Special Issue Article

# Hey Google! Intelligent personal assistants and well-being in the context of disability during COVID-19

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## Abstract

*Background*   Amidst the greatest technological advancement that societies have seen, the (health)care and quality of life of all, and especially of vulnerable individuals, see unprecedented improvements. Intelligent personal assistants (IPAs), such as Google Home (GH), can easily be implemented in their daily lives to facilitate routines. Technology can offer significant benefits for individuals with impairments and/or limitations in achieving greater autonomy and well-being. However, this opportunity still needs to be fully exploited, especially in long-term care facilities. Furthermore, such potential may be particularly needed during social isolation due to health concerns, such as the COVID-19 lockdowns and restrictions. We investigated the validity of implementing GH in residential care for individuals with visual impairments (VIs) and intellectual disabilities (IDs) and assessed the effects of a 10-week intervention on self-reported well-being.

*Methods*   We used a mixed-methods multiple case studies approach ($N = 7$) and performed intensive assessments (20 weeks), including self-report well-being questionnaires and observations focusing on well-being, autonomy, social participation and GH experiences. Nonoverlap of all pairs analyses were performed for quantitative data indexing performance differences between intervention phases. Thematic analysis was performed for the qualitative data.

*Results*   We found meaningful improvements in well-being in five clients, while all rated the experience of using GH positively.

*Conclusions*   Our findings from the quantitative and qualitative analyses document that individuals with VI and/or ID benefit from IPAs in fostering better autonomy by facilitating access to information and entertainment. Further implications and possible barriers to large-scale implementation of IPAs in residential care are discussed.

**Keywords**   COVID-19, Google Home, intellectual disabilities, intelligent personal assistants, residential care, visual impairments

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## Introduction

Individuals with intellectual disabilities (IDs) require specialised care and support due to their unique health conditions. ID is a broad term to describe a neurodevelopmental condition with the onset of intellectual and adaptive functioning in early life (infancy through adolescence). This is characterised by deficits in reasoning, problem solving, planning and learning, encompassing conceptual, social and practical domains (Schalock *et al.* 2010). Prevalence studies indicate that approximately 1% of the global population have an ID (Maulik *et al.* 2011), and among this group, 4% also exhibit additional sensory disabilities, such as visual impairments (VIs; Dunn *et al.* 2020; van Splunder *et al.* 2006). The spectrum of functioning depends on the severity: from mild to profound deficits, with 85% of the ID population presenting mild disability (Patel *et al.* 2020). The extent of care needed depends on the interplay between the severity of the disability and various environmental barriers such as architectural, informational, technological, organisational and attitudinal (Thompson *et al.* 2009; World Health Organization 2015). The more-than-care framework, proposed by van Holstein *et al.* (2022), offers a novel perspective on the vulnerabilities and care needs of individuals with ID. This perspective shifts the responsibility for care from the care providers to the broader environment and circumstances in light of the potential danger of viewing care as an imbalanced dependency relationship between the client and the caregiver. Indeed, the nature of care that individuals with ID receive can significantly impinge on their autonomy and, subsequently, their psychological well-being and self-worth (Petner-Arrey & Copeland 2015; Salt & Jahoda 2020; Wehmeyer 2020). Thus, it takes great attention to design in a care plan that identifies the unique needs and capacities of each client and provides adequate support while promoting autonomy (Deci & Ryan 2002; Lievense *et al.* 2019).

The advancements in technology and its affordability have created the possibility of integrating intelligent personal assistants (IPAs) into the care of individuals with disabilities, which may improve their quality of life. Artificial intelligence reached unprecedented milestones in realising interactive dialogue systems between human users and technology, such as Amazon Alexa and Google Nest/Home, to mention just the most affordable on-the-shelf available systems. These systems process different user input modalities, like touch, voice commands, movement sensors and gaze, and integrate numerous machine learning-based technologies to learn about the user and their needs: optimising facial, gesture, speech recognition and intelligibility. With such vast capabilities, devices supporting this technology show vast potential in education, health care, disabilities systems and home automatisation domains (Këpuska & Bohouta 2018). While such technological advances facilitate and entertain typically developed users' lives, they may represent a paradigm shift in the care and development of users with disabilities. Indeed, a recent review of the literature revealed that smart home technology improves psychosocial outcomes for individuals with disabilities, particularly for those with cognitive impairments and complex needs. Nevertheless, the integration of IPAs into the care and autonomy-supporting goals for people with disabilities is still in its infancy (Jamwal *et al.* 2022). To date, research on assistive technology for individuals with disabilities has mainly focused on providing aid in educational settings (e.g. use of multimedia and smart pens; Perelmutter *et al.* 2017) and telecare (e.g. camera for remote support care; Perry *et al.* 2009; Taber-Doughty *et al.* 2010; Tassé *et al.* 2020), showing promises in clients' improved independence. Notably, the focus seems to primarily be on facilitating the delivery of care, especially in the context of service providers under strain due to high demands, which are expected to further increase in line with the goal of fostering more independent community-integrated living (Taber-Doughty *et al.* 2010).

By taking the more-than-care approach described earlier, the use of IPAs should be seen beyond essential care, namely, in light of empowerment and a sense of agency, by providing the possibility of self-choice and not merely assistance. To this end, only a few reports have been published. One pilot project in the UK implemented an Amazon Echo device in the homes of five users with disabilities, reporting an improved sense of empowerment and independence across 5 months (Vass 2018). In another study, content analysis of Amazon Echo reviews of clients with disabilities revealed increased independence in using the device in the home, demonstrating the immense potential of IPAs to narrow digital accessibility barriers in this population

(Pradhan *et al.* 2018). A case study corroborated these findings with clients using Google Assistant on a smartphone (Lancioni *et al.* 2022a; Lancioni *et al.* 2022b). Home-based devices, however, have the advantage of mitigating the physical challenges of holding the device and mobility-related issues in the context of VIs and/or physical disabilities. To our knowledge, only one study investigated the effectiveness of mainstream home-based IPAs (i.e. Amazon Echo or Google Home) in promoting a sense of agency and well-being in individuals with ID during 12 weeks of use, showing general positive evaluations of the impact of the device on clients' lives (Smith *et al.* 2020) and improvements also in communication (e.g. intelligibility in the voice commands; Smith *et al.* 2021). More recently, these findings were replicated in a longitudinal study with clients with physical and visual disabilities (Vieira *et al.* 2022).

The potential use of IPAs to enhance the quality of life of clients with ID may be particularly salient in periods of crisis. Amidst the COVID-19 pandemic outbreak in the early months of 2020, the (health)care system was under profound strain, leading to precarious conditions in vulnerable populations (Wright *et al.* 2020). To abate the exponential number of infections and death toll, long-term care facilities, including those for individuals with disabilities, implemented no-visit policies. In the Netherlands, 1.7 million people have an ID (Ministerie van Volksgezondheid, Welzijn en Sport 2022), and three-quarters live in long-term home-care facilities due to the complex nature of their ongoing care needs (Wullink *et al.* 2007). Studies at the time of COVID documented worrisome incidences of aggression (Schuengel *et al.* 2020) and the enormous impact of visitation restrictions on clients' and parents' emotional well-being (Honingh *et al.* 2022). In one study, professional carers reported decreases in the quality of care for their clients with ID, deeming digital communication insufficient to clients' social needs (Scheffers *et al.* 2021). In a scenario of reduced social contact due to social isolation, limited visits and other in-person activities, clients whose needs and care partly or largely depend on others may especially benefit from using an IPA. Accordingly, the current study investigated the social validity and the effects of a Google Home device on well-being in the personal apartment of clients with ID and VI in two long-term care facilities in the Netherlands during the COVID-19 pandemic. Firstly, social validity refers to assessing the significance and acceptance of an intervention (for a recent review, see Snodgrass *et al.* 2022), such as integrating an IPA in clients' daily lives in residential care for individuals with disabilities. Testing social validity in this study can provide insights into the effectiveness of the intervention, identify its strengths and weaknesses and determine whether the study's results can be translated into practical outcomes and policies. It is essential in this study because it evaluates whether clients perceive the study's results as necessary, relevant and acceptable. Secondly, bearing in mind the previously reviewed evidence suggesting the benefits of integrating IPAs in the care of clients with disabilities, we hypothesise that utilising a personal device (i.e. Google Home) will improve psychological well-being and will provide a higher sense of autonomy and social participation. Next, qualitatively examining clients' experiences with Google Home and evaluating psychosocial outcomes and use-related challenges will provide invaluable insights into the redesign of care during technological revolutions within the more-than-care paradigm.

## Methods

### Participants

Seven Dutch-speaking clients with mild to moderate ID and VI were recruited from two home-care facilities in the Netherlands throughout 2021. Two clients also presented with a motor disability. The mean age was 51.14 years (range 33–67 years). All clients were trained in conducting practical and industrial routine jobs. Most clients needed supervision with daily tasks, such as cleaning up or cooking. Some were able to do their laundry; one was able to operate the TV, the remote control or a game console. Some clients were able to pour coffee, some to load the dishwasher and two also to go to the shops. Only one client was able to read and send emails, and only one other had a smartphone.

Upon agreement with two long-term care facilities, the study and intervention were explained orally and in writing to employees, supervisors, clients and their legal guardians when applicable that was connected to the site. The study required a stable Wi-Fi connection. As customary in our lab, we worked with

co-researchers with mild IDs, as part of our research team, to create, adapt and test the documents and instruments we then use in subsequent studies. Also, in this study, a simplified version of the Data Protection Impact Assessment, suitable for clients with IDs and checked by the co-researchers, was used to provide clear information to all residents about the user data collected by Google Home. Those who were willing to place a Google Home device in their room were approached to participate in the study through a separate simplified information letter and consent form signed by the client and/or a legal guardian acting on their behalf. In all cases, clients were supported to understand the material they were presented with and had opportunities to discuss the study with their supervisors, legal guardians and the researchers visiting the site. Before the study commencement, they had to orally consent to the placement of the device and voluntarily participate in the initial set-up phase of the device. Clients were also informed that they could stop using the device and remove it from their room without any consequence. The study was approved by the Ethics Committee of the Vrije Universiteit Amsterdam (METc VUmc: 2021.0083) and was conducted in accordance with the Declaration of Helsinki. The Google Home device was made available to clients in their apartments and, with everyone's permission, in the communal living room. The clients were allowed to stop their participation at any time and were compensated by being able to keep the device at the end of the study. Researchers and staff involved in the collection and processing of data signed a confidentiality statement before receiving access to the data. Research data were stored on a secure university server and were exchanged via *mSafe*.

## Procedure

On each site, one researcher helped with the initial steps of the Google Home device by explaining how to give a command. One client received the instructions on paper in a big letter font. In two cases, they also used a memo recorder for the instructions so that clients could listen and practise with them at any time. Throughout the intervention, clients could always approach the supervisors for support.

As illustrated in Fig. 1, the baseline phase was set to take place over 4 weeks; the social validity of the

Google Home device was assessed with the Social Validity Scale (SV; Seys 1987) before the commencement of the intervention. Throughout the
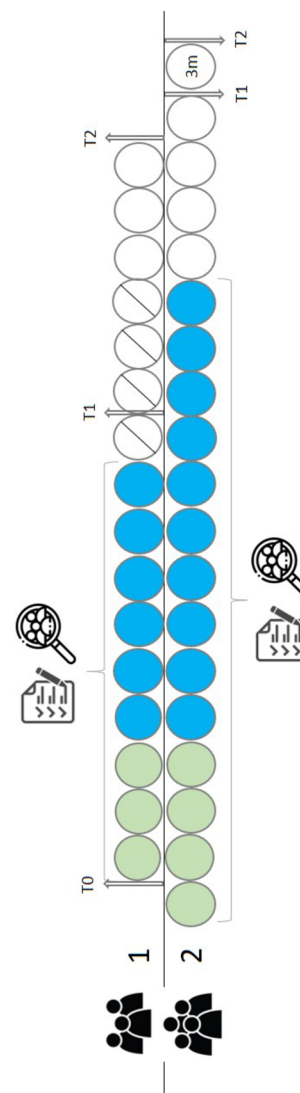


**FIGURE I.** Study design. The figure illustrates the phases of the study and the assessments performed. Horizontally, each site (1 and 2) is illustrated with icons indicating the number of clients participating at each site, respectively 3 and 4. The circles indicate the weeks: the green-coloured ones indicate the baseline phase that starts at T0. The additional icons indicate the questionnaire and observation assessments throughout the baseline and the intervention period. The blue-coloured circles denote the weeks of the Google Home intervention. The crossed white circles denote planned but missed assessments. The white circles indicate the weeks in which no assessments were performed preceding the T1 (post-intervention assessment) and T2 (follow-up assessment). 3m, 3 months.

baseline, the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS; Tennant *et al.* 2007) was administered by a research assistant twice a week, either in person or telephonically. During the intervention phase, which was planned for 10 weeks, questionnaire data were collected once a week. Weekly observations complemented the questionnaires for approximately 1- to 1.5-h duration, performed by a researcher visiting the sites. Following the intervention, social validity was assessed again (T1) and at follow-up (T2). Details of the instruments are provided in the succeeding text.

Note that the study took place throughout 2021, and as such, the times of the assessments were slightly varied across the two sites due to alternating COVID-19 lockdowns. Indeed, as can be inspected in Fig. 1, the baseline phase at site 1 was only possible for 3 weeks instead of 4 weeks due to the start of a new COVID-19 lockdown phase. Moreover, prior to the start of the study, the social validity of the Google Home device was assessed at site 1 only due to difficulties in planning the assessment at site 2. The observation of weeks 7 and 8 did not occur at site 2 due to a COVID-19 lockdown. Next, follow-up assessments at site 2 took place 3 months after T1 due to COVID-19 lockdowns. The intervention also differed with respect to duration, with site 1, only having a 6-week intervention and site 2 having a 10-week intervention.

## Instruments

### *Quantitative measure*

Well-being was assessed using the WEMWBS (Tennant *et al.* 2007), a 14-item self-report instrument. Clients rated their responses to each item on a 5-point Likert scale, with all items framed positively (e.g. 'I feel relaxed'). The scale was unidimensional, with a total score ranging from 14 to 70, with higher scores indicating higher levels of well-being (Hoffman *et al.* 2019). Previous studies have demonstrated the feasibility of the WEMWBS for use in vulnerable populations, including individuals with disabilities (Leck *et al.* 2015). In our study, clients completed the questionnaire twice a week during the baseline phase and once a week during the intervention phase. The questionnaire was also administered at T1 for all clients and T2 only at site 1. The instrument showed good psychometric

properties with high internal consistency, with Cronbach's alpha coefficient of 0.89 and high test–retest reliability of 0.83.

### *Qualitative measures*

The study predetermined four themes to be assessed through semi-structured observations over a 1- to 1.5-h period each week during both the baseline and intervention periods: well-being, autonomy, social participation and Google Home experience. Observations were interrupted throughout weeks 7 and 8 of the intervention at site 2 due to the COVID-19 lockdown. The observations were guided by specific questions, such as 'Does the client ask for help using the Google Home device?'. The observation scripts and conversation reports were coded by a second coder for reliability, with 33% of the reports being coded, resulting in an agreement of 82.0% for autonomy, 83.3% for social participation, 69.3% for well-being and 57.9 for Google Home experience. The inter-rater reliability was determined to be good, with Krippendorff's alpha of 0.83.

Social validity of the Google Home device was evaluated using the SV (Seys 1987) with adaptations from the Technology Acceptance Model (Silva 2015). At three phases of the intervention, slight modifications of this questionnaire were used to match clients' acquired experience with the device (baseline T0 included 13 items, after-intervention T1 included 17 items and follow-up T2 included 7 items). An example item only used at T0 was 'Have you ever used a digital personal assistant device?'; at T1 was 'Is this your first time using the Google Home device?'; and at T2 was 'How much help did you need to use the Google Home device throughout the study?'. Each item was multiple choice with space for comments in the succeeding text. T0 was only administered to site 1 due to unforeseeable health concerns of the responsible researcher and planning difficulties. The questions assessed experience with technology, enjoyment, self-efficacy, perceived usefulness, ease of use, intentions of use and subjective experiences. The questions were framed in clients' expectations prior to the intervention and their experience with the device during and after the intervention. Clients were encouraged to elaborate on their responses, particularly at T1 and T2, to gain a deeper understanding of the usability of the IPA. No

elaborations were noted during T0, while at T1, comments were noted for 31% of the given answers and at T2 for 90% of the answers.

## Statistical analyses

Descriptives of the sample are reported. Next, a mixed-methods multiple case studies design with $N = 1$ was adopted in the study, collecting both qualitative and quantitative data. The quantitative data were analysed using SPSS (version 27.0, IBM Corporation, Armonk, NY). Nonoverlap of all pairs (NAP) was used to analyse the quantitative data and investigate the well-being differences between the baseline, intervention and post-intervention phases. Nonoverlapping data are a well-established indicator of performance differences in single-case research. The NAP approach specifically is an index of the data overlap between one phase and another phase of an intervention and is equal to the number of comparison pairs that show no overlap divided by the total number of comparisons. This approach relies upon the area under the curve statistics but is more appropriate for single-case research data than parametric tests, given that the nature of these data often violates the assumptions of parametric tests (Parker & Vannest 2009). For site 1, NAP scores were calculated from baseline–intervention–follow-up, whereas for site 2, only baseline–intervention. The NAP test scores were expressed as a percentage with a range of 0–100%, and effect sizes were classified as small (0–65%), medium (66–92%) or large (93–100%).

Thematic analysis was performed on the qualitative data using Atlas.ti, clustering themes from observation reports and conversations concerning well-being, autonomy, social participation and Google Home Experiences. These themes were predetermined, thus also known as theoretical themes, because they were driven by the research question rather than freely inducted from the text analyses and were coded to capture patterned data in clients' reports of their experiences throughout the intervention phase. This analysis aimed to identify underlying subthemes, conceptualisations and ideas of the clients around the central themes' (Braun & Clarke 2006). The steps guiding the analyses were as follows: (1) transcribe, read and re-read the data; (2) generate initial codes by collating data relevant to each of these; (3) collate the codes into the predetermined themes, also known as code tree; (4) revise the themes about the extracted codes; (5) determine and refine the thematic map and identify possible subthemes; and (6) structure and summarise the themes.

Last but not least, a summary of the verbatim on the social validity instrument is reported for each phase of the study.

## Results

### Preliminary analysis

Sample characteristics are reported in Table 1.

### Nonoverlap of all pairs analysis: well-being

Nonoverlap of all pairs scores suggest that the improvement in well-being varied across clients, with effect sizes from small (34.29%) to large (97.27%) from baseline to intervention to follow-up. Notably, the largest effect sizes (medium–high) also statistically significant (three of the four clients) were recorded at the second site. Figure 2 illustrates the magnitude of change scores from the average baseline scores to each data point each week of the intervention and at T1 and T2. The results for each client are displayed in Table 2.

### Thematic analysis

#### *Well-being*

The moods of the clients were coded as positive, negative and neutral. Three clients presented a generally positive, relaxed and cheerful mood during the baseline phase, which became more negative, tense and preoccupied during the intervention phase. For one client, the negative mood was however unrelated to their participation in the study, while for the other two clients, the negative mood concerned the use of Google Home (e.g. struggled to use Google Home when rushed and stressed, looking for solutions to make Google Home work better and draining energy because it requires too much concentration). Other clients were more consistently in a positive, cheerful mood and reported finding pleasure in practising and using Google Home independently or finding relief in listening to soothing music with Google Home. Overall, while clients

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**Table 1** Sample demographic characteristics

| Client (site) | Age | Sex | Education | Disability | Employment | Status |
|---|---|---|---|---|---|---|
| 1 (1) | 43 | M | Practical | VI, ID | Paid/adjustments | No partner |
| 2 (1) | 56 | M | Fairly low | VI, ID | Unpaid/volunteering | No partner |
| 3 (1) | 67 | F | School for blind | VI, ID | DCA | No partner |
| 4 (2) | 63 | M | SPE | VI, ID | DCA | Partner |
| 5 (2) | 56 | M | SPE | VI, ID, MD | DCA | No partner |
| 6 (2) | 40 | F | SPE | VI, ID | DCA | No partner |
| 7 (2) | 33 | F | SPE | VI, ID, MD | DCA | No partner |

DCA, day centre activity; F, female; ID, intellectual disability; M, male; MD, motor disability; SPE, special primary education; VI, visual impairment.

found the device somewhat intimidating in the first instances, many reported feeling proud about mastering its use throughout the intervention.

*Autonomy*

Three main subthemes emerged concerning autonomy: the ability to make independent choices, take initiative in activities and ask for help. The clients could choose the placement and purposes of Google Home (e.g. radio and alarm clock) either independently or with the help of a supervisor (e.g. figuring out together what functions the client may benefit from). During baseline, they took the initiative in household tasks, making appointments and communicating with supervisors. All clients practised using Google Home independently during the intervention phase and shared their progress with supervisors. This suggests that clients were able to

take ownership and practise autonomy with the technology.

*Social participation*

The three subthemes coded as social participation are being in the presence of others, seeking contact or isolating from others. The first two types of behaviours manifested as taking an interest in others and/or helping. During the baseline period, all clients sought contact with others by going to the shared living room and having conversations. However, some had difficulty achieving reciprocity in the conversation, and some isolated themselves by eating in their apartment or staying in their apartment. During the intervention period, the use of Google Home positively impacted the clients' social interactions, with more noticeable social contact seeking. The clients who regularly isolated themselves
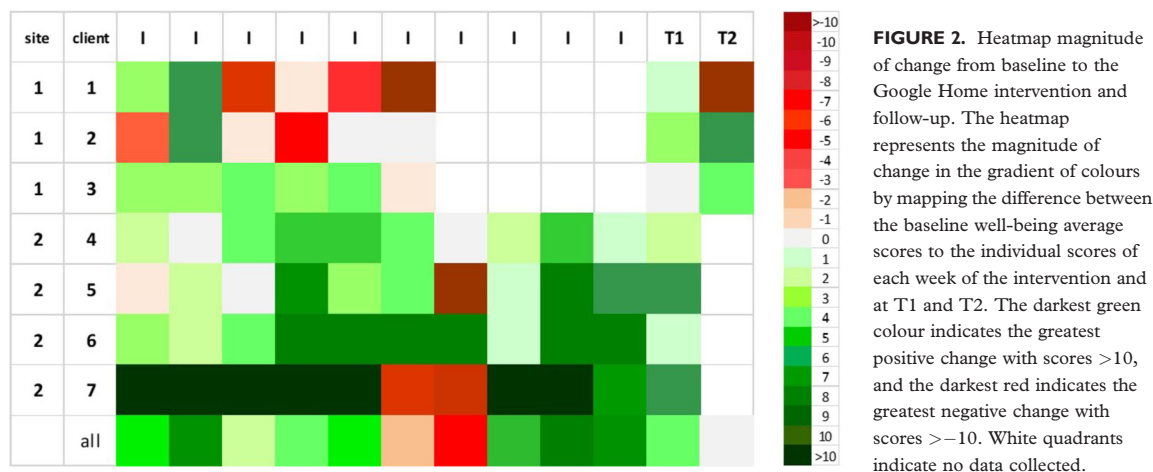


**FIGURE 2.** Heatmap magnitude of change from baseline to the Google Home intervention and follow-up. The heatmap represents the magnitude of change in the gradient of colours by mapping the difference between the baseline well-being average scores to the individual scores of each week of the intervention and at T1 and T2. The darkest green colour indicates the greatest positive change with scores >10, and the darkest red indicates the greatest negative change with scores >−10. White quadrants indicate no data collected.

**Table 2** NAP analyses scores per client

| Site | Client | Baseline–intervention (%) | Intervention–follow-up (%) |
|------|--------|---------------------------|-----------------------------|
| 1 | 1 | 34.29% | 14.29% |
| 1 | 2 | 45% | 87.50% |
| 1 | 3 | 77.14% | 100% |
| 2 | 4 | 84.42%* | — |
| 2 | 5 | 61.69% | — |
| 2 | 6 | 97.27%** | — |
| 2 | 7 | 81.17%* | — |

'%' means percentage of change as calculated with NAP analyses. Site 2 did not have the follow-up assessment of the well-being questionnaire.
*$P < 0.05$, **$P < 0.01$.
NAP, nonoverlap of all pairs.

started seeking contact with others and conversing about what they learned from Google Home. One client showed great enthusiasm in learning facts (e.g. how the lemonade was invented) and coming to share it with fellow residents. Another client learned riddles and jokes that they would then share at the dinner table with others. They also showed interest in others (e.g. how other clients were doing with their device and their use of it) and were helpful to fellow residents in using the device.

*Google Home experience*

Clients' experiences with Google Home devices revolved around the frequency, the type of use, for practical, entertainment functions for themselves or others, and the personal experience, concerning their opinions about the device, ideas for improvement and skills. Four of the seven clients reported using Google Home every day, two several times a day. Only one client indicated that the frequency of use has decreased throughout the intervention, from every day to a few times a week. All clients used Google Home for entertainment, mainly to listen to music, either special songs or the radio and the news. Concerning the practical use, clients asked about the time and the weather forecast mainly. Fellow residents also often used Google Home to listen to the radio and music. Opinions regarding the use of the device were primarily positive: three clients indicated that they found the device easy to use, and the other

two found it helpful and friendly. They presented difficulties with written text. Thus, Google Home was helpful in just using voice commands and spoken output. One client expressed that it became a part of their life. The negative opinions concerned that Google Home did not know everything or it was sometimes difficult to formulate commands that were intelligible to the device. The clients made several points of feedback for improvement. While throughout the first week, clients mostly interacted with the device to understand its capabilities, only afterwards they started using it for specific functions, as mentioned previously. They noted a few aspects that did not work correctly or as expected. For instance, difficulties were reported regarding calendar use (e.g. appointments could only be added but not removed) and broadcasts (e.g. could not listen back to missed programmes), and the device sometimes would get activated when someone walked by or by another voice initiating a command, despite the Voice Match function being set.

Concerning skills, some clients showed difficulty using the Google Home device: trouble stating commands concisely and concretely. Others, however, managed well without guidance, demonstrated curiosity about the device and could handle it well. They often asked better questions than their staff members suggested during the first week of the intervention. The clients who had difficulty with the commands gave them too quickly, used lengthy sentences and/or struggled to remember or pronounce them. However, after a week, they improved and could speak correctly. To help with this, a memo recorder was used so that they could listen to the commands before repeating them. Additionally, an auditory feedback function was activated, such that most clients were using the device with ease by the end of the intervention. Some clients did well in learning the initial commands but struggled with new ones. They tended to become tired quickly, and their attention waned after 15 min of practice. To help, the client was instructed to repeat what they had learned before or taught Google Home one new suggestion. At the end of the intervention, this client still experienced difficulty remembering the commands and used the device less. The theme tree is illustrated in Fig. 3.
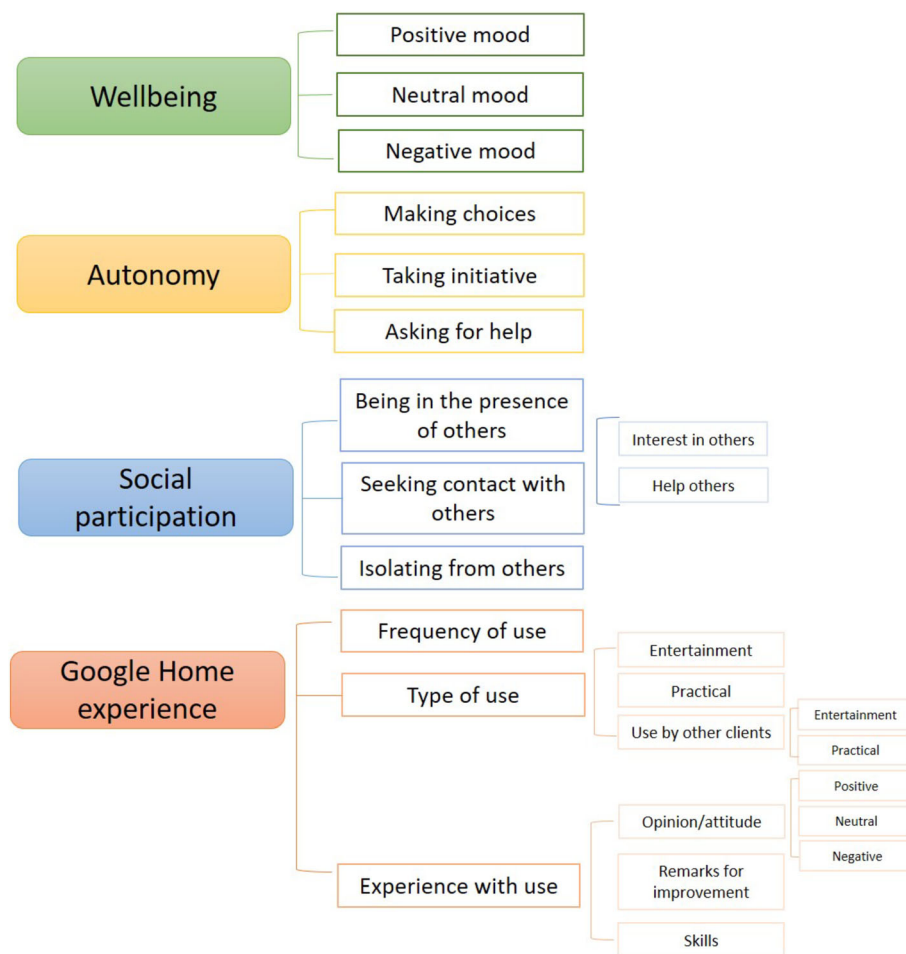
**FIGURE 3.** Theme tree of the thematic analysis concerning well-being, autonomy, social participation and Google Home experiences. The figure illustrates the four main predetermined themes and all the subsequent subthemes that emerged from the coding procedure of the texts.

## Social validity

At the beginning of the study (T0), all clients reported no prior *experience with technology* (e.g. tablets or computers) and were unfamiliar with voice control and the Google Home device. Regarding *self-efficacy*, clients were confident that their supervisors would help them with the device if needed. Expectations regarding *enjoyment and usefulness* prior to commencement varied. Some clients were unsure how the device would work or benefit them and their ability to use it, and some clients were excited at the idea of using it. Concerning expected *ease of use*, only one client thought it would be easy to use and it would make things easier or more relaxed for them;

others did not know what to expect. As for *intention with frequency for use*, one client anticipated that they would use the device daily, another thought that they would do so occasionally and another once a week. Regarding other *subjective experiences*, clients anticipated that they could do other things independently using the device besides what they already could do.

Immediately after the intervention (T1), all clients reported that using Google Home was new to them. Yet two clients possessed a smartphone and one a personal computer, respectively, suggesting that at site 2, there was little prior *experience with technology*. All clients received help from supervisors but also gained more self-confidence, given that some could

do more things than before they had the device (*self-efficacy*). Most clients reported to have *enjoyed* using the device and that it was fun, but two did not enjoy it and one was unsure. The negative experiences were mainly due to the difficulty in formulating commands. *Ease of use* varied across clients, with some finding it immediately easy, some tough and one indicating that it got easier with use. *Frequency for use* was every day for four clients, a few times a week for two and once a week for one. Six out of the seven clients reported with certainty that Google Home makes things easier for them, whereas one was unsure but reported that it made them relaxed. Clients were also asked whether other residents may benefit from the Google Home device. They indicated that it could help other clients, but the extent of it may depend upon the level of understanding and ability to provide commands. Moreover, it may be beneficial for clients with a VI.

At follow-up (T2), four clients indicated that the guidance received helped them very well, two indicated that guidance was good enough and one just a little helpful. At this phase, all clients reported needing little or no help in using the device, and all found it easy to use. Five of the seven clients indicated that the device makes things easier for them, one was unsure and another disagreed because sometimes, the device does not provide an answer and gives suggestions for other commands. Concerning self-efficacy, six clients reported being able to do more things than before and one was unsure. Frequency of use remained unchanged from T1, with four clients using it daily, two a few times per week and one just occasionally.

## Discussion

The study aimed to assess the feasibility of implementing Google Home technology in long-term care facilities for people with VIs and IDs and its impact on clients' well-being, autonomy and social participation, during the COVID-19 pandemic. The study utilised a mixed-methods approach to assess seven clients across two sites over a 20-week period, including a 6- and 10-week intervention phase. The results from the NAP analyses indicate that the effects of Google Home use on well-being were variable across clients, with improvements ranging from small to large, and the most significant improvements on

site 2, which saw a longer intervention phase (10 vs. 6 weeks). While clients initially found Google Home intimidating, most reported feeling proud of mastering its use. Google Home use also positively impacted clients' autonomy, allowing them to make independent choices and take the initiative in household tasks and communication. These findings align with prior research reporting improved autonomy in clients after using assistive technology (Taber-Doughty *et al.* 2010; Tassé *et al.* 2020). Moreover, its use increased social contact-seeking behaviours among clients who had previously isolated themselves in their apartments. To our knowledge, this has not been previously reported in the reviewed literature. As such, this finding needs follow-up as it may have tremendous implications for fostering social connectedness. Clients mainly used Google Home for entertainment purposes, particularly listening to music and radio, and found it easy to use, helpful and nice. However, some clients experienced difficulties in concise and concretely stating commands, and they provided feedback for improving the device's capabilities. By the end of the intervention, most clients had improved in their ability to use Google Home, demonstrating curiosity about the device, asking better questions and handling it well. All clients were given the option to keep the device as recompense for participation, and indeed, all wanted to keep it, suggesting that they benefitted from using it and wish to use it further. As mentioned earlier, it may also take some time before clients fully master the full potential of such a rich device. Hence, we may speculate that improvements in several psychosocial domains may be further increased with time of use. However, this remains an empirical question for future research.

Our study presents several strengths and limitations. The main strength of our study is the timely investigation of an IPA at an all-time high period of need. Notwithstanding the difficulties in maintaining the regularity of the assessments and observations, alternating unpredictable COVID-19 lockdowns affected, to some extent, the execution of our intervention study and subsequently may have had an impact on our findings concerning well-being reports. Indeed, replicating these results in non-pandemic times is essential to establish whether the extraordinary circumstances of COVID-19-related lockdowns and possible subsequent social

isolation contributed to these results. On the one hand, clients could benefit particularly from the device as a substitute for other significant social interactions. On the other hand, we could expect that clients may benefit even more from a digital personal assistant in non-pandemic times, as this would allow them to explore the full potential of such devices when they need more support concerning scheduling personal appointments or learn with and from others how to engage with the device. Another strength of the study is represented by the intensive assessments of well-being, complementing observational and caregivers' reports data across a 20-week timespan, compiling a rich quantitative and qualitative dataset. A larger sample is recommended in future work to further the generalisability of these pioneering findings. By increasing the sample size, subgroup analysis would be necessary to identify which features may be more beneficial to each client based on age and type of disability and provide more tailored care. Cost-effectiveness studies are also needed to inform stakeholders and healthcare ministries about the potential of technology in the psychophysical care of individuals with ID and/or other disabilities.

Based on the results of the study, the following recommendations are suggested. Firstly, it is recommended that smart speakers be considered as an assistive technology option for individuals with VIs and IDs, as they can significantly improve their independence. However, guidance and support should be provided when learning to use the device. Secondly, attention should be paid to the accessibility settings and the choice of device, particularly for devices with built-in screens. Additionally, using a help guide, such as the one developed in this study, can be beneficial for tutors to assist with minor problems. Lastly, privacy concerns should not be overlooked, and users should be informed about how Google analyses user data and how they can protect their privacy. These recommendations may guide healthcare institutions and other to consider using smart speakers as assistive technology for individuals with disabilities. These recommendations align with the systematic review by Dyzel *et al.* (2020) on the use of assistive technology with people with disabilities (e.g. deaf-blindness), highlighting the need to advance understanding of the unique communication needs, strengths and difficulties of individuals with different disabilities and/or specific limitations.

This study is the first to investigate the benefits of IPAs for individuals with VI and/or ID in residential care. The study's mixed-methods approach provides a comprehensive understanding of the effects of a 10-week intervention on self-reported well-being, autonomy, social participation and Google Home experiences. These findings contribute to the growing body of literature on the potential benefits of technology in health care and highlight the need for further research in this area. Indeed, the study's findings can serve as a foundation for future studies investigating the use of IPAs in different healthcare contexts and for different client/patient populations. Moreover, the importance of this study for practice is that it provides evidence that the implementation of IPAs, such as Google Home, can be an effective intervention to improve the quality of life and well-being of individuals with VI and/or ID in residential care facilities, with important implications for residential care facilities, as it provides a promising avenue to improve the care and quality of life for vulnerable individuals.

To conclude, our findings highlight the benefit of technology in promoting autonomy, well-being and participation of individuals with IDs and VIs. However, the thematic analyses concerning social validity and Google Home experience also emphasise the need for increased accessibility for assistive technology and the importance of addressing barriers to access and usage. Our study calls for increased awareness and education of service providers on assistive technologies and emphasise the potential benefits of integrating technology in home-care facilities for persons with ID and VI, alongside the need for continued research and development in this area.

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## Conflict of interest

The authors report no conflicts of interest.

## Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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