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Zooming Through Development: Using Video Chat to Support

Family Connections

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Abstract

Video chat may allow young children and grandparents to develop and maintain bonds when they are physically separated because it enables them to share experiences with each other in real time. We used an ecological model framework (Bronfenbrenner and Morris, 2007) to examine factors associated with the development of the grandparent-grandchild relationship during the COVID-19 pandemic, when many families were experiencing reduced opportunities for in-person interaction. We analyzed survey data from grandparents (N = 855) and parents (N = 846) of children ages 0-5 years. Predictor variables included participant characteristics (age and education level), proximity variables (geographical distance and whether grandparents had met their grandchildren in person), as well as video chat-specific factors (e.g., frequency of video chats, activities used during video chats). The frequency of video chat and the variety of behaviors engaged in during the video chats predicted grandparents' feelings of closeness to their grandchild as well as grandparents' and parents' enjoyment of family video chats. These predictors were statistically significant after controlling for participant characteristics and physical proximity, suggesting that when families are separated (e.g., due to pandemics, deployment, geographic distance, etc.) family video chats may help to build and maintain grandparent-grandchild connections in an enjoyable way. One future implication is that family video chat may introduce children to the connection between screen and world, a supportive first step in understanding and using technology.

Keywords: Video chat, early childhood, grandparent, closeness, proximity, grandparent-grandchild relationship, enjoyment, intergenerational relationships, COVID-19, ecological systems, family systems

Zooming Through Development: Using Video Chat to Support Family Connections

*"We are not seeing each other nearly as often during the COVID pandemic. When we do see each other, I am not holding him very often or for very long. **I want him to remember who I am and how much I love him.**"* - Grandparent of a 20-month-old child

"I love to see her development and how she is growing although we are miles and miles apart." - Grandparent of a 5-month-old child

During the summer of 2020, these grandparents and many others experienced a sense of isolation and distance from their beloved grandchildren. Many adults turned to video chat to connect with family and friends when lockdowns and shelter-in-place orders prevented them from seeing each other in person (Brown & Greenfield, 2021). While much attention has been focused on the impact of the pandemic on schooling, the economy, health disparities, and the public's view of science, relatively little attention has been paid to the impact of COVID-19 on the family system, especially the grandparent-grandchild relationship. With 80% of COVID-19 deaths occurring in adults aged 65 and older (CDC, 2020), the United States Centers for Disease Control (CDC) has recommended that older adults limit in-person interactions. Even as official lockdowns have eased, many families worry about exposing vulnerable grandparents by visiting them (Parker-Pope, 2020). Yet indefinite social isolation is not sustainable: It increases the risk of depression and anxiety in adult family members (Santini et al., 2020), and may interfere with the development of a close grandparent-grandchild relationship (Dunifon, 2013). When families do meet in person, social distancing may affect the quality of shared interactions and reduce opportunities for family closeness. With the support of the middle generation (parents),

grandparents and their grandchildren must overcome the structural challenges of separation and social distancing during COVID-19. In this study, we examine how a technological advancement, namely video chat, mitigates the potential negative impacts of forced separation and reduced in-person contact between grandparents and grandchildren.

Development in Context

Strong family ties are critical for healthy child development (Shonkoff & Phillips, 2000). Studies of grandparent-grandchild relationships have shown that close relationships support both the grandparent and the grandchild through benefits to their health and their psychological well-being (Duflos et al., 2020). For example, a close relationship can bring grandparents a sense of biological renewal and emotional fulfillment (Neugarten & Weinstein, 1964; Peterson, 1999; Thiele & Whelan, 2006). In addition, grandchildren who are close to their grandparents have fewer depressive symptoms (Ruiz & Silverstein, 2007), fewer behavior problems (Lussier et al., 2002), and healthier psychological adjustment (Griggs et al., 2010), although these effects also depend on other aspects of the family context. That is, the influence of grandparents can be both direct (e.g., resulting from interactions that are positive or negative in nature) and indirect (e.g., by increasing or decreasing parent stress; see Dunifon, 2013 for a review).

To better understand the grandparent-grandchild relationship, the overall environment (or "ecological context") of the child should be considered. According to the Bronfenbrenner and Morris (2007) model, the child is supported by the proximal *microsystem,* which includes parent-child and grandparent-grandchild relationships, and the *mesosystem*, which includes the relationships between caregivers in the microsystem, such as parent-grandparent relationships. Technologies such as smartphones have come to play a key role in the mesosystem, supporting caregiver relationships by connecting members of the microsystem (Takeuchi & Levine, 2014;

McClure et al.,., 2018). Families and their relationships are also affected by larger *exosystem*

factors, such as parents' work demands and neighborhood supports, and *macrosystem* factors,

which include government systems and policies, socioeconomic status, and cultural factors that

govern access to infrastructure, including high speed internet. Finally, members of the family

exist within the *chronosystem,* which includes the unique historical events and timespan in which

the child develops, such as the COVID-19 pandemic.

Of these numerous interrelated factors, we have chosen to focus on individual

characteristics of family members, the distance separating the grandchild and grandparent, and

the frequency and quality of video chats between them. We examine how these factors relate to

the closeness of the grandparent-grandchild relationship and family enjoyment of video chats

when grandchildren are young. We focus on children ages 0 to 5 years, whose use of video chat

may maintain relationships with family members they have met in person, or potentially, build

new relationships entirely remotely. Being exposed to video chat may also help very young

children begin learning about screen technology. Our study takes place during the COVID-19

pandemic, but our work is relevant for many kinds of family circumstances such as divorce

(Yarosh et al., 2009), incarceration (Horgan & Poehlmann-Tynan, 2020), and deployment

(Dayton et al., 2014).

Factors Associated with the Development of the Grandparent-Grandchild Relationship

The closeness of the grandparent-grandchild relationship depends in part on the role that

the grandparent plays in the grandchild's life, which may be associated with several demographic

factors. This relationship tends to become less close as children age from childhood through

adolescence and into young adulthood (Dunifon & Bajracharya, 2012; Hakoyama &

MaloneBeach, 2013; Monserud, 2010; Silverstein & Marenco, 2001). Some research also

suggests that grandparents and grandchildren feel less close when the grandparent is older (Davey et al., 2009). We found no prior studies that focused specifically on the development of closeness between the grandchild's birth and age 5 years. However, based on the importance of contingent and warm interactions for the development of early relationships (Bornstein & Tamis-LeMonda, 2010), we speculate that grandparents and grandchildren may grow closer as children develop social capacities (such as joint attention) and linguistic abilities, allowing them to participate in more mutually responsive, reciprocal interactions with their grandparents. .

Grandparents with lower levels of education tend to spend more time with their grandchildren (King & Elder, 1998), which may be especially impactful when grandparents are younger (and recreate with their grandchildren more; Silverstein & Marenco, 2001) and grandchildren are younger.

The proximity or geographical closeness between a grandparent and a grandchild also affects the role grandparents play in the day-to-day lives of their grandchildren, because proximity increases the accessibility of in-person visits. Larger distances are most often associated with lower levels of contact and involvement (Drew & Smith, 1999; Dunifon & Bajracharya, 2012; Cohn & Morin, 2008; Uhlenberg & Hammill, 1998). More frequent in-person contact is associated with closer grandparent-grandchild relationships (Davey et al., 2009; Drew & Smith, 1999; King et al., 2003; Hakoyama & MaloneBeach, 2013), and those who live further apart are often (but not always) less close (Cooney & Smith, 1996; Roberto et al., 2001). However, in one study, distance became positively associated with subjective reports of closeness after controlling for frequency of contact (Davey et al., 2009), suggesting that families who live far apart from one another may employ other strategies for supporting close relationships. For example, among well-resourced young families who live far from their

children's grandparents, it is relatively common to use video chat to help grandparents and

young grandchildren see and communicate with one another (McClure et al., 2015).

During the COVID-19 pandemic, when travel is limited and older adults are specifically

told to restrict in-person interaction, technology may play a more important role in supporting

the grandparent-grandchild relationship. Earlier studies investigated the facilitatory role of email

communication in supporting this relationship (Holladay & Seipke, 2007) and others reported

that technology use may serve as a "turning point" in the development of the relationship

(Bangerter & Waldron, 2014) by allowing geographically separated grandparents to connect with

their grandchildren. In recent years, many researchers have emphasized that video chat allows

for real-time interactions with both audio and visual cues, which reduce communication barriers

and facilitate interpersonal connection (Ames et al., 2010; Ballagas et al., 2009; Kirk et al., 2010;

McClure et al., 2015; 2018). By using video chat during the pandemic, grandparents and

grandchildren can interact freely, at a distance, without the need for masks and while maintaining

the distance recommended for in-person visits (CDC, 2020).

Using Video Chat to Build and Maintain Close Relationships

Although video chatting represented a small percentage of young children's overall

screen exposure reported in a parent survey (Rideout & Robb, 2020), there is evidence that this

technology was being adopted by families with young children even prior to the COVID-19

pandemic. For example, Tarasuik and Kaufman (2017) found that younger children began video

chatting at earlier ages than older children, suggesting that over time, families were introducing

the technology to their children at younger ages. In areas where children lived far from their

extended families, nearly half of participants reported that they used video chat to connect their

infants with people who lived far away, and grandparents were the most-mentioned video chat

partners (McClure et al., 2015). Similarly, families with young children who cannot visit the

child's grandparents in-person due to the COVID-19 pandemic may turn to video chat to

establish and maintain family connections.

In prior studies, grandparents reported enjoying video chat more than phone calls with

young children because they were better able to keep children engaged and could use visible

objects in the child's environment or their own to guide the conversation (Ames et al., 2010).

They also enjoyed the sense of "being there," experiencing the child changing and growing, and

being able to share objects and toys (Ames et al., 2010; Forghani & Neustaedter, 2014). In

another study, parents reported using video chat to help their children recognize and get to know

their grandparents (Kirk et al., 2010). Parents in several studies even reported leaving a video

chat connection open for remote grandparents to participate in family activities such as bedtime

story reading, family meals, or birthday parties (Kirk et al., 2010; Judge et al., 2010). Compared

to a phone call, video chat may be particularly good for building family closeness because it

allows for more than just discussion and can instead facilitate shared gestures and gaze (Kelly,

2015) and rich opportunities for cross-generational play (Ames et al., 2010).

Although video chatting offers promise for connecting remote family members, it may

not be immediately intuitive how best to use it to develop or maintain close relationships with

young children. For example, parents in several studies described needing to choose specific

times of day or arrange activities to try to increase their children's engagement in video chats

with their grandparents (Kelly, 2015; Share et al., 2018). In a survey of parents of 16- to 30-

month-olds, two-thirds of respondents reported that their children engaged in video chat

conversations for less than 5 minutes, and one-half said that their children sometimes ran away

during the video chat (Author, 2021). Running around the room was also common during video

chats for children under 25 months who were old enough to walk (McClure et al., 2017), and children ages 3 to 10 years frequently transitioned in and out of phone and video communications that continued between their parents and grandparents in the children's absence (Forghani & Neustaedter, 2014). Whether short or long, video chats with young children require a certain amount of "work" by adults to make video chat engaging and beneficial for families (Ames et al., 2010). Because of the need to manage video chats and direct the interactions, Share and colleagues (2018) reported that parents and grandparents sometimes found them emotionally taxing, especially when children appeared disengaged despite the adults' best efforts.

Enjoyment of the chats, however, may be important for motivating families to engage in them. Harwood (2000) found that grandparents' and grandchildren's ratings of closeness were correlated with their enjoyment of their conversations with one another. In addition, the most consistent predictor of both closeness and enjoyment was perceiving each other as attentive and accommodating. Although Harwood (2000) studied adult grandchildren and this work occurred before video chat was widely available to the public, it is reasonable to expect that these same factors will play a role in the development of grandparent relationships with young children because accommodation and responsiveness are important for establishing healthy attachment relationships between infants and adults (Bornstein & Tamis-LeMonda, 2010; Egeland & Farber, 1984). Therefore, to build closeness through video chats, it may be especially important for all parties to find the experience enjoyable, and for the adults to do the necessary scaffolding and creative adaptation of activities to maintain children's engagement.

Engaging Children in Video Chats

Researchers have identified several factors that can predict babies' and toddlers' engagement with video chat interactions. First, there are age-related increases in children's

ability to initiate joint visual attention (JVA) in the context of video chats -- e.g. showing objects to a grandparent through the screen, or pointing to objects in the grandparent's environment across the screen -- and the use of these types of cues in family video chats is an important factor in helping young children stay engaged (McClure et al., 2018). Developmental progressions including early physical milestones (whether the baby can sit up, crawl, walk, or hold objects) and social milestones (whether the baby can smile, laugh, or talk) should also broaden the video chat activities available to families.

Second, the technical quality of video chat calls could play a role in how families engage. For example, a larger screen size may help a child and grandparent better see one another, enabling JVA because it is easier to see each other's gaze and objects on the screen. However, the mobility of smaller devices (phones and tablets) may enable reciprocal communications in a different way. Kirk and colleagues (2010) reported that families desired mobility during their video chats, enabling them to move the camera to focus on specific objects or views. On the other hand, technical problems may impact children's engagement and frustrate adults (Vutborg et al., 2010). Poor video resolution, buffering/lag, and frequent disconnections can disrupt the back-and-forth contingency of video chat interactions. Adult video chat participants engaging in conversation rated their involvement and attunement with their video chat partner lower when they experienced transmission lags, although this did not appear to affect how happy they felt (Parkinson & Lea, 2011). McClure and Barr (2017) observed that technology problems, such as the video chat disconnecting or the screen freezing, happened quite frequently in video chats between grandparents and infants, but that parents were successful in helping their child navigate these disruptions. These experiences navigating the disruptions of video chat sessions with parental support may help young children to eventually build a nascent concept of screen-based

digital technology: how events on a screen relate to (but are not the same as) events in the real world (Myers et al. 2019; Rusnak & Barr, 2020; Troseth et al., 2019).

Third, the social and emotional quality of video chat with infants and toddlers may be impacted by the activities that families engage in. Maintaining focus on the child and adapting to them may be important for sustaining their engagement. For example, when grandparents interacted with babies over video chat, the grandparent's sensitivity (i.e. the ability to read and adapt to a child's signals, respond appropriately, and be flexible), expressed in warm, highly contingent activities like peek-a-boo or virtual snack sharing, was related to infant attention during video chats (McClure et al., 2018). The infant's parent also played an important contributing role, because the amount of JVA used among members of the whole family also predicted infant attention during video chats, such as when parents facilitated on-screen grandparents reading a book with children or brought toys to the screen for shared play (McClure et al., 2018). Vutborg and colleagues (2010) argue that it is important for families to engage in diverse forms of interaction during video chats, with the adults adapting their activities to the changing needs or activity level of the child.

During family video chat interactions, adults must not only attend to the needs of the child but also consider whether the video chats are meeting their own social and emotional needs. Grandparents and parents may wish to participate in family activities together (Kirk et al., 2010) and watch the child grow (Ames et al., 2010). If, instead, the video chat makes grandparents or parents feel as though the other party is distracted or reminds them they are missing out on in-person activities, they may find the video chats less enjoyable. For example, grandparents of 3- to 10-year-olds reported wanting to know details about their grandchild's life but worrying about annoying the child with questions (Forghani & Neustaedter, 2014).

Because parents themselves can serve as a type of *gatekeeper* - either allowing or limiting access between grandparents and young grandchildren (Mueller & Elder, 2003; Uhlenberg & Hammill, 1998) - it is also important to consider factors that impact parents' enjoyment of the video chats. Parents who want their child to know and recognize their grandparents (Kirk et al., 2010) may find less enjoyment when they feel their child does not recognize the grandparent or they perceive a lack of closeness between them. Kirk and colleagues also noted that, a closer relationship and lengthier conversations with the parent supported grandparents in having longer and more frequent communications with children, as they would learn things from the parent that they could directly ask their grandchild. Finally, they observed that families tended to use video chat only with people with whom they were quite close, as it gave their video chat partner a somewhat intimate window into their home. Therefore, parents who are not close to their own parent or parent-in-law may find video chats more burdensome and intrusive into their family life.

The Present Study

The present study examines whether the use of video chat with children 5 years and under supports families in creating and maintaining child-grandparent connections. We collected data during the COVID-19 pandemic (June-August 2020) to examine factors that predicted how grandparents rated their closeness to their grandchildren (ages 0-5) and how much grandparents and parents enjoyed video chats between the child and grandparent. We built regression models to examine associations between our identified factors and the perceived *closeness* of the grandparent to the grandchild, and grandparents' and parents' *enjoyment* of video chats (Figure 1). Based on prior research in which grandparents' ratings of closeness with their grandchild were correlated with ratings of enjoyment of or satisfaction with their communications

(Harwood, 2000; Holladay & Seipke, 2007), we used the same predictors in the grandparent

closeness and enjoyment regressions. For comparability, we entered parallel variables into the

parent enjoyment regression but also added a block of predictors related to the parents'

perceptions of the family relationships, as prior literature (Kirk et al., 2010) led us to expect that

these perceptions may also predict parents' enjoyment of the chats.

<center><Insert Figure 1 here></center>

Our models address the following research questions:

RQ1: Are participant characteristics associated with perceived closeness or enjoyment?

Based on prior research demonstrating that grandparent-grandchild closeness may be related to

the age of both the child and the grandparent, as well as grandparents' education level, we

included these variables in Block 1.

RQ2: Is physical proximity associated with perceived closeness or enjoyment of the

video chats? Based on prior research demonstrating that geographic distance and in-person

contact both uniquely predicted relationship closeness, we included both in Block 2.

RQ3: Are the quantity and quality of video chat interactions associated with perceived

closeness or enjoyment of the video chats? Based on prior research on video chat with young

children and families, we created a block of video chat features (Block 3), which included the

frequency of video chat, technical quality of the video chat (device used and technical barriers

encountered), and the social and emotional quality of the video chat (percent of the interaction

that was adult (rather than child) focused, number of activities, and social and emotional barriers

perceived by the adult).

RQ4: Are parents' perceptions of particular family relationships associated with their

enjoyment of the video chats? Based on the unique role that parents play in facilitating video

chats between young children and their own parent or parent-in-law, we created Block 4 for the parent model only. This included the parents' perception of whether their child recognized the grandparent on video chat, the parent's rating of their own closeness to the grandparent, and parents' perception of how close their child felt to the grandparent.

We predicted that grandparents would rate their relationship with their grandchild as closer if they had met them in person, lived closer, participated in more video chats, reported less adult-focused video chat time, and reported more child-focused video chat activities. We predicted that grandparents and parents would rate their enjoyment of the video chats higher if they reported less adult focus, more video chat activities, and fewer social and emotional barriers. We also expected that parents' enjoyment would be higher when they felt close to the grandparent, and when they perceived their child felt close to and recognized the grandparent. We did not make directional predictions for the other included factors because patterns in the prior literature were mixed and did not typically focus on children 5 years and younger.

Method

Participants

Grandparents and parents of children ages 0 to 5 years residing in the United States and Canada were separately recruited to participate in a survey about their use of video chat through general and targeted Facebook ads, ResearchMatch, Prolifics, institutional listservs, outreach to local retirement and senior centers, and online forums for parents, grandparents, and families. To reach a broader audience, the survey was translated into Spanish, and Spanish-language recruitment was done through both Prolifics and ResearchMatch. The ads specified that the study was about video chat, which may have attracted those who already used it. Participants who had never video chatted with a grandparent (or grandchild) were permitted to participate but are not

included in the analyses reported here. In some cases, a related parent and grandparent may have

separately participated, but no effort was made to identify or link their survey data. Grandparents

and parents were asked to complete the survey about their youngest grandchild or child.

The inclusion criteria for the current study are shown in Figure 2. A total of 1201 parents

and 1361 grandparents opened our survey and completed an informed consent statement. We

excluded participants who did not reside in the US or Canada, those who stopped responding

prior to the video chat questions of interest (approximately < 50% of the survey), and those who

reported that their child fell outside the 0- to 5-year age range. Because we chose not to impute

missing data, we also excluded participants who did not provide responses on all predictors

analyzed in our models, either because they skipped an item or because they had no video chat

experience. Demographic details for participants prior to the exclusions for missing data are

available in the Supporting Information (Supporting Table 1), along with breakouts for those

who did and did not report experience with video chat. Demographics for the sample used in the

current analyses are included in Table 1.

<Insert Figure 2 here>

<Insert Table 1 here>

Instruments

A complete copy of the survey can be viewed at https://osf.io/kvd97/. An annotated copy

of the items included in this manuscript is included in the Supporting Information. Predictors

were separated into four blocks of variables, aligned with our research questions. Block 1

represented characteristics of the participants (age of the child, age of the adult, education level

of the adult). The age of the child was estimated in months by subtracting the month and year of

the child's birth from the date the participant completed the survey. The age of the adult

(grandparent or parent) was reported in years. Education was measured on a 7-point scale, but the first 3 low-incidence categories were collapsed. The resulting 5-point scale is reflected in Table 1.

Block 2 represented the physical proximity of the grandparent and grandchild and consisted of a dichotomous indicator of whether they had ever met in person and the log-transform of an estimate of the distance between the homes of the grandparent and grandchild (as used by Cooney & Smith, 1996; Davey et al., 2009). The distance estimate was computed by calculating the distance in miles along the earth's surface between the latitude and longitude coordinates associated with each party's reported zip code or place name.

Block 3 represented the quantity and quality of the video chat interactions between the grandparent and grandchild. Quantity was measured using a 5-point scale of how frequently the video chats occurred (never, less than once per month, a few times a month, a few times a week, every day). The technical quality of the video chats was indicated by the type of device most frequently used (mobile or computer) and the number of technological barriers encountered (out of 5; Table 2, based on the problems observed by McClure and Barr, 2017). The social quality of the video chats was indicated by three variables: 1) the percentage of the video chat that was typically a conversation between adults rather than child-focused (motivated by the findings of McClure et al., 2018); 2) the variety of activities engaged in by the adult (parent out of 7, grandparent out of 6; Tables 3 and 4; a checklist of activities based on those reported by Author 2021 and summed to indicate diversity of forms of interaction as per Vutborg and colleagues, 2010); and 3) the number of social and emotional barriers encountered (out of 2 for parents and 3 for grandparents; Table 2; adapted from studies of how and why families use video chat, e.g.

Ames et al., 2010; Forghani & Neustaedter, 2014; Kirk et al., 2010; Cohn & Morin, 2008;

Yarosh et al., 2009).

Block 4, which represented parents' perception of the relationships between members of

the family, was included only in the parent model. This block included the parent's perception of

whether the child recognized the grandparent over video chat (no/not sure/yes; based on research

by Kirk et al., 2010), along with two parent ratings of family closeness (parent-grandparent

closeness and the parent's perception of their child's closeness with their grandparent). All

closeness ratings used the same 5-point rating scale previously used by Block (2000) and

Silverstein and Marenco (2001).

The primary outcomes reported in this study are grandparent ratings of the closeness of

the grandparent-grandchild relationship (also on the 5-point scale, see Block, 2000; Silverstein &

Marenco, 2001) and parent and grandparent ratings of enjoyment of the video chat sessions

(measured on a slider from 0-100).

Data Collection

Survey responses and study consent were collected through Qualtrics. Participants could

click on links provided in study advertisements to complete the survey. We planned to collect

data from at least 500 parents and 500 grandparents between June and August 2020. Having

exceeded our goal, we stopped recruitment and closed the surveys as planned on August 27,

2020.

Data Analysis

Research questions were pre-registered after data collection closed but prior to exporting

data from Qualtrics. At the time of pre-registration, none of the authors had viewed any of the

data. Pre-registration can be found at https://osf.io/kvd97/. The current study addresses pre-

registered questions 3 (prediction of grandparent closeness and enjoyment of video chats) and 4 (prediction of parent enjoyment of video chats).

Hierarchical linear regression was used to build each model (see Figure 1). Correlations among all model predictors are included in the Supporting Information, Tables 2 and 3. Potential multicollinearity was addressed by checking the Variance Inflation Factors (VIFs) to ensure they were below 5 for all predictors (Chatterjee & Yilmaz, 1992). Multivariate outliers were assessed by looking for cases that produced large residuals (|studentized residual| > 2; Chatterjee & Yilmaz, 1992) or substantial leverage (hat diagonal > (2(k+1))/N; Chatterjee & Yilmaz, 1992) that were also highly influential on at least one parameter (Any Standardized DFBeta > 1 or Cook's Distance > median of the F distribution; Bollen & Jackman, 1990). There were no adjustments needed.

After checks for multicollinearity and outliers were completed, we ran the models with bootstrapping. We report both standardized regression coefficients (betas) and bootstrapped unstandardized coefficients (bs) with bias-corrected accelerated (BCa) confidence intervals. We chose to employ bootstrapping because it is a nonparametric approach that can be used when model errors are not constant across levels of the predictor or are not normally distributed (Williams et al., 2013). All bootstrapping was done using simple resampling with 1000 iterations. .

Results

In-Person Interactions

Most grandparents (97.5%) reported that they had met their grandchild in person. Those who had not had younger grandchildren ($M = 14.24$ months, $SD = 18.47$) and lived farther away

(M = 2,488 miles, SD = 2,741) than grandparents who had met their grandchild (M = 31.74

months, SD = 18.98; M = 512.94 miles, SD = 979.60).

Most parents (89.0%) also reported that their child had met their grandparent in person.

Like the pattern in grandparent responses, children who had not met their grandparent in person

lived farther away (M = 1,955 miles, SD = 2,100) than those who had met their grandparent (M =

608 miles, SD = 1,174). However, unlike grandparent reports, parents reported similar average

ages whether their children had met their grandparents (M = 31.38 months, SD = 18.50) or had

not met them (M = 31.43 months, SD = 18.05) .

Video Chat Interactions

Most grandparents reported that they video chatted with their grandchildren a few times a

week (39.9%) or a few times a month (37.2%), with smaller numbers reporting less frequent

(12.2%) or more frequent (daily; 10.8%) video chat interactions. They most often connected

using a mobile device (78.9%) rather than a computer and reported few technical barriers (M =

0.78 out of 5, SD = 0.92) to video chats (see Table 2 for details of barriers). During the video

chat interactions, grandparents reported that about half the time was spent focused on the adult

rather than the child (M = 50.13 percent, SD = 25.44) and that they engaged in a moderate

number of different activities (M = 3.40 out of 6, SD = 1.19; see Table 3). On average, they

reported experiencing just under 1 of the 3 social and emotional barriers (M = 0.73, SD = 0.81;

Table 2).

<div align="center"><Insert Tables 2 and 3 here></div>

Parents' reports of video chat frequency mirrored that of grandparents, with most

reporting that their child video chatted with their grandparent a few times a week (36.2%) or a

few times a month (41.5%). Smaller numbers reported less frequent video chats (14.1%) or daily

interactions (8.3%). They also most often connected using a mobile device (83.7%) rather than a

computer and reported few technical barriers ($M = 0.98$ of 5, $SD = 0.91$). Although these barriers

were relatively low for both parents and grandparents, barriers were reported more frequently by

parents (see Table 2). They also reported spending about half of the video chat focused on the

adult rather than the child ($M = 55.26$ percent, $SD = 21.13$) and engaging in a moderate variety of

activities during the chats ($M = 3.14$ out of 7, $SD = 1.60$; Table 4). They reported few social and

emotional barriers ($M = 0.61$ out of 2, $SD = 0.62$). Parents rated their own closeness to their

child's grandparent between quite to very close, on average ($M = 3.93$, $SD = 1.06$), and rated

their child's feeling of closeness to their grandparent similarly ($M = 3.57$, $SD = 1.16$). They

typically reported that they thought their child recognized their grandparent on video chat

(85.3%).

<center><Insert Table 4 here></center>

Grandparent Closeness

Grandparents' ratings of closeness to their grandchild were negatively skewed, with more

grandparents giving high ratings than low ratings ($M = 3.96$, $SD = 1.05$, *Median* $= 4$ out of 5).

All hierarchical models explained significant variability in grandparent close   ness (Table 5).

The addition of Blocks 2 and 3 resulted in statistically significant increases in R^2, so the full

model with all 3 blocks was retained as the final model (Table 6).

<center><Insert Tables 5 and 6 here></center>

The frequency of video chats was the largest predictor of grandparent feelings of

closeness (Beta $= 0.30$), even after controlling for distance. Based on the BCa confidence

intervals, child age, having met in person, and the variety of activities engaged in by the

grandparent during the video chats were also significant positive predictors of feelings of

closeness. Statistically significant negative predictors included grandparent education, distance, and the number of social and emotional barriers experienced.

Grandparent Enjoyment

Grandparents' enjoyment of the video chats ranged from 0 to 100. Like closeness, it was heavily skewed (*M* = 90.57, *SD* = 16.09, *Median* = 100). As expected, closeness and enjoyment were positively correlated, *rho* = .24, *p* < .001. The hierarchical models predicting grandparent enjoyment of video chats involved the same three blocks of predictors as the closeness models. All hierarchical models explained significant variability in grandparent enjoyment (Table 7). The addition of Blocks 2 and 3 also resulted in statistically significant increases in R^2.

<Insert Table 7 here>

The final model with all three blocks is represented in Table 8. Distance was the largest predictor of grandparent enjoyment of the video chats (Beta = 0.20), with grandparents living further away giving higher enjoyment ratings. Based on the BCa confidence intervals, frequency of video chats and the variety of activities grandparents engaged in during the video chats were also statistically significant positive predictors of grandparents' enjoyment. Grandparent education and social and emotional barriers encountered were significant negative predictors.

<Insert Table 8 here>

Parent Enjoyment

Parents' enjoyment of the video chats ranged from 0 to 100. Like grandparent enjoyment, parent enjoyment was negatively skewed (*M* = 79.27, *SD* = 19.07, *Median* = 82), although the mean and median were both somewhat lower than for grandparents. The parent enjoyment hierarchical models involved the same first three blocks as the grandparent models. Block 1 (Participant Characteristics) included the child's age and information about the parent (age, education). Block 2 (Physical Proximity) and Block 3 (Video Chat Interactions) remained

focused on the grandparent-grandchild relationship, but now reported from the perspective of the parent. A fourth block was added to the parent model that represented the parent's perspective of the closeness of the family relationships.

Blocks 1 and 2 did not explain significant variability in parent enjoyment of the video chats (Table 9). The addition of Block 3 (video chat interactions) resulted in both a statistically significant overall regression model and increase in R^2. The addition of Block 4 resulted in another statistically significant increase in R^2 and a full model that explained almost one-third of the variability in parent enjoyment.

<Insert Table 9 here>

The final model with all four blocks is represented in Table 10. The closeness of the parent-grandparent relationship was by far the largest predictor of parent enjoyment of the video chats (Beta = 0.42). Based on the BCa confidence intervals, other significant positive predictors included frequency of video chats, the variety of activities engaged in by parents during video chats, and the parent's perception of how close the child felt to the grandparent. Parent education was a negative predictor of enjoyment.

<Insert Table 10 here>

Discussion

The rapid adoption of video chat by families with young children could be important for maintaining close family relationships when physical proximity is not possible, such as during the current unprecedented pandemic that has separated parents and children from grandparents. In the present study, frequency of video chat was the best predictor of grandparent's ratings of closeness to their grandchild, after controlling for how far apart they lived from one another. Frequency of video chats between the grandparent and grandchild also predicted both parents'

and grandparents' enjoyment of the chats. This was significant even after controlling for the child's age, whether the child and grandparent had met in person, and how far apart they lived, suggesting that video chats may help to build connections between separated family members as well as to maintain them. Challenging circumstances may have led to families' physical separation: COVID-19 undoubtedly kept families apart who would otherwise have seen one another regularly or extended the length of separations between remote families. Despite the circumstances, grandparents and parents overwhelmingly enjoyed the video chats, with grandparents who lived farther away enjoying them the most.

Participant Characteristics

Child age was a positive predictor of grandparents' feelings of closeness. Prior research examining the connection between the age of the grandchild and the closeness of the grandparent-grandchild relationship has often shown a decline in closeness as the grandchild moves from childhood, through adolescence, to adulthood (Dunifon & Bajracharya, 2012; Hakoyama & MaloneBeach, 2013; Monserud, 2010; Silverstein & Marenco, 2001). To our knowledge, there has been little research examining how grandparent-grandchild closeness develops during infancy and early childhood. The present study covered a large age range from 0 to 5 years when there are substantial developmental gains in children's social and linguistic abilities, as well as gains in children's use and comprehension of video chat norms (see Barr et al., 2020 for a review). For example, by 21-25 months children can recognize people who they have interacted with exclusively via video chat after infrequent contact (Myers et al., 2017). By 3 to 4 years of age, children understand that the person on the screen is in a physically different location (Barr et al., 2020) but when their parent appears on video chat, it provides a sense of proximity and security (Tarasuik et al., 2016). In the present study, we speculate that

grandparents reported being closer to their older preschool-aged grandchildren because children were better able to understand and navigate the video chat interactions, enabling a more back-and-forth play and conversation that facilitates remote relationship-building.

Grandparent age did not significantly predict closeness in our study. However, the education level of the grandparent negatively predicted closeness. This is consistent with several prior studies in which fewer years of grandparent education was associated with greater emotional closeness (Silverstein & Marenco, 2001) and more frequent friendly, high-quality grandparent-grandchild relationships (King & Elder, 1998). It is possible that the association between lower education and greater closeness is due to the duration and type of activities that grandparents with differing levels of education engage in with their grandchild (King & Elder, 1998). Prior authors have also suggested complex interactions between grandparents' education level, their geographic proximity to the grandchild, the frequency and type of activities they tend to engage in with the child, and the differing roles that grandparents may play in the lives of children of different ages (Hakoyama & MaloneBeach, 2013; King & Elder, 1998). Although the main effect of proximity was controlled for in our study, we did not capture potential interactions among education, proximity, and types of activities that may have helped to further explain this association.

Physical Proximity

As predicted, geographical distance was a negative predictor of grandparents' ratings of closeness and having met in person was a positive predictor. This is consistent with prior research showing that grandparents and grandchildren have closer relationships given more frequent in-person contact (Davey et al., 2009; Drew & Smith, 1999; King et al., 2003;

Hakoyama & MaloneBeach, 2013), which often is reduced when grandparents live further away (Dunifon & Bajracharya, 2012).

Furthermore, the effects of geographical distance are also likely to be impacted by who chooses to move. Although Compton and Pollak (2014) found that higher parental education is associated with living farthest away from grandparents, parents in the millennial cohort may be less likely to move to pursue economic opportunity than previous cohorts (Fry, 2017). Americans often move for economic opportunities, but those who choose to stay report doing so to maintain family ties (Cohn & Morin, 2008). Therefore, the negative relation between distance and closeness in our sample may be partially explained by the priorities of families who chose to live close to one another.

Video Chat Interactions

Video chat frequency was the most significant predictor of grandparent-grandchild closeness. This suggests that video chat frequency may override some of the challenges to frequent contact imposed by COVID-19 restrictions and geographical distance. Thus, video chat may provide a mechanism to increase opportunities for grandparents and grandchildren who are physically separated to spend time together and build connections.

The size and portability of the device that families used did not predict closeness in our study. On mobile devices, smaller image size and poorer image quality may produce a less immersive experience and make video chat partners more difficult to see. However, these disadvantages may be offset by the portability of the device, which can be repositioned as needed to show what is happening (Kirk et al., 2010). Technical barriers also did not predict closeness, despite Parkinson & Lea's (2011) report that buffering or lag often caused video chat partners to feel less involved and attuned. McClure and Barr (2017) observed that parents and grandparents

of infants often scaffolded technical disruptions by providing explanations to children and often

navigated disruptions smoothly. Perhaps families with young children are accustomed to

clarifying and adapting situations for their growing children.

The percentage of time the video chat was focused on the adult rather than the child did

not predict closeness, but the variety of activities the family engaged in during video chat was a

significant predictor. Results are consistent with prior research showing the importance of

sensitive, contingent, developmentally appropriate scaffolding and co-viewing of video chat

(McClure et al., 2018; Myers et al., 2018; Strouse et al., 2018; Troseth et al., 2006). A greater

variety of activities may also reflect that adults are adapting the video chat to the variable activity

level and interests of the child (Vutborg et al., 2010). Higher sensitivity by the adult video chat

partner has been associated with increased child attention (McClure et al., 2018) and child

positive emotional responding (McClure et al., 2020). This positive engagement and

responsiveness on the part of the child may lead to greater feelings of closeness for the

grandparent. Future observational research of grandparent-grandchild video chat interactions

would provide convergent evidence of this association between greater adaptability during

virtual interactions and subsequent feelings of closeness. It will also be important for future

researchers to address the role that siblings may play in these interactions.

The extent to which grandparents encountered social and emotional barriers to

connecting via video chat (e.g., video chats reminding them what they are missing as their

grandchildren grow) negatively predicted grandparents' feelings of closeness. A higher score on

these barriers may reflect that the video chats did not always provide the benefits that motivated

grandparents and parents to engage in them. If grandparents were hoping to watch the child grow

and engage in activities with the parent and child (Ames et al., 2010; Forghani & Neustaedter,

2014; Kirk et al., 2010), the feeling that they are interrupting and are missing out on the child's

development may remind them of how much less connection they have than they desired. It is

not surprising that during the pandemic, when grandparents may interact with the child

infrequently in person, not feeling connected over video chat was related to not feeling that they

had a close relationship. That is, face validity of the measure appears to be met. Finally, long

periods of social isolation increase the risk of depression and anxiety in adult family members

(Santini et al., 2020). It is possible that those grandparents who had less contact with their

grandchildren had experienced more mood disruption that reduced further contact and perceived

closeness. We are currently conducting a short-term longitudinal study to examine changes in

mood and video chat contact as well as the quality of video chat engagement to try to disentangle

these findings.

Grandparent Enjoyment of the Video Chats

As predicted, the variables associated with grandparent-grandchild closeness were similar

to those associated with grandparent enjoyment of video chats with their grandchild. Negative

predictors in both models included grandparent education and the number of social and

emotional barriers experienced during video chats; positive predictors included the frequency of

video chats and the variety of activities engaged in during them. We expected similarities in the

closeness and enjoyment models because prior researchers have found that grandparent-

grandchild closeness is related to enjoyment of and satisfaction with different modes of

communication (Harwood, 2000; Holladay & Seipke, 2007), and closeness and enjoyment were

correlated in our sample as well. Alongside prior work, our findings suggest this association is

robust across *type* of interaction and communication between grandparents and grandchildren --

in-person, telephone, or video chat.

There were also several differences in the predictors. First, child age and having met in

person were not significant predictors in the enjoyment model. In prior studies, grandparents

reported wanting to see grandchildren grow and learn details of their lives (Forghani &

Neustaedter, 2014), so our findings on grandparent enjoyment may reflect that video chat fulfills

this purpose regardless of children's age or the frequency of in-person meetings. In addition,

distance was a positive predictor in the enjoyment model, suggesting that grandparents who live

further away may especially appreciate the opportunity video chat provides to allow them a

window into their grandchild's life.

Parent Enjoyment of the Video Chats

Parent enjoyment of the video chats was predicted by some of the same variables as

grandparent enjoyment, including education level of the parent (negative), frequency of the video

chats (positive) and the number of activities engaged in during the sessions (positive). However,

distance was not a predictor of parent enjoyment and neither were social and emotional barriers.

The parent model also included an additional block comprising parents' perceptions of

the grandparent-grandchild relationship as well as their own relationship with the grandparent.

Parents' closeness with the child's grandparent and their perception of how close their child felt

to their grandparent were both positive predictors of parents' enjoyment of the video chats. From

the parent's perspective, observing video chats in which both children and grandparents are

engaged and appear close may help parents to feel that video chats are fulfilling their desired

purpose, making them more enjoyable.

Parents may act as a gatekeeper to grandparent-grandchild interactions, so the

relationship between the parent and grandparent is a key supporter of intergenerational

relationships (Mueller & Elder, 2003; Uhlenberg & Hammill, 1998). In the present study, when

parents felt closer to the grandparent, this closeness was associated with greater parent enjoyment of grandparent-grandchild video chats. Consistent with the Bronfenbrenner and Morris (2007) model, relationships are not created in a vacuum. Demographic factors, economic resources, physical proximity, and video chats provide opportunities for grandparent-grandchild interactions, but whether the potential of those opportunities is realized depends on other contextual variables, including the relationships of other family members (Mueller & Elder, 2003). In prior studies, grandparent-grandchild phone and video chat communications were more frequent when the grandparent-parent relationship was strong (Forghani & Neustaedter, 2014). Both grandparents and parents reported spending about half of their time in the video chats mainly talking and interacting with one another, and the other half with the child. When parents and grandparents have a closer relationship, parents may feel more comfortable about providing the grandparent with a video window into their home, more motivated to do the work to schedule video chats and manage the video chat activities to engage the child, and more invested in providing opportunities for the grandparent to participate in family activities and see the child grow. In other words, video chats between young children, their parents, and their grandparents may be an opportunity for both the relationships between grandparents and grandchildren *and* between the grandparents and parents to be maintained and strengthened.

Development in Context

The interplay between all these factors happens within the larger contexts surrounding families. First, participants responded to this survey during the COVID-19 pandemic. We can expect that more families were separated, at least temporarily, from one another during this time. Under these circumstances, a reasonable assumption is that grandparents and grandchildren would video chat with one another frequently, as they appear to do in communities where young

families live far from grandparents (e.g. McClure et al., 2015). Contributing to the larger context, the communications discussed here are only possible due to the relatively recent invention of video chat, and the even more recent high levels of adoption of smartphone technology, which supports easy access to video chat platforms (Rideout & Robb, 2020; Nelson Kakulla, 2020). In a time when families became newly separated and others had separations unexpectedly extended, our findings suggest that video chat access played an important role in maintaining relationships that are key to young children's early development.

This work demonstrates how rapid changes in technology play an important role in family relationships. Even though commercial video chat technology has existed since 2003, widespread availability and adoption of video chat usage for many families only began during the COVID-19 pandemic. The technical infrastructure to support this growth and the usability of the interface have improved dramatically over the last decade (2010 to 2020). Beyond the pandemic, these findings suggest that video chat is a valuable way to support grandparent-grandchild relationships in a variety of contexts.

Additionally, video chat may offer opportunities for young children to explore and experiment with how screen media relate to their in-person world (Myers et al., 2017; Strouse et al., 2018; Rusnak & Barr, 2020; Troseth et al., 2019). Compared to other screen technology such as television or streamed videos, features of video chat such as temporal contingency (time dependence between actions and consequences) may support children's learning (Troseth et al., 2006; Roseberry et al., 2014). Socially contingent responses from a grandparent on video chat may help children make connections between the screen and world by helping them view the contents of the screen (the grandparent and their environment) as real (Troseth et al., 2019). Social contingency may also cue children that the person on screen is intentionally trying to

communicate *with them* (Strouse et al., 2018), and not simply with a generic audience. Seeing

familiar people on the screen who talk about things in children's own environment or ask

questions about them may help children to establish that things on screen can be relevant and

meaningful to their life. Activities such as a grandparent commenting on visible objects in the

child's environment, or providing feedback based on the child's behavior, are the kinds of

supports that helped toddlers learn information presented over the screen in research studies

(e.g., Myers et al., 2017; Troseth et al., 2006).

Video chat can also highlight certain differences between screen media content and in-

person experiences for children. For example, there is no *physical* contingency between actions

on the two sides of the screen, yet young children have been observed attempting to share objects

through the screen with grandparents (McClure & Barr, 2017). One 18-month-old child

repeatedly "fed" her grandpa raisins by dropping raisins in front of an iPad screen, which he

pretended to accept and then eat, while she ran to the other side of the iPad, peering back over

the top at his image to check if he was eating them. When her mother asked her, "Remember,

where's PopPop living?" the girl answered by pointing at the screen and stating emphatically,

twice, "Right there" (Barr et al., 2020). It is not clear whether very young children experience

these activities as pretend play or believe they are actual physical exchanges through a screen

and whether this changes their perspective taking ability. Future research can explore this idea

further, as well as whether these activities and beliefs are related to development and video chat

experience.

Similarly, tech glitches such as buffering or failed connections compromise the social

contingency that distinguishes video chat from other screen media, which could confuse children

but could also offer an important learning experience. In prior research, co-viewing parents

helped children to make sense of these disruptions by, for example, explaining that disconnections were due to connection problems rather than a grandparent intentionally leaving, and then playfully responding to the glitches as though they were playing hide-and-seek with the grandparent (McClure & Barr, 2017). These glitches, and parent support during them, may help young children learn that video chat occurs in real time but is not simply a window into another space. Parents co-participating with their children in video chat will be vital for very young children to begin to understand how an image on a screen relates to real events (Myers et al., 2019; Strouse et al., 2018).

Limitations

There were of course several limitations to the present study. Although the study was conducted during summer 2020 of the COVID-19 pandemic, almost all the participating grandparents had already met their grandchild in person. However, the survey did not assess how frequent or recent the in-person contact had been. Quite a few prior studies have shown that proximity is related to the amount of in-person contact between grandparents and grandchildren (Drew & Smith, 1999; Dunifon & Bajracharya, 2012; Pew Research Center, 2008; Uhlenberg & Hammill, 1998). However, because this study did not measure both proximity and frequency of in-person contact, it is unknown how the pandemic may have impacted the previously established relation between these variables. In addition, the collection of more detailed employment and retirement data would have allowed us to explore how these variables are associated with family members' opportunity to spend time together either virtually or in person.

Some of the variables, including closeness, were measured using single-item Likert measures. This is typical in the existing literature, allowing for direct comparison between the current results and those of previous research. However, more thorough and descriptive measures

of closeness, enjoyment, and engagement may provide a more detailed and nuanced understanding of the grandparent-grandchild relationship. Measures could include multi-item survey instruments, dyadic measures of closeness, or observational coding of these variables.

We recruited parents and grandparents for a study about video chat via the internet using services such as Prolific and ResearchMatch, as well as convenience sampling via Facebook and other online advertising. Although the materials were translated into Spanish and Spanish advertisements were placed using the same recruitment services, we obtained a primarily White, English-speaking, middle class sample. Because of the way we advertised, it is also possible that families who responded were more likely to use video chat than the general population. A more diverse sample would produce more generalizable results. Despite these limitations of our sample, the conclusions we draw based on the collected data serve as an important first step to better understanding how families who already use video chat do so to support the grandparent-grandchild relationship.

A deeper look is warranted at the activities that the adults engaged in while video chatting with children. During early childhood, adult co-viewers are important sources of support and facilitation for children's interactions with people on video chat (McClure, et al., 2018). Co-viewers help children understand what they see on screen by directing children's attention (Demers et al., 2013), modeling appropriate responses (Myers et al., 2018; Richert et al., 2011), and signaling that the contents of a screen are worthy of a child's attention (Strouse et al., 2013, 2018; Troseth et al., 2016). Although we found that a greater number of developmentally appropriate activities engaged in by the adults during video chat was related to greater grandparent-grandchild closeness and grandparent and parent enjoyment of the video chats, we did not investigate mechanisms underlying that association. It is possible that the variety of

activities was due to enhanced sensitivity of the video chat partners following the interests of the

child. It is also possible that the number of activities lengthened the video chat and potentially

increased the "stickiness" of video chatting as a solution to family separations. For instance,

enjoyment may be enhanced when children pay more attention to video chat interactions, when

both partners are engaged in playful activities, or when children initiate and respond to displays

of affection that occur across the screen. Grandparent enjoyment may also be higher when, rather

than feeling that they are *missing out* on these milestones (e.g., they hear that the child is now

crawling), they can *virtually participate in* their grandchildren's milestones (e.g., when the child

crawls to the screen). We are considering these factors in more detail in an ongoing follow-up

investigation which will include a multi-method, triadic, and longitudinal analysis of a subset of

families.

In this study, we only addressed the self-reported closeness and enjoyment of families

who reported already engaging in video chats between grandparents and grandchildren. We did

not address issues of access and barriers to video chat for those who were not yet using it. We

did collect data to address these issues and have pre-registered plans for further analyses for this

dataset (https://osf.io/kvd97/, RQ 1 & 2).

Future Directions

Our participants responded about children ages 0 to 5 years. Information about

grandparent-grandchild relationships for children this young is rare in the literature. Future

researchers should examine how the grandparent-grandchild relationship changes during early

childhood, including the role of in-person and video chat contact. Although prior studies have

reported a decline in closeness as grandchildren pass from childhood to adolescence (e.g., Davey

et al., 2009), incorporating measurements taken during early childhood could potentially reveal a

different pattern. Future studies should examine factors such as frequency of in-person and video chat contact, the variety of video chat activities, and how these factors interact with child age. More studies on video chat are needed during children's first five years because during this time developmental changes are most apparent in the quality of video chat interactions, in terms of longer video chats with more complex language and more opportunities for extended contact.

More detailed research examining the parent-grandparent relationship is warranted to examine the role of intergenerational solidarity, defined as closeness between the parent and grandparent. In prior studies, grandparent-grandchild relationships were closer when grandparent-*parent* relationships were strong (Barnett et al., 2010; Brown, 2003; Chan & Elder, 2000; Dunifon & Bajracharya, 2012; Monserud, 2010; Mueller & Elder, 2003; Silverstein & Marenco, 2001). To best address intergenerational solidarity, triadic observational data needs to be examined in conjunction with parent and grandparent self-report data, which we are currently doing as part of our follow-up study.

In the year 2021, several aspects of in-person interaction are missing from the video chat experience, including touch and depth cues that facilitate developmentally important interactions such as physical affection and contact comfort. New technology has added haptic feedback and virtual reality, but these features are not yet widely available to the average family. Emerging technologies are likely to contribute to future versions of video chat, as well as other technologies that will engage children. It is important to acknowledge that just as the contexts surrounding children's use of technology are not static (as demonstrated by this pandemic), neither is our knowledge about the way children use and understand technology. As technology improves and children's use of technology changes, researchers should ask new questions about

how early screen-based interactions occur and how they impact children's understanding and
learning from screen media.

Implications

Strong early grandparent-grandchild relationships may both benefit the family when
children are young and support positive connections later in life. Close grandparent-grandchild
relationships in childhood are associated with close relationships as children age into
adolescence and young adulthood (Hakoyama and MaloneBeach, 2013; Monserud, 2010). In
young adulthood, grandchildren and grandparents who are close report mutual support, love, and
respect (Kemp, 2005) and report that both parties learn from each other and influence each
other's values and identity (Seponski & Lewis, 2009).

Our results during a global pandemic suggest ways to better leverage video chat
technology to help support and sustain important relationships between family members
separated by distance at any time due to illness, incarceration, deployment or immigration. Prior
research demonstrates the importance of sensitive, contingent, developmentally appropriate
scaffolding and co-viewing of video chat by a supportive adult (McClure et al., 2018; Myers et
al., 2018; Strouse et al., 2018). Interventions designed to support positive, frequent, scaffolded
video chat interactions between grandparents and grandchildren may help to promote family
relationship-building activities and connections for very young children during periods of
separation.

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Table 1

Sample Demographics

Demographic variable	Grandparents N = 855		Parents N = 846	
	M	*SD*	*M*	*SD*
Adult age (years)	61.62	9.22	34.45	5.30
Child age (months)	31.31	19.15	31.39	18.44
Household income (estimated from median household income in reported zip code)	$74,138	$29,065	$75,579	$28,729
	n	%	*n*	%
Race				
White	763	89.2%	718	84.9%
African or African-American	31	3.6%	45	5.3%
Asian or Asian-American	15	1.8%	36	4.2%
Native American	7	0.8%	0	0.0%
Other	14	1.6%	22	2.6%
Multiple	14	1.6%	19	2.2%
Declined to answer	11	1.3%	6	0.7%
Hispanic or Latino	19	2.2%	54	6.4%
Education (highest completed)				
Highschool/GED or less	91	10.6%	56	6.9%
2-yeardegree/trade school	146	17.1%	66	7.8%
4-yeardegree	249	29.1%	280	33.1%
MA degree	266	31.1%	264	31.2%
Ph.D., M.D., J.D.	103	12.0%	180	21.3%
Current employment status				
Full-time	300	35.1%	588	69.5%
Part-time	87	10.2%	88	10.4%
Unemployed and looking for work	21	2.5%	28	3.3%
Unemployed and not looking for work	24	2.8%	22	2.6%
Retired	378	44.2%	0	0.0%
Student	1	0.1%	16	1.9%
Disabled	35	4.1%	9	1.1%
Full-time caregiver	9	1.1%	95	11.2%
Child gender				
Male	411	48.1%	402	47.5%
Female	436	51.0%	441	52.1%
Other	2	0.2%	0	0.0%
No response	6	0.7%	3	0.4%

Note. Participants were recruited in English and Spanish and could complete the survey in either language. Some grandparents (*n*=8) and parents (*n*=24) completed the survey in Spanish. Grandparent ages ranged from 37 to 83 years; parent ages ranged from 20 to 56 years.

Table 2

Percent of Grandparents and Parents Reporting Barriers to Video Chat Usage

Barrier	Grandparent	Parent
Technical barriers		
Signal breaking (screen or audio freezes)	42.46%	52.13%
Video call failing/disconnecting	22.34%	29.31%
Figuring out the app and seeing everyone	7.37%	11.35%
Finding the link to join	2.69%	3.31%
Paying for internet/data plan	3.04%	1.89%
Social and emotional barriers		
Other party distracted; feeling of interrupting them	20.47%	48.23%
Feeling grandchild is not connecting with me	11.93%	-
Being reminded I am missing out	40.23%	12.77%

Note. Social and emotional barriers item wording varied for grandparents and parents. Exact wording can be found in the Supporting Information.

Table 3

Percent of Grandparents Reporting They Engage in Each Activity During Video Chats with Their

Grandchild

Grandparent activity	%
Smile	98%
Wave	88%
Show child images or objects in grandparent environment	64%
Sing to or with grandchild	48%
Read to grandchild	31%
Imitate the parent present in the room with the child	10%

Table 4

Percent of Parents Reporting They Engage in Each Activity During Grandparent-Grandchild Video

Chats

Parent activity	%
Ask questions	78%
Point to screen to direct child's attention	73%
Give child hugs and tickles on grandparent's behalf	54%
Play with toys	40%
Suggest activities	32%
Sing songs	23%
Read a book	13%

Table 5

Model fit for Each Hierarchical Regression Step Predicting Grandparents' Ratings of Closeness to Their

Grandchild

Model	Model test	R^2	Adjusted R^2	Change in R^2
Block 1 Participant characteristics	$F(3, 849) = 9.66$***	.03	.03	-
Blocks 1-2 + In-person interactions	$F(5, 847) = 19.49$***	.10	.10	.07***
Blocks 1-3 + Video chat interactions	$F(11, 841) = 26.65$***	.26	.25	.16***

Note. Two participants were dropped from this model because they were missing data for the dependent

variable.

*$p < .05$, **$p < .01$, ***$p < .001$

Table 6

Full Model Predicting Grandparent Closeness

Predictor	Beta	Bootstrapped B	BCa 95% Confidence Interval	
			Lower	Upper
Constant*	-	2.86	2.22	3.52
Block 1				
Child age (months, centered)*	0.13	0.01	0.00	0.01
Grandparent age (years, centered)	0.06	0.01	0.00	0.01
Grandparent education*	-0.08	-0.08	-0.13	-0.03
Block 2				
Having met in person (0 = no, 1 = yes)*	0.09	0.58	0.08	1.07
Distance (log miles)*	-0.24	-0.21	-0.27	-0.16
Block 3				
Frequency of video chats*	0.30	0.36	0.29	0.44
Mobile device (0 = no, 1 = yes)	0.03	0.09	-0.08	0.24
Technical barriers (of 5)	0.02	0.02	-0.05	0.09
Percent interacting with adult	-0.03	-0.00	-0.00	0.00
Grandparent activities (of 6)*	0.12	0.11	0.05	0.16
Social and emotional barriers (of 3)*	-0.18	-0.23	-0.33	-0.15

Note. Asterisks indicate statistical significance as determined by the BCa 95% confidence interval.

Table 7

Model fit for Each Hierarchical Regression Step Predicting Grandparents' Ratings of Enjoyment of

Video Chats with Their Grandchild

Model	Model test	R^2	Adjusted R^2	Change in R^2
Block 1 Participant characteristics	$F(3, 851) = 5.90$**	.02	.02	-
Blocks 1-2 + In-person interactions	$F(5, 849) = 10.69$***	.06	.05	.04***
Blocks 1-3 + Video chat interactions	$F(11, 843) = 12.24$***	.14	.13	.08***

*$p < .05$, **$p < .01$, ***$p < .001$

Table 8

Full Model Predicting Grandparent Enjoyment of Video Chats

Predictor	Beta	Bootstrapped B	BCa 95% Confidence Interval	
			Lower	Upper
Constant*	-	72.90	63.79	80.89
Block 1				
Child age (months, centered)	-0.07	-0.06	-0.12	0.00
Grandparent age (years, centered)	0.01	0.02	-0.10	0.15
Grandparent education*	-0.15	-2.00	-2.85	-1.20
Block 2				
Having met in person (0 = no, 1 = yes)	0.06	5.89	-1.06	13.14
Distance (log miles)*	0.20	2.74	1.63	3.88
Block 3				
Frequency of video chats*	0.18	3.47	2.07	4.99
Mobile device (0 = no, 1 = yes)	0.00	0.11	-2.51	2.92
Technical barriers (of 5)	-0.01	-0.21	-1.34	0.86
Percent interacting with adult	-0.03	-0.02	-0.07	0.03
Grandparent activities (of 6)*	0.15	2.04	0.96	3.16
Social and emotional barriers (of 3)*	-0.08	-1.66	-2.93	-0.50

Note. Asterisks indicate statistical significance as determined by the BCa 95% confidence interval.

Table 9

Model fit for Each Hierarchical Regression Step Predicting Parents' Ratings of Enjoyment of

Grandparent-Grandchild Video Chats

Model	Model test	R^2	Adjusted R^2	Change in R^2
Block 1 Participant characteristics	$F(3,842)=2.51$	.01	.01	-
Blocks 1-2 + In-person interactions	$F(5,840)=1.54$	.01	<.01	<.01
Blocks 1-3 + Video chat interactions	$F(11,834)=12.84^{***}$	.15	.13	.14***
Blocks 1-4 + Parent perceptions of family relationships	$F(14,831)=28.69^{***}$	.32	.32	.18***

$^*p < .05, ^{**}p < .01, ^{***}p < .001$

Table 10

Full Model Predicting Parent Enjoyment of Grandparent-Grandchild Video Chats

Predictor	Beta	Bootstrapped B	BCa 95% Confidence Interval	
			Lower	Upper
Constant*	-	37.42	27.76	47.90
Block 1				
Child age (months, centered)	-0.01	-0.01	-0.08	0.05
Parent age (years, centered)	-0.02	-0.08	-0.34	0.15
Parent education*	-0.08	-1.43	-2.39	-0.51
Block 2				
Having met in person (0 = no, 1 = yes)	-0.02	-1.39	-5.15	2.01
Distance (log miles)	0.06	0.99	-0.35	2.34
Block 3				
Frequency of video chats*	0.16	3.50	2.03	5.02
Mobile device (0 = no, 1 = yes)	0.00	-0.01	-2.91	2.88
Technical barriers (of 5)	-0.04	-0.77	-2.17	0.48
Percent interacting with adult	0.03	0.03	-0.03	0.08
Parent activities (of 7)*	0.08	0.95	0.30	1.61
Social and emotional barriers (of 2)	-0.04	-1.23	-2.80	0.24
Block 4				
Child recognizes grandparent	0.01	0.51	-5.25	6.37
Closeness of parent to grandparent*	0.42	7.57	6.16	8.93
Perceived closeness of child to grandparent*	0.08	1.32	0.17	2.56

Note. Asterisks indicate statistical significance as determined by the BCa 95% confidence interval.
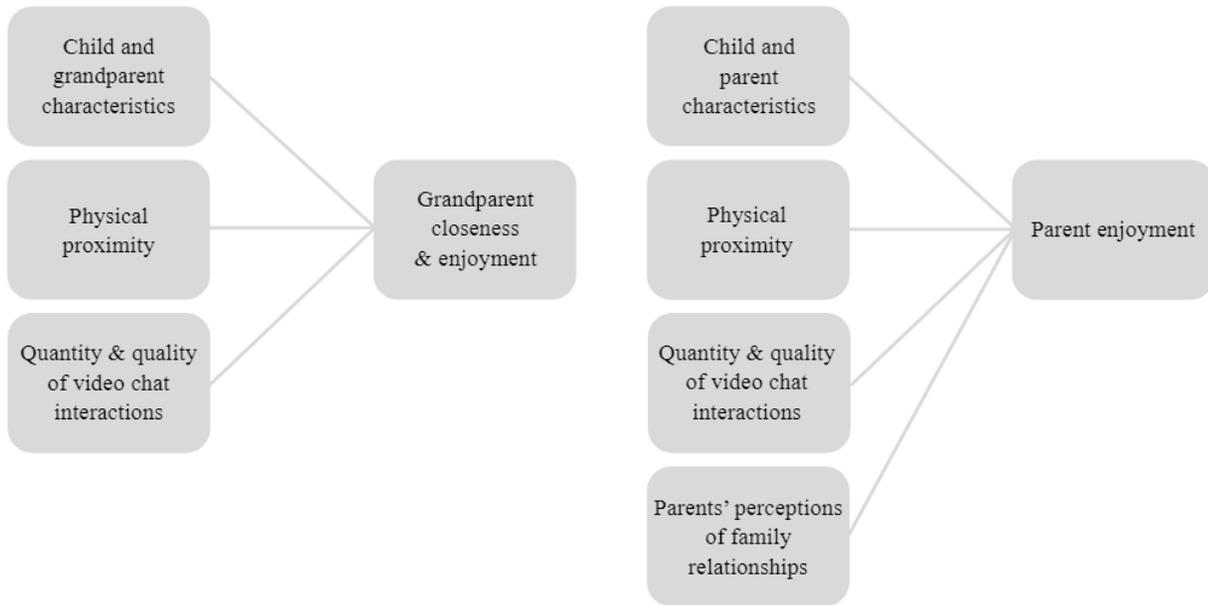
Figure 1

Predictor Blocks for Regression Models

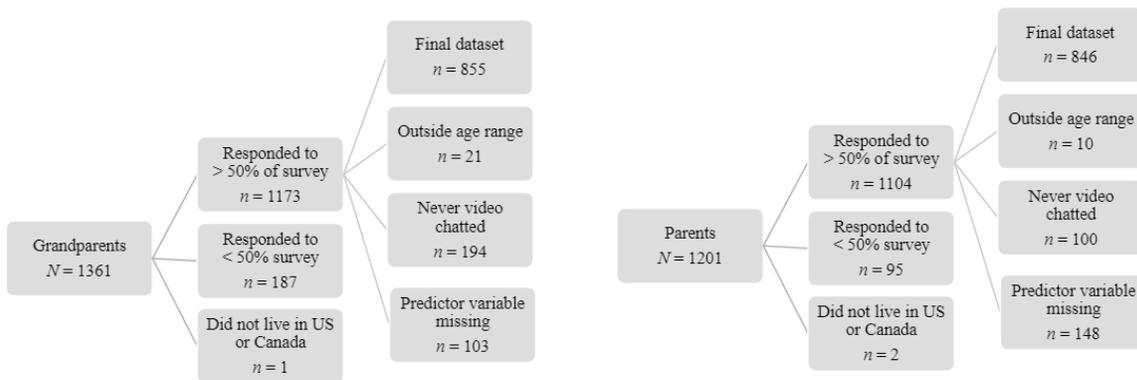*Note.* Left panel: grandparent closeness and enjoyment. Right panel: parent enjoyment.

Figure 2

Participant Inclusions and Exclusions

Note. Left panel: grandparents. Right panel: parents.