

**ALL IN THE FAMILY: EXPLORING DESIGN PERSONAS
OF SYSTEMS FOR REMOTE COMMUNICATION
WITH PRESCHOOLERS**

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By

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ABSTRACT

Although there have been recent advances in remote communication technologies that foster connectedness and intimacy over a distance, systems designed for communicating with preliterate preschoolers—a desired use case—are not yet prevalent, nor are there clear guidelines for their design. We conducted a mixed-methods study to characterize the current practices, goals, and needs of people who wish to use remote communication systems with young children. We present quantitative and qualitative findings on the motivations for communicating, the habits, activities, and patterns that have been established, and the barriers and concerns faced. We synthesized these findings into four design personas that describe the desired functionality and requirements of systems to support remote communication with preschoolers. For each persona, we systematically evaluated 60 research-based systems based on the extent to which each persona’s requirements were covered, demonstrating that none of the personas were greatly satisfied with the available tools.

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1 INTRODUCTION

This thesis contributes to the theme of supporting remote communication. It is not a new theme to address, although uncertainty among researchers and designers, as well as real and as-of-yet unaddressed problems for users still exist. This thesis offers an exploration of a wide sample of users in the attempt to approach a realistic picture of the needs of people who communicate with young children remotely. The findings of an explorative study formed the base for the creation of a set of personas. Personas have the potential to inform designers and researchers of requirements of certain user groups and consequently contribute to designing improved products.

1.1 Problem

Not all families with young children are fortunate enough to live together in the same city. Whether because of the need to move for work, divorce, incarceration, travel for work, or personal choice, preliterate children are often geographically separated from their loved ones. Distributed families use a variety of technologies to stay in touch, such as telephones, videoconferencing technology (e.g., Skype, FaceTime), or even meeting up to play together in virtual worlds. Current videoconference technology works well for two adults who are having a conversation; however, this medium of communication quickly breaks down when trying to engage with very young children who are not interested in sitting still in front of a webcam and having a conversation [2,15,17,56,57]. Traditionally, when adults want to get to know young children, they do not sit down to have a conversation; they get down to the child's level and play with them [4,15,20,23,64]; playing with toys,

reading stories, and general physical play are all ways of getting to know a young child that require technological support to enact over a distance.

Previous research on designing communication tools for remote children include support for many of these activities: e.g., storytelling and reading [5,31,56,57,77]; games and play [18,45,58]; reading and play [14]; photo and video exchange [11,33,55,59,77] in the form of blogs, collages, gifts; teaching children on-site [27]; and communication of physicality and awareness [39,66,70,74,85]. Further, prototypes that were designed to be open-ended and thus fulfill a flexible variety of purposes have also been explored [83].

Designing to support such a variety of activities leads to general purpose tools; however, general tools do not scaffold specific activities such as reading together or building with construction toys. Specific tools, on the other hand, support particular activities, but may only work for one type of user group (e.g., parents) and not another (e.g., grandparents).

The problem is that *designers of remote communication technologies have little guidance on who they are designing for and what these users need, desire, and prefer*. Further, remote communication technologies for children are difficult to design as young kids cannot read interface components, require simple designs that may not support complex activities, and need systems that are easily learned and operated.

1.2 Solution

To inform the design of remote communication technologies for use by preliterate children, we conducted an exploratory study using mixed methods to identify the needs, desires, motivations, current practices, and concerns of 96 people who regularly communicate with children aged 3-6 over a distance. Based on our descriptive findings, we classified the results and designed four *personas* with common motivations, goals, needs, and concerns. Using these personas, we analysed 60 systems in the HCI literature

designed to support communication over a distance and our critical analysis suggests a gap: although many one-off systems have been developed, no persona's needs and desires are adequately supported by present research.

1.3 Steps to the Solution

We conducted an online survey exploring the activities, devices, platforms, and practices around them, which formed the cumulative findings. We conducted descriptive quantitative analysis and also performed thematic analysis on the qualitative data to identify overarching themes amongst disparate respondents. We faced a challenge of describing the findings in an aggregated way, which directed an initial segmentation of users by eight goals. Later our findings informed four segments, that were consequently framed as personas.

1.4 Evaluation

We identified 60 systems from previous literature that were designed to support remote communication. We rated these systems on the extent to which they satisfy the needs of our four designed personas. The results were unsatisfying for the representation of adults who practice remote contact with children, mostly because of insufficient coverage—the mean score of how much the systems address user needs is less than 3.5 out of 10.

1.5 Contribution

The contribution of our work is the identification of new user groups, which differ from familiar groups, such as parents and grandparents. We presented the complete picture of the requirements and concerns of each user group in four personas that can be used to

inform research and design directions in remote communication technologies for preliterate children. Supporting families to communicate over a distance is an area of interest to researchers, designers, and developers and our findings contribute to furthering this important research agenda to foster connection. Overall, our work clarifies a gap and provides data-driven guidance on how to address this gap, with the potential of helping distributed families connect.

2 RELATED WORK

Families are increasingly facing the challenge of their members living separately. Countless reasons for being physically separated include young people moving to other provinces/ countries to study and building their families in places different from the place where they grew up, living separate from their partner due to work, divorced partners who share custody of children together, spending time apart from home due to military deployment or business trips. The phenomena of geographically distributed families has drawn researchers' attention and has resulted in studies of the methods and tools for remote communication of relatedness (i.e., connectedness, intimacy, love, care, belonging, closeness, and awareness).

2.1 Explorative Studies in the Domain

A broad summarizing review of 92 studies on 143 tools designed for remote communication [24] analyzed core elements and characteristics in systems proposed for long-distance communication. They primarily focused on technologies for romantic couples and family members, including cross-generational families, with the purpose to understand the mapping of tool development directions. In their results, six groups of current strategies of mediating relationships through technology were presented, and also the distribution of strategies across the reviewed tools:

- 1) Awareness (39%): displaying presence, activities, and mood in an ambiguous way;

- 2) Expressivity (29%): expressing emotions, feelings, and affections in simple codified or enriched messages;
- 3) Physicalness (13%): feeling the physiological parameters of the partner, or imitating sharing gestures with them;
- 4) Gift giving (8%): showing unconditional love or acting with anticipation of exchange;
- 5) Joint action (8%): shared involvement in new activities, that usually require co-location, or in already established routines between partners;
- 6) Mutual memories (3%): reminding about past activities or special using memorabilia.

A considerable amount of research was specific either in choosing the dyads to investigate or activity to consider; sometimes a combination of both shaped the focus of research. Thus, Forghani and Neustaedter [17] explored routines, needs, and social challenges in distance-separated grandparent-grandchild conversations. Grandchildren who were invited to participate in the research were aged 3-10, which justified their intent to explore direct conversation as a way of remote interaction.

Grandparent and grandchild communication also has been investigated in terms of emotions expressed between grandparents and adolescent grandchildren (aged 10-18), both online and offline [43]. Predominantly, dyads were sharing positive feelings, which they derived from exchanging photos, emoticons, presents, checking wellbeing; giving advice and providing emotional support—activities, that helped teens and grandparents to know each other's feelings and, respectively, to feel greater connectedness as a family.

Yarosh and Abowd [79] interviewed parents and children aged 7-13 with a purpose to reveal the experiences and strategies that work-separated families (including those separated due to military service) use to stay in touch. A co-located adult was found to be someone on whom both parents and children depended in making contact. Children and

parents used varying strategies to manage separation: while the former focused on eventual reintegration and spent time on in-person interaction with the co-located adult, the latter were investing the effort into carrying as in active as possible role in their children's life. Among strategies used by the dyads were playing online games (only 4/14 families), video chatting, and messaging.

The findings of Lauricella et al. [38] have implications for electronic storybook design. Children aged 4–4.5 and their parents were asked to read together, and, hereby, to expose their interaction styles. Parenting behaviours of co-reading differed for computer storybooks since the media platform demanded users to adjust their strategies. Parental engagement predicted boosted content comprehension, regardless of the device used for story presentation. The closeness of parent-child interaction, the child's comprehension level, and the learning mechanism were fairly similar for both platforms, which suggests that computer books bring the same learning benefits for young children as traditional types of books.

An explorative study on how families use video chat observed parents, grandchildren (aged 1-10, initially 5-9 were planned to be recruited), and grandparents during the group calls, and reported findings of their family values and practices around technology. Parents as co-located adults constructed their roles to perform technical and social work to make the call happen. After troubleshooting inevitable technical difficulties, their social work covered coordination of the call participants, presentation of the room or family members seen during the session, behavioural work with children and accommodating their physical needs. In terms of benefits, children were more engaged because of the visual aspect of video chat, parents were motivated to connect grandchildren with grandparents and saw video chat as a working remedy; for grandparents, video chat met their necessity of talking longer with engaged grandchildren [2].

Romero et al. [59] completed a qualitative inquiry on what families value in communication and purpose of it in terms of feelings (positive, negative, and neutral) associated with a type of contact (social, emotional, practical, and special occasion). Findings from the exploratory part of the study with remote family members informed the design of development of an awareness system for connecting home and mobile family members. Qualitative data included observations from 3 three-generational families (13 participants), although the grandchildren's age was not mentioned. The Affective Benefits and Costs of Communication questionnaire was developed to measure affective qualities of the communication medium and included the following scales:

- 1) Obligations, that were experienced or invoked by the activity;
- 2) Expectations, risen or unmet expectations for communication;
- 3) Threats to privacy, the intensity to which one feels their privacy threatened;
- 4) Thinking about, which is expression or receiving of 'I think about you' message;
- 5) Need to be informed, which is staying aware of other people's activities;
- 6) Staying in touch, the measure of feeling connected with others;
- 7) Sharing experiences, the extent to which one finds other people are involved in his/her life, and interested in sharing experiences;
- 8) Recognition, which measured how much one's feelings are understood;
- 9) Group attraction, the feeling of belonging to a group [59].

The patterns of parent-child interactions during a play with traditional toys and tablet apps were observed by Hiniker et al. [26]. Children involved in a lab study were aged 4-6. The comparison of material usage during analog and digital play showed that toys created a shared space for interaction even if they did not explicitly require partnership and welcomed mutual engagement—children invited parents to participate in the activity or asked their opinion on the actions. On the contrary, children created individual spaces with tablets and often ignored the prompts for participation and questions coming from

their parents, but not from the game on the tablet. More instances of responsiveness, conversation, and attention were noticed during play sessions with toys.

2.2 Tools for Communication over Distance with Children

A number of novel systems focus on mediating family ties between children and their long-distance adults. The discussion of systems in this section covers tools proposed by researchers, both general purpose and specific tools, and also ones available on the market.

2.2.1 Specific Tools

A great deal of interest has been dedicated to designing specific communication tools for performing determined activities with distant children. Here we review several directions of activities supported in developed systems.

2.2.1.1 Storytelling and Reading

Reading was found to be one of the obvious activities that people engage with young children while connecting remotely. Systems like Family story play [57] were serving a purpose of improving connection across distance separated family members from generations, and also gave a tool for developing literacy among young children. The prototype integrated wooden frames, physical books, two screens for video conferencing and displaying content of the Sesame Street television show. While parents were fulfilling essential tasks such as synchronizing pages and monitoring children, grandparents received story content as something to collaborate on with grandchildren, and also increase the quality of interaction with them. Grandchildren (aged 2-3) expressed greater engagement and improved engagement in communication with family members who were not present on site. Results were compared to Skype sessions.

Their enhanced system, StoryVisit [56], was designed to create a sense of social and emotional togetherness by reading together over a distance. StoryVisit combined video chat and electronic books in a way that made synchronized reading possible and was designed for use with 2-5 year-olds and their grandparents. The system incorporated an Elmo character as the Interactive Social Agent, the inclusion of which aimed to engage both parties with the story content. Their findings pointed out the increase in usage times, a greater number of sessions, and overall engagement with StoryVisit compared to family video conferencing.

Vutborg et al. [77] built a system that supports regular contact between children and adult family members across time zones. The system incorporates synchronous (Storytelling) and asynchronous (Collage) settings of communication, and was deployed in 2 families with children aged 5-14. Collage mode allowed the users to exchange and interact with personal photos, and the Storytelling component was designed mostly for reading and drawing. Grandparents' availability and time of the day was indicated, although the latter was not well understood by children. The study found problems existing around misalignment in daily routines, circadian rhythms of grandchildren, readiness to respond for communication about a call, and grandparents' need to reserve their personal time from public time. Interesting, children's daily rhythms were found to be closer to their grandparents' rhythms than their parents' rhythms. Also, parents, as the only 'family glue' who mediate communication, could obstruct the other two from possible contact.

Zaturi [31] is a tool designed to address a problem that full-time working parents have, which is feeling guilty for spending an insufficient amount of time at home with children. It is a system for asynchronous communication represented by a mobile solution that enables adults to record audio books for their children, during downtime at work. Micro-moments of spare time at the workplace was identified by monitoring the phone's applications usage, also including the time of walking between buildings. On the parent's

side it was a mobile phone, for children (aged 1-5), a tablet. Finally, this mobile solution helped to achieve greater fitting of the important role of parenting into the regular working day without sacrificing the working schedule (i.e., by utilizing wait time).

A recent library project in progress by Boffi [5] describes a concept that connects a community of retired seniors, who form willing readers, with children (and their families), who are willing listeners. A proposed system will be implemented on a tablet for elder use and the Storybell robot for children, which projects pictures from a storybook onto the wall. An indication of willingness is planned to be managed by a child shaking the bell-shaped robot, and by making the robot chase the child. This approach addresses remote intergenerational communication in a broader sense, providing the possibility to people who do not know each other to meet for reading aloud. The expected benefits of storytelling: for elders—being useful for society and carrying the responsible role of helping younger generation; for parents—receiving help in childcare; for children—enhancing their psychological development.

Systems for remote communication with children were also designed not merely for one activity, but incorporating a combination of them. Systems like People in Books [14] are designed for both reading and playing, with a goal to mediate reading and open-ended play with young children (aged 3-5) and remote family members (parents in the study). The system was deployed on laptops and was an interactive book, which placed live avatars of children and adults, subtracted from video conferencing, into book pages along with the characters in the story. Seeing each other in the world of the story, rather than in distant locations during a video chat, encouraged play. Results showed that the setting of People in Books inclined participants to read the story in a performative way and encouraged open-ended play in the story environment.

2.2.1.2 Games and Play

The fact that young children prefer to be played with, rather than conversed with is well acknowledged in HCI literature. Globetoddler [45] provided travelling parents and their preschool children a tool for enhanced interaction, which connected them in an easy and enjoyable manner. The system interface for a child consisted of a sensor-equipped doll and the interactive Flash interface, with a mobile application on parent's side. Globetoddler displayed two toy-avatars, one represented the parent, another one was controlled by the child with a physical doll. System features included sharing media content, single- (Play Catch Cotton Candy) and multi-user play (Play with Avatars, Play Hide-and-Seek), viewing the world map to see where the parent stays, and shared photo viewing; collectively, features supported both synchronous and asynchronous activities. The system provided balanced access to the same set of features, although two different user types were respected and had their interfaces designed for specific requirements. In the result of the system evaluation, gameplay features received enthusiastic responses, although families expressed a desire for providing users' expressions, reactions, mood, and other rich real-time interactions.

Another intergenerational communication system that does not require parental mediation was SINCOM [58]. It was meant to scaffold possible topics for conversation, based on participation in shared recreational activities. The tool allowed grandchildren and grandparents living at a distance use the system both synchronously and asynchronously. Two activities were incorporated in the prototype: talking via video conference; and taking care of a pet, where a media message of the pet with any changes can be sent to the remote party. Study results were sourced from 3 families with grandchildren aged 4-8. Adults noted grandparents' greater awareness about grandchildren's actions, and the increased number of conversation topics between grandparents and grandchildren, which brought the deeper feeling of closeness.

Toys as tangible interfaces provide unambiguous natural affordances to children of how to approach them, and previous research confirmed their use for communication. Freed et al. [18] studied how children can be connected through remote imagination play with the tangible system. Remote children (5-12 years old) played in small-scale dollhouses with furniture and dolls and were able to communicate in different channels (telephone, mail system, video, and voice channel). Researchers highlighted the perspective that including toys and manipulable objects for the characters into interfaces is particularly helpful in achieving successful use of communication technologies by children.

2.2.1.3 Photo and Video Exchange

Researchers considered the exchange of personal photos and videos as one of bringing together activities in varying forms of, for example, blogs, collages, gifts, and interactive galleries. The eKiss system [11] was created to mediate the feeling of intimacy between children (aged 10-13) and their parents. Parent-child intimacy was supported by communication through mobile technology and sharing pictures and text, that are posted in the family weblog. A notable design feature was that eKiss allowed children themselves to determine how often they want to communicate, and parents were not able to prompt them. Researchers and parents were expected to observe greater motivation from children to share their everyday experiences, which provides an additional evidence that willingness to communicate is not equal for parents and children.

ASTRA, an awareness system implemented by Romero et al. [59], allowed users to share pictures with personalized comments. An asynchronous messaging tool was designed for friends or families to become more involved in each other's lives and see their everyday activities. The prototype, that includes a phone with a camera and mobile device for home, supports asynchronous communication, which subsequently provided content for enriched synchronous communication.

TimelyPresent [33] followed an interesting concept in connecting three-generation families, who faced the challenge of long distance and large time zone differences. Their single-purpose device captured short video clips and presented them to the other side in the form of gift-wrapped messages. Allegory with gifts continued beyond the visual form and made the gifts unavailable to the creator after the message was delivered. To mitigate existing time differences, the feature of delaying presents was added to match the local time of the sender. As distinct from the spontaneous sharing of the moment in ASTRA [59], gift-messages were created as planned performances with thought out content.

Raffle et al. [55] presented asynchronous communication systems for adults and preschoolers. Their study included three experiments all based on “jack-in-the-box” mechanics: Orange Toaster, with which children created and shared self-portraits; Family Toast, a device with picture-coded tokens to look through the photos of distant family members, and also record their reactions for adults; and Play with Elmo, a setting that supported asynchronous exchange of short video messages between children and their adults. A tangible interface of a toy-like messaging device was appropriate for children aged 3-4 and was shown to be accessible, engaging, and intuitive for them. The results shaped the guidelines that designing interfaces for preschoolers should be immediate, playful, and emulate a real-time feeling of interactions; and for adults to be engaged is important to receive rich emotionally loaded feedback from children.

The Collage component of the system for communication with adults over distance by Vutborg et al. [77], discussed in 2.2.1.1, incorporates the approach of sharing pictures as well. Personal photos from two households moved down in separate streams and could be resized and moved. The Collage part of the system helped to catalyze child’s engagement in the talks about daily life.

2.2.1.4 Teaching

Although the system we found in the category of teaching [27] was designed for a use on site, the study revealed strategies parents used to help their preschool or early elementary school children with programming activities, that might have implementations for remote teaching inside families.

Parents and children (aged 4-10) read a paper storybook, which required adhering stickers to the pages in order to program the moves for the main character. After a photo of a book page was taken on a tablet, the accompanying app interpreted the coded sticker's sequence and made animation of digital characters visible on the screen. Children struggled to make sense of the activity if parents were not participating actively; although when they were actively involved, valuable learning interactions exposed how parental scaffolding and structuring in programming with the sticker book fostered their children's computational literacy.

2.2.1.5 Physicality and Awareness

Hugging, kissing, and comforting describe a universal and essential type of interaction in human communication, thus something people would love to be able to transmit over digital communication networks. Research in HCI has explored how to reproduce physicality remotely with divergent types of users. Väänänen-Vainio-Mattila et al. [74] presented a system called Teddy Bear, inspired by the universal and commonly-present character in families with young children. The system appears as a bear toy on the child's end and has a mobile UI for the parent, and is designed for communication of presence, gestures, and hugging. The findings from eight children (4-6 years old) and their parents showed the concept was much appreciated for its non-verbal communication aspects.

Following the physical perspective of mediating communication, Toet et al. [70] proposed prototypes for holding hands over a distance. The haptic accessory transmits the touch by hand-holding and is meant to add an affective impression of physical proximity to a

conversation. Five of the most common hand wrappings in child-parent hand holding positions were identified, as well as distinct sending, receiving, and neutral contact points. The age range of children who participated in the evaluation was not mentioned.

Lee and Schiphorst [39] explored values existing around warmth and affection in parent-child interaction over a distance. Their wearable prototype consisted of a small tangible object embedded with sensors for the parent and hand sleeves for a child. The asynchronous system enabled the parent to send a touch, while the sleeve on the child worked as an output device. Thermal sensation as metaphorical physical intimacy was tested with children aged 7-11.

A similar approach to developing affective communication system is illustrated in Kissenger [85]. While users are video chatting on mobile phones, a device simulates a real-time kiss through multisensory sensations. Although their initial concept included kissing between young grandchild and grandparent, further description of the prototype is more suitable for adults or older children.

Awareness systems for children have been explored in tangible forms as well, which was exemplified by Sun et al. [66]. They designed e-Seesaw—a tangible and playful awareness system for remote parent-child interaction. Addressed system requirements were based on survey results from 5-10 year-olds and their parents. Important to note, children were empowered to control and initiate remote contact. Simple swinging of a toy for reciprocal communication, in which a local device would mirror the movement of the remote one, successfully mediated a feeling of connectedness.

2.2.2 General Purpose Tools

A lesser number of research studies paid attention to designing general purpose tools that were not tied to a particular activity. Prototypes that are designed to be open-ended could fulfill different purposes, and allow people to use them how they want. The ShareTable

system [83] is an example of an open-ended design approach that provided surfaces for remote parent-child contact for divorced households. Each of the two cabinets included the monitor for video chat, and table surface—a projected view of the remote table. The system used a physical metaphor for initiating the call, which was as simple as to open the doors. Two families with 7-11 years old children used ShareTable for: creating a playful context for interaction (drawing, showing toys, and new skills), providing instrumental support (solving math problems remotely, co-parenting), and carrying out meetings (sharing the objects, special moments, physical affections, family handshakes, cards).

2.2.3 Commercial Products

Skype, FaceTime, iChat or Google Hangout are common video conferencing products that fall into general purpose tools available on the market. Not designed for young children specifically, they require an accompanying adult when used with a young audience.

The examples of commercial services and platforms designed for specific activity are both synchronous and asynchronous in nature. The examples of synchronous platforms are:

- 1) Readeo.com for video chat combined with shared e-book reading, the interface still requires an adult being engaged on the child's side;
- 2) AStoryBeforeBed.com, a website where adults can record themselves reading a story with video and audio, and the child will receive it on e-mail and can play back the recording as often as they like;
- 3) Caribu is a mobile app for long distance reading aloud and following stories together, and video conferencing, as well as drawing, learning and playing. It was designed for children 0-7 years old;
- 4) Kindoma apps, formed by a research collaboration between Sesame Street and Nokia, was initially a Family Story Play prototype [57]. Their products are Kindoma Drawtime—an application for shared drawing, playing tic-tac-toe, or

practicing letters in real-time; and Kindoma Storytime—for reading books over video chat with the same page displayed on both user screens.

The examples of applications for asynchronous communication are:

- 1) Your StoryTime app allows recording voice and video for specific bits of a screen. Later the child taps on them and could see and hear his adult;
- 2) Be There Bedtime Stories (betherebedtimestories.com), a mobile app that allows recording a video of the reader and emailing the link to children to watch the adult reading.

2.3 Problems in Designing for Young Children

Formed from the discussion of systems above, the problems identified in designing for young children that we identified are the following:

- There have been a few qualitative studies that have identified the problems experienced by individuals, which can render generalization of the findings difficult. These studies or qualitative parts of them have explored from 2 to 12 families of participants (2 families [77,83], 4 families (and 15 interviews) [33], 8 families [57], about 10 families [17,31], 12 families [14]), and sometimes more (23 families [56], 28 children [55]).
- Designing for an expanded age range of children or for clearly older children (e.g., 5 and older [68], 7-11 years old [83], 5-14 [77], 3-10 [17], 1-5 [31], 4-8 [58], 2-10 [76]) was common, although several papers studied preschoolers (e.g., 3-4 years old [55], 2-3 [57], 2-5 [56], 3-5 [14], 4-4.5 [38]).
- A substantial number of systems were designed for use by adults (e.g., couples, elders or friends), and might not translate well for children (e.g., hugging system [3,16,36,73], kissing and hugging system [60], awareness systems [67]).

- Systems that are not mobile could create difficulties when applied to the living environment of a young child (e.g., fixed table surfaces with mounted projectors [83]).
- Distance communication systems are overwhelmingly intended for dyads of adult-child or child-child ([6,29,81], in fact tested with older children of 7-10 years old). It is unclear if other possible configurations, such as multiple children or triangulated adults warrant attention.
- Designing for cases of specific relationships to a child is common. Case studies generally concern parents [11,14,31,33], divorced parents [83], parents who experience periodic separation either short-term or long-term for a variety of reasons [31,45,79], or grandparents who want to talk to children [33,57,58,77]. A range of distant family members have been considered, as in the asynchronous messaging tool for preschoolers [55].
- Interfaces do not support a child's independent usage, they require the presence of an adult to mediate interaction with the system [57].
- There has been no real middle ground offered between specific tools and general-purpose tools. Systems notably fall into the specific tools category.

2.4 Personas in Product Design

Alan Cooper [10] coined the term personas when describing a development process and evaluation of software. He emphasized once again the importance of questions such as: knowing who one is designing for, what users of a certain product are willing to achieve, if that software-based product helped them to achieve their goal, and whether the offered functionality is easy to use for the targeted group.

Personas are ‘fictitious, specific, concrete representations of target users’, as mentioned by Pruitt [54], and they depict a generalized group of users with similarities in goals and behaviour, generally in a narrative form about a single individual.

Persona use has been frequently linked to improved communication about the target audience within the members of a design team and with stakeholders. Another widely noted benefit of applying the persona tool is increased attention on the needs of the end users.

Miaskiewicz and Kozar’s study [44] demonstrated that incorporating personas into user-centred design processes yields benefits. They collected a panel of experts and using the Delphi methodology, asked them to rate the importance of specific benefits. A satisfying consensus was achieved after iterative rankings of benefits according to their importance. Altogether, 22 benefits of utilizing personas were named and defined by panellists. The five most important of them are audience focus, product requirements prioritization, audience prioritization, challenging assumptions, and prevention of self-referential design. Maintaining the focus of product design and development on customers and their goals (i.e., audience focus) was rated as the most vital reason for the use of personas as a part of a user-centred design.

Rashmi [63] showed how personas, developed for information-rich domains, can benefit from the usage of quantitative methods. They explain the technique of complementing the data from interviews and observations with quantitative data for the improved accuracy of persona creation.

The use and perception of personas in industrial software design were examined by Matthews et al. [42]. The study showed that user-centred design practitioners tend to use personas mainly for communication with others, but not for the design work. As the result of the study, researchers propose to address the flaws of personas (being abstract,

impersonal, misleading, and distracting) and refine the deployment of personas in industrial design by layering them with user study data and user roles.

A case study by Friess [19] exemplifies the evaluation of the efficiency of personas as a tool. The use of personas in decision-making meetings was evaluated with a group of professional designers. The number and frequency of personas' invocations were collected, as well as the functions of personas. The main value of personas was their role-playing (i.e., designers made decisions while “wearing” the persona; 47.5% of personas) and focusing functions (i.e., to focus on the needs of a particular end user; 33.9%).

A project aimed to develop products for older adults [51] is another case study example of how personas and user research are applied to focus on the needs, problems, and goals of different patients.

2.5 Motivation and Identified Gaps

A substantial amount of work has gone into designing systems for various groups of people, such as grandparents, parents, and collectively named ‘other family members’, to communicate with children over a distance. In addition, researchers frequently assume that systems designed and tested with parents or grandparents work for the rest of distributed adults as well. Who falls into that category? Should the category of ‘others’ be considered as a single user type? How big is the audience we are omitting? Do they even compete in quantity with parents or grandparents groups? Do different user groups need special attention in designing for them? What is the real proportion and mapping of the whole sample of people, reflecting the real-world situation? Why have researchers been focusing on the same groups of users (i.e., grandparents) from the adult side? Those are the questions that inspired our research.

There were no studies on the exploration of whether other groups beyond grandparents and parents with distinctive characteristics exist, and what the ideal communication technology means to them. We also saw a gap in understanding how their requirements and expectations differ from typical groups in the centre of research attention.

Little has been done to approach the real mapping of the population of those who communicate remotely with young children. This being said, the needs and priorities that describe their goals are largely speculative.

To scope the research effort, we focused on young preliterate children, aged 3-6, who are assumed to have a limited circle of people with whom they communicate. However, who exactly is included in a child's communication circle, and how to describe their needs, remains unexplored. To account for the practices by which people are staying in touch, we conducted an explorative study.

3 METHODOLOGY

The goal of this chapter is to describe our study that sought to explore how people in real-world scenarios use technologies when communicating remotely with children, in what activities they are involved, and what are their existing practices. The study was carried out to determine what technologies they use with children and how.

3.1 Pre-screen Study

Participants were found through Amazon’s Mechanical Turk (MTurk) crowdsourcing platform, where workers are paid for completing Human Intelligence Tasks. To access the targeted audience, which was anyone who communicates with 3–6 year old children remotely, we first used a screening questionnaire. Among the distractor questions (e.g., “How much do you self-identify as a gamer on the following scale”, “Do you play multiplayer games?”, “Do you use any fitness applications on your smartphone?”, “Please indicate how often you use fitness application”), we asked the target question if participants communicate with children remotely. The screening questionnaire used in this study is presented in the Appendix. A total of 1341 participants (age $M=33.7$, $SD=9.35$; 56.7% male, 42.5% female, less than 1% “other” and “rather not say” together) completed our screening questionnaire. For the study lasting about 55s they were paid US\$0.2. The response rate of “yes” on the target question, which is if they communicate remotely with any children, was 24.3% (326). The next question asked them to specify the ages of any children they communicate with over a distance. The distribution of responses was as follows: 161 (12.0%) of subjects indicated that they

communicate with children 0–3 years old, 121 (9.0%) with 3–6 year-olds, 95 (7.1%) with 6–9 year-olds, and 150 (11.19%) with 9–12 year-olds.

3.2 Main Study

Below we discuss the questions used in our study. Participants who successfully passed the screening questionnaire (i.e., communicated with children 3-6 years old) were invited to the main study that consisted of 6 question blocks (Adult demographics, Communication scenario, Child demographics, Activities and technologies, Reasons and problems, Additional comments). Full questionnaires are included in the appendices.

3.2.1 Demographics and Communication Scenario

Demographic information of the adult participant, i.e., age, gender, marital status, was gathered. In the next questions block, participants were asked to list the scenarios of situations in which they communicate remotely with 3 to 6 year-olds and name a predominant one among them. All the next question blocks asked participants to think about the predominant scenario. In addition, participants were asked questions regarding the demographics of the children they communicate with, and among which we asked questions determining the custody of the child, whether the adult lives in the same time zone with the child, how big is their time shift if applicable, and if there are multiple children typically involved in remote communication.

3.2.2 Activities and Technologies

In the Activities and technologies block, participants were asked to indicate which of the offered activities they do when communicating with children remotely. We wanted to explore what they do and with what frequency. Frequency statements were rated on 6-point scales from “every day” to “not at all” (see appendices). Also, participants were

invited to leave optional open-ended responses on other activities they might be involved, and leave additional comments about activities that they and the children participate in.

The same structure was used to collect responses about technologies. We additionally asked participants to describe in what situations they use which technologies.

In this question block, we also gathered participants' preferences regarding applications, the participants' perception of the child's preferences for various applications, the web platforms, and devices used for communication. To gather possible additional thoughts inspired by the previous questions, we ended this block with another open-ended question regarding other ways they might remotely communicate.

3.2.3 Reasons and Problems

Reasons for communication were gathered with participants checking from 17 given statements and also adding their own in open response. The statements that were included as reasons covered enjoyment, fun, being asked to, and the expectation from an adult.

We asked if there is another adult from child's household participating in communication sessions, and reasons for that. Participants were asked if they themselves have been in the role of mediator between child and another adult. Descriptions of how typical communication sessions unfold and what device the children use were gathered in the same way, by checking all-that-apply answers to given statements, and also providing their own options. Arrangement information was collected, including how sessions are arranged, at what time they usually communicate, if they can provide a reason for their time choice, where is the child during the session, and duration of the session.

Participants' satisfaction with the amount of communication was gathered subjectively, with participants rating their level of agreement with statement about themselves ('I am

generally happy with the amount of contact I have remotely with the child(ren)') and children ('The child(ren) seems generally happy with the amount of contact they have with me'). Statements were rated on a 5-point scale of agreement from "strongly disagree" to "strongly agree". We gathered opinions on the desired amount of communication, asking if participants and their children are content with time they spend communicating or wish to change it.

Participants' and children's enjoyment were gauged using the same scale, followed by an open-ended prompt for thoughts about their or their children's likes or dislikes to communicate over distance. We measured how often child expresses the desire to communicate with the participant over a distance, on a scale from "every day" to "not at all". We included 10 statements to gauge the participant's perception of how communication roles are distributed between themselves, child, and another adult, if applicable. We asked to indicate additional roles if existed.

Communication problems were measured on 18 statements, reflecting possible usability problems, with respect to severity rating scale in heuristic evaluation [50] ("not a problem at all", "minor problem", "major problem", "catastrophic problem", "never happens"), followed by open-ended responses about additional concerns noticed when communicating with the children over a distance.

3.3 Data Analyses

Collected responses consisted of a mix of quantitative and qualitative data. Survey questions (N=56) consisted of multiple-choice, check-all-that-apply, radio-grid questions with 6-point scales (1="every day" to 6="not at all"), 5-point scales (1="All the time" to 5="Never"), 7-point scales (1="less than 5 min" to 7="1 hour or more"), 3-point scales (1="more contact" to 3="less contact"), and 4-point scales (1="not a problem at all" to 4="catastrophic problem", and 5="never happens"), 5-point Likert scales (1="strongly

agree” to 5=”strongly disagree”), and 30 open-ended questions. We coded 28 open-ended question in Nvivo 11 (2 open-ended questions from Adults demographics were not useful for answering our research questions and thus were not coded).

Using a thematic analysis method [7,8], we labeled data from open-ended responses into themes that emerged iteratively. The final themes included eight high-level categories: comparison with their times, relation to a child, number of children involved, activities, problems, technologies, design suggestions, and grateful to technologies. These categories together contained 43 categories on the next level, 6 of which nested additional sub-categories, such as singing together, opening presents live, telling stories, bed-time activities, and child running around.

4 RESULTS

In this chapter, we report findings from the explorative study described in the previous chapter. Cumulative results reflect the full findings from quantitative and qualitative data collected and portray participants collectively. The results that refer to a child’s perspective are based on interpretation from our adult participants. We refer to our adult participants as the “participant” and the children they refer to as “children”, regardless of their relationship with the child. Distinctive results are described as the next step after deep familiarization with the sample, which resulted in characterizing the differences in personas in the next chapter.

4.1 Children

Participants mentioned a total of 132 children participating in communication (mean age=4.5, SD=1.894; 75 male, 57 female). Although we had pre-screened participants for communicating with children aged 3 to 6, we ended up with children’s ages ranging from 2 months to 14 years (median age=4; 56.8% male) due to the fact that participants communicated with between 1 and 4 children (median=1, SD=0.765), some of whom were beyond the age range we were interested in. Figure 4.1 shows the percentage of children in each age category that occurred. Genders of children by age category are shown in Figure 4.2.

Most participants shared the same time zone with the children (69%); fewer live in different time zones (31%). For those who lived in different time zones, the time shift was not substantial (mean time shift=2.1 hours, SD=1.5).

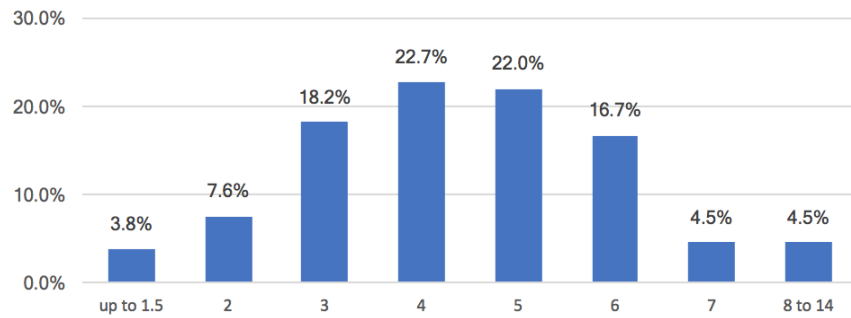


Figure 4.1. Percentage of children in each age category

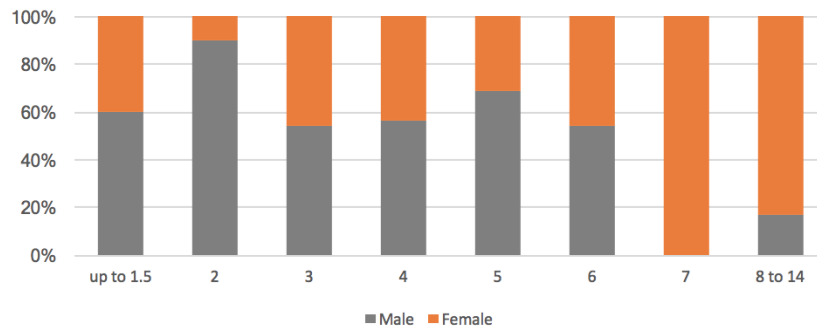


Figure 4.2. Genders of children, percent by age category

4.2 Relation to the Child

Preschoolers with whom participants predominantly communicate over a distance were mainly nephews or nieces (47.6%), and participants' own children (39.3%). Other instances were a friend's child (5.9%), grandchildren (3.6%), cousins (1.2%), a younger brother (1.2%), and the 1st grade student assigned in a long-distance learning program (1.2%). There was a relatively equal distribution of communicating with a single child (48.8%) and multiple children (51.2%).

Among all participants 59.5% had no custody of the child with whom they were communicating, 28.6% had primary custody, 9.5% had shared custody, and 2.4% had less than 50% custody. The proportion of parents in each of these categories is displayed in Figure 4.3. It was expected that the prevalent part of participants with primary or shared custody are parents of the child and that a majority of respondents without custody are comprised of relationships other than parents. The category ‘less than 50% custody’ does not reflect the majority of answers. Children appeared not only as remote participants in the communication but were mentioned as participants from both co-located and remote sides (6, 7.1%).

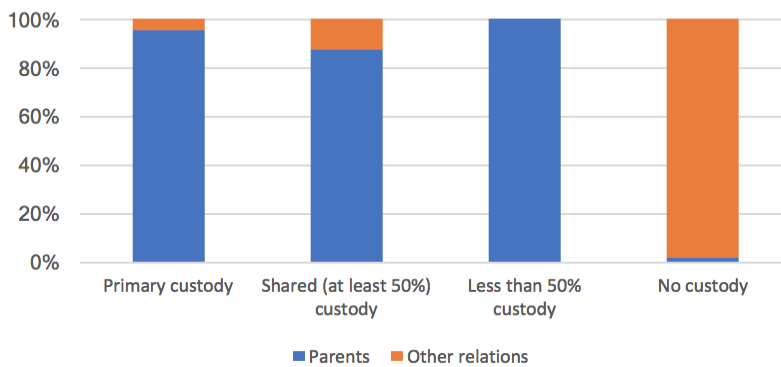


Figure 4.3. Percentage of parents in each custody category

4.3 Activities

We first describe the quantitative results regarding activities participants reported they were doing with children over distance, followed by the qualitative results. Figure 4.4 reflects how frequently participants engaged in activities from our frequency-agreement questions. Based on frequencies of ‘every day’, ‘a few times a week’, and ‘a few times a month’, that are together higher than 60%, the most popular activities are talking, playing, sending pictures and videos, and showing physical objects, with talking and playing being the most noticeably prominent ones.

Figure 4.5 reveals activities that take place every day even more clear. Talking, messaging, and general play were reported as happening every day, whereas physical activities, playing computer/video games, playing card/board games, listening to music, drawing were often not happening at all.

4.3.1 Talking

Adults reported being interested in hearing about children's days, what the children did, to stay in touch with their interests, hear upcoming plans (e.g., visiting on holidays, what to do while visiting, where to go), which are the elements of natural conversation between people. As P33 commented, *“generally the conversation is just catching up on life, but does occasionally involve a story.”*

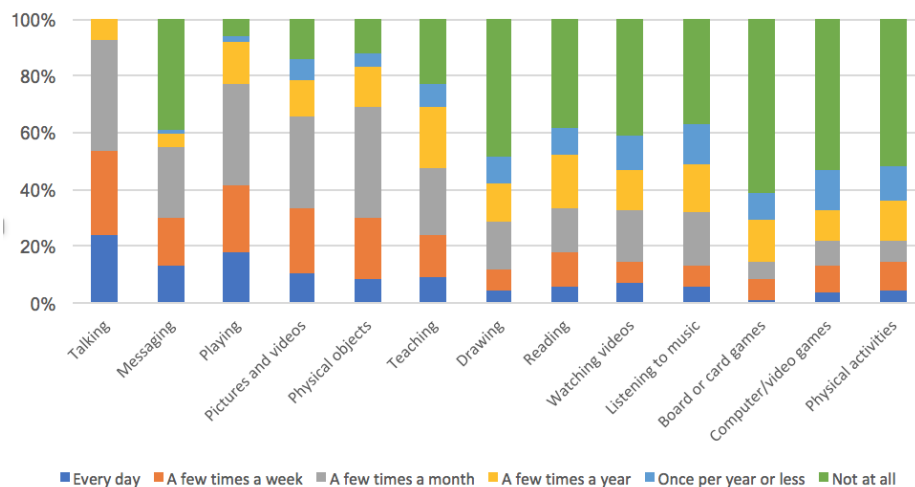


Figure 4.4. Proportion of responses (in percent) for frequency of engaging in activities with children

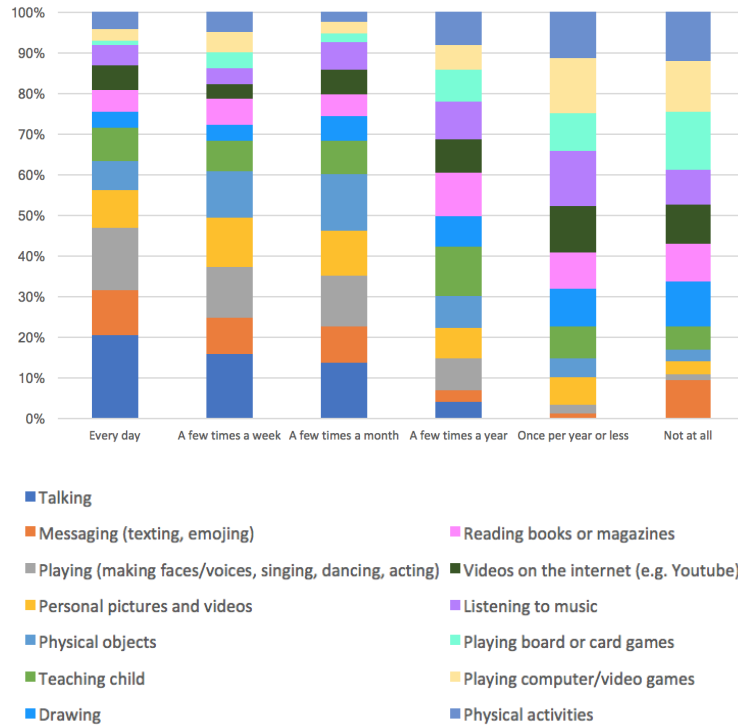


Figure 4.5. Proportion of responses (in percent) for activities in frequency categories

In the result of the thematic analysis on open-ended responses, we distinguished categories of activities, that are overviewed in Table 4.1.

Table 4.1. Overview of participant-reported activities with young children over a distance

Activities	# Participants
Talking	44
Child shows things	26
Expressing fondness	25
Games, playing	23
Reading and telling stories	23
Pictures and videos	18
Adult shows things	13
Presents and mail	13
Pets	10
Teaching	9
Sing	7
Dance	5

Meals live	4
Shopping live	3
Playing music	2
Monitoring	2
Drawing	1
Praying	1

Participants also expressed the need for more parent-specific information, such as to check what a child has eaten, to teach life lessons, to check if they are behaving, *“if everything is functioning smoothly overall”*, to discuss school/preschool activities, to monitor reading habits, and to discuss what they have learned.

Participants reported that the children were interested to find out what an adult is doing at the time and their upcoming events, talk about how they are doing, and express their affection to the adult. For 3-6 year-olds, there was also a notion that they were unsure of how to express themselves verbally:

“Sometimes, they don't have anything to say, but that is okay”—P44.

“Sometimes my other son, who is 1 year old, will take the phone and walk around with it while smiling at me”—P61.

4.3.2 Child Shows Things

One of the important activities for a child was to show objects around them (26, 30.9%): especially toys, drawings, stuff they have done that day, their room, their pets, new dance routines, or how they were learning to swim. *“Showing cool stuff”* seemed to be valuable for children, because they prepare materials for upcoming sessions ahead of time:

“he can show us all the cool things that he has been saving up to show us”—P85.

One fifth (20.9%) mentioned that children were carrying a device during the call, trying to show things around the house. When showing objects inside the house was no longer considered sufficient, they went outside:

“running around carrying me with him on the phone or ipad. to his room to show me things, to outside or in the garage”—P59.

4.3.3 Expressing Fondness

Participants discussed expressing affection, showing fondness, support, saying good night, and imitating activities they would do if physically present with a child before sleep (25, 29.8%):

“tuck him in via video chat”—P13.

“I can't think of anything else, it's mostly just cute stuff before sleep. [...] I'm sure he was a little nervous to sleep someplace new, but they called me before they went to sleep and he was comforted by it”—P83.

“also saying goodnight is just a must”—P21.

“I leave a nightly message saying good night over a cloud pet”—P52.

4.3.4 Games and Playing

These activities include playing video games together (9 instances) and playing over the screen (14). The latter means playing games involving mimicry, laughing, making jokes, playing non-electronic verbal games (e.g., “I spy with my eye”, “20 questions”, guessing and educational games), and also children being *“silly and wild when I talk to them over skype”*, as P50 said.

4.3.5 Reading and Telling Stories

Participants read and tell stories to children as a way to communicate with them over distance and children tell stories to them as well (23, 27.4%). These activities mostly happen when child is getting ready to sleep and function as relaxing procedures:

“So that I can maintain their usual routine of spending the hour before a sleep period engaged in calming activities with me”—P63.

Many mentioned maintaining a usual routine, even when they are physically away from the child:

“even when I’m gone, [they are] still getting to have their bedtime stories and songs”—P63.

Participants noted that children love to have their adults read them bedtime stories and have favorite books. Although reading is an important activity for both parties, only P50 mentioned that her children actively participate in reading from their side and *“follow [the story] along with [me] at home”*. This may mean that technologies participants currently use do not support their established preferences and routines, making reading over distance an uncomfortable or even impossible activity.

4.3.6 Pictures and Videos

Participants share *“silly”* pictures and videos with children, pictures of family, photos and videos of outings or trips, and also take screenshots of children. Participants reported that children enjoy special filters and stickers (*“silly masks”* and *“funny hats”*) that social media platforms like Snapchat and Messenger offer. They also send funny pictures, GIFs, emojis, emoticons, and other things of personal value (pictures of themselves in the new outfits, pictures of their art work, *“favorite allicorns”*, photos of their new toys and Pokémon cards).

Being poor verbal communicators, young children benefit from visual ways of interacting. Two participants expressed that their children enjoy visuals and colours, which partially explains why the kids like photo and video overlays:

“The Snapchats happen often but there are no conversations, just silliness”—P20.

4.3.7 Adult Shows Things

Participants mentioned showing other family members they are with, pets, items they bought, and things around the house. They try to share special moments:

“I might communicate with them while I am doing something fun, like enjoying nature, eating good food or going on vacation—anytime I want to share some special sights with them”—P64.

Children like to see what an adult is doing, explore their surroundings (e.g., hotel room, apartment, trip environments), and Instagram photos. Participants noted that children appreciate when adults show items of the child’s interest (e.g., *“trains or big trucks at the rest stop”*, sports-related items).

4.3.8 Presents and Mail

13 participants (15.5%) mentioned that they use mail as the means for communication with children over distance. Children receive letters, packages, little poems written specially for them, books, pajamas, etc. Anything coming in a box or sealed in an envelope delights:

“she gets a lot of packages (small things) from her Nana (me). She loves opening the boxes and is very excited to tell me what she got”—P40.

“The children like to receive letters from me in the mail, since that is novel for them. It makes them feel special to receive letters and pictures and poems in the mail.”—P64

It is important for respondents to be together on special events, share impressions and feelings, so they reported sharing these moments (e.g., opening presents on holidays and birthdays) live:

“The child [...] and my daughter here with me [...] each open a special present [...] live on camera with each other on Christmas Eve. Each child also opens the birthday gift sent to them by the other child live on camera on their individual birthdays”—P29.

Opening presents live is something everybody enjoys as it involves emotionally loaded moments for both the receiver and sender.

4.3.9 Pets

Pets plays a role in communication with young children over a distance. 10 participants (11.9%) said that pets appear in their sessions on a regular basis. Children love to show off their pets and to see animals from the adult’s household. We noticed two distinct reasons: 1) pets are members of the family, and 2) pets are the medium to keep the child’s attention. As P35 explains, *“at his age he does have a hard time focusing and sometimes the calls are very short. I often try to get one of my cats involved to help keep his attention”*.

We had 31 participants (36.9%) report that children lose interest while speaking, wander off, have problems sitting still and being involved in session long enough, and get bored quickly. We discuss more details about losing attention in the ‘Challenges with children’ section.

One participant used pets to create playful games:

“We have our cats ‘talk to’ each other over facetime. It really makes her giggle. [...] My cat is Judge fat head and my nieces cat is Judge pooper pants. (Yes these are names that she came up with). The cats ‘judge’ who had the goofiest face”—P76.

4.3.10 Teaching

9 participants (10.7%) were participating in educational activities with children, mostly helping with or reviewing homework, but also explaining or teaching something. P20 was grading the child's performance: *"Sometimes she and I will talk about her drama class and she will tell me her lines and I will 'grade them' at her request. It's become an ongoing thing for us for the past 3 months."*

4.3.11 Singing and Dancing

In 12 cases (14.3%), singing or dancing was reported as bringing a feeling of being together:

"She sings and dances and it feels like I'm there"—P40.

Sometimes it is bedtime songs, or singing together, using an *"app for karaoke, [which] makes it easier to view lyrics"*, P82.

4.3.12 Other Activities

In this category, we combined activities with lesser-observed frequencies: sharing meals, shopping, playing music, monitoring, drawing, and praying. Two cases included eating as an online shared activity, in the other cases a session might happen when a child was eating:

"a few times made it a point to 'have tea' together, which was both of us drinking water at the same time over Facetime"—P20

"we've eaten dinner together"—P38.

One participant, who has a large backyard, mentioned unexpected activity they are practicing with their 4 children:

“The playhouse is at the far corner away from sight where I might be able to watch from a window or from our outside deck. I have put walkie-talkies in the playhouse to call the kids in for lunch, or I leave the listening on so I can monitor them when I need to run inside”—P50.

We found two instances of ‘shopping live’, which is when one party happens to be in the store, and another party is participating in their shopping experiences:

“If I’m at the store and buying them something, they can see what it is or pick between 2 items”—P10.

“‘shopping’—many times, he will FT me while he is shopping at Walmart and show me what he wants or costumes he is trying on, etc. Pretty cute.”—P59.

Other more sporadic instances were playing music together, drawing, and praying.

4.4 Places

Several locations, usually 2 or 3, were mentioned as the places where a session could happen (e.g., car, bed, kitchen, living room, outside, etc.) Moreover, 17 people (20.2%) mentioned that their children were moving around during the session.

4.5 Reasons

In terms of the reasons for communicating over a distance from quantitative data, Figure 4.6 shows the results of all-that-apply question. Children’s enjoyment (84.3%) or their own (84.3%) were the most-cited reasons. The next most prevalent reasons were spending quality time with children (67.5%), children’s sympathy for adult and being happy to communicate with them (65.1%), and an enhanced feeling of togetherness when participating in shared activities over distance (61.4%).

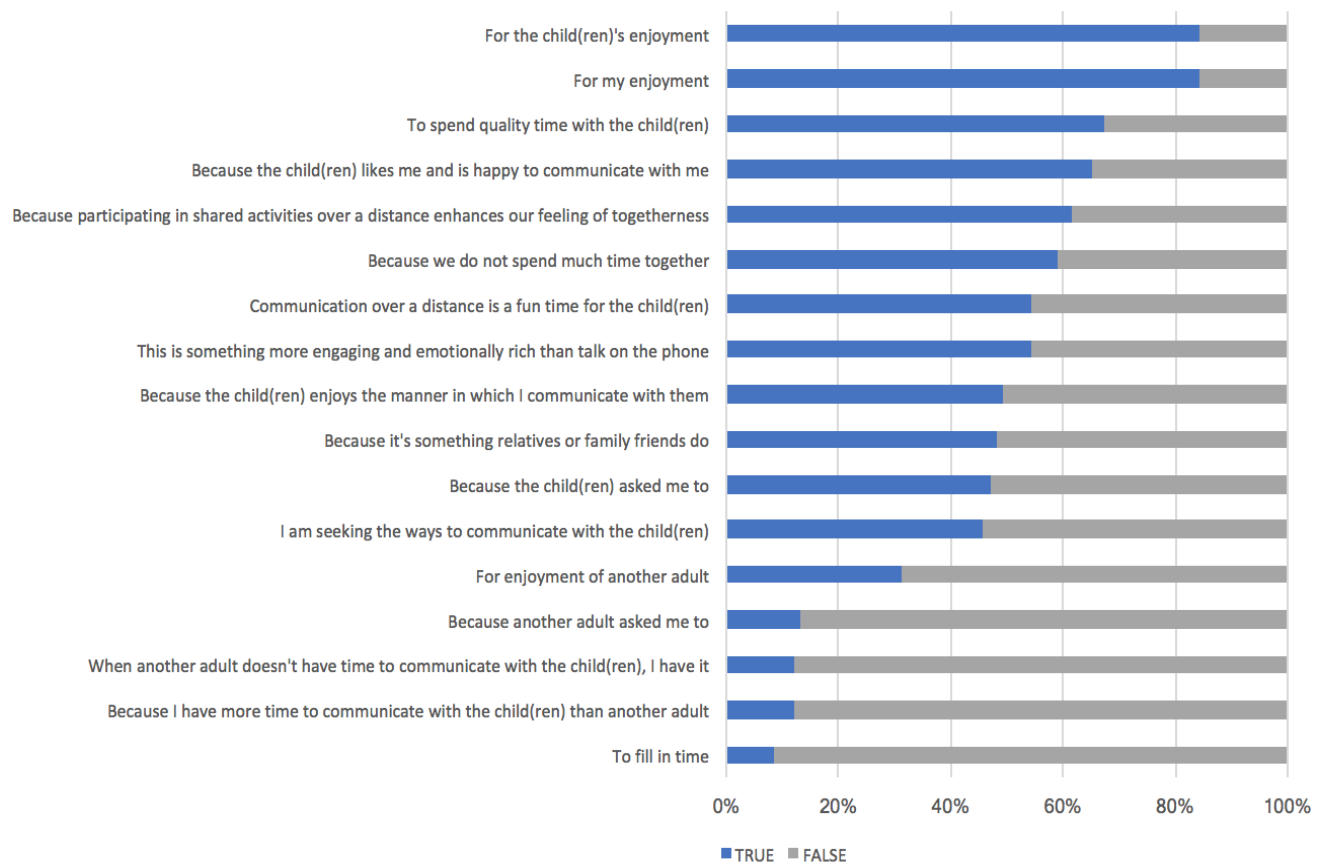


Figure 4.6. Reasons for communication over a distance reported by percentage of respondents

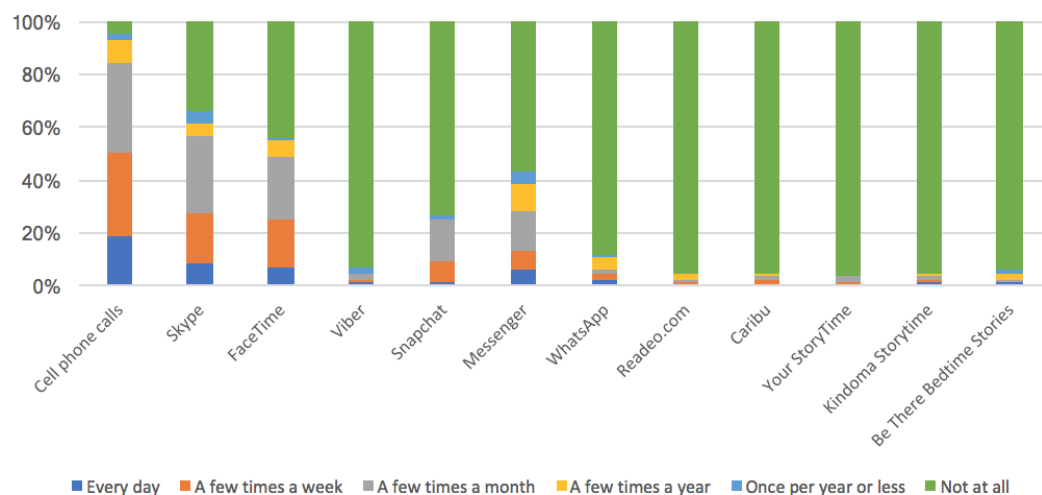


Figure 4.7. Proportion of responses (in percent) for frequency of using proposed technologies with children

In terms of frequency, cell phone calls, Skype, Facetime and Messenger were rated as the most frequently used (Figure 4.7). Interestingly, most participants mentioned the use of more than one technology to serve their needs in communication.

4.6 Co-located Adult

We asked participants to rate how often the adult co-located with a child participating in communication. As was expected for children 3 to 6 years old, the co-located adult participates in communication most of the time (36.1%) or all the time (33.7%). Other responses include some of the time (19.3%), not very often (8.4%), and never (2.4%).

Participants were also asked about reasons why the adult from the child's household participates in the session in a check-all-that-apply question. The most common reasons participants selected were: another adult helps the child to interact with a device (63.9%), guards the device from breaking (48.2%), assists the child when they cannot achieve the intended result using the device or app by themselves (34.9%), and helps to use it in general (34.9%) (Figure 4.8).

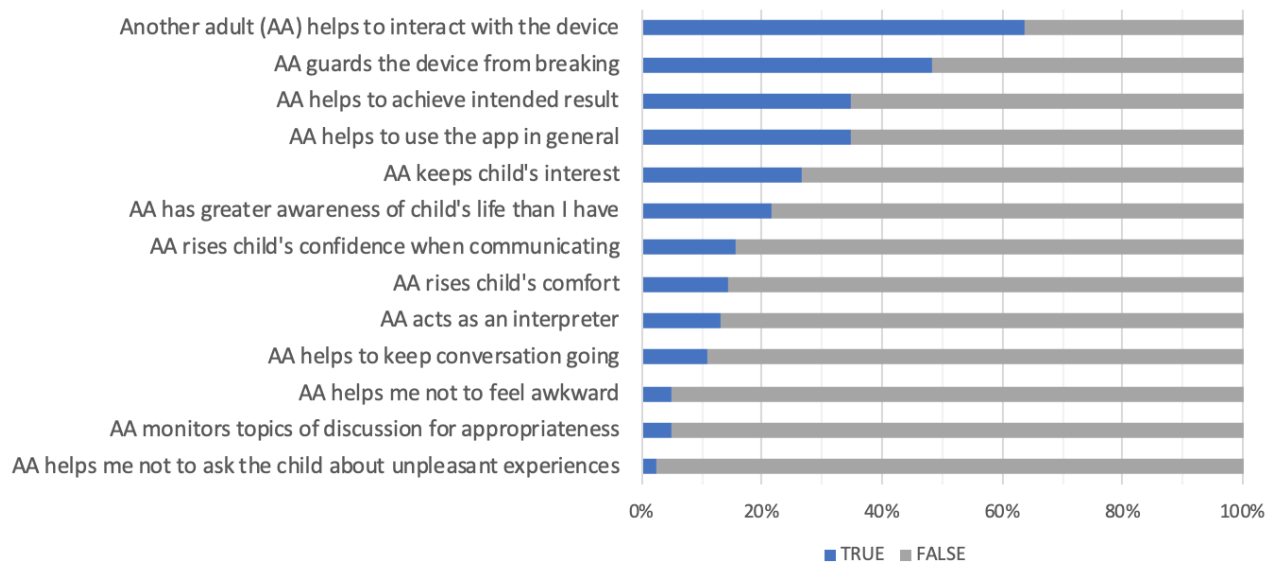


Figure 4.8. Reasons why co-located adult participates in sessions reported by percentage of respondents

4.7 Communication Session

Participants were asked to rate how frequently their session unfolds in terms of the order in which parties join a conversation, their mobility, and the amount of activities performed during the session. The most important findings in this set of questions were: 1) the session starts as a group of adults and then continues into a larger group as children join them (60.2%); 2) a child (31.3%) and an adult (24.1%) change their locations during the session, which is supported by qualitative findings; and 3) the parties cover two different activities while communicating (24.1%). Figure 4.9 shows these results in detail.

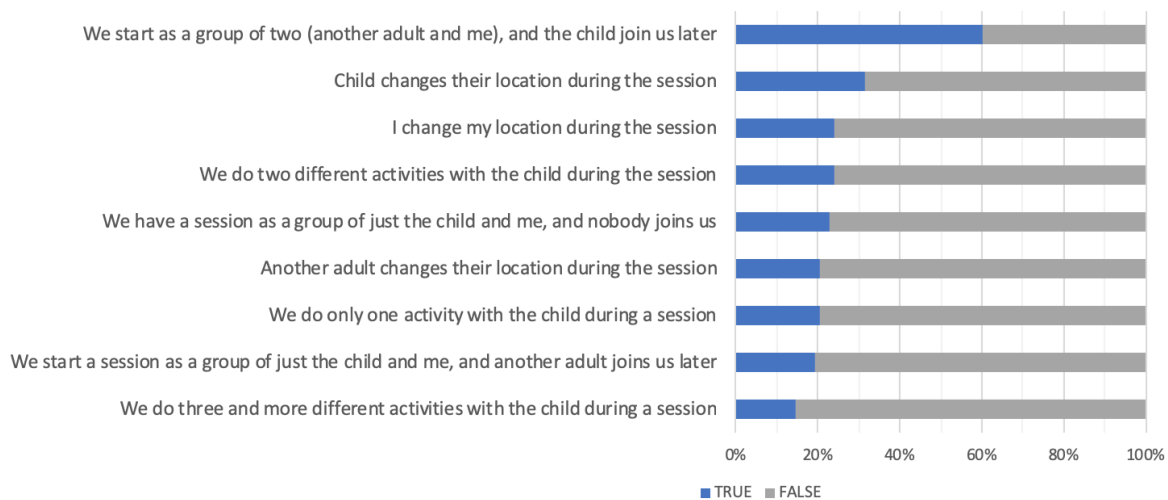


Figure 4.9. Proportion of responses (in percent) for stated situations

A communication session does not last for long, it is usually from 5 to 30 min (reported by 72.3%), with a child's explicit participation even shorter, from 5 to 20 min (57.8%). Proportion of responses in each duration interval are shown in more details in Figure 4.10.

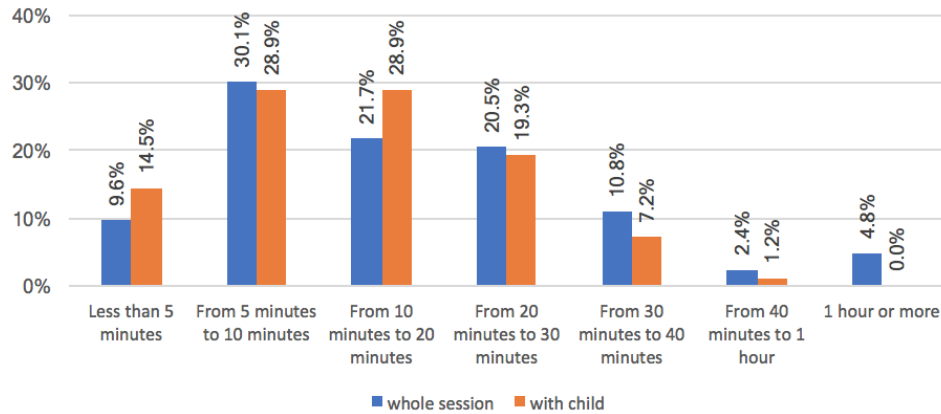


Figure 4.10. Proportion of responses (in percent) for a session duration

4.8 Amount of Contact and Enjoyment

We evaluated the amount of remote contact with children on 5-point scale (1=“strongly agree” to 5=“strongly disagree”); participants reported to be generally happy with the amount of contact (1.75, SD=.080), and stated that children seem to be satisfied with it as well (1.79, SD=.084). In terms of wishes to change, participants (59.0%) wished to have the same amount of contact, although many wished for more (37.3%). Participants mostly perceived that children wish for no changes in the amount of contact (50.6%) or wish for more contact (48.2%). Participants thought that the children enjoyed themselves (1.63, SD=.673) and also enjoyed the contact (1.58, SD=.662). According to participants, most of the children expressed a desire to communicate several times a week (48.2%). Fewer showed their desire to communicate a few times a month (27.7%), every day (16.9%), and a few times per year (7.2%).

4.9 Preferences and Concerns

In this section we describe the likes and dislikes that adults expressed, as well as the preferences perceived by the adults from the child’s side.

4.9.1 Adults about Themselves

Judging from the highest amount of instances (35), adults like the ability to see the child, stating that:

- 1) seeing is better than just listening, and also helps the child to put a face to the name, (e.g., *“Video chat is more fun than talking on the phone, as they're more engaged”, P15; “videochat isn't just a random voice that children won't associate with me”, P34; “It allows us to 'see' each other in real time and makes communication more personable”, P26; “using facetime allows me to connect more with my younger child than talking on the phone”, P60*);
- 2) they appreciate seeing facial expressions (e.g., *“I can understand a lot more when there's accompanying video”, P37; “stay connected with my babies in a way that voice alone cannot provide <3”, P63*);
- 3) being able to leverage nonverbal communication. (e.g., *“She's very smart and verbal, but being able to see each other means we can make silly faces [...] and use nonverbal communication while conversing”, P39; “video chat has made interacting with children much easier”, P86*.

Video chat services, in general, were mentioned (25 instances) to be easy to use (e.g., *“user friendly from an adult perspective”, P29*), convenient (*“so readily accessible on my smartphone”, P45*), and user friendly (e.g., *“Facetime is very accessible and kid-friendly, which is one of the reasons our family has iPhones collectively”, P62; “Facetime is super easy for a 4 year old to use and it just makes her so excited to be able to use it”, P76; “It's easy enough for him to answer the calls and know how to use the app”, P92*).

Another theme of appreciation for remote communication technologies (19 instances in total) centred around staying connected and being involved (e.g., *“I appreciate that we are able to connect and feel like we are with each other”, P29; “I like feeling close to the kids as they grow up even though we are so far away”, P33; “makes me feel closer to the kids even when I can't be with them in person”, P47*), easier to be a parent (e.g., *“They have made it so much easier to be a good father and be connected even when I am away when I don't want to be. You can be more involved in their lives and*

make them feel like they can contact you when they need you”, P42), sharing experiences, photos/videos, showing things (e.g., “She sings and dances and it feels like I’m there. She shows me her toys and tells me stories. I can see and hear her very clearly”, P40), and taking screenshots of a child.

Importantly, these types of remote communication technologies were reported as the only way to have a relationship with a child when an adult does not see them often or at all (13 instances; e.g., *“Harder to do over Skype or Google Hangouts but not impossible and can still have a great relationship”, P26; “It creates a means to communicate with someone I really care about”, P30; “being able to see the kids as they grow and be a part of their lives even though I’m far away from them physically”, P58; “I basically like to keep the children apprised that I am related to them and connected to their lives, even if I don’t see them in person all the time”, P64; “I like that I am able to video chat with him otherwise, I would only ever get to see him in person”, P67; “its a great way to keep in contact at a moments notice without actually living close”, P72). The services also make physical visits become more special (e.g., *“It makes it so much easier to visit regularly”, P93*). Participants value communication services for providing connection any time and immediately (4) and for not glitching (1).*

Participants used social media filters and overlays mainly because their children enjoy them (7; e.g., *“She loves using the filters and being different animals or having different effects put on her face. She kicks an absolute kick out of it and I like seeing her laugh at herself.”, “her favorite part is [...] to have fun with the Snapchat filters and turn herself into dogs and Pandas”, P20*).

Technologies save adults from estrangement (3; e.g., *“I do not get the opportunity to travel out to visit so it helps me see him grow up and also so he sees me and I am not a stranger”, P35; “they will know me when I can visit without [them] being scared of me”, P52; “the capability of being able to ‘see’ him via these apps on a regular basis makes it so that I’m not a stranger to him and allows us to get to know each other”, P76*.

Other credits that go to technologies from the attitude of adult are (1 instance each):

- 1) Ensuring the safety of the child (e.g., *“The best thing technology does when my kids aren't near me is ensure their safety. It gives me a peace of mind to be able to communicate in real-time their positions and well-being”, P62*);
- 2) Tracking a physical location and identifying the dearth in education (*“I like that I can keep track of where they are physically, but it also helps to gain understanding of areas in education and in personal life that they might need encouragement or extra help with”, P50*);
- 3) No need to have facilitating adult;
- 4) It is easier for children to operate comparing with phone calls (e.g., *“as my sons are abit too young to understand on the phone, cause they don't hold the phone up. It works great with video chats”, P41*);
- 5) A child being able to reach an adult;
- 6) Awareness of the other party’s availability (e.g., *“It is easy to see when they are online and they can tell when I can or can't talk”, P22*).

Nonetheless, participants mentioned that they are irritated by all sorts of technical problems (35 instances; e.g., unreliability of the service, problems with connection or slowness, low-quality video/audio, data usage and fees, and relying on everyone having a charged battery):

“The quality of the video or voice is often terrible and distorted. This makes communicating extreme (catastrophic problem on your scale) and hard because the video freezes, the voice is hard to understand and the call often disconnects. It often happens a few times and the kids are normally not interested or too excited when the call is finally successful”—P50.

Privacy and security concerns were also voiced (9 instances), which included control of communication circles and guarding from random friend requests. Being physically separated and feeling impersonal or distant were mentioned as a limiting factor (9; e.g., *“I'm not actually there in person. You can do a lot over Facetime, like have a dance party, but it's way more fun in person”, P55*). Other concerns were: 1) the fact that children are “glued” to electronic devices and spend too much time on the phones (4), 2) child-unfriendliness and

inappropriateness (4), 3) necessity of adult assistance (2), 4) obligation to pay (2), and 5) the lack of physicality (2; e.g., *“There is nothing like cuddling with your child”, “Physical touch is something that is missing in this type of communication”, P42*).

Other less frequent dislikes were the unmet need of awareness of played messages (*“I do not like that I do not always know whether or not my children play the messages for them”, P52*), that communicating might actually prevent in-person visits (*“to communicate so often makes it seem like don't need to visit as much, because up to date”, P59*), over-stimulating technology (*“Sometimes the technology itself is over-stimulating and defeats the purpose of trying to make a child tired, or keep him tired”, P69*), and accidental calls from children.

4.9.2 Adults about Children

We did not include children's responses directly, as our goal was to understand the perspectives of the adult users. The direct perspectives of children deserve their own research approach, as it is important to not assume that adult users are able to express the preferences of the children with whom they communicate. We did ask the adult participants for their perception of the children's preferences; however, we caution that these results should not be interpreted as representative of the children's preferences directly, but as filtered through the lens of the adults who interact with them. Describing the child's preferences, participants emphasize talking face-to-face (41), and spending time with family members and belonging to family as a group (16). Participants reported that preschoolers appreciated the ease of use of communication services and devices, being able to play games meanwhile (10; e.g., *“They LOVE screens”, P31; “some of the apps we use let him play games while he is waiting on me to call”, P46; “its so easy to get in touch with me and I'm not talking about just a normal phone call- if they need to reach me they can push a button and BOOM there I am on their screen...visually. Kids have a hard time picking up cues from voice only so now that they can see me...it helps a lot!”, P73; “kids think these technologies are cool and fun”, P78; “It is an easy, fun, and seemingly natural way to communicate”, P88*).

Our participants felt that the children are curious about the participants' activities and places they stayed (10 instances), including pets (e.g., *"I can show them how my cat and dog are doing, etc"*, P15). Participants felt that the children like being in control (8; e.g., *"calls me whenever she wants to for the most part. I [...] get her Snapchats through out the day"*, P20; *"my daughter feels like she has control. at such a young age and being able to access me anywhere is amazing"*, P21; *"He likes being in control and knowing which buttons do what"*, P69), and feel discouraged if they are not able to operate technologies independently (3; e.g., *"They don't like that they don't know how to operate all of the features and depend on parents to handle working the technology"*, P48).

The adults also felt that children themselves enjoy showing objects and pets (7; e.g., *"[child likes] video chatting because it is more engaging, they can show me their new dance routines"*, P15). They were also reported to love filters, stickers, and masks provided by social media platforms (7; e.g., *"her favorite part is [...] to have fun with the Snapchat filters and turn herself into dogs and Pandas"*, P20; *"[child loves] The stickers to add on the videos and photos he sends me"*, P25; *"She thinks it's cool to send special filters on snap chat"*, P38).

There were a few items among the child's reported preferences that received only few responses:

- 1) Adult reading to them, story time (3);
- 2) Talking to other children (2);
- 3) Sharing pictures and videos (2);
- 4) Watching videos (1) and to being able to save pictures and conversations (1).

Interestingly, apart from numerous preferences for communication enhanced by video, the adults reported that sometimes children choose to talk on the phone because *"it makes them feel more grown-up"*, P15.

While participants felt that preschoolers appreciate the ease of using video chat services (10), they also felt that children experience frustration and impatience from technical

problems that interrupt communication (13; e.g., being disconnected, video lags, freezing, slowly running apps, glitches, dropped calls, and also not having disk space for more games; “*they get frustrated when the technology fails or app/technology is broken and won't open or they get stuck and don't know how to resolve glitch*”, P59).

There were also 9 references made to interfaces not being child friendly, children accidentally pressing buttons, unintentional call drops, hard to operate devices, overly sensitive screens, and other interaction difficulties (e.g., “[*children*] *have to be careful what they touch on the screen, otherwise they will accidentally end a video call etc. They are so eager to touch the screen and be a part of the technology, but the technology is not kid-friendly enough for them to be that involved and I think it bums them out*”, P29; “*they don't want [...] to hold the phone in front of their face to chat with me*”, P57; “*My child doesn't like how sensitive the touch screen [...] is so sometimes she'll end calls on accident*”, P62; “*Not being able to be held*”, P70; “*she touches the wrong button or screen and it disconnects the call*”, P89).

Children do not welcome interruption if they are being stopped from watching videos, cartoons, and games (5; e.g., “*There are times when I Facetime in, and they don't want to slow down from their activities*”, P57). Adults inferred that children do not like to communicate remotely due to difficulty of staying focused and attentive (5), as they have other priorities in mind (e.g., “*it is hard to sit still. I know she'd rather actually play*”, P93).

Similarly to adults, there was the notion that children also miss the physical touch (4; e.g., “*I feel like sometimes they would rather be able to hold me*”, P52; “*He can't hug, kiss, or see me*”, P56), and it is “*still not in person*” communication (4).

Participants reported that the children feel bad when they are not able to operate technologies independently (3; e.g., “*frustrated that they need adult to help them with everything*”, P29; “*not being able to control the device*”, P33; “*They don't like that they don't know how to operate all of the features and depend on their parents to handle working the technology*”, P48). Availability issues, misunderstanding, and impatience are among their concerns (2; e.g., “*He [...] gets frustrated*

when I can't answer the phone or messenger when I'm busy", P42; "Time commitment can be a problem for children, and knowing that communication is possible, but not happening as frequently as they would like is disappointing", P86).

Being unable to see the interlocutor was mentioned as disappointing for young children (2; e.g., *"they often prefer to see someone when they are talking, but I think that they grasp that not all phone conversations allow you to see the other person. I think that they are sometimes frustrated by misinterpretations that arise during communication at a distance", P71).*

There have been sporadic occurrences of the factors that were not met enthusiastically by children:

- 1) Over-parenting (e.g., *"I can always find them and tell them to come home or inside. There is no hiding from me when the technology is present"*);
- 2) Difficulties with showing things;
- 3) The absence of a direct interaction (e.g., *"we can't always interact directly over the apps. Such as draw together on the same picture, or read from the same story"*);
- 4) Device withdrawals by an adult;
- 5) The necessity to share a device, to log in in their account.

4.10 Challenges with Children

Video chat brings noticeably more fun to children, but children can be sometimes more distracted when talking online than in person. Losing attention and low attention span were acknowledged by more than one third (31, 36.9%) of participants. Talking to the camera takes a lot of "coaxing" for children and they have no patience for long conversations (e.g., *"If it is just me communicating, the kids sometimes ignore me and pretend I am not talking to them (selective hearing??)", P50; "Sometimes it's like I'm a tv show for her and she wanders off", P39;).*

Participants adapted specific strategies for keeping the child's attention (e.g., mail, packages, pets on the screen):

“I sometimes feel a lot of pressure to make the communications fun and entertaining (and to keep their attention long enough!) Sometimes I feel like I'm running out of ideas to keep things fun and fresh and new and exciting. I don't want them to get bored with the communications because the connection is so important”—P29.

Participants noted that incorporating video in communication allows them to better maintain the child's attention (e.g., *“She loves to 'see' who she is talking to it holds her interest more than when I just speak to her on the phone. I can get more time out of her”, P40*).

Other participant observations were: 1) children are able to maintain attention and enjoy conversation more when multiple children are involved, rather than just an adult and themselves; 2) it is hard to hold the phone and maintain the presentation of themselves in the frame; 3) confusion with a separate view of remote adult (i.e., why adult cannot see what they can see); and 4) misunderstanding of necessity to *“talk at the screen”*, since children focus on what is physically near.

4.11 Summary

In this section, we presented the preliminary findings from the data analysis, both quantitative and qualitative. The commonalities noticed in responses of participants were described. Cumulative results include demographic findings (e.g., children, adult's relation to the child), primary findings (e.g., activities, places, reasons for communication, technologies and devices used, and challenges encountered), and secondary findings (about co-located adult, description of the communication session, amount of desired contact and enjoyment, preferences, and concerns).

5 PERSONA CREATION

In this section we report the process that led to the creation of personas. While analyzing the data, we became deeply familiar with it, enough to notice the differences in scenarios over the entire sample. The diversity of users, e.g., from 20 to 55 years, was large. Illustrating the aggregated data became challenging. Rather than continue to seek commonalities, we decided to separate findings into personas.

The notion of personas was first introduced by Cooper [10], and represents a fictional archetype of an actual target user, expressing their interests, goals, and attitudes. This design tool is helpful for making people involved in the design process and think about end users not as abstract and detached, but as vivid persons living among us with detailed stories of their wants and frustrations. A persona represents target users whose behavioural characteristics are similar, and is described as ‘fictitious, specific, concrete’ [54]. The benefits of incorporating them into product design have been demonstrated in research [44]. Our purpose of using this design method, and in making a set of persona cards, is to advocate the observed diversity in motivations and expectations from communication with their little loved ones.

We first describe the segmentation of users based on eight determined goals and next on the four overarching goals. The summarized results of the last segmentation are presented as four personas of adult users, who communicate with 3-6 year-olds over distance.

5.1 First Segmentation

Mulder S. and Yaar Z. [46] mentioned three possible approaches that one could use to group users into segments when generating personas: to segment by goals, by usage lifecycle, or by combination of behaviours and attitudes. Inspired by their suggestion, we first separated the sample into 8 segments based on participants' goals of communication with young children. Even though there was no direct question about goal in the survey, it was still possible to infer the attitude from all responses of one subject, because participants used the space of open-ended responses to reflect their story, inspired by the more defined questions. The results of the first segmentation presented in Table 5.1.

Table 5.1. Segmentation on eight goals

Goals	Distinctive instances
Continue to be a parent when apart	<ul style="list-style-type: none">- when away from home (no details)- when leaving for a job daily- when travelling/ business trip- when a child is with another parent- when visiting parents (child stays overnight with grandparents, or parents are leaving to take care of grandparents)
To take care and control	<ul style="list-style-type: none">- check in on child during classes- check if the child is behaving- calling during downtime at work (check things done/eaten)- while child is being babysat (to have peace of mind)- calling from work to teach children about things
Continue bedtime routine	<ul style="list-style-type: none">- calling home to say goodnight to another child- say good night, story time- Facetime when they cannot be together for bedtime- making sure the call is before bed time
Not a stranger	<ul style="list-style-type: none">- children get to remember what adult looks like (when not seeing each other often)- child can recognize an adult when seeing on holidays- child sees adult and he is not a stranger- easier to visit regularly- children get to know adult, and they are not scared of adult when he visits

Have relationship	<ul style="list-style-type: none"> - calling each day - helping with homework sometimes - not seeing often, but making sure to have a relationship with a child - to keep in touch, to talk and laugh, make jokes - to keep up with child's life and interests - to see a child growing up - to call on birthdays - to remind about themselves (children do not forget about adult and know their relative)
Maintain family connection	<ul style="list-style-type: none"> - calling each day (separated couple) - open family discussions, making sure family members keep in touch (children are happy to see family from another household, to talk to remote children as well, <i>"my daughter likes to facetime with her cousins too"</i>, <i>"my sister-in-law and her husband always want to talk with us as well"</i>) - to strengthen family bonds and ties (<i>"It's our way of staying connected as a family"</i>) - to speak with family members - to make plans for visits, to participate in the events and make physical visits more special
Form deep connection	<ul style="list-style-type: none"> - to keep current with child's life and update the child about their life - always on special occasions, such as holidays or birthdays; opening presents live - close personal activities (bedtime stories or calls, drinking tea together, playing with each other, "I spy" game, grading drama classes, Snapchats, typing books for children, homework, Minecraft together) - private chats with children individually - deep connection between children (<i>"build and maintain a friendship that benefits our children"</i>, <i>"[connect] my nieces and nephews on both sides of the family"</i>, <i>"a huge way my kids and I communicate with them"</i>) - to keep the children apprised that an adult is related to them and connected to their lives - the only real alternative to be involved in child's life (to show children that an adult cares about them and miss them, to learn about children as they grow up, and to develop a closer relationship with a child)
Strong presence in child's life	<ul style="list-style-type: none"> - to see children as they grow and be a part of their lives - family days on Sunday, the first day of school - to be like a close relative across the street when apart - willing to build deep connection (<i>"we want my niece and I to have a strong bond"</i>) - strong emotional bond (bedtime stories, playing with pets) - high level of dedication (<i>"I am on board with anything that can connect me"</i>)

	<i>with my youngest granddaughter”)</i> - high level of fondness (“ <i>I love this children as if they were my own. I try to make sure that we can talk as much as we can that way we can develop a strong relationship</i> ”)
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5.2 Second Segmentation

Eventually eight segments merged into four overarching segments: *Parenting* (27 subjects, sample weight 33.75%), *Not a stranger* (3, 3.75%), *Basic relationship* (29, 36.25%), and *Strong relationship* (21, 26.25%). Some goal outliers were coded as ‘else’ (online tutor, 1) and ‘NA’ (not detailed enough response, 3), and were not included further, leaving 80 goal-clear participants to be sorted in personas.

The second segmentation left uncertainties about the classification of two participants who had a wide range of goals, so they were assigned to a stronger goal segment, because it included their stated goals. For example, from key phrases that P52 mentioned (“*because they live in another state [I call] on birthdays, holidays and weekends, every other weekend. [...] I can stay in touch with them and they will know me when I can visit without being scared of me. [...] [I say them] Good night over Cloudpet*”), we concluded that her goals were to form a deep connection, not to be a stranger, and to continue the bedtime routine. The overarching goal was to form a deep connection, which resulted in *Strong relationship* in the next segmentation phase. Full characteristics of the four segments are provided in the appendices.

5.3 Summaries of Segments

The quantitative and qualitative data for *Parenting*, *Not a stranger*, *Basic relationship*, and *Strong relationship* was reviewed and summarized separately. The summarization process took 2 stages to gain more condensed information. The example of the summary structure for the *Basic relationship* segment is as follows (other segments followed the same structure):

- 1) *Demographics*: sample size: 29, 36.25%; relation to child: 24 uncles/aunts, 1 parent, 1 grandparent, 1 family friend, 1 brother, 1 cousin; age 20-51 (32.52, SD=7.462; median 30, mode 27); gender 44.8% female; marital status single (13, 44.8%), married/domestic (12, 41.4%), divorced (4, 13.8%);
- 2) *Goals*: to have a relationship, to maintain family connection;
- 3) *Range of activities*: talking (15 instances), sending photo and video (5), showing things, letters and packages, reading, games/playing, singing;
- 4) *Consistency of communication*: a few times a week (1 participant), every week (8), a few times a month (1), every month (2), a few times a year (3), NA (14);
- 5) *Services*: Facetime (14 instances), Skype (11), Phone call (7), Mail (5), PS, Xbox (4), Facebook (3), Text, Google Hangouts (2 each), Marco Polo, karaoke app, WhatsApp, NA (1 each);
- 6) *Problems*: technical (18 instances), the lack of attention (8), general help, help to initiate (4); not able to hold, not able to control device (depending on parents, on solving the glitch), no hug (not being there) (3 each); impersonal, interruption not welcomed, unsupervised device, translate (2 each); safety, advertisements, accidental call, limit a screen time, feature upload later, help with conversation, understanding child's words, misinterpretation over a distance, rare visits allowed, pay for application (1 each).

Apart from differences revealed in segment summaries from quantitative data, the most valuable insights were formed by the qualitative data that accompanied the segmentation.

5.4 Persona Cards

Aggregate descriptions of each user type, showing an abstract summary and being detached from real people, are not yet personas. A photo, name, demographics, and user scenario make the difference in viewing the persona as being real rather than just a segment, and thus provide vivid representation of the targeted user group [46].

Personalizing each segment’s summary allowed us to put personalities into personas, even without pictures, as we did not collect images of how participants looked. Further, we chose to not include images on our persona cards, as recent literature shows that when diversity in terms of the visual representation of users of a system is not considered, it can harm the identification that users feel with those interactive systems [52]. As it is not possible to represent diversity in for example, age, race, ethnicity, body shape, or hair colour in a single image, we decided to leave images off our persona cards.

We explain the formation of the persona cards using the example of *Strong relationship* segment. The development of personas from other segments (*Parenting*, *Not a stranger*, and *Basic relationship*) follows the same process.

5.4.1 Name

We took the names from NameVoyager [88], which allows exploration of the popularity of names over time. We also added a descriptor to the name, so it automatically associates with the primary differentiator of the goal. Additionally, we used alliteration to make the names more memorable.

5.4.2 Relation to Child, Age, Marital Status

The majority of respondents (13, 61.9%) in the *Strong relationship* segmentation were uncles/aunts to the children, 13 (61.9%) were female, and 12 (57.1%) single. Aged 23-55 (34.80, SD=8.912; Median 32.5, mode 27), they averaged into a description of a single aunt aged 34. Adding her goals of forming a deep connection with a child and building a strong presence in the child’s life, we can infer that the child had close feelings for the aunt, which produced the persona’s name *Amanda the Favorite Auntie*. The other persona names were *Patricia the Ultimate Parent* (mother, 35, married), *Brian the Birthday Uncle* (uncle, 31, single), and *Frances the Familiar Face* (aunt, 38, married).

5.4.3 Persona Stories

Collecting the highlights from participants we identified as *Amandas* and reflecting repeating patterns in their scenarios, we created her story. *Amanda's* card is provided in Figure 5.1, along with the other three persona cards.

5.4.4 Quote

We selected quotes focused on one or two points that distinguished and characterized this persona. For *Amanda the Favorite Auntie*, we selected expressions of a wish for the relationships to be as with her own children, participating in all family events, and games involving pets online.

Patricia the Ultimate Parent

Mother, 35, married

User story

Patricia calls her kids from work on down-times to check on them (in morning, during the day, at least once), or any chance she gets, mostly to check up on them and teach them about things. She will call when she is not home in time.

When Patricia is out of town for business trip or to care for family (2-4x yearly), she will video chat with kids around their nap time and ask how their day was like, and make sure to video chat before bedtime, so they are still getting to have their bedtime stories and songs.

On weekends Patricia tends to let her kids stay overnight with grandmother, and they will call her before sleep to see her face and talk a little.

"I will tuck him in via video chat when I am away"

"I use Facetime to talk to my son when we can't be together for bedtime"

"I am almost never without my kids when I'm not at work. Whenever I get some down time at my job I will try to facetime with my sons"

Goals

- continue to 'parent' when leaving the house or being apart
- to take care, check in and control
- continue bedtime routine when apart

Activities and Frequencies

Talking	Daily (or more often)
Playing	Daily
Showing things	Daily (when away)
Bedtime activities (reading, expressing fondness)	Daily (when away)
Messaging (pictures/videos with overlays)	Daily (when away)

Platforms

- phone call
- facetime/ skype
- facebook messenger
- snapchat (a few times a week or less)

Concerns

- technical issues with connection, video, audio
- no hugs, it is not being there
- child is not able to hold device at all or in the right way
- lack of attention
- occasional hang ups, too sensitive screen
- help and supervision needed
- adult's availability

Frances the Familiar Face

Aunt, 38, married

User story

Frances chats with her nephew from another state weekly.

When he visits Frances on holidays, he knows who she is.

"They will know me when I can visit without being scared of me"

Goals

- to be recognizable to a child
- not to be a stranger to a child

Activities and Frequencies

Talking	A few times a week – a few times a month
Playing	A few times a week – a few times a year
Messaging (pictures/videos with overlays)	A few times a week – a few times a year
Showing things	A few times a month – Once per year or less

Platforms

- facetime/ skype
- facebook messenger

Concerns

- lack of attention
- technical issues

Brian the Birthday Uncle

Uncle, 31, single

User story

Brian's sister-in-law lives in another city. Brian usually skypes with his niece on Saturday mornings, so that he can see what they are up to and his sister-in-law can see how he is doing.

Niece talks about school, how she is learning to swim, shows him toys and pets and loves to see Brian's dog as well. It is an open family discussion and everyone in a room is chiming in. They play music together between once a year and once a month.

Calls happens on a birthday, or after an event, or when the niece just wants to tell him something about her day. Brian sends presents to her 1-2 times a year.

"Making sure my family keeps in touch"
"Distance keeps us from seeing each other. I call my nephew on birthday, holidays, and when I think about him a lot"
"We like to talk often while playing games. It's our way of staying connected as a family"

Goals

- to have relationship
- to maintain family connection

Activities and Frequencies

Talking	A few times a week – a few times a month
Messaging (pictures/videos with overlays, texting)	A few times a week – a few times a month
Showing things	A few times a month
Playing/ games	A few times a week – a few times a year
Letters and packages	A few times a year
Reading, teaching, sing (play music)	A few times a year

Platforms

- Facetime/ skype
- Phone call
- Mail
- PS, Xbox
- Facebook

Concerns

- technical
- lack of attention
- general help and help to initiate the call needed
- child is not able to hold device at all or in the right way, depending on adults
- no hug, it is not being there
- impersonal (minor)
- interruption not welcomed by child (minor)

Amanda the Favorite Auntie

Aunt, 34, single

User story

Amanda skypes with her two nephews a few times a week, she might show them her pets, apartment, everything they're curious about. Kids talk about their drama class and she will 'grade' their lines, they played 'I spy with my eye' several times. She helps them with homework occasionally. Once a month or once every other month they play Minecraft together (nephews play with Amanda's kids too) and talk while playing. Amanda leaves a nightly message saying good night over a Cloud Pet once a week or every other week. Kids love to have her read them a bedtime story.

She also sends packages to them, so they are discussing new outfits she sent them, plans for the next visit. Children like to receive letters from her in the mail, with funny pictures and little poems she wrote to them. They make up stories a lot, and this inspires her to write them up.

Amanda talks to them on every holiday, and loves to watch them opening presents and birthday gifts. She calls anytime she wants to share some special sights with them while doing something fun like enjoying nature, eating good food, or going on vacation.

"Their mother and I grew up together since we were babies so I love these children as if they were my own. I try to make sure that we can talk as much as we can that way we can develop a strong relationship"
"It's a regular thing, several times a week and always on special occasions like holidays or birthdays. I talked to her on her first day of school this year"
"My cat is Judge fat head and my nieces cat is Judge pooper pants. The cats 'judge' who had the goofiest face. It's fun to be able to see each other and make goofy faces. It's just super important to be close to family"

Goals

- to form deep connection
- to remain strong presence in child's life

Activities and Frequencies

Talking	Daily – Weekly
Messaging (pictures/ videos with overlays)	Daily – A few times a month
Bedtime activities (reading, drawing, fondness)	Daily – A few times a month
Playing/ games	Daily – A few times a month
Teaching (help with homework)	A few times a week
Showing things	A few times a week – A few times a month
Sing/ dance	Weekly
Letters and packages	Monthly – A few times a year
Presents live, shopping live	A few times a year – Once per year or less

Platforms

- phone call
- facetime/ skype
- facebook messenger
- snapchat (a few times a week or less)

Concerns

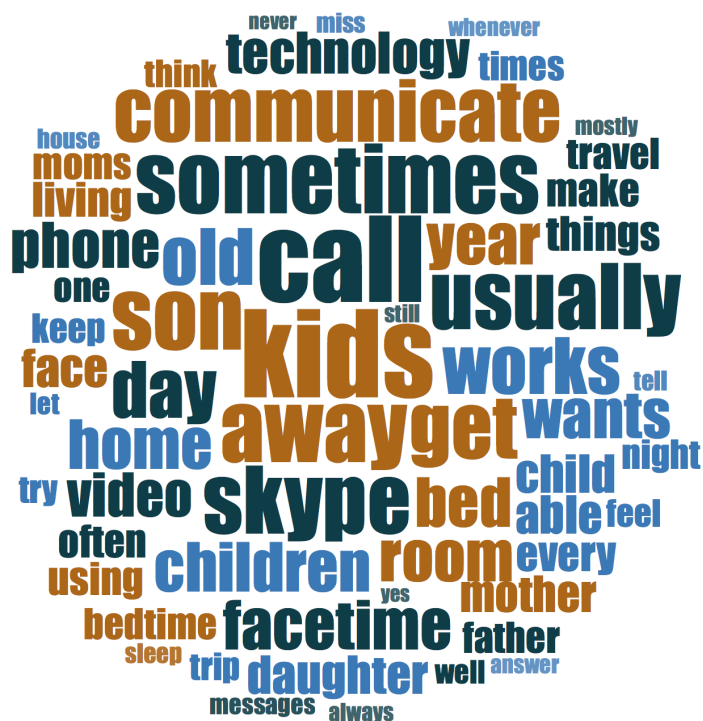
- technical issues with connection, video, audio
- no hugs, it is not being there
- child is not able to hold device at all or in the right way
- lack of attention
- occasional hang ups, too sensitive screen
- help and supervision needed
- adult's availability

Figure 5.1. Example of final persona cards

5.5 Word Clouds

Differences in attitudes toward communication over distance are supported by word frequency clouds (Figure 5.2). For example, the most frequently used words by participants from *Patricia the Ultimate Parent* were *kids*, *call*, *away*, *sometimes*, *son*, *skype*, *work*, and *bed*, which shows that parents are rarely away from children and interaction “‘over distance’ is an odd concept” (P62) for them, unless it is their norm and they are used to situation, and that they engage in activities with their children on site, when at home together. For *Frances the Familiar Face*, these words are *living*, *call*, *nephew*, *weekly*, *chat*, *room*, *convenient*, *help*, and *keep*, which is again in line with the developed picture of *Frances*, for whom communication services provide a convenient means to remind about themselves to a distant family. The *Brian the Birthday Uncle* persona included the words *nephew*, *phone*, *live*, *facetime*, *call*, *year*, *niece*, *skype*, *communicate*, *able*, and *family* to describe his experiences of occasional calling to maintain a loose connection with a distant child. *Amanda the Favorite Auntie* (*niece*, *living*, *skype*, *nephew*, *days*, *makes*, *chatting*, and *want*) wants to be immersed in the daily life of the child, makes sure to be involved with their life, and calls daily or several times per week.

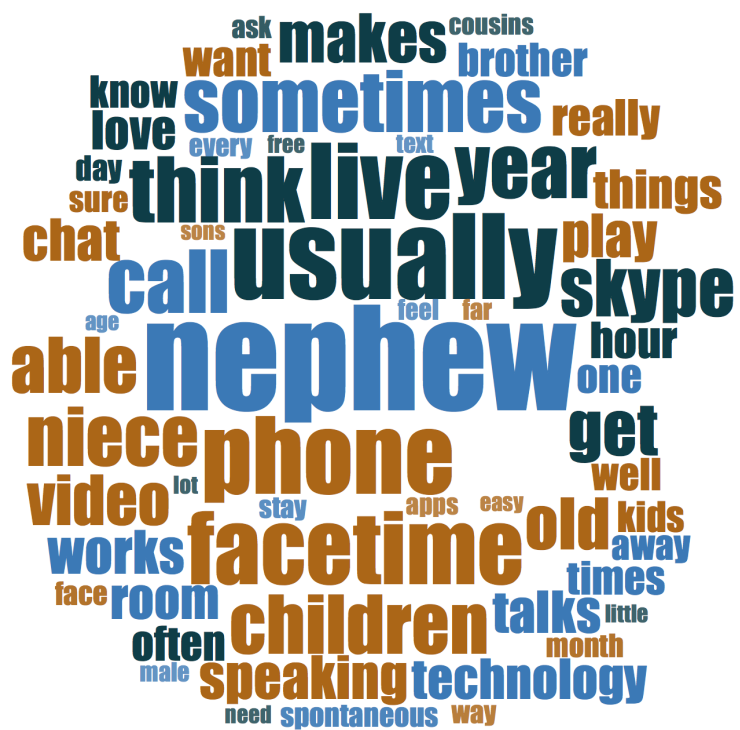
Patricia the Ultimate Parent



Frances the Familiar Face



Brian the Birthday Uncle



Amanda the Favourite Auntie



Figure 5.2. Word clouds for personas

5.6 Persona Requirements

The summaries of segments provide an understanding of goals, preferences, and practices, and we attempted to formulate the descriptions of ideal systems for personas. Requirements included general requirements for systems, specific requirements for synchronous systems with symmetric communication, asynchronous systems with symmetric communication, and asynchronous systems with asymmetric communication (Table 5.2).

The observed requirements evidently grow and stratify from *Frances the Familiar Face* towards *Amanda the Favorite Auntie*, leaving *Patricia the Ultimate Parent* being unique and different from the uncles and aunts included in the other three personas.

Table 5.2. Persona requirements for systems

Patricia the Ultimate Parent	Frances the Familiar Face	Brian the Birthday Uncle	Amanda the Favorite Auntie
General requirements to systems:			
<ul style="list-style-type: none"> ● keep a child's attention ● reliable technically (high-quality video and sound, no freezing or call drops; always charged and online, accessible) ● safe for internal communication 	<ul style="list-style-type: none"> ● keep a child's attention 	<ul style="list-style-type: none"> ● keep a child's attention ● reliable technically (high-quality video and sound, no freezing or call drops) ● tangible interfaces (limited screen time) 	<ul style="list-style-type: none"> ● keep a child's attention ● reliable technically (high-quality video and sound, no freezing or call drops) ● kid-friendly interactions, appropriate content ● see/track growing progress of children ● security of internal communication ● child copes with system independently ● close personal activities ● express a high level of fondness ● tangible interfaces (limited screen time)

Systems for synchronous and symmetric communication, with video, that allow to:			
<ul style="list-style-type: none"> •physically touch, hug, be there •check the child's mood in a real time •Check on how a child is doing in school/care, if they have eaten and what •teach about things over a distance •say good night, tuck a child in bed, sing bedtime songs, shared reading •child walk around and show things easily •child can hold •communicate nonverbally, personally, emotionally and fun •child copes with system independently •see Patricia's availability 	<ul style="list-style-type: none"> •both a child and Frances walk around and show things easily 	<ul style="list-style-type: none"> •physically touch, hug, to be there •children on both sides to communicate •both a child and Brian walk around and show things easily, see Brian's reaction •shared reading •shared games (for child, their parents, Brian, and Brian's children) •shared singing, playing music •child copes with system independently •child can hold 	<ul style="list-style-type: none"> •to be there •both a child and Amanda walk around and show things easily •say good night •shared reading, drawing •shared games, playing •shared singing, dancing •collaborative work on homework
Systems for asynchronous and symmetric communication:			
<ul style="list-style-type: none"> •share pictures/videos 	<ul style="list-style-type: none"> •share pictures/videos (with funny overlays) 	<ul style="list-style-type: none"> •share pictures/videos (with funny overlays) 	<ul style="list-style-type: none"> •share pictures/videos (with funny overlays) •leave nightly messages •status of message being read
Systems to asynchronous and asymmetric communication:			
		<ul style="list-style-type: none"> •Send physical objects 	<ul style="list-style-type: none"> •Send physical objects

Figure 5.3 illustrates how the needs of personas varies across the modes of communication. The amount and details of demands are not constant from the lowest bandwidth mode (asynchronous asymmetric communication—e.g., sending physical

objects) to the generic requirements. *Amanda* has the highest rank across all the modes, because she is the most demanding persona. She requires to be enabled to stay immersed in child’s life as much as possible in all modes of communication. *Patricia* and *Frances* do not care as much about ways to send presents, and *Patricia* is not interested in asynchronous updates about her child. This makes *Patricia* to inhabit the lowest rank in asynchronous modes. However, she requires specific features for her synchronous communication, although not as much as *Amanda*. The rank of persona’s demands switches between asynchronous asymmetric, asynchronous symmetric, synchronous symmetric, synchronous asymmetric system types, and generic requirements to systems.

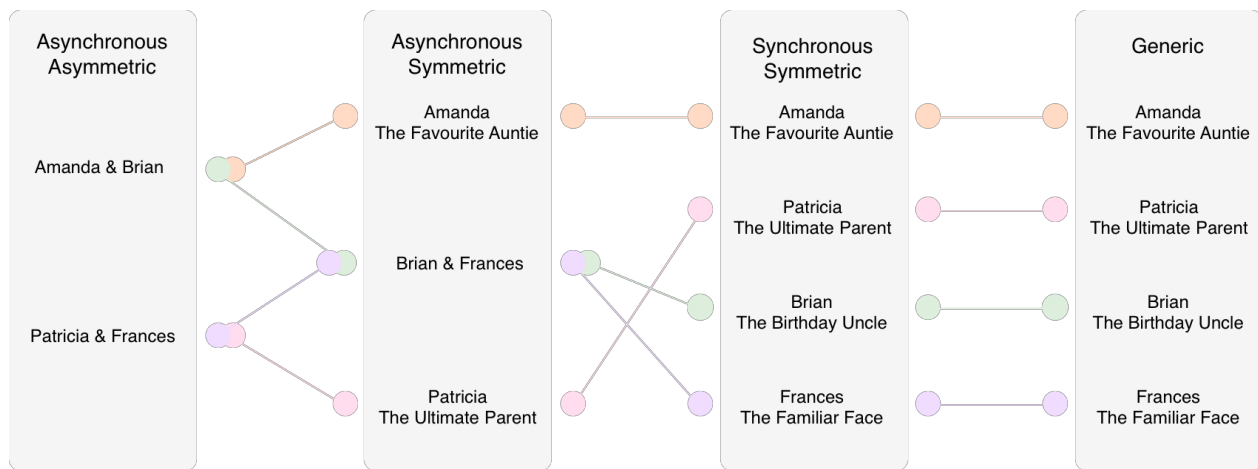


Figure 5.3. The switch of the demand rank between system types

5.7 The Severity and Breadth of Requirements

In Table 5.3, we suggest the assessment of each requirement in order to facilitate prioritizing and decision-making for designers. We did not take into consideration the severity of requirements in the evaluation of systems, but evaluated the systems thinking about the requirements all on an equivalent level. To make our findings actionable for designers, we use the following 0 to 4 rating scale, adapted from heuristic evaluation [50] to rate the severity of the requirement violation:

0 = I don't agree that this is a usability requirement at all

1 = Cosmetic requirement only: need not be incorporated unless extra time is available on project

2 = Minor usability requirement: incorporating this should be given low priority

3 = Major usability requirement: important to incorporate, so should be given high priority

4 = Imperative usability requirement: crucial to incorporate this requirement in the product, failing to do so leads to usability catastrophe.

Table 5.3. Severity of the requirements

Requirement	Patricia	Frances	Brian	Amanda
General Requirements				
•keep a child's attention	4	4	4	4
•reliable technically	4	0	3	3
•security of internal communication	4	0	1	4
•tangible interfaces (limited screen time)	1	0	2	3
•kid-friendly interactions, appropriate content	3	0	0	4
•see/track growing progress of children	0	0	0	3
•child copes with system independently	1	0	0	3
•close personal activities	3	0	1	4
•express a high level of fondness	3	0	1	4
Synchronous and symmetric communication				
•physically touch, hug, be there	4	0	3	3
•check the child's mood in a real time	4	0	0	2
•Check on how a child is doing in school/care, if they have eaten and what	3	0	0	0
•teach about things over a distance	3	0	0	0
•child to walk around and show things easily	4	3	4	4
•persona walks around and shows things easily	1	3	3	3
•child copes with system independently	4	0	4	4
•child can hold	3	0	3	3
•communicate nonverbally, personally, emotionally and fun	4	0	4	3
•child can see persona's availability	3	0	1	1

• children on both sides to communicate	2	0	3	1
• shared reading	4	0	4	4
• shared games	1	0	4	4
• shared singing,	3	0	3	3
• shared playing music	1	0	3	1
• shared dancing	1	0	1	3
• shared drawing	1	0	1	3
• collaborative work on homework	2	0	0	3
• say good night, tuck a child in bed	4	0	0	4
Asynchronous and symmetric communication				
• share pictures/videos (with funny overlays)	3	4	4	4
• leave nightly messages	1	0	0	4
• status of message being read	0	0	0	2
Asynchronous and asymmetric communication				
• Send physical objects	0	0	3	3

5.8 Evaluation of Systems

There are many one-off systems designed to ease remote communication between people, and kids in particular, that have been created and presented in the literature on HCI. Using 60 articles from the HCI domain published in 1996-2017, we evaluated the systems and prototypes that researchers designed to communicate intimacy, maintain connectedness, and support shared activities remotely. We rated the systems, as described in published papers, on how much they satisfy the various persona’s requirements for each persona. Thus, each system received four scores out of 10 (e.g., ShareTable [83] received 2 (3 features addressed out of 13) for *Patricia the Ultimate Parent*, 0 for *Frances the Familiar Face*, 2 (2/10) for *Brian the Birthday Uncle*, and 3 (5/16) for *Amanda the Favorite Auntie*; see Table 5.4). The mean scores are below 3.2 because we evaluated systems based on all persona’s requirements. We found no systems addressing synchronous, asynchronous, symmetric, and asymmetric modes in a single tool. Because coverage of the requirements was low (mean score for *Patricia* was 3.2, SD=1.127, *Amanda* 3.1, SD=1.565, *Brian* 2.9, SD=1.706, *Frances* 2.3, SD=2.572), we concluded that although there are a number of

systems that have been created and published, they do not sufficiently address the needs of the personas (Figure 5.4).

We also recorded if the system was designed with young children in mind, or if it was considered appropriate for young children. We grouped systems that were designed for 3-6 year-olds or included this age in *Yes* (19/60 systems, Figure 5.5), and systems that were designed for older children, adults, and elders—in *No* (41/60). Abstracting from personas, we could infer that more than 2/3 of systems designed for remote communication have been focused on supporting older user groups. Simultaneously, we identified systems that were designed for other users, but if adapted would work for young children with certainty (e.g., a system for open play in different environments with customizable scenes, managed with layering in 3D space [28], that has been designed for families with 6-12 year old children) or with less certainty and labeled as *appropriate* in Figure 5.5 (e.g., haptic video chat system that allows users to touch a person’s image on a touchscreen and communicate the touch sensation [86], designed for adults).

The systems that we considered to be inappropriate for young children (e.g., ambient display for awareness and increased communication frequency in the form of a drooping and colour-changing flower [1], designed for couples; or picture weblog filled with pictures and notes [11], tested with 5-12 year-olds, which requires users to read and write) formed the *No* group (24/60), systems promising greater likelihood to work with young children formed a *Yes* (23/60), and those with lesser probability formed *Maybe* (13/60). Subsequently, only 38.3% of the systems were considered to be appropriate for young children, and 21.7% were questionable. Looking at the mean scores of systems designed and appropriate for young children (16 systems), *Amanda’s* needs were addressed the most (mean score 4.7), followed by *Brian* (4.3), *Patricia* (4.0), and then *Frances* (3.8).

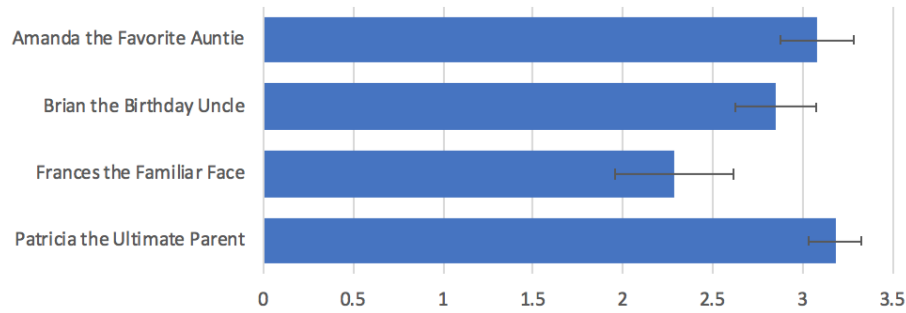


Figure 5.4. Mean score and SE of systems for personas

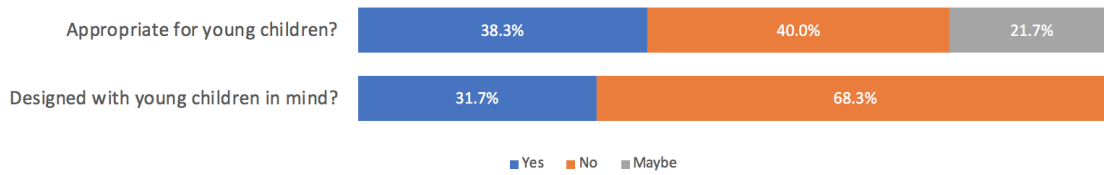


Figure 5.5. Thinking about young children in systems, percentage

5.8 Justification of the Evaluation of the Systems

Scores are low overall because we evaluated systems on the basis of the requirements of the entire set of needs expressed by the personas. For example, *Brian's* or *Amanda's* needs included features in synchronous symmetric communication, asynchronous symmetric, and asynchronous asymmetric. Such a wide set of requirements is challenging to address in one solution and was hardly observed in any of the analyzed tools. In this section, we walk through each of the systems, justifying how it fits the persona needs.

The Huggy Pajama [68], an asymmetric system for physical interaction, is a mobile doll on the parent's side and hug and warmth reproducing pyjamas for a child. The score for *Patricia* is 4 (5 features supported, formed a *Yes* and coded in yellow in Figure 5.15; 9 features are not supported, formed the *No* and coded in blue) based on the four requirements that are addressed: physical touch and hug, saying goodnight and tucking in bed in some way, child can use (wear) the system by themselves, doll-pajama system is safe

for internal communication, and the support of nonverbal communication. Things not supported for *Patricia* are keeping the child's attention, reliable and accessible (a child might simply take off the jacket), checking child's mood, wellbeing, teaching about life, bedtime songs/reading, easiness for a child to show things around and to see parent's availability, sharing photos and videos. The score for *Frances* is 0 because the doll does not keep a child's attention and does not allow both the child and *Frances* to walk around and show things easily. Colour changing cloth, used to communicate distance and mood data, might still be ambiguous for 3-6 year olds. Moreover, colour changing accessories are placed on the chest of a child's pyjama and might simply be not noticed. The system does not support sharing of pictures and videos. *Brian's* score is 3 (3 yes, 7 no) since physical touch is supported, an interface is tangible, and the child can use the system independently. *Brian's* unaddressed requirements that differ from *Patricia's*, are the inability for two children to communicate and the lack of shared activities supported. *Amanda's* score is 4 (6 yes, 10 no) based on the security of communication, child's ability to use system independently, supporting hug as a close personal activity, and a tangible interface, which allows communicating goodnight. Among the unaddressed features are interaction from the child, a low bandwidth system which may not be sufficient for expressing a high level of fondness, and the inability to leave nightly messages. The colour coding of requirements supported in the Huggy Pajama is reflected in Figure 5.6.

ShareTable [83], a camera-projector system for video chat with a collaborative tabletop surface, was designed for divorced families. It was tested with 3-11 year old children. The score for *Patricia* is 2 (3 yes, 10 no), due to the safety of the internal communication, teaching about life, and that personal nonverbal communication was supported. Because the ShareTable was a prototype, technical difficulties were experienced in 9 out of the 24 sessions, and we do not consider the experience to be reliable technically. Also, we consider the system not being successful in keeping a young child's attention, it was the co-located parent or older sibling who did. The score for *Frances* is 0, asynchronous communication and mobility of the system are not provided. *Brian's* score is 2 (2 yes, 8 no)

based on the tangible interface and unstructured play and games supported. *Amanda's* score is 3 (5 yes, no 11) since the system, among the other features, allows to express a high level of fondness such as to imitate handholding by touching the surface at the same time.

Patricia the Ultimate Parent	Frances the Familiar Face	Brian the Birthday Uncle	Amanda the Favorite Auntie
<p>General requirements to systems:</p> <ul style="list-style-type: none"> keep child's attention reliable technically (high quality video and sound, no freezing, call drops; always charged and online, accessible) safe for internal communication <p>Systems for synchronous and symmetric communication, with video, that allows to:</p> <ul style="list-style-type: none"> Physically touch, hug, to be there check child's mood in real time Check on how child is doing in school/care, if they have eaten and what teach about things over distance say good night, tuck child in bed, sing bedtime songs, shared reading child to walk around and show things easily communicate nonverbally, and are personal, emotional and fun child copes with system independently, child can hold see Patricia's availability <p>Systems for asynchronous and symmetric communication:</p> <ul style="list-style-type: none"> share photos/videos 	<p>General requirements to systems:</p> <ul style="list-style-type: none"> keep child's attention <p>Systems for synchronous and symmetric communication, with video, that allows to:</p> <ul style="list-style-type: none"> both child and Frances to walk around and show things easily <p>Systems for asynchronous and symmetric communication:</p> <ul style="list-style-type: none"> share photos/videos (with funny overlays) 	<p>General requirements to systems:</p> <ul style="list-style-type: none"> keep child's attention reliable technically (high quality video and sound, no freezing, call drops) ?? tangible interfaces (limit screen time) <p>Systems for synchronous and symmetric communication, with video, that allows:</p> <ul style="list-style-type: none"> Physically touch, hug, to be there children on both sides to communicate both child and Brian to walk around and show things easily, see Brian's reaction shared reading; shared games (for child, their parents, Brian, and Brian's children); shared singing, playing music child copes with system independently, child can hold <p>Systems for asynchronous and symmetric communication:</p> <ul style="list-style-type: none"> share photos/videos (with funny overlays) <p>Systems for asynchronous and asymmetric communication:</p> <ul style="list-style-type: none"> Send physical objects 	<p>General requirements to systems:</p> <ul style="list-style-type: none"> keep child's attention reliable technically (high quality video and sound, no freezing, call drops) kid-friendly interactions, appropriate content see/track growing progress of children security of internal communication child copes with system independently ?? close personal activities ?? express high level of fondness ?? tangible interfaces (limit screen time) <p>Systems for synchronous and symmetric communication, with video, that allows:</p> <ul style="list-style-type: none"> Physically touch, hug, to be there both child and Amanda to walk around and show things easily say good night shared reading, drawing; shared games, playing; shared singing, dancing; collaborative work on homework <p>Systems for asynchronous and symmetric communication:</p> <ul style="list-style-type: none"> share photos/videos (with funny overlays) leave nightly messages; status of message being read <p>Systems for asynchronous and asymmetric communication:</p> <ul style="list-style-type: none"> Send physical objects

Figure 5.6. Colour coded explanation of addressed and unaddressed requirements on the example of the Huggy Pajama [68]: yellow—addressed, blue—unaddressed

Globetoddler [45] is a system that consists of a doll on a child's side and mobile device for a parent, which supports synchronous and asynchronous communication. Interaction was designed for preschool children and their travelling parents. The setup was tested in families with children aged 2.5-6. The score for *Patricia* is 6 (6 yes, 5 no) since activities offered in the system were designed to keep a young child's attention, communication is safe, a child stands as an independent user, and the requirements that are incorporated in synchronous and asynchronous modes in the system (e.g., to teach about life, say good

night, sing songs, communicate nonverbally, experience is emotional and fun, share pictures and videos). The score for *Frances* is 8 (3 yes, 1 no) because of the lack of inability to show things on the go for the child. *Brian's* score is 6 (5 yes, 4 no) due to the doll interface on the child's end, the mobile client for the parent, and an option to play games together. The score is lowered by the absence of communication of physical touch, shared singing and playing music, and unsupported options for children on both sides to communicate. *Amanda's* score is 8 (11 yes, 4 no), simply because in *Amanda's* ideal system, there would also be support for: tracking growing progress of the child, physicality, ability to show objects on the go and to send physical items to a child.

Virtual Box [12,80] is an asynchronous asymmetric system for virtual and physical play, designed to communicate intimacy between children and (grand) parents. It is based on the game hide-and-seek and offers a Hider interface in the Internet browser and a Seeker interface in a personal digital assistant (PDA). The Virtual Box includes activities such as locating hidden boxes, editing contents, hiding again, and was tested with 6-9 year-olds. *Patricia's* score is 4 (5 yes, 7 no) due to the unsupported features of: physical touch, checking mood, wellbeing, teaching about life, bedtime songs/readings, and the child's inability to show things on the go (they can share photos from a desktop application). The score for *Frances* is 7 (2 yes, 1 no) since the system keeps the child's attention and allows them to share the visuals. *Brian's* score of 4 (4 yes, 6 no) is based on the unsupported features of: tangible interface, physicality, children communicating from both sides, showing things and seeing *Brian's* reaction, and sending physical objects. The absence of child-friendly interactions (PDA, desktop app), tangible interfaces, tracking the growing progress, insufficiency to communicate a high level of fondness, physicality, say goodnight, show things on the go, be aware of messages being read, send physical objects, and no shared activities other than playing the 'hide-and-seek' formed *Amanda's* score of 4 (6 yes, 10 no).

eMutts [82] is an asynchronous asymmetric system in the form of keychain-sized toys, that allow parents to stay aware of their children's everyday environments and activities. Data from the sensors is uploaded to the computer in the end of the day. The design drew from interviews with children aged 7-14. *Patricia's* score is 4 (6 yes, 8 no) because eMutts is safe for internal communication (only if data is protected when a child lost the eMutt), allows to have a window into the child's day, and although not explicitly knowing about the child's wellbeing, the child might use eMutt to intentionally record anything for the parent. A preschooler can hold and use the toy part of the system independently, although they might need assistance transferring data at home. *Frances's* score is 3 (1 yes, 2 no) because only the child is enabled to show things on the go and send pictures later at home. *Brian's* score is 3 (3 yes, 7 no) because there is a tangible interface part that the child can use independently and a visual channel is supported. *Amanda's* score is 3 (6 yes, 12 no) because for her needs the system is limited and supports asymmetrical communication only.

The Magic Box [76] is a system for intergenerational play at a distance, designed for grandparent-child tangible exchange. It differs from conventional postal exchanges in a way that Magic Box has predictable delivery times and is more convenient because the delivery and pick up times are tied to the sleep/wake cycle. This cultural probe was tested with children aged 2-10. *Patricia's* score is 3 (4 yes, 8 no) because the content of the box keeps the attention, communication is safe, nonverbal, personal, and emotional, pictures can be shared (although printed out), and the system is easy to use for a child. *Frances's* score is 3 (1 yes, 2 no) because of drawn attention and shared pictures. *Brian's* score is 4 (4 yes, 5 no) and *Amanda's* is 5 (7 yes, 8 no) because synchronous symmetric communication is their main requirement and is not supported.

The Collage [76,77,80] is a technology for creating, displaying, and interacting with photos and text. It uses mobile camera phones and touch screens and affords asynchronous and synchronous interaction. The technology probe was deployed with one

family with separated parents and grandchildren aged 4 and 9. *Patricia's* score of 2 (3 yes, 11 no) is justified by the fact that the texting component of the system might not work for young children, although nonverbal communication is provided by sharing photos, and the pictures by themselves might not be enough to keep preschoolers' attention. Although the 4-year-old in the study had no problems making photographs, he asked adults to help handle the button sequence for posting in Collage. *Frances's* score is 3 (1 yes, 2 no) and *Brian's* score is 2 (2 yes, 9 no) because from the features of their interest only sharing photos and child's ability to hold a device are supported. *Amanda's* score is 2 (3 yes, 14 no) because child-friendly interaction and the texting content might not be appropriate and used by a young child without the help of the older sibling. Fondness could be communicated with pictures, although it is hard to express love in high extent using the Collage.

The Collage and Storytelling [77] is a solution for regular contact between children and adult relatives in different time zones. The Collage, the asynchronous component, includes a family gallery with photos cascading down in two streams. The Storytelling, the synchronous component, mediates book reading, sharing photos, and drawing. The system was designed for 4-8 year-olds and was tested with 5-14 year-olds. *Patricia's* score is 4 (7 yes, 9 no) because the system supports shared reading, can be considered fun with drawing and storytelling features, and the interface is visual and appropriate for a young child. *Frances's* score is 5 (2 yes, 2 no), justified by asynchronous photo sharing and enabled audio while involved in shared activities. *Brian's* score is 5 (5 yes, 6 no) because desired features from symmetric (children on both sides might be able to use the interface, shared reading and drawing) and asymmetric (photo cascade) communication are supported. *Amanda's* score is 4 (8 yes, 10 no) because interactions are child-friendly and close personal activities are supported, such as shared drawing and storytelling.

eKiss [11,80] is a picture weblog filled with pictures and notes sent from children through mobile technology. This asynchronous asymmetric system (active from the child's side

only) was designed to mediate intimacy between children and parents while being physically separated. The system was tested with children aged 5-12. *Patricia's* score is 3 (3 yes, 9 no) because a weblog is secure for internal communication, although a young child might have problems sending accompanying notes. Even if pictures indicate the child's mood or wellbeing, *Patricia* will notice it with delay (i.e., when she checks the blog on the desktop). *Frances's* score is 0 (0 yes, 3 no) and *Brian's* score is 1 (1 yes, 8 no) caused by the absence of synchronous and symmetric interactions in general. *Amanda's* score of 2 (2 yes, 13 no) is influenced by the security of internal communication, and by the one-directional photo-sharing feature.

Zaturi [31] is an asynchronous system, which enables working parents to identify their micro spare time and to use it for recording audio books for their babies. A mobile application is designed for 1-5 year-olds and tested with children aged 1-8. *Patricia's* score is 3 (4 yes, 9 no), as the system is asynchronous and does not cover the range of real-time feedback *Patricia* wants to receive from the child. The app supports audiobook recording, and the child is able to use a graphical interface on a tablet at home. The system keeps the child interested in the story, so *Frances's* score is 3 (1 yes, 2 no) and *Brian's* score is 3 (3 yes, 7 no). *Amanda's* score is 4 (6 yes, 10 no) because the system is child-friendly in terms of interactions and content, and is designed for recording and listening to stories, in which intimacy and fondness can be communicated. However, the absence of a synchronous connection with the child is missing for *Amanda*.

Orange Toaster, Family Toast, Play with Elmo [55] are asynchronous messaging systems for adults and preschoolers, with a tangible interface and 'jack-in-the-box' mechanics. Orange Toaster allows children to independently create and share selfies. Family toast allows children to use physical tokens with pictures of relatives to browse respective family member's pictures and share reactions. Play with Elmo allows exchanging mischievous video messages. Participants were 2-7 years-old. *Patricia's* score is 4 (5 yes, 7 no) because it is a fun and nonverbal tool for play, but insufficient for the interests of *Patricia* as a parent.

Frances's score is 7 (2 yes, 1 no)—the tool easily keeps a child's attention and sends pictures and videos. *Brian's* score is 5 (5 yes, 5 no) and *Amanda's* is 6 (8 yes, 6 no) because the systems provide *Amanda* with the tool to communicate personally and express a lot of fondness in playful messages, implemented as a tangible interface with young age-appropriate content and interactions.

SINCOM [58] is an intergenerational tool, which supports asynchronous and synchronous communication without parental mediation. It incorporates two activities: video call as a synchronous setting and a Pet care, in which both parties can record a video of their pet with changes they made and add a voice message, as an asynchronous play. Tested with 4 and 8 year-olds. *Patricia's* score is 3 (3 yes, 8 no) because there is an activity to make and track changes in the Pet care part, which keeps a child engaged and uses nonverbal communication, and the interface is simplified for children. *Frances's* score is 3 (1 yes, 2 no) and *Brian's* score is 4 (4 yes, 6 no), because the interface can be used by children from both locations and a game is offered for them, apart from the video call. *Amanda's* score is 3 (4 yes, 11 no) because asynchronous play does not provide *Amanda* with a great awareness about the child and it is hard to maintain fondness and intimacy.

TimelyPresent [33] is a single purpose device for asynchronous messaging for children, their parents, and grandparents, who live in different time zones. The message in the system is represented as a gift-wrapped short video clip. The arrival time of presents is delayed to match the local time of the sender. Presents were not accessible to the sender once given to a recipient. Participating families had children aged approximately 5 years old. *Patricia's* score is 4 (5 yes, 7 no) because the tablet set up is usable by child and presents are a personal and emotional way to communicate. *Frances's* score is 7 (2 yes, 1 no) and *Brian's* score is 4 (4 yes, 5 no) based on the possibility for children from two households to exchange presents. *Amanda's* score is 4 (7 yes, 9 no) based on the present exchanging feature, which can contain a planned nightly message or allow for expressing fondness in a short message in another way.

Family story play [57] is a system with a tangible book frame for synchronized reading and video conferencing for 2-3 year-olds and their long-distance grandparents. Agent Elmo in the book supports conversation, entertains, guides users, and coaches adult in asking dialogic questions. *Patricia's* score is 5 (6 yes, 6 no) because the setting was mobile, video chat allowed for nonverbal communication, and the interface was designed to enable a child to participate independently, although parents assisted children in sessions. *Frances's* score is 3 (2 yes, 1 no) because co-reading with questions from grandparents is engaging for children and both parties can move around easily. *Brian's* score is 5 (5 yes, 5 no) because one of his desired shared activities is supported, and seeing reactions is possible. *Amanda's* score is 6 (10 yes, 6 no), lowered by the absence of physicality and other shared activities in synchronous mode and the absence of asynchronous communication.

Story Visit [56] is a system for synchronized reading and video chatting. While reading the same e-book over video chat, family members can point to the spot on the page, see tips for dialogic reading of picture books, control a character which also asks dialogic questions and keeps the child's attention in the story, and be automatically connected with a shared family account. The system was designed for 2-5 year-olds and was tested with children from 1 to around 6 years old. *Patricia's* score is 3 (4 yes, 8 no) because the application runs on laptops and limits a child's ability to carry it around and operate independently. Parents were noticed to be the ones who initiate a session. *Frances's* needs were met with a 3 (1 yes, 2 no) because the child's attention is kept. *Brian's* score of 2 (2 yes, 8 no) and *Amanda's* score of 4 (7 yes, 9 no) are influenced by losing the child's independence and tangibility of interface, compared to the previous system [57].

The People in Books system [14] was designed for synchronous reading and open-ended play with 3-5 year-olds in a long distance relationship (runs on laptops). The system allows for seeing each other in the world of the story, while users' full-body gestures and poses are captured and inserted into the book. *Patricia's* score is 3 (4 yes, 8 no) because the application is mainly a synchronous fun tool, not designed to keep *Patricia* aware of the

child's wellbeing. *Frances's* score of 3 (1 yes, 2 no) and *Brian's* score of 5 (5 yes, 6 no) are based on the playful activity, in which the child from the other household can participate, although only synchronous communication is offered. *Amanda's* score is 4 (7 yes, 9 no) because the application provides participants with an expressive and energetic means of synchronous communication, even though it is not fitting into bedtime routines. The lack of tangibility and any asynchronous mode made the impact on assessment.

VideoPal [29] is a tool for children's asynchronous communication, which supports interaction with close friends from homes. It allows for the sending of video messages that are organized into conversation threads. The system was designed for 9-10 year-olds and tested with 9-11 year-olds. *Patricia's* score is 3 (3 yes, 9 no) because the tool supports communication of close friends, whose nature of communicational interests is different from *Patricia's*, and is asynchronous. *Frances's* score is 3 (1 yes, 2 no), *Brian's* is 2 (2 yes, 7 no), and *Amanda's* is 3 (4 yes, 11 no) because it is possible to leave nightly messages with this application.

PlayPals [6] is a toy system for remote playing for 5-8 year-olds, which communicates virtual co-presence and transmits gestures. The system was tested with two 8 year-olds. *Patricia's* score is 3 (4 yes, 8 no), *Frances's* score is 3 (1 yes, 2 no), *Brian's* score is 5 (5 yes, 5 no), and *Amanda's* score is 4 (6 yes, 10 no). Synchronized dolls and audio channels create virtually shared pretend play, participation in which is personal, although is somewhat a lean way to check on the child's wellbeing or life events. We consider the tangible interface, child-friendly interactions, and independent usage by the child to be favourable features for child-oriented communication.

VideoPlaydate [81] comprises a series of prototypes for free play via video conferencing. It includes Vanilla Video conferencing (two screens for current participant's and remote participant's view), Pan-zoom-tilt (camera controlled by a researcher, and the child sees different remote views on request), Projector Rug (floor mat projection of remote

participant's rug), and Mobile (once mobile screen undocked, back camera is activated). Testing was done with 7-8 year-olds. *Patricia's* score is 3 (4 yes, 8 no) because a playful setting works for showing things on the tablet, and invites users to communicate nonverbally. *Frances's* score of 7 (2 yes, 1 no), *Brian's* score of 4 (4 yes, 6 no) and *Amanda's* score of 4 (6 yes, 10 no) are formed by the ability of children on both sides to communicate, the option of mobile screen with back camera, and shared play as one of the desired activities.

IllumiShare [30] is a system of shared task space and personal space. The condition which brought the richest experience for participants was a combination of Skype and shared projection space on the table. Conditions were tested with 9-11 year-olds while remote playing. *Patricia's* score is 4 (5 yes, 8 no) because the projected surface allowed for showing things more comfortable than via video chat, and allowed people to use their hands and materials such as pen and paper, toys, cards, and dice. The IllumiShare session might be not easy to initiate for a young child, although is appropriate for young users once initiated. Remote child-child interactions on the table allow for both *Frances* and a child to show objects, see each other reactions, but not show big objects or surroundings on the go. This yields *Frances's* score to be 5 (2 yes, 2 no) and *Brian's* score to be 4 (5 yes, 7 no). Shared space is empowering to a wide range of the on-table activities such as reading, playing rock-paper-scissors, drawing, and doing homework. *Amanda's* score is 4 (7 yes, 9 no) based on activities.

SeeSaw [75] is an asynchronous video messaging tool, which captures reactions during (reaction video) and immediately after (autoreply feature) viewing a message. Reactions are connected to threads, which feels conversational. The tool was tested with youth 14-26 year-olds. *Patricia's* score is 3 (4 yes, 9 no) because the tool supports only asynchronous mode, although the mobile device makes showing objects on the go possible. Seeing themselves in the original video clip and at the same time as the adult's reaction might be misleading for a young child, also the conversational threads in the interface could look

unclear to them. *Frances's* score is 5 (2 yes, 2 no) because the system supports walking around and showing things. *Brian's* score is 3 (3 yes, 7 no) because children on both sides can communicate and see reactions. SeeSaw enables *Amanda* to record nightly messages and be aware if videos were seen since reactions are recorded automatically. *Amanda's* score is 3 (5 yes, 11 no).

e-Seesaw [66] is a tangible awareness system for remote parent-child interaction. The requirements addressed in the system are based on survey results from 5-10 year-olds and their parents. It is a simple toy for reciprocal communication, in which a local device mirrors the movement of the remote one. The toy was tested in two families with 6 and 8 year-old children. *Patricia's* score is 3 (3 yes, 9 no) because the toy provides nonverbal and playful communication. Although being insufficient for *Frances* (score 0), the toy supports some of *Brian's* needs (score 3, 3 yes, 6 no)—the interface is tangible and children on both sides can use it without help. *Amanda's* score for the toy is 3 (4 yes, 11 no) because the feeling of connectedness is mediated in a low bandwidth, and neither synchronous nor asynchronous communication on a deep level is supported.

HaptiHug [73] is a representation of a hug over distance. The cues for haptic feedback are recognized from text-based messages in the chat (e.g., emoticons) and followed by visualization of hugging avatars in the 3D virtual world and hugging sensation, coming from the inflatable vest around the torso. *Patricia's* score is 2 (3 yes, 10 no) because it enables her to communicate nonverbally and mediate physical touch. *Frances's* score is 0 and *Brian's* score is 1 (1 yes, 8 no), due to physical communication, and *Amanda's* score is 1 (2 yes, 13 no) due to physicality and security. For a young child, receiving hugs via the vest might be somewhat ambiguous and scary. The system is also not friendly for input coming from the child as it designed to use chat and type special cues.

Hugvie [36] is a tool for communication by hugging a person-shaped pillow and chatting. The tool was designed to enhance affection between partners and tested with 18-22 years

old adults. Because Hugvie is a pillow with a pocket for a cell-phone, and requires hugging to start a conversation, but does not communicate a hug to the partner, *Patricia's* score is 2 (2 yes, 10 no). *Frances's* score is 0, and *Brian's* is 2 (2 yes, 7 no). *Amanda's* score is 2 (3 yes, 12 no) because the interface is tangible and a child does not require help to use it, although video chat, shared activities, and asynchronous mode are not supported.

Hugginess [3] is represented as a pair of T-shirts with conductive fabric. The prototype might be accompanied with a mobile application, which logs the hugs detected by the t-shirt and thus identifies the lack of physical contact. Because all that child is expected to do is to wear a T-shirt, we consider this system to be appropriate for a child's independent usage. The smartphone application provides an adult with means to check child's wellbeing and mood, inferred from hugs amount. *Patricia's* score for Hugginess is 3 (3 yes, 9 no). *Frances's* score is 0, *Brian's* is 1 (1 yes, 8 no), and *Amanda's* is 2 (3 yes, 12 no).

XOXO [60] is a prototype for transmitting kisses and hugs through a robotics interface and jacket. The kissing module looks like a little human head and trunk, whereas the hugging module is implemented as a jacket with vibrotactile feedback. The prototype was designed to facilitate strong reciprocal affection. *Patricia's* score is 3 (4 yes, 9 no) because the need to communicate a hug is covered, although *Patricia* also has other needs for synchronous communication. A child could use the system without help as it involves wearing a jacket, but the need for kissing the robot might be difficult to understand. *Frances's* score is 0 and *Brian's* is 3 (3 yes, 6 no). For *Amanda*, assuming that XOXO allows for communicating fondness and physicality, the score is 3 (5 yes, 10 no). Other synchronous activities that *Amanda* wants to partake in with the child and asynchronous connection are not available.

Haptic accessory adds a feeling of touch to a conversation [70] and is designed to communicate the intuitive affective experience of hand-holding. Because the prototype aims to transmit touch in all possible hand configurations in child-parent interaction, it

could enrich the experience of online communication with a young child. Even though nonverbal communication is mediated, a young child should understand a model of holding hands during the video chat session in order to feel the touch. This makes *Patricia's* score 2 (3 yes, 10 no). *Frances's* score is 0 because none of her requirements are met. *Brian's* score is 2 (2 yes, 7 no) because his needs for synchronicity are mainly unmet. *Amanda's* score is 4 (6 yes, 9 no) because the prototype mediates close personal communication, transmits touch, and expresses fondness.

Teddy Bear [74] is a toy for non-verbal interaction between 4-6 year-olds and parents. It communicates gestures and hugging. An indication of availability, synchronous nonverbal communication of presence, and video streaming from the child's side (i.e., in one of the conditions the bear's eyes allowed the parent to see what child was doing) make *Patricia's* score 7 (8 yes, 4 no). *Frances's* score is 7 (2 yes, 1 no), assuming that remote adult can see everything the bear is facing. A tangible interface, communication of hugs, video streaming between two households (which is seen on the display on the bear), make *Brian's* score 7 (7 yes, 3 no) and *Amanda's* score 5 (7 yes, 8 no). However, researchers noted that gestures for strong emotions were not easily understood by young children.

Bear-with-me [16] is a system with two bears used for mobile symmetric intimate communication (e.g., hug and pat) between couples. Bears communicate with each other through Twitter and detect squeeze, touch, and motion. The input is represented on another bear's paws, chest or back with a blinking light, which might be difficult to notice and interpret for a young child. *Patricia's* score is 3 (4 yes, 9 no) because a child might misunderstand the metaphor of hugging the bear to communicate a hug to the parent. *Frances's* score is 0, *Brian's* score is 2 (2 yes, 7 no), and *Amanda's* score is 2 (3 yes, 12 no).

InTouch Tactile Tales [41] is a handheld pebble with a docking station, that allows users to 'send a squeeze'. In future work, researchers want to add a way to leave a nightly message with the pebble, and also imagine the pebble to project pictures from the story on

the wall, while a distant adult is reading. The system was tested with 4-7 year-olds. Participants used pebbles to enhance a storytelling experience and transmit touch. Due to the system's projections of pages from the story, the added voice channel, and goodnight messages that were possible, *Patricia's* score is 5 (6 yes, 7 no), *Frances's* is 3 (1 yes, 2 no), *Brian's* is 6 (6 yes, 4 no), and *Amanda's* is 5 (9 yes, 8 no).

A wearable prototype that is implemented as a vest, as provided in [53], transmits social touch, such as an arm around shoulders. *Patricia's* score is 3 (4 yes, 9 no), *Frances's* score is 0, *Brian's* score is 2 (2 yes, 7 no), and *Amanda's* score is 2 (3 yes, 12 no). We consider that the prototype requires no effort from the child to wear the vest, meaning that they can use the system independently. Communication has one direction, and the unpredicted feeling of physical warmth might be meaningless or even scary to a young child.

A "Hugging" vest for touch pressure therapy [13] allows users to give a calming and comforting hug to a child. The vest is light, not bulky, silent when inflated, and controlled from a smartphone. The vest doesn't keep the child's attention unless pressure applied, is safe for internal communication, transmits the feeling of a physical hug, and the child's interaction is passive. Thus, *Patricia's* score is 3 (4 yes, 9 no), *Frances's* is 0, and *Brian's* is 2 (2 yes, 7 no). *Amanda's* score is 2 (3 yes, 12 no) because for the young child, pressure as the only communication channel might be misunderstood, and it is also insufficient for *Amanda* to communicate fondness and stay aware of the child's life.

A wearable prototype for asynchronous child-parent communication over a distance was used in [39] to explore the values existing around warmth and affection. The system consists of a small object for the parent and a hand sleeve for a child. The prototype was tested with children aged 7-9, and designed for school-aged children 7-11 years old. Because it supports thermal communication, which is one directional and initiated by parent, the system covers needs similarly to the "Hugging" vest [13]: *Patricia's* score is 3 (4 yes, 9 no), *Frances's* is 0, *Brian's* is 2 (2 yes, 7 no), and *Amanda's* is 2 (3 yes, 12 no).

Haptic video chat system [86] allows a user to touch the person’s image on a touchscreen with a bare hand and communicate a touch sensation. We consider touching the live image of the interlocutor without an intermediate while video chatting to be intuitive for young children, and this feature makes the system unique. The system was tested with adults. *Patricia’s* score is 5 (6 yes, 6 no) because a child can use it independently once someone helps to initiate video chat and set up a jacket. *Frances’s* score is 3 (1 yes, 2 no) and *Brian’s* score is 4 (4 yes, 5 no). *Amanda’s* score of 3 (5 yes, 10 no) is based on the fact that video chat and transmission of touch through pressure can keep a child’s attention, the interaction of touching a person on the screen is child-friendly, but no other shared activities are supported.

While people video chat, Kissenger [85] allows simulating a real-time kiss through multisensory actuation. A hardware device is attached to the bottom of the smartphone and transmits force data in real-time. Because the child can carry a mobile phone and show things around and the hardware allows enriched communication with kiss simulation, *Patricia’s* score is 5 (6 yes, 7 no). *Frances’s* score is 7 (2 yes, 1 no) assuming that video chatting and kissing engage the child and keep them involved. We are unsure if a young child can use the system independently because it is based on a conventional video chat application, so *Brian’s* score is 4 (4 yes, 6 no). *Amanda’s* score is 4 (6 yes, 9 no), due to our assumption that the interface allows for exchanging a high level of fondness.

AWElectric [49] is a wearable interface that transmits goosebumps. The system consists of two jackets (sender and receiver) that are inflatable, use LED lights to enhance the interaction, and have speakers embroidered into the fabric. The speakers are intended to play powerful music to provoke frisson. We expect that a tangible and shareable sensation of goosebumps might not be received well by young children because it represents a complicated feeling. *Patricia’s* score is 3 (4 yes, 9 no), *Frances’s* is 0, *Brian’s* is 3 (3 yes, 6 no), and *Amanda’s* is 3 (4 yes, 11 no), because no shared activities and real-time tracking of the child’s wellbeing are supported.

A tangible interface with two pillows, as shown in [21], is aimed to support closeness in a long-distance relationship. The system is designed for use in the context of a couple's goodnight ritual. Messages are recorded into the pillows while holding it tight and can be listened to by laying the head on the pillow. LEDs in the cushion indicate if the recording is ongoing and what amount of pressure is applied. The prototype was tested with 23–27 year old couples. *Patricia's* score is 3 (4 yes, 10 no) because she can say goodnight and sing a bed-time song using paired pillows, although the understanding of the young child to talk to the pillow should be explained to them and tested. *Frances's* score is 0, *Brian's* score is 2 (2 yes, 7 no), and *Amanda's* score is 4 (6 yes, 9 no) because the pillows were designed to support nightly messages and exchange love, and nothing else can be done using the system.

A system for co-dining experience, shown in [78], allows for moving the partner's dishes remotely to imitate serving food and showing respect. The prototype displays animated messages on a tablecloth, prints digital messages on edible materials, and was tested with 20–40 year old participants. Gesture-based control, which remotely operates the hosting table and dishes, will be not understood by young children. This makes the system inappropriate for preschoolers and affects the assessment. Thus, *Patricia's* score is 2 (3 yes, 11 no) because of nonverbal and personal communication and ability to check what a child has eaten, *Frances's* score is 0, *Brian's* score is 1 (1 yes, 9 no) because of dining supported as a shared activity, and *Amanda's* is 2 (3 yes, 13 no) based on dining as a shared and close personal activity.

KIZUNA [48] is a system for asynchronous dining, which improves the perception of a remote person's presence with synchronization of both dining activities. The system was designed for family members and friends who live apart in different time-zones. It works as the exchange of recorded video messages, a reply to which is recorded when the local person sits and places dishes on the table. The amount of food is detected by the system to end the session when it's logical. Playback speed is adapted to match a streamed video

with the local diner’s progress. The system was tested with students aged 21–32 years. This system is even more complicated for a young child than the synchronous one discussed above [78], forming *Patricia’s* score to be 2 (3 yes, 11 no) just because it allows her to check what the child has eaten. *Frances’s* score is 0, *Brian’s* is 2 (2 yes, 9 no), and *Amanda’s* is 2 (3 yes, 13 no).

Another study suggested designs for synchronized tangible mediated communication in a dining context [34] for 3 scenarios (a couple, a family with children, and a couple with close friends), that creates a sense of togetherness and interpersonal communication with haptic feedback technology. The family dinner scenario was tested in the family with children 6 and 12 years old. In the “Circle of Hands”, distant family members connect their part of the on-table object into one unit. The design enables users to communicate through touch by twisting, pressing, and squeezing. When one part of the “Circle of Hands” is touched, the same movement occurs in the other part, simulating interaction with the same object. The prototype enables a young child to interact with a physical part of the unit, but it is not clear if they understand the meaning of twisting the object and seeing it moving. *Patricia’s* score is 3 (4 yes, 9 no), *Frances’s* is 0, *Brian’s* is 4 (4 yes, 5 no)—because several children can participate in nonverbal communication—and *Amanda’s* is 3 (4 yes, 10 no) because physical touch can be communicated only if the child is holding the receiving part, which is insufficient in communicating love to the preschooler, and no other activities are supported.

WaaZam [28] is a synchronous system, which provides customized video environments for open creative play, managed with layers in 3D space. The system places remote members into one digital place and supports transformations, gestures, and object play. It was designed for and tested with families with children aged 6-12 years old. The elements of the scene-maker user interface and the scene selection with gestures might bring troubles for young children and need to be adapted for them. *Patricia’s* score is 4 (5 yes, 8 no) because shared play and nonverbal communication is supported and that young child

should be able to use the system. *Frances's* score is 3 (1 yes, 2 no) and *Brian's* score is 4 (4 yes, 7 no) because *Brian* is pleased to see children on both sides playing, dancing, and singing in WaaZam. *Amanda's* needs build on *Brian's* and include close personal activities and expressing the high level of fondness, so her score is 4 (7 yes, 9 no).

Emotar [37] is a system for asynchronous movie watching, which allows feelings of communication. The system was designed for people who are set apart both in time and space and tested with 19–47 year-olds. The viewer's facial response was collected and used to create their Emotar. The system, which shares emotion awareness, is desired by *Patricia*, although young viewers might experience problems relating the Emotar's facial expressions to their parents' faces. *Patricia's* needs are met to the extent of 3 (4 yes, 9 no) because a means of checking the child's mood is provided. *Frances's* score is 3 (1 yes, 2 no), *Brian's* score is 3 (3 yes, 8 no), and *Amanda's* is 3 (4 yes, 11 no). Emotar might be appealing to *Amanda* merely as a secure way to participate in close activities, such as watching videos together and being aware of the partner's emotions.

LumiTouch [9] is a picture frame for real-time communication. Working in passive mode, the frame indicates the remote person's presence with ambient glowing. Active mode allows for communication with light patterns and squeezing the frame. Both passive and active modes might be too subtle for a young child to understand, so *Patricia's* score is 2 (3 yes, 10 no) for internal nonverbal communication and maintaining awareness of presence. *Frances's* score is 0, *Brian's* is 1 (1 yes, 8 no) because of the tangible interface, and *Amanda's* score is 1 (2 yes, 13 no).

The Happy Box [40] is a system for non-verbal and tangible interaction designed for elders to communicate with their families and friends. Two boxes are Internet-connected and have one surface divided into 6 square areas, in which tokens can be inserted. A square is lit up on both boxes, and if tokens match on both boxes, a square area pulses. We assume the communication with lights is too ambient for young children and they

might have problems to understand a metaphor meant for adults. *Patricia's* score is 3 (4 yes, 9 no) because the Happy Box allows for nonverbal communication, seeing *Patricia's* availability, and enabling the child to use it independently. *Frances's* score is 0, *Brian's* is 2 (2 yes, 7 no), and *Amanda's* score is 2 (3 yes, 12 no) due to the tangible interface and the child's possible ability to understand interactions.

Lightbound [67] is an awareness system for distant family members, which represents the output with ambient pulsating light. The input is collected from either real-time heartbeat or a pressure-sensitive surface. The system is designed to enable romantic partners to feel present in each other's lives. Lightbound is another example of a subtle unobtrusive system that might not work well with young children. *Patricia's* score for the device is 2 (2 yes, 11 no) and *Amanda's* is 1 (2 yes, 13 no) assuming that communication is nonverbal, personal, and safe; *Frances's* and *Brian's* scores are 0.

The Cubble [35] system provides a hybrid approach to maintain emotional closeness for couples in long-distance relationships. Dedicated objects and mobile apps provide bidirectional message sending (colour glowing), sending vibrations, and 'holding hands' by pressing the surface. Participants' age ranged from 22 to 31. Communication with a young child via light, vibration, and heat might be challenging and lowers the persona's potential satisfaction with the system. *Patricia's* score is 2 (2 yes, 11 no) because internal communication is safe, personal, and nonverbal; *Frances's* score is 0; *Brian's* score is 1 (1 yes, 9 no) because tangible cubes were used in the study; and *Amanda's* score is 1 (2 yes, 14 no).

The Rüg [69] is designed for long-distance communication between friends and provides a sense of 'being there'. It is a pair of pressure and heat-sensitive rugs, that exchange and display collected data, such as pressure shape, on the other carpet surface. Participants described the technology, which displays footprints of their distant friend on the rug, as 'cool but creepy', and we imagine young children might have similar concerns. *Patricia's*

score is 3 (4 yes, 10 no) based on safe internal connection, ability to ‘be there’, nonverbal communication, and seeing *Patricia’s* availability. *Frances’s* score is 0, *Brian’s* is 2 (2 yes, 8 no), and *Amanda’s* is 2 (3 yes, 13 no).

“Forget me not” [1] is an ambient display designed for couples in long-distance relationships. A drooping and colour-changing flower conveys communication frequency and increases awareness of the necessity to maintain a healthy relationship. Evaluating the amount of logged phone calls between partners, the flower indicates the intensity of relationships. The system looks like a toy, and therefore has a high chance to attract a young child’s attention, although understanding the drooping and colour-changing behaviour is expected to be a challenge. Features such as keeping the child’s attention, safety, security, and nonverbal communication are addressed in the system. Thus, *Patricia’s* score is 2 (3 yes, 10 no), *Frances’s* is 3 (1 yes, 2 no), *Brian’s* is 1 (1 yes, 8 no), and *Amanda’s* is 1 (2 yes, 13 no).

CASY [87] is an asynchronous system designed to support intimacy in communication between children and their distributed family members. Dedicated objects like a picture frame and a pillow with display support exchanging video snippets such as ‘good morning’ and ‘good night’ messages. Parties can indicate their current state such as, ‘I’m going to sleep’ or ‘I just woke up’. *Patricia’s* score is 5 (6 yes, 7 no), relying on the ability of video messages to keep a child’s attention, indicating an availability of the partners, and a tangible interface for a child. *Frances’s* score is 7 (2 yes, 1 no) for attention kept and videos shared asynchronously, *Brian’s* score is 4 (4 yes, 5 no), and *Amanda’s* is 5 (7 yes, 8 no). The idea of enabling two or more children to communicate, required by Brian, was not addressed in the described system and was expressed as future work.

ASTRA [59] is a messaging system, which allows for sharing pictures with personalized comments, and was designed for friends or families to see each other's everyday activities and become more involved in each other’s lives. The prototype includes a phone with the

camera and a mobile device for home, supports asynchronous communication, and enriches synchronous communication providing content for talks. Because the system works asymmetrically and only the parent can send pictures while on the move, Patricia might be dissatisfied with the system. *Patricia's* score of 2 (2 yes, 11 no) is also caused by possible difficulties of reading text notes for a child, and no video messages or asynchronous mode supported. Based on these criteria, *Frances's* score is 4 (2 yes, 3 no), *Brian's* is 2 (2 yes, 9 no), and *Amanda's* is 2 (3 yes, 14 no).

Hermes@Home [61] is a messaging system for awareness and intimacy between home inhabitants, which provides an opportunity to express emotions, mood or health state, activities, locations, or simply keep in touch. The home unit and the 'away' interface include a display, on which users can scribble notes, and a webcam. The system was tested with adult family members. The interface heavily relies on the reading, writing, and typing skills of users, so we consider it to be inappropriate for young children. *Patricia's* score is 2 (2 yes, 11 no) because communication is closed and nonverbal (e.g., a child can scribble drawings or simple messages). *Frances's* and *Brian's* scores are 0; *Amanda's* score is 1 (2 yes, 13 no).

Gust of me [32] is designed for parents and their adult children who live apart to involve them in close friend-based relationships. A system consists of two Gustbowl devices in two households, into which users can throw everyday items, making the bowl wobble, take the picture of what is inside, and send it to the paired bowl. The effect of 'Mom, I'm home!' is achieved. The Gustbowls were tested in families with adult children. We do not consider the system to be able to keep a child's attention because it was designed to be unobtrusive. Even adults, such as the mother in the study, noticed only 4 out of 14 wobbles of the bowl. Nevertheless, we do consider the simple way of communication with the Gustbowls to be approachable for preschoolers. Features such as showing things easily from both sides make communication for two children possible, whereas the tangible interface, which child can operate without help, and child-friendly interactions yield the following

evaluations for the personas: *Patricia's* score is 4 (5 yes, 9 no), *Frances's* is 4 (2 yes, 3 no), *Brian's* score is 5 (5 yes, 6 no), and *Amanda's* is 4 (7 yes, 10 no).

The Hug [22] is designed to provide elders with a richer social interaction with distant family members. Implemented as two soft velvety pillows, the system facilitates remote voice and tactile sensation, such as heat and vibration. Squeezing the left paw of the Hug is dedicated to starting a conversation, and squeezing the right paw to terminating it. This interaction might lead to unintentional call drops with young children. *Patricia's* score is 5 (6 yes, 7 no) because of the inviting look of the toy, which a child can use independently, the ability to convey hugs, say good night, and sing bedtime songs. *Frances's* score is 3 (1 yes, 2 no) because of the attention problem addressed, *Brian's* score is 6 (5 yes, 4 no) due to a tangible interface, which two children can use, and *Amanda's* score is 6 (9 yes, 6 no) for its ability to express a high level of fondness, in addition to the already listed benefits.

Peek-a-drawer [62] is a furniture-based symmetrical communication device. The participant places an object in the upper drawer and closes it, causing it to take a picture of the content, and uses the lower drawer to see a picture of the belongings, which the other user shared. The tool was designed for elders and their grandchildren. The communication is lightweight, playful, and straightforward, and therefore should create no problems for young users. *Patricia's* score for Peek-a-drawer is 4 (6 yes, 8 no) because the idea of playing through the furniture might appeal to young children, both parties can show things easily, communicate nonverbally, share photos, and a child benefits from using the tool independently. *Frances's* score is 6 (3 yes, 2 no) and *Brian's* score is 5 (6 yes, 5 no) due to a tangible interface and how it enables children to communicate. *Amanda* would also appreciate the child-friendly interactions, security of communication, child's independence as a user, and a close personal way to express love. *Amanda's* score is 5 (9 yes, 8 no).

The 6th Sense [72] prototypes were designed to support closeness and intimacy at a distance. The light sculpture measures the amount of movement near it. If movement is long enough, the lamp interprets it as presence and a connected lamp lights up; if no motion observed, it dims down. The devices were tested with a three-generation audience. The tool is non-intrusive, and the light change from it might not be perceived as meaningful by a young child, if it is noticed at all. The system needs to be tested with youth to ensure that they understand the metaphor of presence and make a connection between light and the availability of their adult. Thus, *Patricia's* score is 2 (3 yes, 10 no) for the safe and nonverbal communication, and also the possibility to see *Patricia's* availability. The 6th Sense addresses nothing from the needs of *Frances* and *Brian*, so their scores are 0. *Amanda's* score is less than 1 (1 yes, 14 no), which the system receives for the security of communication.

The digital family portraits [47] system was designed to make extended family members aware of the daily life of their elders, who live independently. For these purposes, picture frames are placed in two households. Once a day, the frame updates information on the current and recent (from the last 4 weeks) conditions of the remote household. Presented information includes icons for activity, health, relationships, and the level of measurement of those. Icon patterns also tell how recent and aggregated the data is. Digital family portraits were designed as one-directional awareness system and might address some of *Patricia's* needs and leave a child's desire to be aware of the adult unsupported. The system addresses a safety of communication and might make *Patricia* aware of the child's mood and wellbeing, although a child needs a co-located adult to set corresponding icons about their health, environment, relationships, activity, and events. This forms *Patricia's* score as 3 (3 yes, 9 no). *Frances's* score is 0, *Brian's* is 1 (1 yes, 8 no), and *Amanda's* score is 1 (2 yes, 13 no) because their needs are mostly unmet and only the tangibility of the interface and security of communication benefit the system.

Casablanca [25] is an industrial design project of a simple means of communication. Two possible Intentional Presence Lamps (IPL) were presented, that indicate a person's presence if activated. The Curtain IPL is a picture frame, in which a physical curtain indicates social availability. With the Lampshade IPL, remote users synchronously collaborate in the visual representation of themselves on their lamps. The ScanBoard prototype provides a shared digital surface for sharing notes, pictures, and snippets, which would be challenging for a young child to use. We consider the Curtain IPL and Lampshare IPL to support lightweight communication, which might not be understood by young users. *Patricia's* score is 2 (2 yes, 10 no) for enabling a child to see *Patricia's* availability, *Frances's* and *Brian's* scores are 0, and *Amanda's* score is 1 (1 yes, 14 no).

SoftAir chairs [71] allow communicating 'living together' in everyday objects, such as couches. Chairs in separate households that detect pressure and movements and convey remote presence with light and sounds to another chair, are a subtle way to communicate and might be perceived as creepy by young children. *Patricia's* score for SoftAir is 2 (3 yes, 10 no) for nonverbal communication and that *Patricia's* availability is indicated to a child. *Frances's* score is 0, whereas *Brian's* (1 yes, 8 no) and *Amanda's* (2 yes, 13 no) scores are 1 for it having a tangible interface.

Feather, scent and shaker [65] are devices designed to maintain simple intimacy. They were designed for couples. Both Feather and Scent were paired asymmetrical systems, in which the input is done by holding the picture frame. The Shaker was designed for a less intimate relationship and includes identical devices for both ends. Shaker conveys a vibrating pattern of the remote device. We imagine that a young child can use the system independently, although probably in a more chaotic and meaningless way, which is not necessarily interpreted as an "ephemeral, poetic experience of connection" for them. *Patricia's* score is 2 (3 yes, 10 no), *Frances's* is 0, *Brian's* is 1 (1 yes, 8 no), and *Amanda's* is 1 (2 yes, 13 no).

Lollipop [84] is a device for remote oral interaction between two people. An ear-shaped lollipop contains a microphone and transmits vibrations and sounds of the licking “gestures”. Candy might be welcomed by young children, although whether or not they can understand the vibration is a different question. The kissing that was intended to be supported with Lollipop is sexual in nature, which is different from the types of kisses that parents and children exchange. *Patricia’s* score is 2 (3 yes, 10 no) because edible candy can keep a child’s attention and the device provides safe and nonverbal communication. *Frances’s* score is 3 (1 yes, 2 no) for keeping the child interested in candy. *Brian’s* score is 3 (3 yes, 7 no) due to a tangible interface and physicality. *Amanda’s* score is 3 (4 yes, 12 no) due to the factors mentioned above.

5.9 Summary of System Evaluations

Figure 5.7 summarizes the details of the targeted audience and the appropriateness for kids. Note the threads going to the *Inappropriate for young children* node. They include systems *Designed for young children* (e.g., ShareTable [83], as young children were using a camera-projector system together with older siblings or co-located parent), systems *Designed for larger age range* (e.g., in Collage [76], 4 year-olds could take photographs on a mobile phone but not send them; he had to ask his 9 year-old brother or mother to post), 2 systems *Designed for older children* (e.g., eKiss [11]—a picture weblog filled from MMS messages, which requires children to read and type notes and was tested with 5-12 year-olds; and VideoPal [29]—an asynchronous video messaging tool, which was tested with 9-10 year-olds and whose conversation threads and interface are too complex for kids), and a large part of *Designed for adults and elders* (20 systems; e.g., in Bear-with-me [16], a system designed for couples, a child might have difficulties interpreting messages as input from the relocated person is represented on the toy with a blinking light, and sending them, as the system uses the metaphor of hugging the bear to communicate a hug to the parent).

Examples of systems that might work for young children are from *Designed for young children* (1 system; e.g., the hugging vest [13], which is controlled from a smartphone and applies pressure to the child; because pressure is the only communication channel, it might be misunderstood and insufficient) and from *Designed for older children* (3 systems; e.g., “Circle of Hands” system [34] for tangible communication, which enables the young child to interact with physical unit, but it is not clear if they understand the meaning of twisting the object and seeing it moving, because the system was tested in families with children aged 6 and 12).

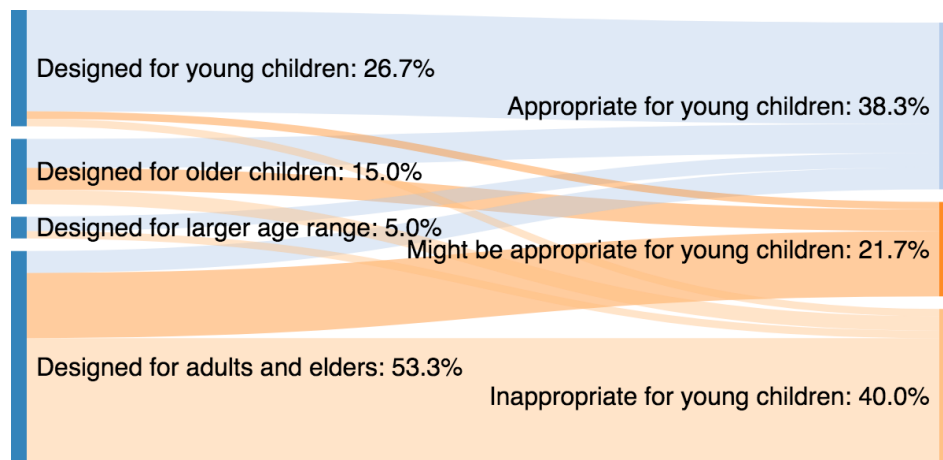


Figure 5.7. Designed / appropriate for young children

Interestingly, the most noticeable (9 out of 32 systems) connection coming to *Might be appropriate for young children* was from tools designed for adults and elders. It can be explained by ease of use and intuitive interactions, such as in a haptic video chat system [86], in which the child can “touch” the person on the screen and communicate pressure. We consider touching a live image while video chatting without an intermediate to be intuitive for young children.

Table 5.4. Systems evaluations

#	System	Patricia the Ultimate Parent out of 10	Frances the Familiar Face out of 10	Brian the Birthday Uncle out of 10	Amanda the Favorite Auntie out of 10	Designed with young children in mind?	Appropriate for young children?
1	Huggy Pajama [68]: asymmetric system for physical interaction	4	0	3	4	Yes	Yes
2	ShareTable [83]: camera-projector system for video chat with collaborative tabletop surface	2	0	2	4	Yes	No
3	Globetoddler [45]: remote interaction system for preschool children and their traveling parents	6	8	6	8	Yes	Yes
4	Virtual Box [12,80]: asynchronous system for virtual and physical play	4	7	4	4	No, older children	Maybe
5	eMutts [82]: asynchronous asymmetric system in the form of keychain-sized toys	4	3	3	3	No, older children	Yes
6	The Magic Box [76]: system for intergenerational play at a distance	3	3	4	5	Yes, larger range	Yes
7	The Collage [76,77,80]: technology for creating, displaying and interacting with photos and text	2	3	2	2	Yes, larger range	No
8	The Collage and Storytelling [77]: respectively asynchronous and synchronous solutions for contact between children and adult relatives in different time zones	4	5	5	4	Yes, larger range	Yes
9	eKiss [11,80]: asynchronous asymmetric system (picture weblog).	3	0	1	2	No, older children	No
10	Zaturi [31]: asynchronous system for recording audio boooks	3	3	3	4	Yes	Yes
11	Orange Toaster, Family Toast, Play with Elmo [55]: asynchronous messaging systems for preschoolers	4	7	5	6	Yes	Yes
12	SINCOM [58]: asynchronous and synchronous communication within intergenerational tool	3	3	4	3	Yes	Yes
13	TimelyPresent [33]: asynchronous messaging device for children, their parents, and grandparents	4	7	4	4	No	Yes
14	Family story play [57]: system with tangible book	5	3	5	6	Yes	Yes

	frame for synchronized reading and video conferencing						
15	Story Visit [56]: system for synchronized reading and video conferencing	3	3	2	4	Yes	Yes
16	People in Books system [14]: synchronous reading and open ended play in long distance relationship	3	3	5	4	Yes	Yes
17	VideoPal [29]: tool for children's asynchronous communication	3	3	2	3	No, older children	No
18	PlayPals [6]: toy system for remote playing for 5-8 year olds, communicates virtual co-presence, transmits gestures.	3	3	5	4	No, older children	Yes
19	VideoPlaydate [81]: systems for free play in video conferencing: Vanilla Videoconferencing, Pan-zoom-tilt, Projector Rug, and Mobile	3	7	4	4	No, older children	Yes
20	IllumiShare [30]: system of shared task space (projection) and person space (Skype)	4	5	4	4	No, older children	Maybe
21	SeeSaw [75]: asynchronous video messaging tool	3	5	3	3	No	No
22	e-Seesaw [66]: tangible awareness system for remote parent-child interaction	3	0	3	3	Yes	Yes
23	HaptiHug [73]: representation of a hug over distance	2	0	1	1	No	No
24	Hugvie [36]: hugging person-similar shaped pillow for chatting	2	0	2	2	No	Maybe
25	Hugginess [3]: two T-shirts with conductive fabric	3	0	1	2	No	Maybe
26	XOXO [60]: kissing and hugging through robotics interface and jacket	3	0	3	3	No	No
27	Haptic accessory, which transmits the touch in hand wrappings [70]	2	0	2	4	Yes	Yes
28	Teddy Bear [74]: a toy for non-verbal interaction between young children and parents	7	7	7	5	Yes	Yes
29	Bear-with-me [16]: mobile, symmetric intimate communication via two bears	3	0	2	2	No	No
30	InTouch Tactile Tales [41]: handheld peddle with docking station, which allows to 'send a squeeze'	5	3	6	5	Yes	Yes
31	Wearable prototype that mediates temperature of social touches like arm around shoulders [53]	3	0	2	2	No	No
32	"Hugging" vest for touch pressure therapy [13]	3	0	2	2	Yes	Maybe

33	Wearable prototype for asynchronous child-parent communication over distance [39]	3	0	2	2	No	No
34	Haptic video chat system [86] allows to touch person on a touchscreen with bare hand and communicate touch	5	3	4	3	No	Maybe
35	Kissenger [85]: while video chatting, device simulates real time kiss through multisensory sensations	5	7	4	4	No	Maybe
36	AWElectric [49]: wearable interface which transmits goosebumps	3	0	3	3	No	No
37	Tangible interface with two pillows [21]. Messages can be recorded to the pillows	3	0	2	4	No	Maybe
38	System for co-dining experience [78]	2	0	1	2	No	No
39	KIZUNA [48]: system for asynchronous dining	2	0	2	2	No	No
40	Design suggestions for synchronized dining tangible mediated communication [34]	3	0	4	3	No, older children	Maybe
41	WaaZam [28]: synchronous system with video environments for open creative play	4	3	4	4	No, older children	Yes
42	Emotar [37]: system for asynchronous movie watching, which allows to communicate feelings	3	3	3	3	No	Maybe
43	LumiTouch [9]: picture frame for real time communication	2	0	1	1	No	No
44	The Happy Box [40]: system for non-verbal and tangible interaction	3	0	2	2	No	Maybe
45	Lightbound [67]: awareness system for distant family members, which represents the output with ambient light	2	0	0	1	No	No
46	Cubble [35]: dedicated objects and mobile apps for bidirectional messages	2	0	1	1	No	No
47	The Rüüg [69]: two pressure and heat sensitive rugs	3	0	2	2	No	Maybe
48	'Forget me not' [1]: an ambient display (drooping and colour-changing flower)	2	3	1	1	No	No
49	CASY [87]: awareness system for children and their distributed family members	5	7	4	5	Yes	Yes
50	ASTRA [59]: asynchronous messaging system which allows share pictures with personalized comments	2	4	2	2	No	No
51	Hermes@Home [61]: messaging system for	2	0	0	1	No	No

	awareness and intimacy between home inhabitants						
52	Gust of me [32]: paired bowls, designed for parents and their adult children who live apart	4	4	5	4	No	Yes
53	The Hug [22]: pillow for remote synchronous voice and tactile sensation	5	3	6	6	No	Yes
54	Peek-a-drawer [62]: symmetrical communication via furniture	4	6	5	5	Yes	Yes
55	The 6 th Sense [72]: awareness system, which communicates presence in the light sculpture	2	0	0	1	No	No
56	Digital family portraits [47]: awareness system, which informs extended family members of daily life of their elders	3	0	1	1	No	Maybe
57	Casablanca [25]: industrial design prototypes of simple means of communication. The Curtain Intentional Presence Lamp (IPL), Lampshade IPL, and ScanBoard	2	0	0	1	No	No
58	SoftAir communication chairs [71]: prototype for communication of presence in paired chairs	2	0	1	1	No	No
59	Feather, Scent and Shaker [65]: paired asymmetrical and symmetrical systems for communication in couples	2	0	1	1	No	No
60	Lollipop [84]: remote oral interaction between two people	2	3	3	3	No	No

6 DISCUSSION

In this chapter, we discuss our results and their implications on the design of communication tools, the limitations of fulfilled work, as well as provide suggestions for future studies. In our work, we identified user requirements through a mixed-methods study, generated personas, and analysed existing systems in the context of these personas.

6.1 Discussion of Findings

6.1.1 Patricia the Ultimate Parent

Almost all parents in our sample (90%) were used to form *Patricia's* persona. A distinctive feature of *Patricia* was the prevalence of daily calling (see Appendix B, Parenting, Figure 1) on the cell phone and landline (40.7%; see Figure 2). The next everyday used services were Facetime, Facebook (video chat), and Skype with a noticeably decreased usage rate (14.8% each), which suggests that parents are not inclined to hang out “remotely” with their children. As qualitative findings suggest, parents call from work to hear essential information about the child’s wellbeing, because they know they would play, read, and enjoy time with children in the evening after work, being physically together. Parents seem to use video chat mostly in situations that do not follow everyday scenarios, such as when they are away on a trip or children are staying with grandparents. These are the times when parents encounter the need to continue their established routines, although

remotely, which means the finest hour for features such as remote playing and bedtime storytelling to rescue the situation.

We found dedicated systems for specific activities, such as reading, commercial products (e.g., readeo.com, thestorybeforebed.com, Your StoryTime app), and when we asked participants explicitly if they use them, only one out of 27 parents responded affirmatively and indicated that they were using them with varying frequency from a few times a year to everyday.

The biggest concerns for *Patricia* are being unaware of the child's availability, a wish for a private and safe connection, and also to hug the child.

6.1.2 Frances the Familiar Face

Frances is the least represented persona since formed from only 3 aunts. They communicate with their nephews or nieces a few times a week as the best, but not every day (see Appendix B, Not a Stranger, Figure 4). To make sure a child recognizes them when visiting, *Frances* video chats with distant family a few times a month (Figure 5). For their purpose, *Frances* is equally contented with synchronous and asynchronous communication (e.g., sending pictures, physical objects), using the latter one without any feeling of insufficiency.

6.1.3 Brian the Birthday Uncle

Participants from *Brian's* persona use the same channels as the *Amanda* and *Patricia* groups, such as cell phone calls, Skype, and Facetime, although with a difference in frequency, which is mostly from a few times a month, and less so, a few times a week (see Appendix B, Basic Relationship, Figure 8).

6.1.4 Amanda the Favorite Auntie

Amanda's usage of services looks as a middle between *Patricia's* and *Brian's*, which is supported by their growing levels of connectedness (*Brian*—to have basic relationship and maintain it, *Amanda*—to form strong connection, *Patricia*—to be an omnipresent parent) (see Appendix B, Strong Relationship, Figure 11). The set of dominant activities is relatively the same, although it is the greater frequency of involvement in them that allows *Amanda* to achieve the deeper connection with a child.

6.1.5 Other Thoughts

In 2000, the number of American families with two and more children (about 21 million) far surpassed the number of families with one child (14.3 million) [89]. As our recruiting was done in the USA, where it is still more common to have siblings than to be the only child as statistics show for 2017, we reached a large sample of uncles and aunts in relation to children. That formed a large group of participants, which exceeded parents and grandparents. We assume that the sample weight of *Brian* and *Amanda* personas might be diminished if a similar study would be done in other countries. That might be a major limitation of generalization of our results.

6.2 Implications for Design

The findings of our study can inform researchers in:

- The existence of user groups other than parents and grandparents;
- The surprisingly impressive sample weight of the currently ignored user group of aunts and uncles;
- The profound difference in goals and needs of the discovered user groups from the needs of parents;

- Diversity in the levels of relationships, and desire to be supported within the aunties and uncles group; and
- Presentation of the goals and needs of each user group observed.

For designers, our findings are beneficial for providing the full picture of the needs of already known user groups, such as parents. The requirements of a parent for system features are defined in the study and can be addressed in a single system. In other words, designers can avoid limiting the functionality to 2-3 features and produce several tools for one person, and rather design for everything that a parent needs in one system.

User groups, such as *Frances*, *Brian*, and *Patricia* were not previously addressed with such specificity, and following their requirements when designing interfaces for remote communication with young children would make it possible to develop a tool targeted for one persona.

6.3 Limitations

In our study, grandparents were not reached through MTurk, and there is little representation of them in the data (3.6%, 3/84, nobody older than 55). It is possible that grandparents will fit into the developed personas *Frances the Familiar Face*, *Brian the Birthday Uncle*, or *Amanda the Favorite Auntie*, depending on the intensity of relationship they have with their grandchildren; however, we acknowledge that this user group is underrepresented in our sample. It is presently unclear if further research is needed to develop a specific persona for grandparents or if they can be subsumed within the already-developed personas.

All responses for children's perspectives were gathered from the explicit answers of their adults. For instance, evaluation to what degree children like or dislike features in systems

can only be interpreted as the perception of their desires filtered through the lens of the adult user. Further work needs to directly investigate the child's perspective.

We evaluated the number of uncles/aunts in the communication circle of the American child, which might differ from the other cultures. We also discussed the possible reasons for the observed prevalence in our sample. The generalization of results to the broader population of users across cultures and countries might be questionable due to the geographical limitation of the participants in our sample.

We acknowledge that involving only one researcher in performing the thematic analysis, inferring goals, and gathering preliminary finding into segments could lead to skewed sample weights of the developed personas. However, the personas are beneficial, first, in discovering different levels of closeness that people have with children, as we discussed in the implications for design.

Our personas represent people who frequently communicate remotely over a distance with preschool-aged children and are derived from their lived experiences. This is grounded in prior work in the field, but is a unique research contribution in the way it addresses the current barriers, needs, and perspectives around adults and pre-literate children who are separated by geography but are wanting to connect.

6.4 Future Work

The personas reflect the different characteristics of adults, who represent only one part of the communication connection. Stage of development, psychological and social needs, and literacy level of children should be kept in mind to respect systems designed for children. Moreover, deeper exploration of the child's participation in remote sessions could lead to observing different strategies with the adult personas, or even discovering personas among the young users.

The value of our findings is not in giving a precise representation of the population, but rather in providing an insight of who wants to use these types of systems and how their needs differ. However, there is future work that arises from our findings.

First, it would be useful to conduct a similar explorational study in other cultures, to check if the cultural difference can reveal new personas, or expose different requirements. Second, it would be valuable to collect data from children directly (e.g., from field observation of technologies usage), rather than interpret responses from adults. Third, we would like to explore how children communicate with the proposed personas, whether children's communication strategies differ towards personas among adults and how they do so. Fourth, we wish to explore how young children communicate with adults remotely, and to explore whether young children themselves have distinct differences in goals and needs, that require separated treatment (i.e., personas) in system design. Fifth, to be more generalizable to real use settings, we would like to consider designing for the settings other than one child and one adult (e.g., two children, one adult; two children, no adults). Finally, the next step in this work is to use the personas in interactive systems design—specifically, to prototype four systems for *Patricia*, *Amanda*, *Brian*, and *Frances* and test them in actual use with representatives of each adult persona.

7 CONCLUSION

7.1 Summary of Research

This thesis presented our research about the communication practices between children and their adult relatives living at a distance. Families who are geographically distributed use a variety of technologies to stay in touch; our mixed-methods study characterized their motivations, habits, preferences, goals, and concerns. Based on our descriptive findings, we designed four personas that can be used to inform research and design directions in remote communication technologies for preliterate children. We further analysed 60 existing systems from the HCI literature, revealing that none of the personas' needs are adequately addressed.

7.2 Contribution

The contribution of our work is a presentation of the adult users, who are involved in remote communication with young children, as a whole, and detailed development of their personas. This work adds an important perspective to the theme of remote communication with young children and introduces several personas of unexplored user groups, among the ones that are already familiar to researchers and designers. Supporting families to communicate over a distance is an area of interest to researchers, designers, and developers and our findings contribute to furthering this important research agenda to foster connection and boost user satisfaction with the end products.

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APPENDIX A

A.1 Screening Questionnaire

1. What is your age?
2. Indicate your gender:
 - a. Female,
 - b. Male,
 - c. Other,
 - d. Rather not say
3. Please indicate how often (on average) you play games:
 - a. Every day,
 - b. A few times per week,
 - c. Once per week,
 - d. A few times per month,
 - e. Once a month,
 - f. A few times per year,
 - g. Once per year,
 - h. Not at all.
4. How much do you self-identify as a gamer on the following scale:
Slider from “Not at all” on the left to “Gamer” on the right, with tick count of 100.
5. Do you play multiplayer games?
 - a. Yes,
 - b. No.
6. How much time of you time spent playing games is with done with others compared to playing alone?
Slider from “Play Alone” on the left to “Play with Others” on the right, with tick count of 100.

7. Do you use any fitness applications on your smartphone?
 - a. Yes,
 - b. No.
8. Please indicate how often you use fitness application:
 - a. Every day,
 - b. A few times per week,
 - c. Once per week,
 - d. A few times per month,
 - e. Once a month,
 - f. A few times per year,
 - g. Once per year,
 - h. Not at all.
9. Do you communicate over a distance with any children?
 - a. Yes,
 - b. No.
10. Please indicate the ages of any children you communicate with over a distance?
 - a. 0-3 years old,
 - b. 3-6 years old,
 - c. 6-9 years old,
 - d. 9-12 years old.

A.2 Consent Form

Communication and Reading Patterns with Young Children

Researcher(s): Valentyna Artemchuk, MSc Student, Department of Computer Science, University of Saskatchewan, valentyna.artemchuk@usask.ca

Purpose(s) and Objective(s) of the Research: The purpose of this project is to understand experiences of and motivations for or against communication with young children over a distance.

Procedures: In this study, you will be asked to complete a survey, asking you some questions about yourself.

Funded by: The Natural Sciences and Engineering Research Council of Canada (NSERC).

Potential Risks and Benefits: There are no known or anticipated risks to you by participating in this research. Your participation will help us to understand experiences of and motivations for or against communication with children over a distance. This will help us design communication tools better suited for communication with young children over a distance.

Confidentiality: Confidentiality will be maintained throughout the study. The entire process and data will be anonymized. Data will only be presented in the aggregate and any individual user comments will be anonymized prior to presentation in academic venues. Only the researchers will have access to the data to ensure that your confidentiality is protected.

Storage of Data: Data (including survey and interview responses, logs of computer use) will be stored on a secure password-protected server for 7 years after data collection. After 7 years, the data will be destroyed. Paper data will be shredded and digital data will be wiped from hard disks beyond any possibility for data recovery.

Right to Withdraw: You may withdraw from the research project for any reason, at any time without explanation. Should you wish to withdraw, you may do so at any point, and we will not use your data; we will destroy all records of your data. Your right to withdraw data from the study will apply until the data have been aggregated (one week after study completion). After this date, it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data.

Follow up: To obtain results from the study, please contact Valentyna Artemchuk (valentyna.artemchuk@usask.ca).

Questions or Concerns: Contact the researcher(s) using the information at the top. This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

A.3 Main Study Questionnaire

A.3 Block 1 Adult Demographics

You are eligible to participate in this study if you ever communicated with 3 to 6 year-old children over a distance. Please answer the following questions about yourself.

1. What is your age?
2. Indicate your gender:
 - a. female,
 - b. male,
 - c. other.
3. Insert your gender in case you selected 'other' in the previous question
4. What is the highest degree or level of school you have completed? If currently enrolled, mark the previous grade or highest degree received:
 - a. No schooling completed,
 - b. Nursery school to 8th grade,
 - c. 9th, 10th or 11th grade,
 - d. 12th grade, no diploma,
 - e. High school graduate - high school diploma or the equivalent (for example: GED),
 - f. Some college credit, but less than 1 year,
 - g. 1 or more years of college, no degree,
 - h. Associate degree,
 - i. Bachelor's degree,
 - j. Master's degree,
 - k. Professional degree,
 - l. Doctorate degree,
 - m. I prefer not to answer.

5. If you are a student, please indicate your subject.
6. Please indicate your employment status:
 - a. Employed for wages or salary employee,
 - b. Self-employed,
 - c. Out of work and looking for work,
 - d. Out of work but not currently looking for work,
 - e. A homemaker,
 - f. A student,
 - g. Military,
 - h. Retired,
 - i. Unable to work,
 - j. I prefer not to answer.
7. Please indicate your marital status:
 - a. Single, never married,
 - b. Married or domestic partnership,
 - c. Widowed,
 - d. Divorced,
 - e. Separated,
 - f. I prefer not to answer.
8. Please indicate your household income:
 - a. Less than \$10,000,
 - b. \$10,000 to \$25,000,
 - c. \$25,001 to \$45,000,
 - d. \$45,001 to \$65,000,
 - e. \$65,001 to \$85,000,
 - f. \$85,001 to \$100,000,
 - g. \$100,001 to \$150,000,
 - h. \$150,000 or more,
 - i. I prefer not to answer.

9. Please indicate your ethnicity:
- a. American Indian or Alaskan Native",
 - b. Asian,
 - c. Native Hawaiian or Other Pacific Islander,
 - d. Black or African American,
 - e. Hispanic/Latino,
 - f. White,
 - g. Two or more categories,
 - h. I prefer not to answer.

A.3 Block 2 Communication Scenario

Please answer the following questions about yourself.

1. Please list the scenarios of situations in which you communicate with 3 to 6 year-old children over a distance.

We left the next example as a placeholder: “e.g., 1) I Skype with my 4 year-old daughter when I travel for work; 2) I use FaceTime with my nephews (3 and 5) because they live in another city”.

2. Which is the predominant scenario among those that you listed above?
3. Speaking about your predominant scenario, is it your own child you communicate remotely with?
 - a. Yes,
 - b. No.

4. What is your relationship to the child in the predominant scenario?

We left the next example as a placeholder: “e.g., Mother, Uncle, Grandmother, Family Friend”.

A.3 Block 3 Child Demographics

Thinking about your predominant scenario of communication with a child over a distance, please answer the following questions about that child.

1. How old is the child?
2. Child's gender:
 - a. Male,
 - b. Female,
 - c. Other.
3. Custody of the child:
 - a. I have primary custody,
 - b. I have shared (at least 50%) custody,
 - c. I have less than 50% custody,
 - d. I have no custody.
4. Do you live in the same time zone with the child?
 - a. Yes,
 - b. No.
5. If you live in different time zones with the child, please give your time difference from child's household.

We left the next example as a placeholder: “e.g., 2 hours ahead of child's household”

6. If in your predominant scenario there are multiple children involved, please state the ages and genders of the other children.

A.3 Block 4 Activities and Technologies

Please answer the following questions thinking about activities you do with the child(ren) over a distance.

1. Please indicate which of the following activities you do when communicating with the child(ren) over a distance and how frequently you do them:

	Every day	Between once a week and every day	Between once a month and once a week	Between once a year and once a month	Less than once a year	Not at all
Talking						
Messaging (texting, emoting)						
Playing (making faces/voices, singing, dancing, acting)						
Exchanging personal pictures and videos						
Showing physical objects						
Teaching child						
Drawing						
Reading books or magazines						
Watching videos on the internet (e.g. Youtube)						
Listening to music						
Playing board or card games						
Playing computer/video games						
Engaged in physical activities						

2. Are there other activities you do with the child(ren) over a distance? How often do you participate in them?
3. If there are any additional comments you want to make about activities you and the child(ren) participate in, please list them here.

4. Please indicate which technologies you use for communicating with the child(ren) over a distance? How often do you use them?

	Every day	Between once a week and every day	Between once a month and once a week	Between once a year and once a month	Less than once a year	Not at all
Cell phone (calls using mobile plan)						
Skype						
FaceTime						
Viber						
Snapchat						
Messenger						
Whatsup						
Readeo.com						
Caribu						
Your StoryTime						
Kindoma Storytime						
Be There Bedtime Stories						

5. Are there other technologies, apps or online platforms you use to communicate with the child(ren) over a distance? How often do you use them?
6. Please describe in what situations you use technologies for communication with the child(ren) over a distance.
7. If there are any additional comments you want to make about technologies, apps or online platforms you and the child(ren) use to communicate over a distance, please list them here.
8. Please describe what you **LIKE** about the technologies, apps, or online platforms that you use for communication with the child(ren).
9. Please describe what you **DO NOT LIKE** about the technologies, apps, or online platforms you use for communication with the child(ren).
10. Based on your observations, please describe what the child(ren) **LIKES** about the technologies, apps, or online platforms you use for communication with them.

11. Based on your observations, please describe what the child(ren) DOES NOT LIKE about the technologies, apps or online platforms you use for communication with them.
12. If there are any additional comments you want to make about how and in what ways you communicate with the child(ren) over a distance, please list them here.

A.3 Block 5 Reasons and Problems

Please answer the following questions thinking about the ways you and the child(ren) communicate over a distance.

1. Please indicate the reasons why you communicate with the child(ren) over a distance (check all that apply):
 - ☐ Because we do not spend much time together,
 - ☐ For my enjoyment,
 - ☐ For the child(ren)'s enjoyment,
 - ☐ For enjoyment of another adult,
 - ☐ Because it's something relatives or family friends do,
 - ☐ To fill in time,
 - ☐ To spend quality time with the child(ren),
 - ☐ Because participating in shared activities over a distance enhances our feeling of togetherness,
 - ☐ This is something more engaging and emotionally rich than talk on the phone,
 - ☐ Because I have more time to communicate with the child(ren) than another adult,
 - ☐ When another adult doesn't have time to communicate with the child(ren), I have it,
 - ☐ I am seeking the ways to communicate with the child(ren),
 - ☐ Because another adult asked me to,
 - ☐ Because the child(ren) asked me to,
 - ☐ Because the child(ren) likes me and is happy to communicate with me,
 - ☐ Because the child(ren) enjoys the manner in which I communicate with them,
 - ☐ Communication over a distance is a fun time for the child(ren).

2. Please list any additional reasons you might have to communicate with the child(ren) over a distance.
3. How often does another adult from the child(ren)'s household participate in the communication between you and the child(ren)?

All of the time	Most of the time	Some of the time	Not very often	Never
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4. Please indicate the reasons why an adult from the child(ren)'s household participates in the communication session between you and the child(ren) (check all that apply):

- ☐ Another adult acts as an interpreter,
- ☐ I cannot keep the child(ren)'s interest for an entire session,
- ☐ I cannot keep conversation going with the child(ren) without another adult present,
- ☐ Another adult monitors the direction and topics of discussion for appropriateness,
- ☐ Another adult has a greater awareness of the child(ren)'s life than I have,
- ☐ Another adult helps me to avoid situations in which I might ask the child(ren) about unpleasant experiences,
- ☐ Another adult helps me not to feel awkward,
- ☐ Another adult guards the tablet, computer, or other device from breaking,
- ☐ Another adult helps the child(ren) interact with the tablet, computer, or other device,
- ☐ Another adult helps the child(ren) to use the app in general,
- ☐ Another adult is around for cases in which the child(ren) cannot achieve the intended result using the device or app by themselves and needs assistance,
- ☐ Another adult helps the child(ren) to be more confident when communicating,
- ☐ The child(ren) feels more comfortable when another adult stays close.

5. Please list any additional reasons you might have for another adult from the child(ren)'s household to participate in the communication session between you and the child(ren).
6. When communicating with a child over a distance, have you yourself ever been in a role of the mediator between a child and another adult? If so, please describe the situation.
7. Which of the following describes a typical scenario of how communication sessions unfold? (check all that apply)
 - We start communication session as a group of two (another adult and me), and then continue into a larger group as the child(ren) join us,
 - We start communication session as a group of just the child(ren) and me, and then continue into a larger group as another adult joins us,
 - We have communication session as a group of just the child(ren) and me, and nobody joins us,
 - We do only one activity with the child(ren) during a communication session (e.g., read a book),
 - We do two different activities with the child(ren) during a communication session (e.g., read a book and draw a picture),
 - We do three and more different activities with the child during communication session (e.g., read a book, draw a picture, and she shows me her new toys),
 - I change my location during the communication session,
 - The child(ren) changes their location during the communication session,
 - Another adult changes their location during the communication session.
8. If you have any additional comments about how your typical communication session unfolds, please list them here.
9. How are the communication sessions typically arranged? Do you have a regularly-scheduled meeting time or is it more spontaneous? Please describe the process by which a communication session is arranged.

10. At what time of the day do you usually communicate with the child(ren) over a distance? Please answer in your time if you live in different time zones.

We left the next example as a placeholder: “e.g., 8-8:30am or 6-8pm my time”,

11. Please explain why your communication with the child(ren) happens at that time of the day?,

12. Please describe where the child typically is during the communication session with you (e.g., in the kitchen, in the bed, in common area on couch) and why they are there?,

13. When you communicate with the child(ren) over a distance, how long (typically) is each of the following?

	Less than 5 minutes	From 5 minutes to 10 minutes	From 10 minutes to 20 minutes	From 20 minutes to 30 minutes	From 30 minutes to 40 minutes	From 40 minutes to 1 hour	1 hour or more
The whole session. It is time spent communicating with another adult as well, if they participate in your session							
The part of session, when the child(ren) explicitly participates in communication with you. It is time spent communicating with the child(ren) only.							

14. Please answer on the scale from “Strongly agree” to “Strongly disagree”:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I am generally happy with the amount of contact I have remotely with the child(ren).					
The child(ren) seems generally happy with the amount of contact they have with me.					

15. Please indicate whether you and the child(ren) wish to have more, less, or the same amount of contact:

	More contact	Less contact	About the same amount of contact
I wish to have _____			
I think that the child(ren) wishes to have _____			

16. Please indicate which devices the child(ren) uses for communicating with you over a distance (check all that apply):

- ☐ Cell phone (regular calling with mobile operator),
- ☐ Desktop (e.g. Windows, Linux, OS X, etc.),
- ☐ Mobile device (e.g. phone, tablet, etc., where you use apps to be connected),
- ☐ Other.

17. Indicate what devices the child(ren) uses for communicating with you over a distance in case you selected 'other' in the previous question.

18. Please answer on the scale from “Strongly agree” to “Strongly disagree”:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I like communicating with the child(ren) over a distance.					
The child(ren) likes communicating with me over a distance.					

19. If you have any thoughts about why you or the child(ren) like(s) or do(es) not like to communicate over a distance, please list them here.

20. On scale of “Every day” to “Not at all”, please indicate how often (on average) the following happens:

	Every day	Between once a week and every day	Between once a month and once a week	Between once a year and once a month	Less than once a year	Not at all
The child(ren) expresses a desire to						

communicate with you over a distance						
--------------------------------------	--	--	--	--	--	--

21. When you communicate with the child(ren) over a distance, who usually do each of the following?

	Me	Another adult	Child	Not applicable
Decides when is time to communicate				
Schedules communication sessions				
Sets it all up and organizes the session for both sides				
Initiates the session				
Chooses what activity to do				
Leads the talk, proposes topics of discussion				
Monitors topics for appropriateness for child				
Monitors others to avoid topics about unpleasant experiences for the child(ren)				
Plays the role of interpreter between all parties				
Helps the child(ren) to feel more confident when communicating				

22. If there are any additional roles in your communication with the child(ren) over a distance, please list them here as well as who plays that role.

23. Please think about how much you are concerned about each of the following when communicating with the child(ren) over a distance. How severe you might find each of the following?

	Not a problem at all	Minor problem	Major problem	Catastrophic problem	Never happens
Another adult keeps the child(ren) from interacting with device (phone, tablet, laptop, etc)					
Another adult allows the child(ren) to touch and explore the device					
Child(ren) needs help to initiate the session					
Child(ren) needs help to accept the call or join the session					
Child(ren) needs help to use the communication application in general					

Child(ren) is confused with using the application by themselves					
Child(ren) cannot achieve intended result using application by themselves					
Child(ren) asks you or another adult to show how to do something in application					
Child(ren) is outside the frame of video capturing, I cannot see the child					
Child(ren) is busy with seeing themselves in app and making faces to themselves					
Being unaware of the child(ren)'s availability					
Being unaware of the child(ren)'s presence at home					
The child(ren) being unaware of your availability to communicate					
Child(ren) has issues with interaction techniques (long press, click and hold, drag and drop, gesture recognition, etc)					
Another adult is somewhere around during the session and keeps an eye on the child(ren)					
Another adult sits with the child(ren) during the whole session					
Child(ren) expresses a desire to control the communication process					
Child(ren) shows signs of losing the interest in the activity					

24. If there are any additional concerns or problems you noticed when communicating with the child(ren) over a distance, please list them here as well as your perceived severity of the problems.

A.3 Block 6 Additional Comments

If there are any additional comments you want to make about communication with young children over a distance, please list them here.

Thank you for participating in this study!

APPENDIX B

B.1 Segmentation on Four Goals

B.1.1 Parenting

1.1 Demographics

Relation to child: 90.0% of all parents (27 participants)

Sample weight: 27, 33.75%

Age: 24-45 (33.81, SD = 5.955). Median 34, mode 38

Gender: 66.7% female

Marital status: married/domestic 77.8% (21 participants), single 14.8% (4), divorced 3.7% (1), separated 3.7% (1)

1.2 Goals

Continue to be a parent when apart:

- when away from home (no details);
- when leaving for job daily;
- when adult is not home in time;
- when travelling/ in a business trip;
- when child is with another parent;
- when visiting parents (children stay overnight with grandparents, or parents are leaving to take care of grandparents).

To take care, control:

- check in on child during classes;
- check if child is behaving;

- calling during downtime on work (how is child's day, what he has eaten);
- while child is being babysat (to have peace of mind);
- calling from work to teach them about things.

Continue bedtime routine:

- to call home to say goodnight to another child;
- to say good night, story time;
- to Facetime when we can't be together for bedtime;
- making sure the call is before bed time;
- to read them bed time stories that they follow along with at home.

1.3 Activities

The frequency of engagement in proposed activities is summarized in Figure B.1, and was calculated from quantitative part of data.

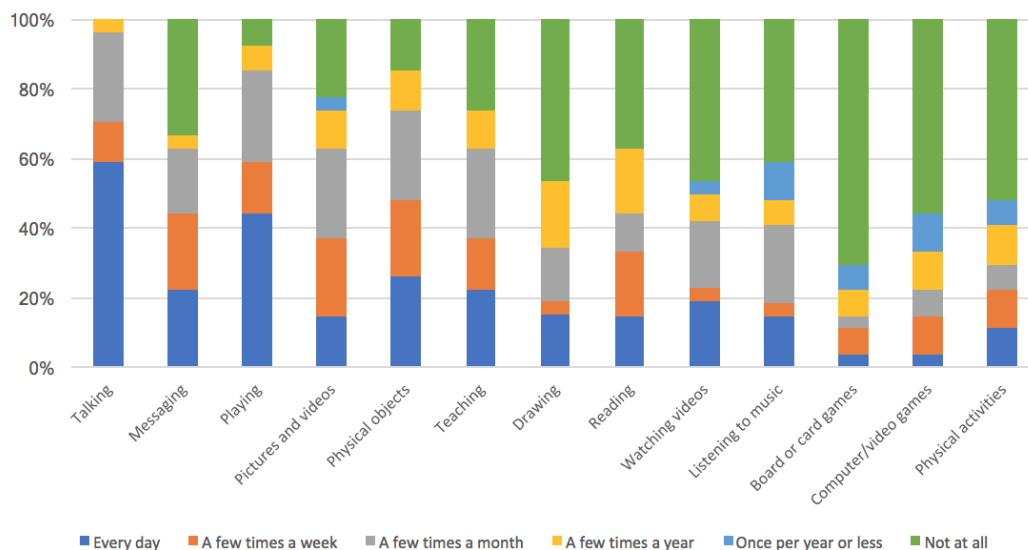


Figure B.1. Frequency of engagement in activities over distance for Parenting segment, in percentages

Bedtime:

- tuck the child in via video chat when adult is away;

- *“saying goodnight is just a must”;*
- *“always at bed time so I can say goodnight”;*
- say good night and sweet dreams;
- still getting to have their bedtime stories and songs;
- *“just cute stuff before sleep”;*
- *“like I am still part of the bedtime routine”;*
- try to make sure it is before bed time.

Talking:

- to tell of upcoming events things that have happened;
- talking about child’s day;
- telling stories;
- to monitor, check in with them;
- to check how children are doing (in school, with grandparents, with babysitter, at home);
- to check on child when adult is not home;
- to see if they are behaving;
- *“He will tell me about his day and what he's eaten since I was gone”;*
- *“I ask him if he got his juice and breakfast”.*

Sending video/photo:

- with stickers;
- special filters on snapchat;
- use the overlays to joke around;
- funny pictures.

Showing things:

- child’s room, dog;
- adult shows what they did today, items they bought;
- children try to show things to adult;

- child walks around to show things.

Reading:

- to read a bedtime story to child;
- to read them bed time stories that they follow along with at home;
- getting ready for story time.

Play:

- making faces: children often get silly and wild;
- 20 questions.

Teaching:

- teach children about things.

Eating dinner together

Dancing/ singing

Pray

1.4 Consistency of communication

Daily as min, sometimes several times per day or per shorter period of time (4 hours of being babyset).

When happens:

- when on trip (13);
- when on job (+ commuting to job) (7);
- when children stay with grandparents (7);
- when child is at school, every chance when adult is not home in time, or for bedtime (3).

1.5 Services

Figure B.2 shows the usage of platforms and services by Parenting group, calculated from quantitative part of data.

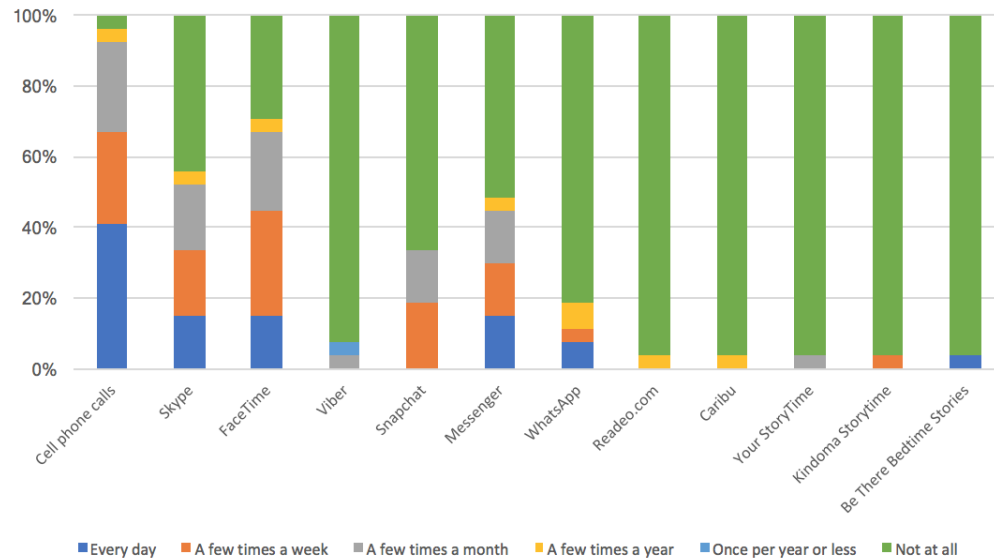


Figure B.2. The usage of services for Parenting segment, in percentages

Services from qualitative data:

- Facetime (15 instances);
- Skype (11);
- Phone call (+ landline) (5);
- Facebook (4);
- Snapchat (3);
- BBM, google duo, hangouts, WhatsApp, walkie-talkies (1 each);
- NA (2).

1.6 Problems

The perceived severity of problems offered in quantitative part is reflected in Figure B.3.

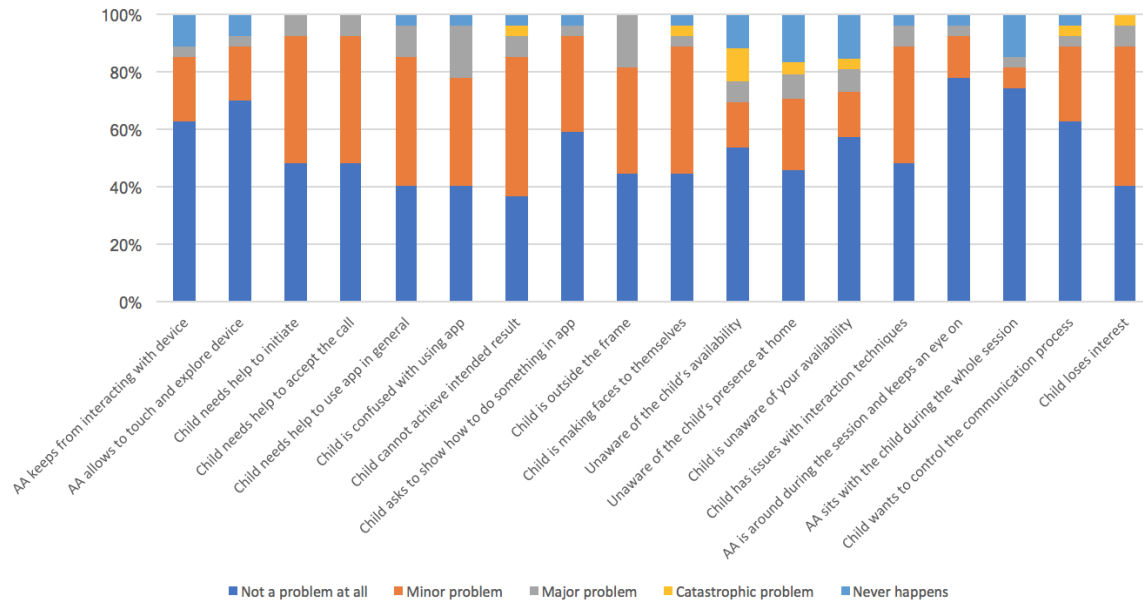


Figure B.3. The perceived severity of problems for Parenting segment, in percentages

Problems from qualitative data:

- Technical (11 instances);
- No hugs+ not being there, safety, help+ help to accept call (3 each);
- Lack of attention, adult's availability, impersonal, not able to hold, occasional hang up + too sensitive screen (2 each);
- doubt to talk to screen, understanding child's words, nonverbal communication, keep child tired, translate, help with conversation, interruption not welcomed, unsupervised phone (1 each).

B.1.2 Not a Stranger

2.1 Demographics

Relation to child: 7.5% of all Nephew/Niece relationship (3 participants)

Sample weight: 3, 3.75%

Age: 29-44 (37.33, SD = 7.638). Median 39, mode NA.

Gender: 100.0% female

Marital status: married/domestic 66.7% (2 participants), single 33.3% (1)

2.2 Goals

- child can recognize adult when seeing on holidays;
- *“he sees me and I am not a stranger”*;
- easier to visit regularly;
- *“they will know me when I can visit without being scared of me”*.

2.3 Activities

The frequency of engagement in proposed activities by Not a Stranger group is reflected in Figure B.4.

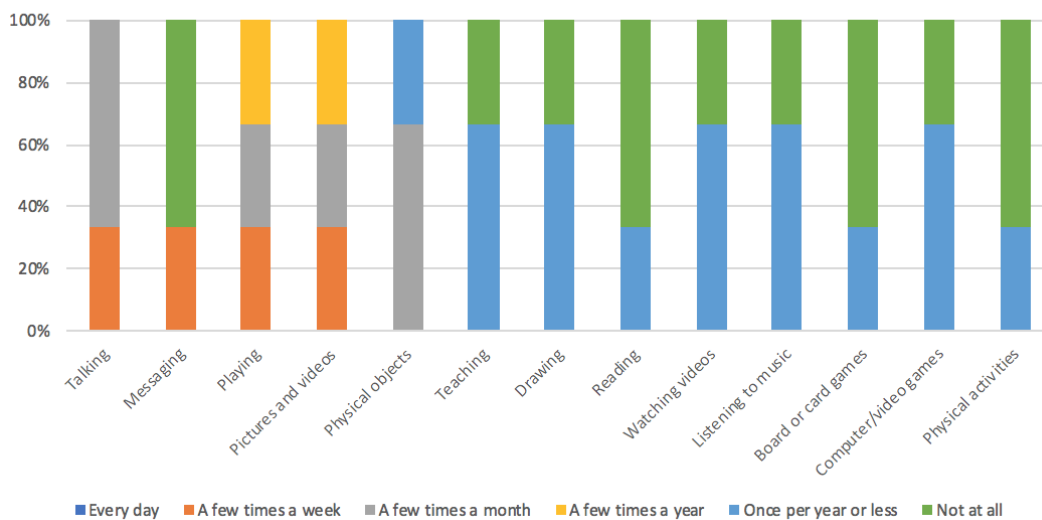


Figure B.4. Frequency of engagement in activities over distance for Not a Stranger, in percentages

Talking:

- just chat.

Sending video/photo:

- Children like the different filters one can use.

Showing things:

- trying to get one of the cats involved;
- to see adult and their environment;
- child brings things for adult to see easily.

2.4 Consistency of communication

- every week, weekends (2 instances);
- a few times a year (1).

2.5 Services

The usage of proposed services by Not a Stranger segment is summarized in Figure B.5.

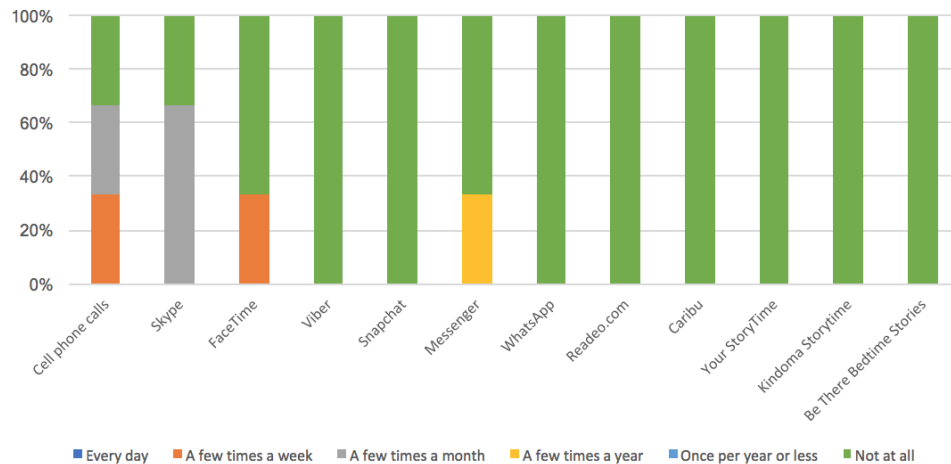


Figure B.5. The usage of services for Not a Stranger segment, in percentages

Services from qualitative data:

- Facebook (1 instance);

- Skype (1);
- Xbox (1);
- NA.

2.6 Problems

The perceived severity of problems for Not a Stranger segment is presented in Figure B.6.

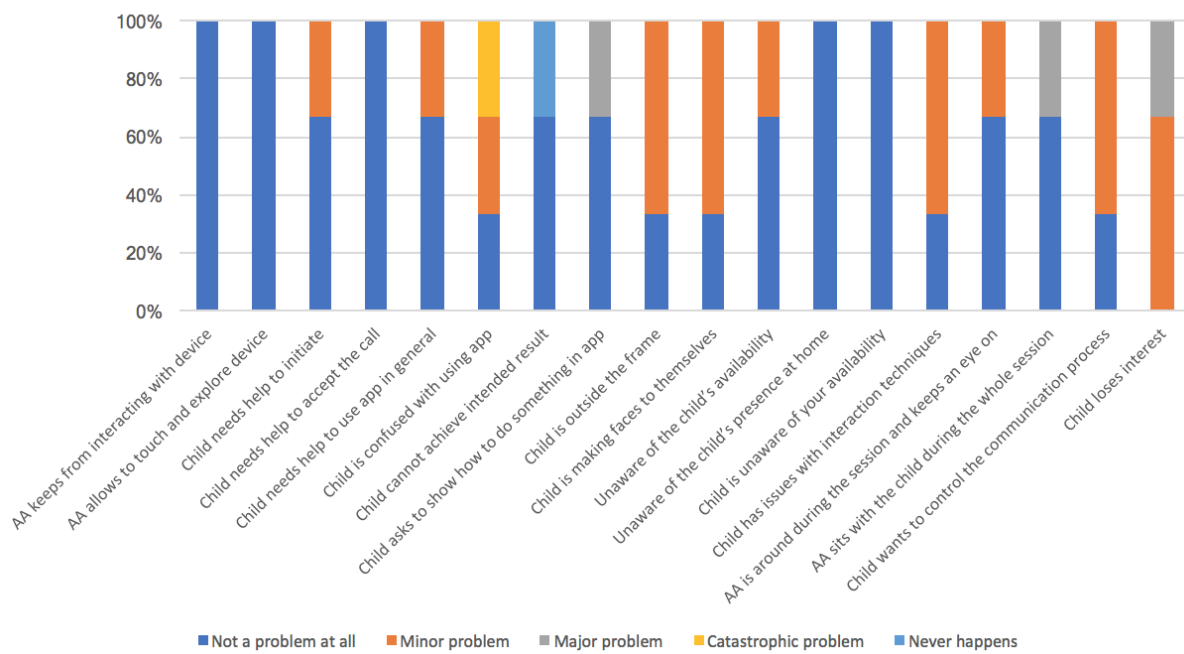


Figure B.6. The perceived severity of problems for Not a Stranger segment, in percentages

Problems from qualitative data:

- Lack of attention (2 instances);
- Technical (1).

B.1.3 Basic Relationship

3.1 Demographics

Relation to child: 82.8% of all nephew/nieces (24 participants), 3.0% of parents (1), 33.3% of grandparents (1), 25.0% of family friends (1), 100% of brothers (1), 100% of cousins (1)

Sample weight: 29, 36.3%

Age: 20-51 (32.52, SD = 7.462). Median 30, mode 27.

Gender: 36.25% female

Marital status: single 44.8% (13 participants), married/domestic 41.4% (12), divorced 13.8% (4).

3.2 Goals

To have relationship:

- calling each day;
- helping with homework sometimes;
- not seeing super often, but making sure to have relationship with child;
- to keep in touch, to talk and laugh, make jokes;
- to keep up with child's life, interests;
- to see child growing up;
- to call on birthdays;
- to remind about themselves (children do not forget about adult, knowing their grandmother).

To maintain family connection:

- as separated couple, calling each day;
- open family discussions, making sure family keeps in touch (children are happy to see family from another household, to talk to remote children as well, "*my daughter*

likes to facetime with her cousins too”, “my sister-in-law and her husband always want to talk with us as well”);

- to strengthen family bonds and ties (*“It’s our way of staying connected as a family”*);
- to speak with family members;
- to make plans for visits, to participate in events and make physical visits more special.

3.3 Activities

The frequency of engagement in proposed activities is presented in Figure B.7.

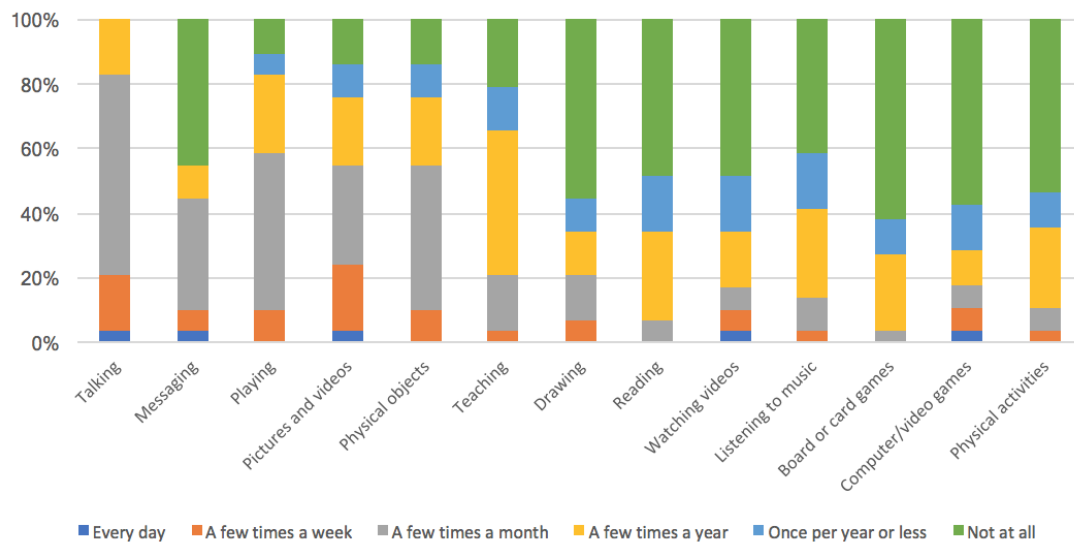


Figure B.7. Frequency of engagement in activities over distance for Basic Relationship, in percentages

Talking:

- talking (3 instances);
- to talk and laugh;
- laughing and making jokes;
- child tells things in more detail;
- *“Just to ensure that everything is functioning smoothly overall”*;
- about child’s day in preschool;
- something about their day;

- about the children's days and see what they are up to;
- *"them talk about school, or a toy they have, or how they are learning to swim"*;
- occasionally involve a story;
- nothing fancy, just video chat.

Sending video/photo:

- sending them photos, they send photos of their new toys and Pokémon cards;
- filters on the different social media sites;
- to send pictures and videos, photos of outings in nature;
- older children send text messages;
- leaving messages for each other.

Showing things:

- showing things to adult, like their toys and drawings;
- *"show me things"*;
- *"shows me a toy"*;
- *"to show us toys, his pets, see our pets"*;
- frequently the family dog;
- child can show to adults all the cool things that he has been saving up to show;
- child shows things in his room, outside or in the garage, outside in the yard;
- child walks around to show things;
- show each other things around the house, so children can see adult's reaction;
- show each other things and see how children are growing;
- where and what adult is doing, and also exploring the surroundings.

Letters and packages:

- sending letters and packages;
- to send objects and physical mail;
- send presents to children;
- send to child fun things in the mail.

Reading:

- *“he will read his favorite book”*;
- reading.

Teaching:

- explain/teach something to children.

Games/ play:

- video games;
- over video games;
- play Xbox Legos at same time;
- over the PS4 while playing games with him and my brother (and my daughter);
- making silly faces;
- playing games;
- child plays with adults over the screen.

Sing (karaoke, 2 instances)/ play music together.

Shopping live:

- *“show me what he wants or costumes he is trying on”*.

Presents live:

- watch the child opening presents (on birthdays, holidays).

Other things live:

- *“they are either eating dinner or riding in a car, so we discuss those things”*.

3.4 Consistency of communication

- A few times a week (1 instance);
- Every week (8);
- A few times a month (1);
- Every month (2);
- A few times a year (3);

- NA (14).

3.5 Services

Figure B.8 shows the usage of platforms and services by Basic Relationship group, calculated from quantitative part of data.

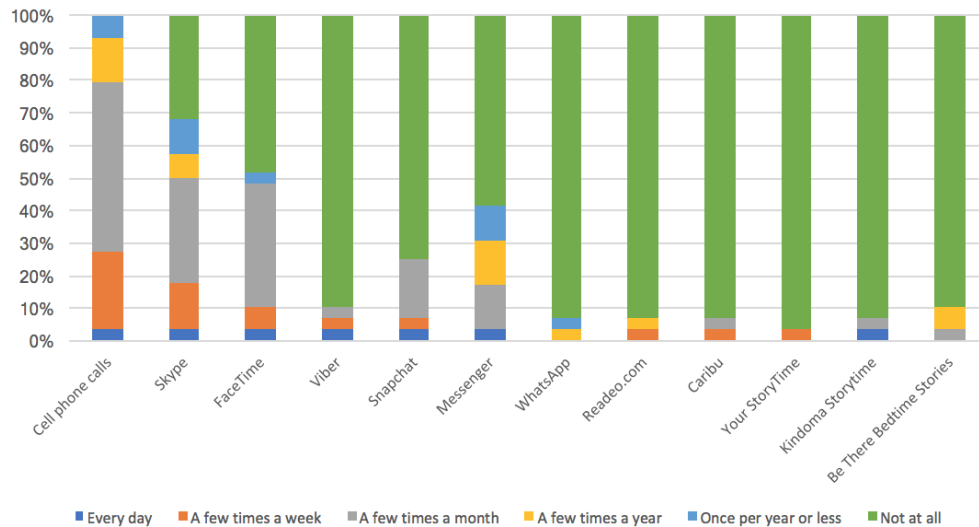


Figure B.8. The usage of services for Basic Relationship segment, in percentages

Services from qualitative data:

- Facetime (14 instances);
- Skype (11);
- Phone call (7);
- Mail (5);
- PS, Xbox (4);
- Facebook (3);
- Text, google hangouts (2 each);
- Marco polo, karaoke app, WhatsApp, NA (1 each).

3.6 Problems

Figure B.9 shows the perceived severity of given problems by Basic Relationship group.

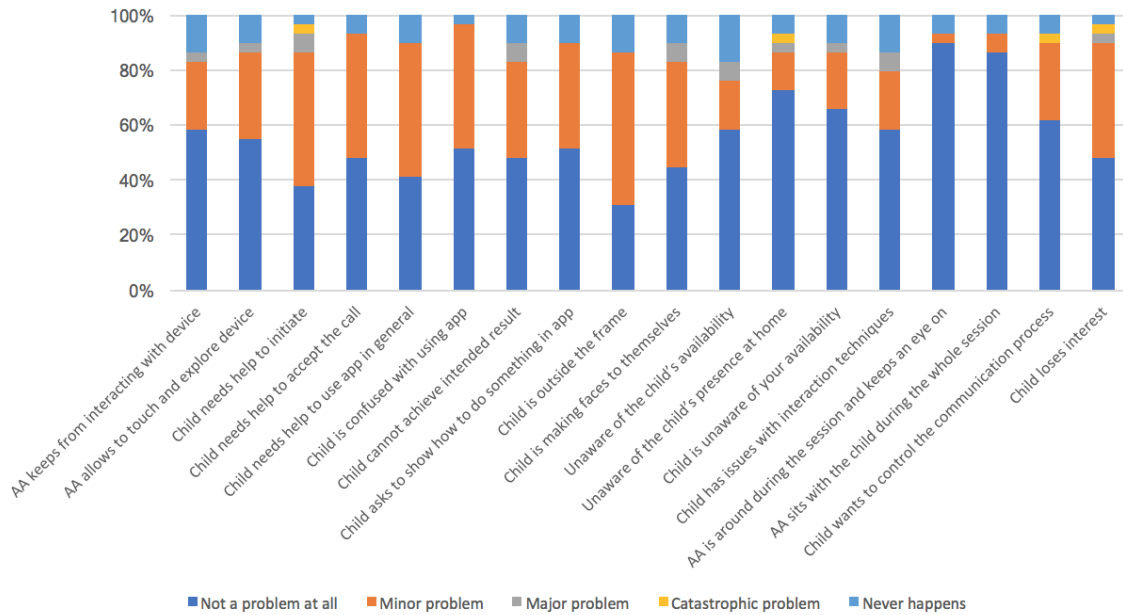


Figure B.9. The perceived severity of problems for Basic Relationship segment, in percentages

Problems from qualitative data:

- technical (18 instances);
- the lack of attention (8);
- general help, help to initiate (4);
- not able to hold, not able to control device (depending on parents, on solving the glitch), no hug (not being there) (3 each);
- impersonal, interruption not welcomed, unsupervised device, translate (2 each);
- safety, adds, accidental call, limit screen time, feature upload later, help with conversation, understanding child's words, misinterpretation over distance, rare visits allowed, pay for app, (1 each).

B.1.4 Strong Relationship

4.1 Demographics

Relation to child: 32.5% of nephew/nieces (13), 75.0% of family friends (3), 66.6% of grandparents (2), 6.1% of parents (2), 100% of godmothers (1)

Sample weight: 21, 26.25%

Age: 23-55 (34.80, SD = 8.912). Median 32.5, mode 27.

Gender: 61.9% female

Marital status: single 57.1% (12), married/domestic 38.1% (8), divorced 4.8% (1)

4.2 Goals

To form deep connection:

- to keep current with child's life and adult's (every evening);
- always on special occasions like holidays or birthdays, opening presents live;
- close personal activities: bedtime stories or calls, drinking tea together, playing with each other, I spy, grading drama classes, Snapchats, typing books for children, homework, Minecraft together;
- daily—weekly, 2/month;
- to have private chats with children individually;
- deep connection between children (build and maintain a friendship that benefits children, *“my nieces and nephews on both sides of the family”, “a huge way my kids and I communicate with them”*);
- to keep the children apprised that adult is related to them and connected to their lives;
- the only real alternative to be involved in child's life (*“show them that I care about them and miss them”*), and to learn about them as they grow up, to develop a closer relationship with child).

Strong presence in child's life:

- to see the children as they grow and be a part of their lives;
- calling each family day on Sunday, first day of school;
- *“to be like a close relative across the street when apart”*;
- parent and calling adult are willing to build deep connection (*“we both want my niece and I to have a strong bond”*);
- strong emotional bond (bedtime stories, playing with pets);
- a high level of dedication (*“I am on board with anything that can connect me with my youngest granddaughter”*);
- a high level of fondness (*“I love this children as if they were my own. I try to make sure that we can talk as much as we can that way we can develop a strong relationship”*).

4.4 Activities

The frequency of engagement in proposed activities is presented in Figure B.10.

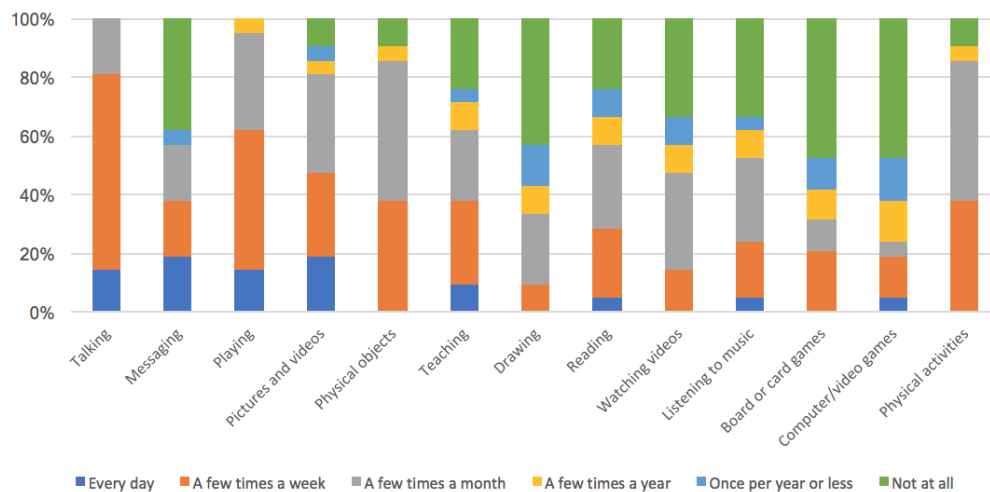


Figure B.10. Frequency of engagement in activities over distance for Strong Relationship, in percentages

Talking:

- talk about child's drama class;
- child tells what she did and how she is doing;

- to share with adult what's going on with them and find out what's going on with adult;
- about school work and grades, to find out how child's day went;
- about child's day and school;
- to find out what children learned in daycare;
- to say about school and the books child is reading;
- children explain what they learned;
- child tells adult about her day;
- how child's day went (after daycare);
- how children are doing, to hear how their week has gone;
- asking children how their day was;
- talk about child's day and what she is doing;
- *"discussing her new outfits I sent her"*;
- plans for the next visit;
- children make up stories a lot, and adult types them out into books for them;
- tells stories to adult;
- on every holiday and child's first day of school;
- birthdays, Christmas (several);
- *"make sure to Facetime them on holidays and my birthday"*;
- always on special occasions like holidays or birthdays.

Showing things:

- adult shows to children their pets, and apartment;
- children show their new dance routines;
- *"show' me stuff she's done, or new ballet moves she's learned"*;
- child shows toys (3);
- child shows things (2);
- adult shows them how cat and dog are doing;
- *"to see what I'm doing"*;

- adult shows things they like live via Skype, such as trains or big trucks at a rest stop;
- child sends silly pictures on Snapchat (filters);
- *“see my dog in the background”*;
- *“see my dogs or other family members”*;
- walking around the house (showing things);
- to share some special sights (*“while I am doing something fun, like enjoying nature, eating good food or going on vacation”*).

Sending video/photo:

- send pictures and emoticons to each other;
- *“silly masks that you can use on things like messenger”*;
- funny gifs and emojis;
- send pictures of the family, *“of her in the new outfits and funny pictures of unicorns or her favorite allicorns”*;
- regular text messaging, and Instagram;
- sending videos back and forth;
- child likes seeing short videos or photos of trips or funny things that adult did.

Bedtime:

- to say good night;
- adult leaves nightly message saying good night over a Cloud Pet;
- video chat when children are getting ready to go to bed;
- before child’s bedtime;
- before child goes to bed on school nights;
- bed time.

Read:

- help child to read;
- *“I usually read stories”*;
- read children a story at bedtime;

- *“loves to have me read her a bedtime story”;*
- to read a bed time story.

Play:

- *“she will tell me her lines and I will 'grade them'”;*
- played “I spy”;
- guessing games as well as verbal educational games;
- play;
- playing a game;
- child plays with things, and interacts with her sister;
- making silly faces, use nonverbal communication while conversing;
- child loves cards;
- play games involving mimicry;
- play games on the phone;
- play Minecraft together (*“they play with my kids too”*);
- play on the same Minecraft server together;
- *“cats 'talk to' each other, cats 'judge' who has the goofiest face”.*

Letters and packages:

- exchange letters through the mail;
- sending packages to child;
- letters in the mail (funny pictures, poems adult wrote), packages;
- send books to children.

Presents live:

- opening presents and gifts on Christmas and birthdays;
- watch children opening presents.

Shopping live:

- *“pick between 2 items, when I'm in the store”.*

Sing/ dance:

- child sings and dances;
- *“singing with my niece”*.

Teaching:

- help with homework (2 instances);
- figure out problems for child’s homework.

Drawing

Other things live:

- in the car talking over the car speaker system.

4.5 Consistency of communication

- Daily (4 instances);
- A few times a week (4);
- Every week (4);
- A few times a month (3);
- NA (6).

4.6 Services

Figure B.11 shows the usage of platforms and services, calculated from quantitative part of data.

Services from qualitative data:

- Skype (12 instances);
- phone call, mail (5 each);
- Facebook (4);
- Facetime, Google Hangouts (3 each);
- Google Duo, Xbox, Discord, text (2 each);

- Snapchat, car speaking system, Google Allo, WhatsApp, Cloud Pets, Instagram (1 each).

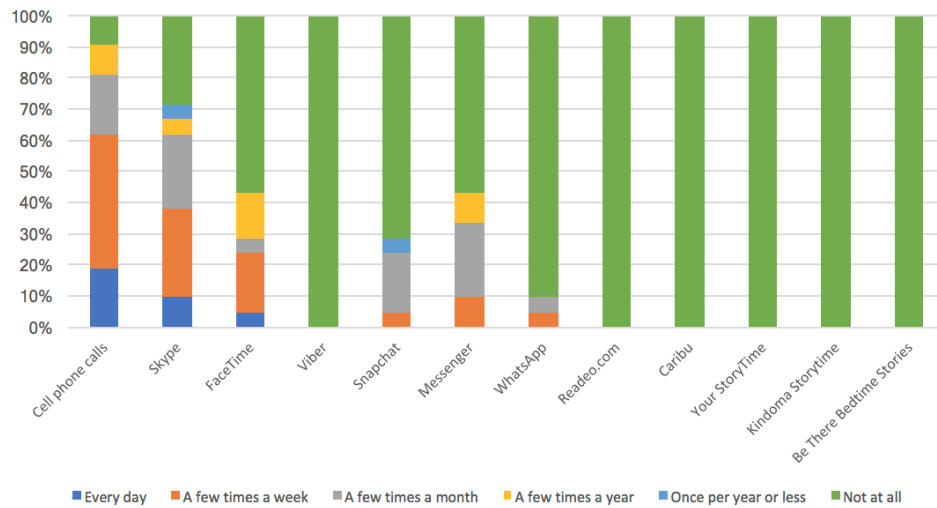


Figure B.11. The usage of services for Strong Relationship segment, in percentages

4.7 Problems

Figure B.12 shows the perceived severity of given problems by Strong Relationship group.

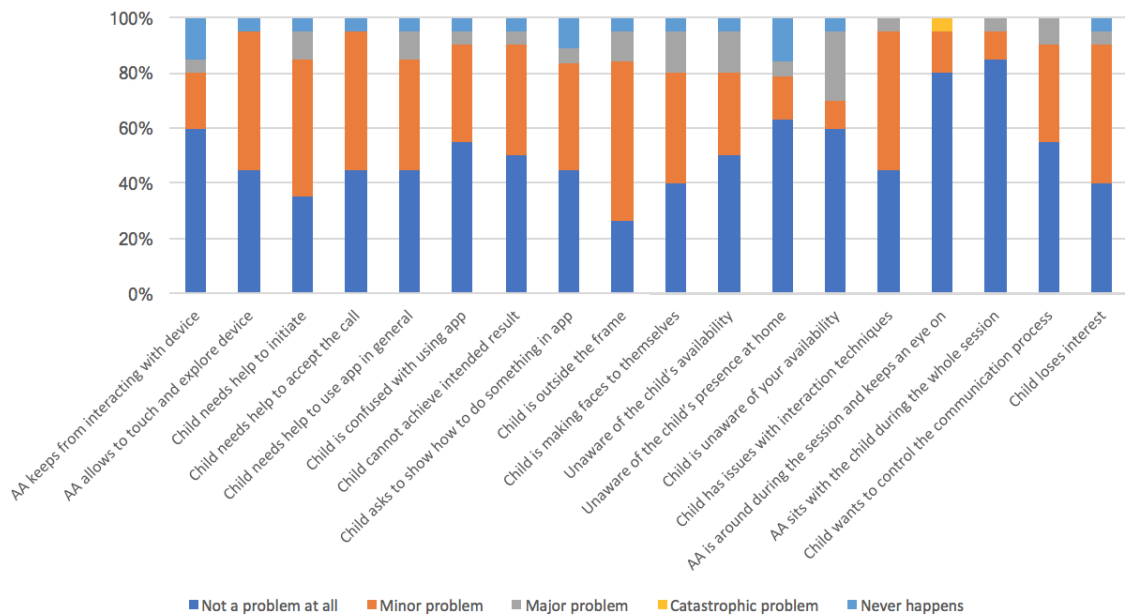


Figure B.12. The perceived severity of problems for Strong Relationship segment, in percentages

Problems from qualitative data:

- technical (7 instances);
- the lack of attention (sitting still), inappropriate (not kid-friendly) (5 each);
- security (4);
- not able to hold, accidental call (too sensitive) (3 each);
- help (depending on parents), features (drawing, reading), limiting screen time, not being there, showing things (2 each);
- unsupervised device, interruption not welcomed, impersonal, sharing device, status of message being read (1 each).