtual assistants (VA; e.g., Amazon Alexa or Google Assistant), defined as applications able to understand voice commands and carrying out tasks for users, are becoming increasingly accessible around the globe (Hoy, 2018), and especially among families with young children (Aeschlimann et al., 2020; Xu et al., 2021). As the age for children's first technology use is steadily dropping – by now far reaching into early childhood (Chaudron et al., 2015) – it comes as no surprise that the VA-market is launching more and more products and services specifically targeted at young users (e.g., BBC, 2021; Wiederhold, 2018). Correspondingly, the share of today's family households equipped with a VA is steadily increasing (e.g., UK: Foster, 2020, US: Daws, 2020), with a growing numbers of parents (71% of US users) considering the purchase of a second device for children entertainment purposes.

Yet, despite this rapid growth, the usage of VAs by families with young children has received limited scholarly attention thus far. In fact, most existing work has focused on the investigation of individual adults (Kowalczyk, 2018; Pridmore & Mols, 2020; or more recently on older

adults: Kim & Choudhury, 2021) and perceptions of VAs along the lines of general functionality (Hoy, 2018; Weber & Ludwig, 2020), sociability and anthropomorphism (Purinton et al., 2017), as well as (medical) everyday support (Noda, 2018; O'Brien et al., 2020; Pradhan et al., 2018). However, with such rapid in-roads into family life, new facets of VAs are growing in importance: First, multiple family members represent multiple potential users that can engage with the VA individually or collectively resulting in different use forms: parent alone, child alone, and co-usage (Purinton et al., 2017). Second, as VAs form a novel technology in the home environment, new use-practices and potentially new use-motivations arise (McLean & Osei-Frimpong, 2019; Sundar & Limperos, 2013). Third, as families differ in their individual characteristics and living conditions, which have been found to influence use of technology more generally (Lorenz & Kapella, 2020, pp. 1–44; Piotrowski & Valkenburg, 2015), families are likely to differ in their approach to and perception of VAs as well.

Hence, a fundamental knowledge gap emerges regarding the extent to which different *types of families* have different *motivations* for different *forms of VA-usage*. To fill this gap, data were collected from a cross-

<sup>☆</sup> The study's preregistration and additional online materials can be viewed on OSF (<https://osf.io/629b7/>).

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sectional online survey in the Netherlands with self-reports of 305 parents, who have at least one child between the ages of 3–8 years and a Google Assistant-powered smart speaker in their home. To address important heterogeneity between families, this study first builds a family typology by differentiating between families' dispositional, developmental, and social/contextual characteristics as suggested by the first proposition of the Differential Susceptibility to Media effects Model (DSMM) (Valkenburg & Peter, 2013). Then, this typology is combined with a structural approach to test hypothesized relationships grounded in the Technology Acceptance Model (TAM; Davis, 1989) and the Uses and Gratification theory (U&G; Katz et al., 1973).

In doing so, this research makes three meaningful contributions. First, we provide new empirical findings for the application of well-established technology approach and acceptance theories in the novel context of VAs in families. Second, this study aims to equip VA-developers with insights about specific aspects of VA-technology to help better define its functionality for the family home. And third, we hope to inform other scholars and policy makers about meaningful intervention criteria for the future study and guidance of families in their VA-use practices.

## 2. Theoretical background

### 2.1. VA-usage in the family home

Investigating VA-usage in the family context means looking at a modern technology that can be accessed, operated, and enjoyed by multiple different people simultaneously (Beirl & Rogers, 2019; K. Lee et al., 2020). Since a family can be regarded as a social network of at least one individual representing a legal guardian (i.e., parent) and the other an individual with need for care (i.e., child; Lorenz & Kapella, 2020, pp. 1–44), a challenging point in scholarship is that VA-usage in the family home can take different forms: it may occur by the parent alone, the child alone, or by the parent and child together, also known as co-usage (K. Lee et al., 2020). To overcome this challenge and to fill the gap in existing quantitative studies, that (Beirl & Rogers, 2019; Garg & Sengupta, 2020) have not yet separated different use forms as dependent variables but see indeed differences in executed commands and behavioral routines between parents and children, this study differentiates between use-intentions for parent only use, child only use, and co-usage.

In terms of families' criteria, we specifically focus on those with children between 3 and 8 years for two reasons. On the one hand, children of this age are already able to speak full sentences – a requirement to operate voice-controlled devices like VAs (Lovato & Piper, 2019). On the other hand, since parent-child media conversations appear to accelerate around age 3 and peak around age 8 (Beyens et al., 2019), important questions are raised as to what extent such young children, in light of their developmental vulnerabilities (Plowman, 2015), are already involved in using VAs at home and how parents deal with their gatekeeper-role. Regarding the latter, we specifically focus on parents' motivations and use intentions as they are ultimately the ones granting or restricting children access to technology. Although children's specific motivations for use are interesting in and of themselves too, parents' responses are deemed to be informative for this research's purpose following existing literature that sees parental characteristics as relatively robust indicators for children's media use (Meeus et al., 2019) and that understands parents' complex needs for media selection to be inclusive of children's needs as well (Broekman et al., 2016).

### 2.2. Technology acceptance

To understand acceptance and use of VAs in the family context, it is crucial to inspect parents' VA-related perceptions and behavioral intentions as selectors and gatekeepers of this technology. Amongst a variety of multidisciplinary theories developed to study the adoption of technology, the Technology Acceptance Model (TAM; Davis, 1989) has

emerged as the most often discussed and applied framework (King & He, 2006; Kowalczyk, 2018). In that, TAM represents a refined version of the Theory of Planned Behavior developed by Ajzen (1991) and understands a stronger intention to use a technology (here: the VA) in the near future as its greater acceptance.

Several studies applying TAM (Abdullah & Ward, 2016; Davis, 1989; Guner & Acarturk, 2020; King & He, 2006) show technology use intention to be mainly determined by two key beliefs: The *perceived usefulness* and the *perceived ease of use* of a technology – with higher levels of both leading to stronger behavioral use intentions (Guner & Acarturk, 2020; Kowalczyk, 2018; Y.-H. Lee et al., 2013). While perceived usefulness describes the subjective perception of how probable it is that a certain technology will be helpful to perform a specific behavior, perceived ease of use refers to the subjective estimation of how much mental and physical effort is needed to properly use that technology for its intended purpose (Davis, 1989). Moreover, it has been established that when existing technological barriers (ease of use) are overcome, there is a greater chance that the technology's potential (usefulness) is realized (Davis, 1989). Since VAs still count as a rather novel smart-home technology and since family users' skills are likely to be yet developing, we expect a positive relationship between perceived ease of use and perceived usefulness for the formation of parents' VA-use intentions. Hence, built on the existing body of TAM-literature, we preregistered the following hypotheses, in which *intention to use* refers to all three VA-use forms (parent alone, child alone, co-usage).

**H1.** The higher parents' level of perceived ease of use of their virtual assistant, the greater their intention to use it in the family home.

**H2.** The higher parents' level of perceived ease of use of their virtual assistant, the more likely they are to perceive it as useful in the family home.

**H3.** The higher parents' level of perceived usefulness of their virtual assistant, the greater their intention to use it in the family home.

### 2.3. Additional use motivations

Despite TAM's robustness and wide empirical validation, the model is often critiqued for neglecting additional variables that capture users' motivation for technology use (Baron et al., 2006; Walker & Kim, 2015), which is why TAM has been extended in multiple ways. Most notably, the UTAUT (and UTAUT2 respectively; Venkatesh et al., 2012) was put forth as a unified framework to more comprehensively explain technology adoption and use. Yet again, critique exists regarding the model's lack of parsimony, which arises from its attempt to be more comprehensive (Bagozzi, 2007).

With this pitfall in mind, and to more accurately account for the novel attributes of VAs that can create new motivations for engagement (see Sundar & Limperos, 2013), aspects of TAM have been often complemented with a selection of needs arising from U&G theory (McLean & Osei-Frimpong, 2019). U&G theory explains that people actively select a medium out of an individual precondition to satisfy a specific need (Katz et al., 1973). And, indeed, we see that research focusing on parental media selection for children explicitly encourages the application of U&G to better account for parents' complex media-use motivations (Broekman et al., 2016).

Leaning on related research leading up to this study, we see emphasis on three specific key aspects of technology that can translate into three different motivations for VA-engagement. One is the *hedonic* aspect, which is connected to the emotional experience of joy and pleasure obtained from using a technology (Schuitema et al., 2013). It helps to "escape from the boredom of everyday life" (Sherry, 2004, p. 330) and is subsequently understood to predict future media use (Roth & Koenitz, 2016). The second key aspect is of *symbolic* nature. Since research has found that (technological) products typically carry certain attributes with them, either relating to the company that produces the product, to

the function the product fulfills, or to the status it has in society, technology offers a way to define one's social identity (Venkatesh & Bala, 2008). Consequently, ownership of technology alone can satisfy this need and motivate engagement (McLean & Osei-Frimpong, 2019). The third one is the *social* aspect that orbits technology adoption and use. A strong body of research stresses the importance of normative processes that lead to adoption of information technology in private use-settings (i.e., Cheung et al., 2011; Li, 2011). With the social need to belong and the intention to retain access to (social) resources (Helsper, 2012), the pressure (for or against use of a certain technology) executed by one's social environment can be an important factor when deciding whether or not to engage with technology. In sum, based on these observations, we adopt the underpinnings of U&G theory and distinguish, in line with scholarship on technology acceptance, three additional motivations: (1) hedonic, (2) symbolic, and (3) social.

We hereby operationalize *hedonic motivation* as *enjoyment*. Enjoyment has been shown to have a positive influence on the intention to use a VA (Kowalczyk, 2018), and as such we hypothesized (*intention to use again* refers to all three VA-use forms):

**H4.** The greater parents' enjoyment of their virtual assistant, the greater their intention to use it in the family home.

Furthermore, we operationalize *symbolic motivation* as *social status* gained by owning a VA. Previous research here finds the more strongly people consider a technology to be a social status symbol, the stronger their intentions to use it (de Graaf et al., 2019; Venkatesh & Bala, 2008). Thus, we expected:

**H5.** The more parents perceive their virtual assistant to be a status symbol in their social environment, the greater their intention to use it in the family home.

Finally, under the assumption that parents are motivated to comply with attitudes and behaviors of important others (e.g., peers) in order to "maintain [...] satisfying self-defining relationship[s]" (Li, 2011, p. 563), we operationalize *social motivation* as one's perception of *social influence* (i.e., peer pressure). Correspondingly, we expect parents to have stronger VA-use intentions if their peers recommend using a VA in the family home as well (Abdullah & Ward, 2016; Kelman, 1958; Pridmore & Mols, 2020; Venkatesh & Bala, 2008). We hypothesized:

**H6.** The more parents perceive social influence around a virtual assistant, the greater their intention to use it in the family home.

## 2.4. Individual differences

Next to components arising from TAM and U&G that could lead to greater acceptance of technology, literature has accentuated the influential role of multiple, often interrelated, individual variables on media selection (Valkenburg & Peter, 2013). To properly account for the impact of these individual differences on the acceptance of a VA, we form a family typology. A typology is a way to conceptionally structure a population along different subgroups (Bowers & Sprott, 2012; Nylund et al., 2007) – here types of families – which may differ in their approach to accept and use VAs. This means, instead of investigating their characteristics separately, we look at their interplay and explore how they shape different family types in this study's sample.

The first proposition of the DSMM serves as the theoretical foundation for important individual indicators (Valkenburg & Peter, 2013). The DSMM was developed to better understand individual differences in media approach, use, and response behavior. Its first proposition targets users' characteristics that exist prior to any media use situation, and differentiates between dispositional, developmental, and social susceptibilities. Such additional individual characteristics are not formally addressed in TAM (Kowalczyk, 2018) and substantially differ from the added U&G-motivations in that the susceptibilities describe conditions (e.g., size of the household) that facilitate or complicate technology use, whereas the motivations describe benefits derived from VA-usage

directly (e.g., using a VA to belong to one's social group). To select meaningful variables that operationalize each of the three susceptibility dimensions, we build on existing literature on technology use that has established associations between individual characteristics and media use behavior.

**Dispositional Susceptibility.** Dispositional susceptibility refers to characteristics that relate to users' personal dimensions and inclinations. Previous research has found associations between ownership or usage of technology and the following key variables: gender of parent and child (Lorenz & Kapella, 2020, pp. 1–44), socioeconomic status (SES: Correa, 2016; Porter & Donthu, 2006; Rogers, 1995; Scheerder et al., 2019; van Deursen et al., 2021, pp. 1–17; van Dijk, 2005), parents' trust in technology (McKnight et al., 2011), their internet literacy (Guner & Acarturk, 2020; Helsper, 2012b; van Deursen et al., 2016, 2021, pp. 1–17), and personal experience with the technology (Agarwal & Prasad, 1999), as well as the child's temperament (Bronfenbrenner & Morris, 1998; Nabi & Krcmar, 2016), and tendency for parasocial attachment (Bond & Calvert, 2014).

**Developmental Susceptibility.** Under developmental susceptibility, Valkenburg and Peter (2013) understand the changes in behavior that arise from growing up and getting older. Existing research points to the influence of age towards technological affinity, as adults typically perceive their cognitive capabilities and technology-related efficacy beliefs to get weaker when getting older (Morris & Venkatesh, 2000; Porter & Donthu, 2006), whereas children tend to become better acquainted with media technologies with rising age (Barr & Linebarger, 2017).

**Social/Contextual Susceptibility.** Social/contextual susceptibility refers to factors on micro (e.g., family, peers), meso (e.g., school, community) or even macro (e.g., cultural norms) level that can eventually influence individuals' responsiveness to media. Under consideration of this study's context, namely the family home which can be located on micro level, literature points to potentially meaningful indicators such as parental media-mediation styles (Beyens & Beullens, 2017; Beyens et al., 2019), the occurrence of technology use in the family context (i.e., co-usage versus individual usage; Lee et al., 2020; Wiederhold, 2018), household density (Correa, 2016; Eynon & Helsper, 2015; McLean & Osei-Frimpong, 2019), and the degree of technological 'smartness' in the home (Haug et al., 2020; Pridmore & Mols, 2020).

Against the backdrop of literature on the above mentioned developmental, dispositional, and contextual characteristics predicting technology use, and since previous work has not looked at the interplay of all abovementioned characteristics in distinguishing different types of families and their relationship with TAM and U&G, we pose the following open research questions:

**RQ1.** What dispositional, developmental, and social/contextual variables meaningfully distinguish types of families in the study's sample?

**RQ2.** Do the family types identified in RQ1 differ in their a) perceived ease of use, b) perceived usefulness, c) enjoyment, d) social status, and e) social influence?

Fig. 1 summarizes the theoretical model put forth, including all preregistered confirmatory hypotheses and research questions.

## 3. Methods

### 3.1. Design

A cross-sectional online-survey was designed as part of a joint research project with the University of Amsterdam Human(e)AI Research Priority Area. The questionnaire was administered and distributed by a Dutch survey company (i.e., Kantar) among a panel consisting of owners of a Google Assistant-powered smart speaker device in the Netherlands. Google Assistant was chosen because, at the point of data collection, Google Home was the most popular smart speaker in the Dutch market, already present in about 1.5 million households by 2020

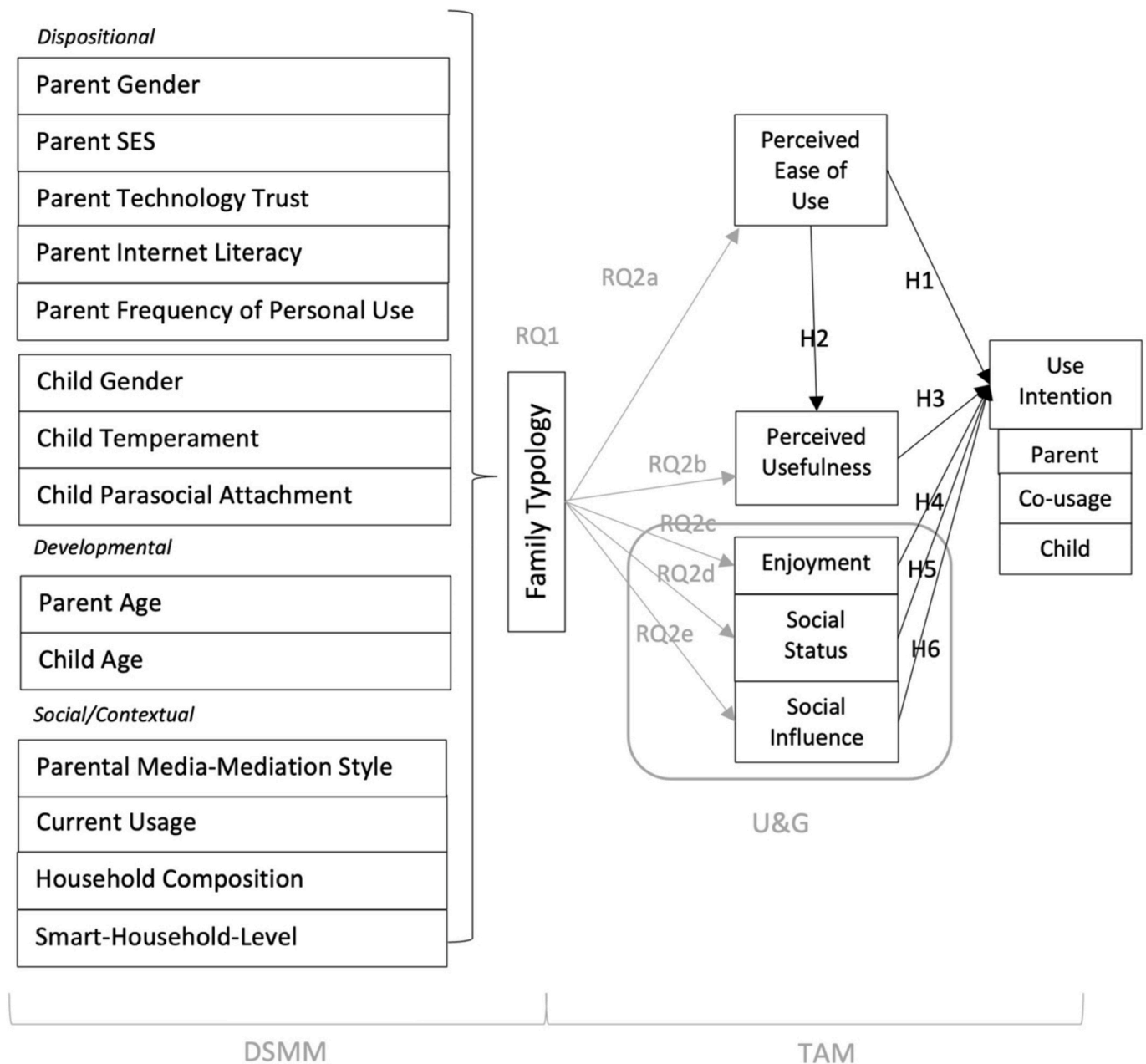


Fig. 1. Conceptual model.

(van Gelder, 2020). Data for this study were collected in two time-frames between January 8–31, 2020 including families who purchased a VA before 2020, and between April 12–18, 2021 including families who purchased a VA as of 2020. Inclusion criteria that were used for identifying potential participants by the panel company and that serves for regular panel screening are provided in the supplementary online materials on OSF (<https://osf.io/629b7/>). The study’s proposal was officially approved by the university’s ethics committee (2020-YME-12545), its study plan was preregistered on the Open Science Framework, and respective data management guidelines were followed.

3.2. Procedure

After consent was given, each parent was asked to report on individual characteristics of themselves and their child, as well as about their VA-related use-perceptions and -intentions. The remaining part of

the questionnaire was dedicated to the joint research project asking about associations with Google Assistant, privacy concerns, and related information searches. To strengthen data quality, an attention check was implemented (i.e., It is important that you stay focused during this questionnaire. Select “Strongly agree” here; see Kees et al., 2017). Participants who failed this check were screened out ( $n = 66$ ). In total, participation took about 15 min.

3.3. Participants

The final sample consisted of 305 (156 mothers) valid responses from parents (18+) with at least one child between 3 and 8 years and a Google Assistant-powered smart speaker in their home. Parents were on average 39.76 ( $SD = 7.20$ ) years old with fathers being slightly older ( $M = 41.99$ ,  $SD = 7.92$ ) than mothers ( $M = 37.62$ ,  $SD = 5.68$ ). Distributions of the sample along demographic variables of household size and socioeconomic status (SES) as well as numbers of representativeness of the Dutch

population are provided in Table 1 of the supplementary online materials on OSF together with additional information on the composite measure of SES.

### 3.4. Materials and measures

A total overview of key measures can be found on OSF (i.e., survey document). If not mentioned otherwise below, items were rated on a 7-point Likert scale ranging from 1 = *Strongly disagree* to 7 = *Strongly agree*. Basic demographics of the parents (i.e., gender, SES, age) as well as the size of their household were provided by the panel company's database. Using R-package *lavaan* version 0.6–7 (Rosseel, 2012), we report on measurement validity for the TAM-variables in the results section (see 4.1.2) as part of the structural analysis, while an overview of measurement validity criteria of the multi-item DSMM-variables can be found in Table 2 in the supplementary materials on OSF. Advice by other scholars (Hooper, 2008; Hu & Bentler, 1999; Kline, 2015) regarding a selection of recommended fit indices such as Chi-Square ( $>0.05$ ), TLI ( $\geq 0.95$ ), SRMR ( $<0.08$ ), RMSEA ( $<0.08$ ), and CFI ( $\geq 0.9$ ) was used to judge model fit, with lowest weight given to the Chi-Square p-value statistic (Kenny, 2020). Cronbach's alpha coefficients for all variables were calculated using R-package *psych* version 2.0.12 (Revelle, 2020) and served as indicators for internal consistency reliability (judged based on Kline, 1999).

#### 3.4.1. Measurements for TAM

**Perceived Ease of Use.** This variable was measured using a validated four-items scale (e.g., 'I find that interacting with Google Assistant does not require much mental effort.').  $\alpha = 0.89$  adapted from existing research (Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Walker & Kim, 2015).

**Perceived Usefulness.** This variable was measured via four validated items adapted from existing research (e.g., 'Using Google Assistant on a smart speaker improves our daily lives';  $\alpha = 0.9$ ; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Walker & Kim, 2015).

**Use Intention.** This measurement was based on the validated item by Venkatesh and Davis (2000). We adapted it to the three different use cases in the family, which resulted in three separate measurements, while also specifying its formulation to match how each parent had used their device thus far (see measure of 'Current Usage'): 'In the near future, I plan to use Google Assistant on a smart speaker to start/continue a) using it only for myself, b) using it with my child, c) to let my child use it for him/herself.'

#### 3.4.2. Measurements for added motivations along U&G

**Enjoyment.** Enjoyment was measured using a three-items question battery (e.g., 'I find using Google Assistant enjoyable.') taken from existing TAM-research (Venkatesh & Bala, 2008). To obtain additional information about participants' perception of the unique verbal interaction with the assistant, the following item was added: 'I find it enjoyable to be able to talk to Google Assistant.' Internal reliability was high among all four items ( $\alpha = 0.91$ ).

**Social Status.** Social status was measured via one item (i.e., 'People in my social circle who use Google Assistant on a smart speaker have a high social status.') from Venkatesh and Bala (2008). This single item was selected because of the limited scope of the survey and because of language discrepancies occurring when translating the original English measurement into our survey language (i.e., interpretation of 'prestige' as potentially negatively biased in Dutch language without good alternative).

**Social Influence.** To measure social influence we adopted the validated two-items battery by Venkatesh and Davis (2000) and added a third (i.e., 'People who are important to me I have actively recommended to use Google Assistant.') to capture whether parents have also actively contributed to forming social norms (and not only adhered to them). Eventually, only the original two items were used in the final

analyses as initial fit of the measurement model pointed towards weaknesses in the added third item (see OSF for changes of preregistration). Internal reliability of the modified social influence scale (with only the two original items) was high ( $\alpha = 0.86$ ).

#### 3.4.3. Measurements for the DSMM-variables

The following constructs were included in the creation of the typology: Parent technology trust, parent internet literacy, parent frequency of personal VA-use, child temperament, child parasocial attachment, parental media-mediation style, current usage, number of young children, and smart-household-level.

**Parent Technology Trust.** Parent's dispositional belief towards a technology to perform as expected was assessed via the adjusted three-items measurement ( $\alpha = 0.78$ ) by McKnight et al. (2011; e.g., 'I usually trust information technology until it gives me a reason not to.').

**Parent Internet Literacy.** Parents' skills to navigate the internet and to comprehend and use online content appropriately and effectively were measured via the validated information-navigation subscale ( $\alpha = 0.87$ ) by van Deursen et al. (2016; e.g., 'I find the online search for information exhausting'). Data suggested an underlying two-factor structure in line with the original scale. It split up into a subscale for 'information' ( $\alpha = 0.80$ ) and 'navigation' ( $\alpha = 0.80$ ), whereby the information subscale assessed one's ability to look for and retain general information online and the navigation subscale focused more on one's ability to remember, land on, and orientate through specific websites.

**Parent Frequency of Personal VA Use.** This variable was measured by the extent to which an individual had spoken to Google Assistant via a selection of different devices (i.e., iPhone, Android smartphone, smart speaker from Google, smart speaker from other brands, etc.) in the past month. The scale ranged from 1 = *Never*, 2 = *Once a month*, 3 = *2–3 times a month*, 4 = *Weekly*, 5 = *Daily* to 6 = *Multiple times a day*. This variable was further categorized into 'irregular' and 'regular' use with answers higher or equal to '2–3 times a month' counting as 'regular' (i.e., coded as 2) and answers indicating fewer usage as 'irregular' (i.e., coded as 1).

**Child Temperament.** This variable was measured using the short temperament scale items for the extraversion, negative affectivity, and effortful control temperament type developed by Sleddens et al. (2012). Parents were asked to rate the fit of their child's behavior to all three temperament types separately (along Putnam, 2012). Consequently, each item represented its own construct and was rated on a 7-point scale ranging from  $-3 = \textit{not at all like this description}$  to  $3 = \textit{exactly as described}$ .

**Child Parasocial Attachment.** Parasocial attachment, which occurs when an individual forms a relationship with a media character (here: Google Assistant) that is emotionally tinged and, thus, similar to a real social relationship (Bond & Calvert, 2014), was measured through the 5-point Character Personification subscale ( $\alpha = 0.83$ ) by Bond and Calvert (2014; e.g., 'My child treats Google Assistant as a friend.'). Item two from the original scale (i.e., '[Child] gets sad when [character] gets sad or makes a mistake.'). was removed as the item was judged to be unsuitable for the study's scenario. Data suggested an underlying two-factor structure splitting up in a subscale for 'parasocial relationship' ( $\alpha = 0.51$ ) and 'anthropomorphism' ( $\alpha = 0.88$ ), which was conceptually in line with the original measurement. The subscale for parasocial relationship hereby referred to perceived interpersonal dimensions of seeing the VA as a trusting friend, while the subscale for anthropomorphism concentrated on VA-aspects of human like emotions, needs, and desires. Respective model fit indices of the two-factor structure were acceptable, except for the RMSEA fit index ( $.68 > 0.08$ ).

**Parental Media-Mediation Style.** This variable describes how parents choose to monitor their child's media behavior (Beyens & Beullens, 2017) and was measured via an adjusted version of the Parental Media-Mediation Style (PMMS) scale developed and validated by Beyens et al. (2019). To minimize the survey's scope, we summarized the total of twelve items, which separately referred to certain media formats (i.e., TV programs, films, computer games), into six combined items (e.g., 'How often do you prohibit your child from watching certain

TV programs/movies or playing a certain computer game?'). Those six items were measured on a 4-point scale (1 = *Never*, 2 = *Almost never*, 3 = *Sometimes*, and 4 = *Often*;  $\alpha = 0.76$ ), resulting in subscales for restrictive, negative active, and positive active mediation respectively.

**Current Usage.** Parents were asked how often their child (1 = *Never* to 6 = *Multiple times a day*) had spoken to Google Assistant independently as well as together with a parent in the past month. Based on these answers a dichotomous variable was calculated to indicate how families were 'currently' using their device (1 = parent only, 2 = usage with child, including co-usage and child independent usage).

**Number of Young Children.** This variable was assessed through an indication of how many children between the ages of 3–8 years are living in the household. Answer options varied from one child up until four or more children.

**Smart-Household-Level.** An indication of the Smart-Household-Level was provided by the number of other smart household devices (e.g., smart heating system, smart smoke detector, smart doorbell etc.) present in the home.

### 3.5. Data analysis

To build a family typology (RQ1), a Latent Class Analysis (LCA) using R-package *poLCA* version 1.4.1 (Linzer & Lewis, 2011) was employed by fitting a 2-class model up to and including a 7-class model. To facilitate calculation and interpretation of latent classes for the typology, all continuous DSMM-measure responses were converted into categories. Decisions on how to best categorize were based on the conceptual understanding of the variables' scales and their distribution in the study's sample. Unless otherwise indicated in the methods section (see 3.4.3), a median-split method for relatively normally distributed Likert scales and a modal-split method for measurements on an ordinal level were used, which always resulted in two groups scoring 'low' (coded '1') or 'high' (coded '2'; parents' age was split in two groups by the mean, while the children's age was split conceptually in pre-schoolers, i.e., age 3–5, and school-aged children, i.e., age 6–8). See supplementary online materials (i.e., Data & Analyses) on OSF for more detailed information. Naturally, this type of analysis relies on an inductive approach, where data provide the criteria and patterns along which different emerging latent classes are then described (see e.g., Bowers & Sprott, 2012; Miranda et al., 2019). After performing LCA and allocating each parent to its respective parent type, dummy variables were created to prepare for subsequent structural modelling.

To answer RQ2 and to test our preregistered hypotheses, we performed structural-equation-modelling (SEM) analysis using R-package *lavaan* version 0.6–7 (Rosseeel, 2012). SEM was chosen as it allows the simultaneous examination of a series of dependent relationships together with direct and indirect effects among latent constructs taking measurement error into account (Walker & Kim, 2015). First, for all key TAM components a correlation matrix was created based on extracted confirmatory factor scores (Table 3 in the supplementary online materials on OSF). Second, a check for missingness was employed. No missingness could be detected for the TAM-construct variables, thus, no imputation strategy was used. Third, after checking assumptions via *Quant-Psyc* R-package version 1.5 (Fletcher, 2012), which revealed deviations ( $p < 0.05$ ) from multivariate normality, the measurement model was specified, tested, and summarized via the *lavaan* function using normal maximum likelihood estimation (MLE) and the bootstrap Monte Carlo technique. Lastly, three different models were run with alternated reference groups of family types (i.e., family type 1 compared to others, family type 2 compared to others, family type 3 compared to others). Model fit criteria suggested by Hooper (2008), Hu and Bentler (1999), Kline (2015), and Kenny (2020) was used again for evaluation. To adequately account for multiple testing (Miles & Shevlin, 2000), a more conservative p-value ( $p \leq 0.0083$ ) following Bonferroni correction principals ( $0.05/6 = 0.0083$ , six total comparisons between the four family types resulting from 1 vs. 2, 1 vs. 3, 1 vs. 4, 2 vs. 3, 2 vs. 4, 3 vs. 4)

was used to judge on statistical significance.

An a-priori power simulation using *pwrSEM* (Wang & Rhemtulla, 2021) with effect sizes taken from existing related TAM-research (Abdullah & Ward, 2016; de Graaf et al., 2019; Kowalczyk, 2018) suggested that a sample size of  $N > 150$  (in accordance with Black & Babin, 2019) will be sufficient for obtaining adequate power to detect effects of interest with an exception for paths involving the variable social influence (estimated effect size of 0.20). Due to the increased model complexity by the LCA in this study, we recruited participants beyond this benchmark.

## 4. Results

### 4.1. Preregistered analyses

#### 4.1.1. RQ1 - Latent Class Analysis for family typologies

Latent class analysis was used to identify potential family typologies. As iterations for the 7-class model did not finish, only the 2- to 6-class models were further inspected. Fit indices did not converge on a single solution, which is generally the rule rather than the exception in applied LCA-practice (Nylund-Gibson & Choi, 2018). The lowest BIC and cAIC suggested a 2-class solution, whereas the lowest adjusted BIC (aBIC), shown to be most appropriate for categorical indicators (Nylund et al., 2007), existed for the 4-class solution, with class 1 holding 57 parents, class 2 holding 95, class 3 holding 103, and class 4 holding 50 parents of the sample (see supplementary online materials on OSF: Table 4 for respective fit indices, Fig. 1 for screeplots of all five different LCA solutions, Fig. 2 for probability graphs of indicators per identified class).

A multivariate analysis of variance (MANOVA) was run to understand how the four resulting typologies (classes) differed (see Table 5 in the supplementary online materials for an overview of those results on all LCA-indicators). Overall, we found clearest significant differences between classes on four variables: parents' levels of internet literacy, VA-use frequency, trust in technology, and media-mediation. Firstly, parents of class 1, 2, and 3 all showed low to medium scores for the three different media-mediation styles, which led us refer to them as 'laissez-fairs'. This was opposed to parents of class 4, who reported overall higher scores for all mediation styles and were thus labeled as 'mediators'. Secondly, while parents of classes 1 and 2 were quite similar in their trust in technology, parents of class 1 had significantly higher internet literacy levels than parents of class 2, thus their technological 'informedness' seemed best to distinguish them from each other. In contrast, trust levels most clearly differed between class 3 and 4, with parents of class 4 being more skeptical towards technology despite their highest personal VA-use frequency of all four classes. This resulted in the distinction between 'trusting' versus 'skeptical' types. Together, these observations led to the following typology (see also Table 1): class 1 *Informed-Laissez-fairs* (IL; 19% of the sample), class 2 *Uninformed-Laissez-fairs* (UL; 31% of the sample), class 3 *Trusting-Laissez-fairs* (TL; 33% of the sample), class 4 *Skeptical-Mediators* (SM; 17% of the sample).

#### 4.1.2. Hypotheses testing and RQ2 - structural equation model

**Measurement model.** Initially, fit of the measurement model was not fully acceptable ( $\chi^2 = 314.457$ ,  $p = 0.00$ , SRMR = 0.079, RMSEA = 0.087, CFI = 0.938). Based on modification indices suggesting specific changes to the measurement model, we tested the final model with a reduced social influence scale (supplementary online materials on OSF provide visualization of the improved measurement model and the revised correlation matrix in Fig. 3 and Table 6 respectively), which revealed acceptable model fit ( $\chi^2 = 214.698$ ,  $p = 0.00$ , SRMR = 0.055, RMSEA = 0.074, CFI = 0.959).

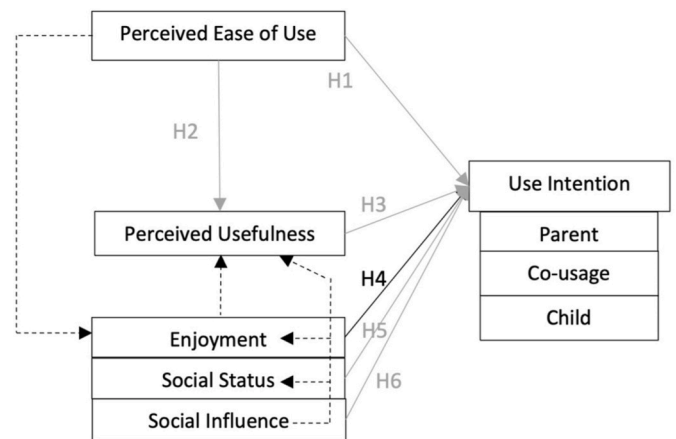
**Structural model.** Based on modification indices, revealing initially unacceptable model fit ( $\chi^2 = 1808.530$ ,  $p = 0.00$ , SRMR = 0.227, RMSEA = 0.180, CFI = 0.566), we decided on a step-wise procedure to obtain adequate fit in the final model (see changes from preregistration on OSF accordingly). Results of the added regression paths to improve

**Table 1**  
Family typology.

Family Type	Name	Class	Distribution in sample	Description
IL	Informed-Laissez-fairs	1	57 parents (19%)	Parents of this type show medium trust in technology as well as in their internet literacy level, report a medium frequency of personal VA-usage (i.e., weekly), and apply a laissez-fair media-mediation style, meaning that they have low to medium scores for restrictive, negative active, and positive active styles.
UL	Uninformed-Laissez-fairs	2	95 parents (31%)	Parents of this type rank medium on technology trust and frequency of personal VA-use (i.e., weekly). In addition, they show low internet literacy levels and apply a rather laissez-fair mediation style, meaning that they have low to medium scores for restrictive, negative active, and positive active styles.
TL	Trusting-Laissez-fairs	3	103 parents (33%)	Parents of this type are characterized by high levels of trust in technology and internet literacy. They report a medium frequency of personal VA-usage (i.e., weekly) and tend to apply a laissez-fair media-mediation style, meaning that they have low to medium scores for restrictive, negative active, and positive active styles.
SM	Skeptic-Mediators	4	50 parents (17%)	Parents of this type are characterized by low trust in technology, yet medium internet literacy levels. Parents' frequency of personal VA-usage is highest in this type (i.e., daily) compared to all other types, and parents of this type prefer to more strongly mediate their child's media behavior, which is expressed by higher scores for all three mediation styles.

model fit are reported in the exploratory analyses section of this paper (see 4.2).

Taking the adjusted significance level of  $p = 0.0083$  (see 3.5.2. above), data supported hypothesis 4 for the relationship between *enjoyment and co-usage intention* ( $b = 0.481, SE = 0.107, CI[0.26, 0.68]$ ). Hypotheses 1, 3, 5, and 6 however, were not supported as none of the regression paths between perceived ease of use, social status, or social influence and the three use intentions (parent alone, child alone, and co-usage) were statistically significant. Moreover, we found no support for the hypothesized (H2) indirect effect between the prediction of perceived usefulness by perceived ease of use. Fig. 2 visualizes all significant structural model paths including the ones added for model improvement that are reported on in section 4.2 (see Table 7 in the



**Fig. 2.** Final structural model.

supplementary online materials for a summary of all hypothesis tests with respective beta weights and confidence intervals).

*Note.* The identified structural paths held true for all family types: Bold refers to supported hypothesis H4; dotted arrows refer to additional significant regression paths; grey arrows refer to rejected regression paths (H1, H2, H3, H5, H6).

With regards to RQ2, we overall found no unique motivations for each of the four family types, indicating that the SEM-results depicted in Fig. 2 remained stable for all identified latent classes. Nevertheless, we detected a series of differences across some of the four classes in our typology (see Table 2): We found a significant difference in enjoyment scores between family type 4 (Skeptic-Mediators) and type 1 (Informed-Laissez-fairs;  $b = 0.725, SE = 0.226, CI[0.28, 1.16]$ ) as well as type 3 (Trusting-Laissez-fairs;  $b = 0.594, SE = 0.158, CI[0.29, 0.91]$ ) in that Skeptic-Mediators have a higher likelihood to report greater enjoyment ( $M = 5.54, SD = 1.03$ ) than Informed-Laissez-fairs ( $M = 4.83, SD = 1.29$ ) and Trusting-Laissez-fairs ( $M = 4.81, SD = 1.49$ ). We also found a significant difference in social influence between family type 3 (Trusting-Laissez-fairs) and type 2 (Uninformed-Laissez-fairs;  $b = -0.594, SE = 0.198, CI[-0.98, -0.20]$ ) as well as type 4 (Skeptic-Mediators;  $b = 0.788, SE = 0.295, CI[0.22, 1.38]$ ) in that Trusting-Laissez-fairs are likely to perceive less social influence ( $M = 2.19, SD = 1.25$ ) than Uninformed-Laissez-fairs ( $M = 2.78, SD = 1.51$ ) and Skeptic-Mediators ( $M = 2.98, SD = 1.79$ ). Table 3 provides an overview of descriptive statistics on all TAM-constructs per family type.

#### 4.2. Exploratory analyses

Post-hoc added regression paths to improve SEM-fit revealed additional significant indirect effects (see Table 8 in the supplementary materials). First, perceived ease of use positively related to enjoyment ( $b = 0.693, SE = 0.086, CI[0.52, 0.86]$ ), and enjoyment showed a significant positive relationship with perceived usefulness ( $b = 0.561, SE = 0.089, CI[0.38, 0.73]$ ). Second, we found a positive association between social influence and perceived usefulness ( $b = 0.247, SE = 0.061, CI[0.13, 0.37]$ ), enjoyment ( $b = 0.121, SE = 0.046, CI[0.04, 0.22]$ ), as well

**Table 2**  
Significant differences in enjoyment and social influence scores across family types.

Motivation	Family Type Comparison	$\beta$	SE	CI
Enjoyment	SM vs. IL	0.725	0.226	[0.28, 1.16]
Enjoyment	SM vs. TL	0.594	0.158	[0.29, 0.91]
Social Influence	TL vs. UL	-0.594	0.198	[-0.98, -0.20]
Social Influence	TL vs. SM	0.788	0.295	[0.22, 1.38]

*Note.* IL = Informed-Laissez-fairs (type 1), UL = Uninformed-Laissez-fairs (type 2), TL = Trusting-Laissez-fairs (type 3), SM = Skeptic-Mediators (type 4).



**Table 3**  
Descriptive means and standard deviations of all TAM + U&G model components for each established class.

Components	Overall (N = 305)	Informed- Laissez-fairs (n = 57)	Uninformed- Laissez-fairs (n = 95)	Trusting- Laissez-fairs (n = 103)	Skeptic-Mediators (n = 50)
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Perceived Ease of Use	5.13 (1.26)	5.23 (1.17)	5.03 (1.15)	5.09 (1.38)	5.26 (1.31)
Perceived Usefulness	4.29 (1.35)	4.09 (1.30)	4.42 (1.16)	4.10 (1.47)	4.64 (1.42)
Enjoyment	5.03 (1.25)	4.83 (1.29)	5.11 (0.95)	4.81 (1.49)	5.54 (1.03)
Social Status	3.74 (1.96)	3.54 (1.80)	3.63 (1.79)	3.55 (1.95)	4.54 (2.28)
Social Influence	2.60 (1.51)	2.71 (1.55)	2.78 (1.51)	2.19 (1.25)	2.98 (1.79)
Use Intention – parent	3.38 (1.82)	3.56 (1.81)	3.37 (1.68)	3.25 (1.85)	3.46 (2.04)
Use Intention – co-usage	5.34 (1.41)	5.07 (1.57)	5.38 (1.68)	5.13 (1.64)	6.04 (0.86)
Use Intention – child	4.56 (1.85)	4.09 (1.96)	4.79 (1.53)	4.29 (1.96)	5.22 (1.81)

Note. Means refer to average sum scores of all components except for Social Status and the three Use Intention variables which represent the actual scores (due to one-item scales).

as social status ( $b = 0.365$ ,  $SE = 0.090$ ,  $CI[20, 0.55]$ ). See dotted arrow pathways in Fig. 2.

Moreover, MANOVA results between the family types and three levels of use intention showed differences between parents' co-usage and child-independent use intentions (Pillai's Trace = 0.073595,  $F(3, 9) = 2.5232$ ,  $p = 0.007$ ; see Table 3). Specifically, Skeptic-Mediators ( $M = 6.04$ ,  $SD = 0.86$ ) had a significantly stronger co-usage intention compared to parents of the other types (IL:  $M = 5.07$ ,  $SD = 1.57$ , UL:  $M = 5.38$ ,  $SD = 1.12$ , TL:  $M = 5.13$ ,  $SD = 1.64$ ). They also had a significantly stronger intention to let their child use the virtual assistant independently in the near future ( $M = 5.22$ ,  $SD = 1.81$ ) compared to Informed-Laissez-fairs ( $M = 4.09$ ,  $SD = 1.96$ ) and Trusting-Laissez-fairs ( $M = 4.29$ ,  $SD = 1.96$ ).

Lastly, we explored how the proposed TAM + U&G framework would unfold in SEM analysis without the inclusion of the family typology. Testing the model with the adjusted social influence measurement and five of the seven model modifications (i.e.,  $PU \sim E$ ,  $E \sim PEoU$ ,  $UI_2 \sim UI_3$ ,  $PU \sim SI$ ,  $SS \sim SI$ ) revealed acceptable fit ( $\chi^2 = 289.337$ ,  $p = 0.00$ , SRMR = 0.078, RMSEA = 0.069, CFI = 0.952) and largely overlapping significant paths compared to the total model (Table 9 in the supplementary online materials provides an overview of those results).

## 5. Discussion

Despite the rapid growth of the VA-market niche among families with young children, we know little about whether different types of families have different motivations for different forms of VA-usage. Thus, in order to identify different types of VA-adopting families and to establish their motivations for specific VA-use forms (i.e., parent alone, child alone, co-usage), we investigated a sample of 305 Dutch smart speaker-adopter parents with young children aged 3–8 years.

### 5.1. Four key indicators to distinguish families

According to our identified 4-class typology (RQ1), parents in this study's sample most meaningfully differed along four dispositional and social/contextual susceptibilities. Those were: internet literacy, VA-use frequency, trust in technology, and preferred degree of mediation. Finding those variables to be crucial in differentiating between individual media technology users largely corresponds with previous research, as it explicitly explains knowledge resources (here: internet literacy) and experience (here: VA-use frequency; Goldenthal et al., 2021; Guner & Acarturk, 2020; Helsper, 2012a; van Deursen et al., 2016) as well as trust in technology (Gulati et al., 2019) to be important factors paving (or complicating) individuals' technology acceptance. Furthermore, differences found in families' preferred degree of mediation align with conclusions from existing work that finds parenting styles to have a key-distinguishable function among parents (Beyens & Beullens, 2017; Broekman et al., 2016).

Yet, although those four indicators help shaping our family typology in this study, they do not follow logical heuristics when considered together. For example, one might anecdotally have thought that 'the more often parents use their VA, the higher their internet literacy and trust scores, and the weaker their need for mediation'. Instead, when being combined together in the four classes, the combination of different expressions on those four indicators reveals rather unexpected groupings (i.e., Skeptic-Mediators have highest VA-use frequency albeit lowest trust scores, Uninformed-Laissez-fairs report medium trust and use frequency paired with a laissez-fair mediation style despite low literacy levels). To us, this suggests that a subpopulation-approach, as taken here via the LCA, can better reflect families' heterogeneity than the traditional independent consideration of individual criteria that is more typical for the field.

Besides the identified four key indicators, we additionally see, in line with work by Kay (2012), that the implementation of smart-home technology is not limited to mainly wealthy and tech-savvy households (Gerbner et al., n.d.; Lorenz & Kapella, 2020, pp. 1–44), as we did not find SES to be a significant distinguishing factor in our typology. A potential reason for this could be the sample's specification or perhaps the affordable price (i.e., about 30 EUR) of a smart speaker today. Similarly, no overall significant distinguishable function of gender or age could be identified, although anticipated based on existing literature (Ferreira et al., 2017; Hagen, 2007); just as with the role of the child's temperament and tendency for parasocial attachment (Bond & Calvert, 2014; Nabi & Krcmar, 2016). Here though, we want to point out that, since reliability of the parasocial relationship subscale was only of low reliability ( $\alpha = 0.51$ ), our null-finding could actually be attributed to weaknesses in measurement. Future research is needed for clarification.

To conclude, when aiming to target a heterogeneous sample of VA-using families in future (intervention) studies, we recommend not using solely static individual characteristics such as gender, age, or SES, but instead advice researchers to consider distinguishing factors such as internet literacy, use frequency, technology trust, and mediation style as meaningful malleable study criteria to identify subpopulations when investigating complex social network structures like families. Not only can this allow to better capture a diverse sample, but also to more precisely identify families' needs for and effects of technology use practices in the home. Here, we explicitly note that this research zoomed in on the Dutch family culture around technology acceptance. While VAs still form an emerging home technology in the Netherlands, this is certainly neither necessarily applicable across cultures nor independent of historical developments. Replication attempts over time as well as cultural comparisons are thus welcome additions to the field.

### 5.2. Hedonic-utilitarian hypothesis and Co-use practices

The application of the TAM + U&G model supported our hedonic-hypothesis specifically for parents' co-use intentions in that the VA's aspects of enjoyment are associated with parents intention to use the VA

together with their child(ren). Enjoyment has already been found to be crucial in previous work on conversational agents (e.g., Ischen et al., 2020) and other interactive technology (Roth & Koenitz, 2016), inferring the technology to become its own experiential communication entity with positive effects on users' behavioral intentions. Interestingly though, while the dominant role of enjoyment particularly aligns with research looking at families' use of technology (e.g., Beirl & Rogers, 2019; Broekman et al., 2016; Bentley et al., 2018), it seems to be less of a relevant factor in existing TAM research on smart speaker acceptance by average aged adults in a single-user context (McLean & Osei-Frimpong, 2019). Future research on VA-use motivations should therefore carefully consider the specific user population when it comes to identifying enjoyment needs.

Based on the novelty of VAs within families, we further initially hypothesized ease of use to be an important influence of parents' perceived usefulness as well as their use intentions directly. Instead, we found that *the easier parents find the VA to operate, the higher their enjoyment, and the higher their enjoyment, the higher their perceived usefulness*. It seems that fewer hurdles in operating the device (ease of use) might lead to less frustration and, thus, increase chances to experience pleasure (enjoyment). This, in turn, can result in a utility for parents (usefulness), which manifests itself, for instance, in family dynamics and organizational habits, when parents use media to entertain or simply occupy their child by technology (Beirl & Rogers, 2019; Bentley et al., 2018; Garg & Sengupta, 2020). Based on these findings, we therefore want to give voice to a potentially emerging hedonic-utilitarian hypothesis that might unite motivations of enjoyment with aspects of usefulness and ease of use when it comes to the adoption of VAs. As the detected pathway was unexpected, we encourage future scholars to further investigate this hedonic-utilitarian hypothesis. For this, we see most value in focus group or interview studies to first gain a better understanding of parents' motives, which can then in a second step be tested in an experimental setting where aspects of the device or contextual factors (e.g., home situation) are manipulated. If proven to be robust, the intertwinedness of hedonic and utilitarian motivation can be of great value for developers and future scholars to better define the functionality of a VA for the family home (e.g., 'babysitter' or 'entertainer' along Cingel & Kremer, 2013). Especially families that are generally more involved in their child's engagement with the VA (i.e., Skeptic-Mediators) would form particularly promising study targets, as we found them (based on exploratory findings) to report not only greater enjoyment (as well as usefulness scores, although not statistically significant) but also higher co-usage and child independent use intentions.

Lastly, there seems to be something interesting at play between mediation and enjoyment. Specifically, recall that we found that parents in our sample, who mediate their child's media behavior more strongly (i.e., by that reporting higher scores for positive active, negative active, and restrictive mediation), report higher enjoyment scores *as well as* higher co-use intentions. Given this pattern, we can assume that monitoring one's child's media behavior, and with that potentially also the interaction with the VA, might create moments of joyful co-usage in and of itself. Although this indeed might point towards a unique asset of VAs, we are careful with concluding that a stronger mediation is always the best way to go, as existing scholarship on parent-child media interaction provides arguments for potential boomerang effects of restrictive and especially inconsistent mediation (Meeus et al., 2019). Future research which disentangles and tests effects of different media-mediation styles on VA-use practices in the family home would be a welcome addition to the field. With further empirical inquiry, policy advisors (e.g., UNICEF, UNCRC) and intervention scholars can then be guided in designing targeted campaigns to promote a 'healthy' balance for monitoring children's engagement with emerging smart-home technology to further exploit its potential for the family home.

### 5.3. Underestimated impact of social influence

Surprisingly, results showed no significant direct effect of social and symbolic motivations for parents' intentions to use their VA in the family context, regardless of which form of VA-usage whatsoever. Since existing research overall agrees on the influential role of social norms on technology adoption, we reason that those components could actually matter more for families who do not yet own a smart speaker and are asked about their purchasing intention instead. An empirical investigation of a non-adopter sample would be insightful here. Additionally, more precisely locating users (i.e., long-time user versus recent adopter) and measurement components (i.e., expected usage versus experienced usage) on the journey of technology use will better explain causal reactions.

For social influence, though, we do in fact see positive indirect relationships via other motivations (i.e., perceived usefulness, enjoyment, social status) as well as a significant difference between three of the four family types (i.e., Trusting-Laissez-fairs significantly lower than Uninformed-Laissez-fairs and Skeptic-Mediators). Due to the novelty of VAs in the family home and the lack of personal references to own childhood experiences, as this technology did not exist at the time of parents' own childhoods, parents who are less informed or generally more skeptical towards technology might seek for more social orientation than other parents do or than they would for other already more established media devices. We therefore encourage scholars to particularly consider the component of social (peer) motivation in future investigations.

### 5.4. Theoretical and methodological implications

As the extension of TAM by mechanisms of U&G theory identified a crucial but unexpected interplay of hedonic and utilitarian motivations, we see the need for conversation about fundamental mechanisms (ease of use and perceived usefulness) of technology acceptance and extended gratifications from emerging smart-home technology (following the idea of U&G 2.0 by Sundar & Limperos, 2013).

Strictly speaking, TAM was developed in the very early stages of today's digital society. However, just as society has evolved in their engagement with technology (e.g., wider access to and greater affinity with technological devices in everyday life), theory with which we aim to model underlying mechanisms of this engagement needs to be adapted accordingly or perhaps even changed more fundamentally. Especially with their new functionalities and affordances, VAs form new media (Sundar & Limperos, 2013) that traditional technology acceptance models might be no longer able to cover, even with respective extensions. As parents had on average surprisingly high perceptions of the VA's ease of use ( $M > 5$  for all family types) without any direct effect on their use intentions, we want to raise awareness for the possibility that TAM's core component 'ease of use' takes up a different role in our model and perhaps in the study of VA-use more generally. In other words, the different, and potentially lower affordances of voice-controlled technology compared to those required in the early phase of computers might redistribute the weight of factors predicting technology acceptance altogether.

Having said that, we agree with McLean and Osei-Frimpong (2019) and encourage stronger adaptation of technology acceptance for modern innovations that regard VAs more as social characters. We did not focus on this in the present study, but expect social aspects of technological entities to become increasingly important especially when aiming to increase enjoyment with the device in the family environment. Scientific literature would theoretically benefit from investigations that compare a series of different existing (e.g., the UTAUT with the TAM + U&G model) as well as adapted models that revisit not only extensions of TAM, but also TAM's core mechanisms (i.e., indirect and direct relationships of perceived ease of use) and consider potentially upcoming factors (e.g., VA as a social companion).

Furthermore, while we indeed find differences in certain individual DSMM-characteristics among families, which led us to the formation of four types, we do not find distinct differences in perceptions of and use intentions for VAs across them. Theoretically speaking, this means that individual dimensions are not necessarily associated with unique motivations for using a VA in the family home, at least not in this sample. Nevertheless, as this study mainly looked at the media selection stage of the DSMM, the actual impact of individual differences on cognitive, emotional, and excitative responses to VAs may indeed occur later in time (i.e., on the media effects stage, Valkenburg & Peter, 2013). Further research is necessary to test this.

Methodologically speaking, the combination of analyses (i.e., LCA and SEM) formed a fruitful approach to better summarize subpopulations of families within our sample along a selection of individual characteristics and to model out a series of structural relationships among the latent theoretical constructs. Integration of those two approaches, however, is not without challenge. Specifically, by trying to best capture the complexity of different manners of VA-use by investigating differences between families (and between family members even) in conjunction with diverse motivations, the model itself naturally becomes incredibly complex. Nevertheless, to evaluate how robust the four identified indicators are for distinguishing between families and their technology use, the methodological approach used in this study can further be translated to different samples, use stages, as well as types of technologies to expand knowledge on technology adoption.

Finally, we want to emphasize implications of our measurement adjustment of the social influence scale. We initially added a third item to capture parents' own contribution to norms around adopting and using a VA in the family home, since we were looking at fairly early adopters that might act as advocates for or against VA-usage themselves. However, given that we found our measurement to be relatively weak (see section 3.4.2), we conclude that the adherence to and setting of social norms indeed reflect different angles on social influence, and thus theoretically represent separate constructs, which should therefore be in the future practically investigated using separate assessments.

### 5.5. Limitations

Despite the novel insights of this study, its preregistered framework, and innovative analytical approach of combining LCA with SEM, findings should be interpreted through the lens of the following limitations:

Perhaps most notable are two statistical pitfalls. First, even though the choice for the 4-class solution was well-justified by the LCA-fit indices and conceptual understanding of the typology, we want to emphasize the existence of those classes for this specific sample and the interpretative freedom in the LCA evaluation. Second, although we arrived at fairly acceptable SEM-fit, we underwent measurement adjustment (for the social influence scale) and made several model additions. Post-hoc drawn regression paths should therefore be processed with additional reflection as mentioned in the discussion (5.).

Also, due to the cross-sectional nature of this study, we cannot be confident about the directional relationship between model components. Although our hypotheses were theoretically guided, it is possible that, for instance, more co-usage actually leads to more enjoyment. Longitudinal and experimental research is needed to test for causal pathways.

Further, the study's data stemmed from parents' self-reports. The decision to survey parents was based on the gap in existing literature on individual characteristics of families and their use motivations as well as on empirical evidence that strengthens the robustness of parental indicators for children's media use (Meeus et al., 2019). Despite those reasons, our approach relied upon self-reports that almost always face issue of social desirability (especially when it comes to reporting on one's child's behavior). This subsequently could have influenced the formation of family types and the SEM-results. To more thoroughly account for the bi-directional interplay between VA-use and family

connectedness, researchers might want to employ an ethnotheoretical approach (Plowman, 2015) for a complementing or even alternative viewpoint on VA-acceptance in the family home. For example, follow-up studies might tap more closely into the process of domestication (Silverstone, 1993) of a VA in the home to explore the family space and more concrete use practices of parents and children. Furthermore, additional qualitative research on parents' and children's perception of VAs as well as their reasoning behind using it in the family context would be a meaningful addition to this field.

## 6. Conclusion

The rapid rise of VAs in the family home created the need for empirical inquiry to better understand whether different *types of families* have different *motivations* for different *forms of VA-usage* (i.e., parent only, child only, co-use). Findings of this study contribute first ground. We found that families in this sample are mostly distinguishable by their internet literacy skills, VA-use frequency, trust in technology, and preferred degree of parental media-mediation. This unique family clustering supports taking a subpopulation approach to better capture user heterogeneity and target family user populations in future interventions and policy campaigns. Structural analysis between VA-use motivations and intentions did not always show expected associations between individual dimensions and unique use-motivations. However, they did highlight the power of enjoyment motivations in predicting co-usage intentions. Moreover, they highlight how enjoyment is an important linking element between utilitarian motivations (ease of use and usefulness) and use. Looking ahead, it seems there is much to be gained from continued understanding as to how VA-devices may jointly meet the utilitarian and hedonic needs of families.

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## Author statement

**Rebecca Wald:** Conceptualization, Methodology, Data collection, Formal analysis, Writing – Original Draft, Writing – Reviews & Editing, Visualization, Project administration. **Jessica Taylor Piotrowski:** Conceptualization, Methodology, Writing – Review & Editing, Funding acquisition, Supervision. **Theo Araujo:** Conceptualization, Methodology, Data collection, Writing – Review & Editing, Supervision. **Johanna M.F. van Oosten:** Conceptualization, Methodology, Writing – Review & Editing, Supervision.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Our data is shared on OSF: <https://osf.io/629b7/>

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.chb.2023.107526>.

[org/10.1016/j.chb.2022.107526](https://doi.org/10.1016/j.chb.2022.107526).

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