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Research Article

Virtual Grandparenting: Identifying Barriers to Supportive Video Chat between Grandparents and Grandchildren

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Many grandparents today are physically separated from their families. Given that maintaining close family relationships (with both adult children and grandchildren) is associated with increased physical, mental, and emotional health across generations, it is important to determine how families can maintain close relationships with grandparents when physically separated. Technology offers one potential support: the proliferation of video chat. Recent work suggests that the frequency of video chat and the variety of behaviors engaged in during video calls predicts family closeness and enjoyment of using this communication method, regardless of the physical distance between parties. However, the frequency of grandparent-grandchild video chat varies across families. Here, we explore how demographic, physical (e.g., distance), technological (e.g., number of devices and barriers), and social factors (e.g., children are distracted) predicted: (1) whether or not video chat was used by grandparent-grandchild dyads, and (2) the frequency of video chat in the families using the technology. This work suggests that geographical distance, having met in person, and the number of devices owned were positive predictors of grandparents and grandchildren having ever video chatted. However, the factors associated with the frequency of video chat were different in the parent and grandparent models and included grandparents' comfort with technology and the type of device used by the parent and child. These findings not only have implications for supporting grandparent-grandchild relationships but also for all family members separated by distance, immigration, incarceration, health emergencies, and displacement.

1. Introduction

The landscape of childhood is changing as academic demands [1] and time spent using technology [2] have increased while time spent playing outside [3] has decreased. Similarly, the landscape of parenting and grandparenting is also changing; according to a representative survey of 200 grandparents conducted by the American Association for Retired Persons (AARP), today's grandparents are likely to be in the workforce (40%) and live more than 200 miles away from at least one grandchild (52%), and the majority (68%) state that distance is a barrier to seeing grandchildren more often [4]. Grandparents, too, are spending more time with technology, with 40 percent feeling tech savvy and reporting that they use video chat and other forms of technology to stay connected [4]. This paper explores the factors that predict video chat usage between grandparents and grandchildren within the context of the family system. Little

is known about the factors that contribute to families' use of video chat to establish or maintain important relationships. Grandparents' and/or parents' hurdles or ease with technology (i.e., general technology comfort, device access, connection issues, etc.) may play an important role in the amount of time young children interact with grandparents over video chat, thus representing potential limitations or opportunities to develop important family relationships and social support with impacts across multiple generations.

2. Grandparent-Grandchild Relationship

By the age of 65, almost all Americans (96%) have become grandparents according to the AARP [4]. The role of grandparenting on both grandparent-grandchild relationships and grandparents' lives has come under recent investigation. Research suggests that the development of a close intergenerational relationship has positive effects for both grandparents [5–7] and grandchildren [8–10]. The impact of grandparents on grandchildren can be both direct (e.g., reading and playing with the child) and indirect via parents (e.g., impacts on parent stress) [11].

While limited extant research specifically investigates the closeness between grandparents and their grandchildren under the age of 5 years, research clearly demonstrates the importance and lifelong implications of warm, responsive, and contingent interactions for young children's development in general [12]. Research with older children suggests that greater physical distance between grandparents and grandchildren can negatively impact grandparent-grandchild relationships [13–16]; 68% of grandparents report that distance is the biggest barrier to seeing their grandchildren [4]. Notably, more frequent in-person contact has positive effects [13, 17–19]. Distance and frequency of contact appear to have dynamic and interdependent impacts, with research controlling for frequency of contact actually reversing the relationship between distance and perceived closeness [17], suggesting that compensatory mechanisms (e.g., more frequent in-person visits) can significantly alter these relationships. Therefore, an important question is whether, as grandparents and grandchildren begin to interact more frequently online, this virtual contact will help build and sustain these important relationships, even with very young grandchildren.

While separations due to factors such as incarceration, immigration, and employment have been impacting families for decades, more recently, the COVID-19 pandemic has resulted in increased physical separation of grandparents from their grandchildren [20]. The farther away grandparents live from family, the higher the risk of isolation and loneliness, via less direct face-to-face contact [21]. Technology offers a tool that can potentially be leveraged to help 'fill the gap' that is left when grandparents are physically distanced and socially isolated from their grandchildren. Digital forms of interaction are an increasingly common way for remote grandparents to connect with their grandchildren [22–25], with recent work suggesting that video chat is becoming more prevalent with grandparents, even of those with younger grandchildren [4, 24–27].

A number of factors should be considered regarding this emerging technology: how the technology can be leveraged and by whom; the ways in which different types of technologies can be supportive in building and sustaining interactions; the context of virtual interactions, including both the quantity of interactions (how often virtual interactions take place) as well as the quality of those interactions (what is happening during the calls). Other factors such as the child's age, the presence of supportive family members to scaffold interactions, and the participants' comfort with technology also need to be carefully considered.

Social presence theory [28] is one useful framework for thinking about how different types of technology can support and sustain relationships. Richer communication, such as in-person interactions, hold an advantage over less socially reciprocal interactions [29] in terms of their effects on overall life satisfaction as well as satisfaction with one's relationships. Similar benefits are seen with older adults who use video chat: they have a lower risk of depressive symptoms than those who use communicative technologies that are less immediate and vivid (i.e., email, social networks, and instant messaging) [30]. Video chat, compared to phone calls, also seems to be enjoyed more by grandparents of young children [31] and is utilized by families to help grandparents engage with grandchildren (e.g., by sharing toys and objects, communicating, and participating in family activities [24, 31–34]).

It is important to acknowledge that, as with in-person interaction, video chat with young children is not without challenges. According to Kakulla [27], some older adults report that they feel discomfort or anxiety about the use of technology, yet its use by older adults has increased dramatically during the pandemic to access healthcare, attend religious services, and for other important functions. In 2019, only 50 percent of older adults had used video chat; by 2020, that number had increased to 70 percent [27]. The limiting issue for many young families and older adults is not lack of technological comfort but rather one of access to stable and reliable internet. Although saturation of mobile technology is complete across the US, with 95% ownership of smartphones in the homes of families with children 8 years and under [2], in the homes of older adults [27] there are technical barriers of "underconnectivity" caused by unstable internet and use of older devices that cannot meet the demands of the video chat platform [35]. In practice, this means that calls are disrupted by lags or disconnections, directly impacting the major benefit of video chat: social contingency or responsiveness. Also, grandparents report other challenges: they face emotional barriers, such as tolerating the sadness that arises when they are reminded about what they are missing by not being together in person, and they express uncertainty about how to connect with very young children through screens [27, 32]. Similarly, supporting video chat interactions with young children requires effort from adults to manage and direct the interactions [31, 36]. Thus, there are a number of potential challenges to overcome when video chatting in general and with young children.

Despite these challenges, video chat represents an important potential avenue for supporting and sustaining intergenerational relationships. Use of technology, and specifically, of video chat, varies based on both age in general and within age based on demographic factors [37, 38]. For example, Hargittai et al. [38] found that both socioeconomic status and autonomy of use (e.g., ability to use devices when and where they want) impacted usage.

In recent work using the same sample as presented in this paper, Strouse et al. [24] used surveys to better understand the video chat patterns of hundreds of parents and grandparents. They found considerable variation in frequency of video chatting: some families did not video chat at all, some video chatted relatively infrequently (e.g., once per month), and others reported video chatting every day. Of interest, Strouse et al. [24] also found that frequency of video chat was associated with grandparents' feelings of closeness to their young grandchildren during the COVID-19 pandemic. Given that video chat frequency was the strongest predictor of perceived closeness, it is important to better understand potential barriers to video chat. By understanding what factors predict video chat frequency, we can identify potential areas for supporting families to use technology to build and sustain intergenerational relationships.

A number of potential factors could potentially affect the use of video chat as a means to support and sustain grandparent-grandchild relationships. Here, we explore how various factors impact whether or not families video chat, and if so, how frequently they do so; these include demographic factors (grandparent age, parent age, child age, and grandparent and parent education levels), physical factors (distance, time zone differences, whether the grandparent had ever met the grandchild in person), technological factors (comfort with technology, device ownership, mobile device usage, and technological barriers), and social factors (social barriers to video chat).

We take an intergenerational approach, given the cross-generational nature of grandparent relationships with very young grandchildren and the gatekeeping role of the parent generation. Data were collected during the first year of the COVID-19 pandemic (June-August 2020) before vaccines were available to protect particularly vulnerable grandparent populations. For this reason, we anticipated that there would be a number of grandparents who had never met their own grandchildren.

Our regression models explored the following research questions:

RQ1: Which grandparent factors are associated with ever having used video chat as a means of communication between grandparents and grandchildren?

RQ2: Which parent factors are associated with ever having used video chat as a means of communication between grandparents and grandchildren?

RQ3: Which grandparent factors are associated with video chat frequency?

RQ4: Which parent factors are associated with video chat frequency?

Based on prior research [4], we predicted that technology barriers (lack of both devices and stable internet), comfort with technology, and geographic distance would predict video chat use and frequency. However, due to pandemic conditions and the lack of prior data, it was less clear whether having met in person would be associated with video chat use or frequency of use.

3. Materials and Methods

3.1. Participants. This study used the same method and sample of Strouse et al. [24], and this description of the methods partly reproduces the original wording. 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, Prolific, 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 Prolific and ResearchMatch. The ads specified that the study was about video chat, which may have attracted those who already used it and may have introduced some selection bias. 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 1. 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. Participants were included in the analyses for research questions one and two whether or not they had video chatted (logistic regressions) and the subset of participants who had video chat experience were included for the analyses for research questions three and four (ordinal regressions; Figure 1).

Demographics are available in Table 1. Income was calculated based on the median income of the responding adult's zip code.

3.2. Instrumentation. An overview of the project and complete copies of the surveys can be accessed at https://osf.io/kvd97/. Annotated versions specific to the items reported in this paper are posted at https://osf.io/nrkxp/. The following variables were used in our analyses.

3.3. Predictors. Demographics. Demographic predictors for all models included the age of the responding adult, age of the target child, and the highest education level of the responding adult. Child age in months was estimated by subtracting the month and year of the child's birth from the date when the responding adult completed the survey. Adult age was reported in years. Education was reported on a 7-point Likert-style scale, but the first three levels (no

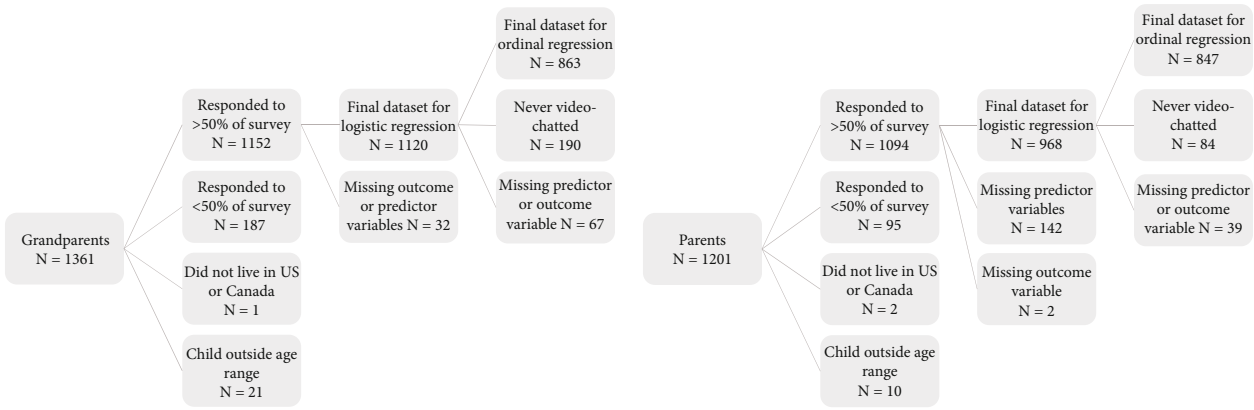

Figure 1: Participant (grandparents and parents) breakdown for logistic and ordinal regressions.

formal schooling, less than high school/GED, and high school/GED) were collapsed for all analyses (see Table 1)

Physical Factors. Physical predictors for all models included the geographic distance and difference in time zones between the grandparent's and grandchild's residences and whether the grandparent-grandchild dyad had ever met in person. The distance in miles along the Earth's surface between the home of the grandparent and grandchild was calculated using the latitude and longitude of each party's zip code or city name. Because of substantial skew, we calculated the log-transform of the distance estimate to enter in our models, similar to the approach used by other researchers [17, 24, 39]. Time zone difference was calculated using the absolute value of the time zone offset from Coordinated Universal Time of the grandchild's home minus that of the grandparent's home. Whether or not the grandparent and grandchild had ever met in person was included as a dichotomous predictor in all models

Technological Factors. Two technological factors were included in all models: an indicator of the adult's comfort with technology and a composite tally of the number of technology-based devices that were owned in their household. We generated a question, "How comfortable are you with using technology?" to assess comfort with technology measured on a 5-point scale. The number of devices was tallied from a checklist of 12 digital devices using a question from the Comprehensive Assessment of Family Media Exposure questionnaire [40].

Two additional technological factors (mobile device usage and number of technological barriers) were included in the ordinal models to address research questions 3 and 4 regarding video chat frequency and were only asked of the subset who had experience video chatting. Mobile device usage was a dichotomous indicator of whether they typically used a mobile (smartphone or tablet) or nonmobile (computer) device for video chats. The score for technological barriers was a count (out of 5; Table 2) of the number of barriers they reported frequently encountering when video chatting (e.g., "Signal breaking up", "Finding a link to join"). Items were created based on the technological problems observed by McClure and Barr [41]. Exact item wording is available at https://osf.io/nrkxp/

Social Factors. In the ordinal models for research questions 3 and 4, we also included a count of the socioemotional barriers (Table 3) that adults reported encountering when video chatting (e.g., feeling like they are interrupting). Items were created based on studies reporting social and emotional barriers to video chat [31, 32, 34, 42]. The count was out of 3 for grandparents and 2 for parents, as the item about feeling disconnected from the child was not asked of parents. Exact item wording is available at https://osf.io/nrkxp/

3.4. Outcomes. The outcome variable for the logistic models used to address research questions 1 and 2 was a dichotomous indicator of whether or not the grandparent and grandchild had ever video chatted. The outcome variable for the ordinal models used to address research questions 3 and 4 was the frequency of video chat between the grandparent and grandchild on a 5-point ordinal scale (Every day, A few times a week, A few times a month, Less than once a month, Never) that was based on several prior studies [26, 40, 43].

3.5. 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. Parents answered survey questions about their own experience and comfort with technology and video chat as well as their experience with their child video chatting with a selected grandparent. Grandparents answered survey questions about their own experience and comfort with technology and video chat with a selected grandchild. See survey at https://osf.io/kvd97/.

3.6. Data Analysis. Research questions were preregistered after data collection closed but prior to exporting data from Qualtrics. At the time of preregistration, none of the authors had viewed any of the data. Preregistration can be found at https://osf.io/kvd97/. The current study addresses preregistered question 2.

Table 1: Demographic details for complete sample.

	Grandparents $N = 1116$		Parents $N = 968$	
	M	SD	*M*	SD
Adult age (in years)	62.02	9.39	34.61	5.5
Child age (in months)	30.85	19.59	31.93	19.04
Household income (estimated from median household income in reported zip code)	$72,762	$27,707	$74,796	$28,420
	n	%	*n*	%
Education (highest completed)				
High school/GED/or less	146	13.1	90	9.3
2-year degree/trade school	206	18.5	76	7.9
4-year degree	313	28	308	31.8
MA degree	328	29.4	297	30.7
PhD, MD, JD	123	11	197	20.4
Distance between grandparent and grandchild (in miles)	489.97	1016.9	717.85	1347.7
Time zone difference between grandparent and grandchild	0.51	1.47	0.82	2.1
Child gender				
Male	544	48.7	462	47.7
Female	561	50.3	501	51.8
Other	2	0.2	0	0
Declined to answer	9	0.8	5	0.5
Race				
White	1001	90	813	84
African or African-American	42	3.8	57	5.9
Asian or Asian-American	15	1.3	39	4
Native American	7	0.6	1	0.1
Other	19	1.7	27	2.8
Multiple	18	1.6	22	2.3
Declined to answer	14	1.3	9	1
Hispanic or Latino	23	2.1	65	6.7
Current employment status				
Full-time	373	33.4	660	68.2
Part-time	112	10	96	9.9
Unemployed and looking for work	32	2.9	38	3.9
Unemployed and not looking for work	29	2.6	28	2.9
Retired	502	45	0	0
Student	4	0.4	20	2.1
Disabled	49	4.4	14	1.4
Full-time caregiver	13	1.2	110	11.4
Declined to answer	2	0.2	2	0.2

To address our research questions, we ran four models. In the first two models, to examine factors that predicted whether or not grandparents and parents used video chat, we ran two logistic models (one for grandparents and one for parents). In the second model, which included only those who did video chat, we ran two ordinal models (one for grandparents and one for parents) to predict the frequency of video chat use.

4. Results

4.1. Video Chat Usage. Table 4 provides frequencies for key variables. The vast majority of grandparents reported that they had met their grandchild in person (97%), and 83.1% reported that they had video chatted with their grandchild. Parents responded similarly, with 88.2% of parents reporting that their child had met their grandparent in person and

Table 2: Technical barriers reported by grandparents and parents.

	Grandparents $n = 861$		Parents $n = 847$	
	n	%	n	%
Figuring out the app and seeing everyone	64	7.4	97	11.5
Finding the link to join	24	2.8	27	3.2
Video call failing/disconnecting	190	22.1	251	29.6
Signal breaking up	363	42.2	443	52.3
Paying for internet	25	2.9	15	1.8

Table 3: Socioemotional barriers reported by grandparents and parents.

	Grandparents $n = 861$		Parents $n = 847$	
	n	%	n	%
Child is distracted	176	20.4	408	48.2
Being reminded of child growing	345	40.1	107	12.6
Feel like child is not connecting with me	99	11.5	N/A	N/A

91.5% having video chatted with their grandparent. Grandparents reported owning about the same number of devices as parents (grandparents $M = 7.02$, SD = 1.83; parents $M = 6.99$, SD = 1.77). Over 80% of grandparents and 88% of parents responded that they felt somewhat or very comfortable using technology, but 13.9% of grandparents and 11.1% of parents reported feeling very or somewhat uncomfortable with technology (grandparents $M = 4.01$ out of 5, SD = 1.26; parents $M = 4.42$, SD = 1.19). Those who video chatted reported encountering both technological barriers (grandparents $M = 0.77$ out of 4, SD = 0.91; parents $M = 0.96$ out of 4, $SD = 0.89$) and social barriers (grandparents $M = 0.71$ out of 3, SD = 0.80; parents $M = 0.61$ out of 2, SD = 0.62). The most common technological barrier facing both grandparents and parents was the signal breaking up and the video call failing/disconnecting (Table 2). But despite facing those challenges, grandparents (87.8%) and parents (87.4%) who video chatted reported grandparent-grandchild video chats as frequent as a few times a month or a few times a week.

4.2. Prediction of Video Chat Usage. To predict whether or not families ever engaged in grandparent-grandchild video chat, we constructed two logistic regression models, one based on grandparents' survey responses and the other based on parents' responses. As predictors, we included the adult's age in years and education level, the child's age in months, the log distance in miles and number of time zones between the grandparent and child, a dichotomous indicator of whether the grandparent and child had ever met in person, the adult's comfort level with using technology, and the number of digital devices the adult owned.

For the grandparent model, our initial checks of the model assumptions indicated that grandparent age, child age, and log distance variables did not have linear relationships with the log-odds of the outcome variable (Box Tidwell test). To address the violation, we computed restricted cubic spline (rcs) transformations with 4 knots for these variables, as recommended by Croxford [44], using the R command rcs from the rms package [45]. The rsc log distance variable still failed the assumption check, so we took the square root, and it then passed. The final logistic regression (Table 5), computed using glm [46] had good model fit according to a log likelihood ratio test, $\chi^2(8) = 88.06$, $p < .001$, McFadden's $R^2 = 0.09$. Greater distance ($p < .001$), the grandparent and grandchild having met in person ($p < .001$), and more devices owned ($p = .001$) predicted a higher likelihood that the grandparent and grandchild had video chatted. Grandparent age was a significant negative predictor of grandparent-grandchild video chat ($p < .001$), with older grandparents less likely to video chat. Grandparent education, child age, the time zone difference, and the grandparent's comfort with technology were not significant predictors.

In Table 5, the estimates represent the expected change in log odds of video chatting when the predictor changes by one unit, holding the other predictors constant. The exp(Est.) column is the ratio of the two odds. For example, as devices owned increased by 1, the odds of video chatting increased by 16 percent, as shown by the 1.16 exp(Est.). As the spline of grandparent age increased by 1, the odds of video chatting decreased by 28 percent as shown by the .72 exp(Est.).

For the parent model, no transformations were needed. The final logistic regression (Table 6) had good model fit according to a log likelihood ratio test, $\chi^2(8) = 146.52$, $p < .001$, McFadden's $R^2 = 0.26$. Higher levels of parent education ($p < .001$), greater distance between the grandparent and grandchild ($p < .001$), the grandparent and grandchild having met in person ($p < .001$), and more digital devices owned ($p < .001$) all predicted a higher likelihood that parents and grandparents had video chatted. Higher parent

Table 4: Response frequencies with numerical coding in parentheses.

	Grandparents $N = 1116$		Parents $N = 968$	
	n	%	*n*	%
Grandparent met child in person (1)	1082	97	854	88.2
Grandparent has not met child in person (0)	34	3	114	11.8
Technology comfort				
Very uncomfortable (1)	103	9.2	81	8.4
Somewhat uncomfortable (2)	66	5.9	26	2.7
Neither uncomfortable or comfortable (3)	74	6.6	6	0.6
Somewhat comfortable (4)	344	30.8	151	15.6
Very comfortable (5)	529	47.4	704	72.7
Household technology ownership				
Television	1088	97.5	926	95.7
DVR	544	48.7	250	25.8
Streaming service	957	85.8	909	93.9
DVD/VCR player	811	72.7	545	56.3
Personal computer	1062	95.2	898	92.8
Regular mobile phone	194	17.4	58	6
Smartphone	1079	96.7	955	98.7
Tablet/e-reader	904	81	805	83.2
MP3 player	298	26.7	188	19.4
Children's educational game device	117	10.5	196	20.2
Console-based gaming system	322	28.9	580	59.9
Virtual assistant	458	41	452	46.7
Grandparent has video chatted with child (1)	928	83.1	886	91.5
Grandparent has not video chatted with child (0)	188	16.8	82	8.5
Device used for video chat*				
Mobile (1)	679	78.9	708	83.6
Nonmobile (0)	182	21.1	139	16.4
Video chat frequency*				
Less than once a month (1)	105	12.2	107	12.6
A few times a month (2)	319	37	355	41.9
A few times a week (3)	345	40.1	314	37.1
Every day (4)	92	10.7	71	8.4

Note. *Device used for video chat and video chat frequency are reported only for the subsample used in the ordinal regressions.

age was associated with a lower likelihood of having video chatted ($p = .014$).

4.3. Prediction of Frequency of Video Chat. To predict the frequency of grandparent-grandchild video chat for families who reported that they had video chatted, we constructed two ordinal regression models based on grandparent and parent responses. We included the same set of predictors as in the logistic models (adult's age, child's age, adult's highest education level, log distance, time zone difference, whether they had met in person, comfort with technology, and digital devices ownership) plus 3 additional predictors, a dichotomous indicator of whether they video chatted using a mobile device, a sum of the number of technical barriers they reported encountering, and a sum of the number of social barriers they encountered.

For the ordinal models, we checked the proportional odds assumption, or whether the effects of the explanatory variables were consistent across the thresholds in the outcome variable, using the Brant test. There were no violations for the grandparent model. The ordinal model (Table 7), run using the polr command from the MASS package in R [47], had good fit according to a log likelihood ratio test, $\chi^2(11) = 52.85$, $p < .001$, McFadden's $R^2 = 0.02$. Higher grandparent comfort with technology was associated with greater video chat frequency ($p = .037$). More technological barriers ($p = .018$) were associated with greater frequency of video chat usage, likely due to increased

Table 5: Logistic regression predicting grandparent reports of grandparent-grandchild video chat.

Variable	Estimate	SE	Exp(Est.)	z	p	95% CI	
Spline grandparent age (yrs.)	−0.33	0.98	0.72	−3.84	<.001	−0.50	−0.16
Spline child age (mo.)	0.02	0.02	1.02	1.11	0.267	−0.01	0.05
Grandparent education	-0.03	0.07	0.97	-0.49	.627	−0.17	0.10
Spline(log(distance))^(1/2)	2.09	0.38	8.08	5.57	<.001	1.37	2.84
Time zone difference	0.01	0.09	1.01	0.06	.955	−0.15	0.22
Met in person (1 = yes)	1.73	0.43	5.64	4.08	<.001	0.89	2.57
Comfort with technology	0.10	0.06	1.11	1.58	.114	−0.03	0.22
Devices owned	0.15	0.05	1.16	3.27	.001	0.06	0.24
Intercept	−1.64	0.60	0.19	−2.75	.006	-2.81	−0.47

Note. $N = 1116$, AIC = 942.

Table 6: Logistic regression predicting parent reports of grandparent-grandchild video chat.

Variable	Estimate	SE	Exp(Est.)	z	p	95% CI	
Child age (mo.)	<0.001	0.01	1.00	−0.23	.821	−0.02	0.01
Parent age (yrs.)	−0.05	0.02	0.95	−2.47	.014	−0.10	−0.01
Parent education	0.51	0.11	1.67	4.48	<.001	0.29	0.73
Log distance	0.20	0.03	1.22	5.73	<.001	0.13	0.26
Time zone difference	0.05	0.10	1.05	0.51	.614	−0.11	0.30
Met in person (1 = yes)	1.49	0.38	4.44	3.96	<.001	0.74	2.22
Comfort with technology	0.12	0.10	1.13	1.10	.273	−0.10	0.31
Devices owned	0.34	0.08	1.40	4.45	<.001	0.19	0.49
Intercept	−2.71	1.05	0.07	−2.59	<.001	−4.78	−0.66

Note. $N = 968$, AIC = 433.

Table 7: Ordinal model predicting grandparent reported frequency of grandparent-grandchild video chats.

Variable	Estimate	SE	Exp(Est.)	z	p	95% CI	
Grandparent age (yrs.)	−0.03	0.01	0.97	−4.38	<.001	−0.05	−0.02
Child age (mo.)	−0.01	3e-3	0.99	−3.73	<.001	−0.02	−0.01
Grandparent education	0.07	0.06	1.07	1.28	.200	−0.04	0.18
Log (distance)	−6e-4	0.02	1.00	−0.04	.971	−0.03	0.03
Time zone difference	0.02	0.05	1.02	0.41	.685	−0.07	0.11
Met in person (1 = yes)	−0.38	0.45	0.68	−0.84	.399	−0.54	0.07
Comfort with technology	0.11	0.05	1.12	2.09	.037	0.01	0.21
Devices owned	0.06	0.04	1.06	1.59	.113	−0.01	0.13
Device type (1 = mobile)	−0.23	0.16	0.79	−1.49	.137	−0.53	0.08
Technology barriers	0.17	0.07	1.19	2.37	.017	0.03	0.32
Social barriers	−0.07	0.08	0.93	−0.84	.403	−0.23	0.09
Intercept (1|2)	−3.98	0.76	0.02	−5.21	<.001	−5.47	−2.49
Intercept (2|3)	−1.96	0.75	0.14	−2.60	.009	−3.43	−0.49
Intercept (3|4)	0.29	0.75	1.34	0.38	.702	−1.18	1.76

Note. $N = 861$, AIC = 2093.

opportunities to experience barriers. Greater grandparent and child age were associated with less frequent video chat use ($p < .001$).

In Table 7, the child age estimate of −0.01 means the odds of higher frequency of video chat to lower frequency is multiplied by $\exp(-0.01) = 0.99$ times when child age increased one month, meaning that the odds of video chat frequency decreased by 1 percent when child age increased by 1 month. As another example, the odds of a higher frequency of video chat increased by 12 percent when comfort with technology increased by 1 level, and by 19 percent with 1 additional technology barrier.

Table 8: Ordinal model predicting parent-reported frequency of grandparent-grandchild video chats.

Variable	Estimate	SE	Exp(Est.)	z	p	95% CI	
Parent age (yrs.)	−0.04	0.01	0.96	−3.11	.002	−0.07	−0.02
Child age (mo.)	−4e-3	4e-3	1.00	−1.18	.239	−0.01	3e-3
Parent education	0.21	0.06	1.23	3.32	.001	0.09	0.34
Log (distance) (1|2)	−0.04	0.03	0.96	−1.11	.266	−0.10	0.03
Log (distance) (2|3)	0.04	0.02	1.04	1.64	.100	−0.01	0.09
Log (distance) (3|4)	−0.05	0.04	0.95	−1.09	.275	−0.13	0.04
Time zone difference	0.01	0.04	1.01	0.40	.692	−0.06	0.09
Met in person (1 = yes)	−0.15	0.22	0.86	−0.67	.497	−0.58	0.28
Tech comfort	−0.05	0.05	0.95	−0.92	.358	−0.16	0.06
Devices owned	−0.02	0.04	0.98	−0.44	.658	−0.09	0.06
Device type (1 = mobile)	−0.86	0.18	0.42	−4.88	<.001	−1.21	−0.52
Tech barriers	0.01	0.07	1.01	0.09	.927	−0.14	0.15
Social barriers	−0.08	0.11	0.92	−0.76	.460	−0.29	0.13
Intercept (1|2)	−4.25	0.63	0.01	−6.76	<.001	−5.48	−3.01
Intercept (2|3)	−2.35	0.61	0.10	−3.84	<.001	−3.55	−1.15
Intercept (3|4)	0.34	0.64	1.40	0.52	.600	−0.92	1.60

Note. $N = 847$, AIC = 2006.

For the parent model (Table 8), the log distance variable violated the proportional odds assumption, so we applied a proportional odds model to that variable using the clm function in the ordinal package in R [48]. That is, the estimate of the odds for that variable was free to vary at each level of video chat frequency. The model had good fit according to a log likelihood ratio test, $\chi^2(13) = 61.29$, $p < .001$, McFadden's $R^2 = 0.03$. Higher parent education was associated with greater video chat frequency ($p = .001$). Greater parent age ($p = .002$) and mobile device usage ($p < .001$) were associated with less frequent video chats.

5. Discussion

Research has shown the beneficial role that grandparents can have within the family dynamic. Therefore, maintaining some form of closeness is important for grandparents, parents, and children alike [11]. Prior to COVID-19, some families already used video chat (e.g., Skype, Facetime, or Zoom) successfully with their toddlers and infants [2, 26, 41, 49] but this use was relatively low. In prior analyses, we found that frequency of video chat was associated with grandparents' feelings of closeness to their grandchildren [24]; thus, it was important to determine what factors predicted the use of video chat between grandparents and grandchildren and the frequency of that video chat. Further, an intergenerational approach was necessary, given that young infants cannot navigate the technology on their own, some older adults are uncomfortable with technology, and the intermediate generation (parents) can be considered gatekeepers for these interactions.

Here, we found that grandparent and parent reports aligned in indicating that geographic distance between the grandparent and grandchild, whether or not the grandparent and grandchild had met in person, and the number of digital devices owned were significant positive predictors of whether or not the grandparent and grandchild ever video chatted [13–19]. The grandparent and parent models also aligned in that the older the grandparent or the parent, the less likely they were to have ever engaged in grandparent-grandchild video chat. Child age, time zone difference, and the responding adult's comfort with technology were not significant predictors.

Together, these results suggest that extended families, especially those that are separated by geographical distance, are highly motivated to use video chat in spite of barriers, and that those with more access to technology in general are better equipped to connect virtually. Thus, supporting these virtual connections is not as simple as ensuring that families have a device for video chatting and providing training on how to use that device. Indeed, a hint may come from the one place where the models diverged, namely, in education as a predictor of video chat use. This variable was not a significant predictor in the grandparent model, but was in the parent model. It is possible that parent education, similar to the number of devices, acts as a proxy for other factors that may have influenced the accessibility and convenience of video chat, such as having access to a device that was not being used by other family members or having time during the day to schedule video chats.

Different predictors emerged as important for predicting the frequency of video chat for grandparents and for parents. Among families who did video chat, both grandparents' comfort with technology and the number of technology barriers encountered were positively related to greater frequency of video chat use. This suggests that when supporting grandparents' use of video chat, it is important to support their comfort with technology while also normalizing the occurrence of technology barriers. Indeed, especially when considering video chat with young

children, supporting grandparents to persist despite technology barriers and turning disruptions into games with young children (e.g., a dropped call becomes a digital type of peek-a-boo, [41]) may help support increased video chat frequency and, in turn, increased feelings of closeness.

In contrast, for parents, mobile device use (compared to desktop or laptop use) was a negative predictor of video chat frequency despite being used the most. One possibility is that, when supporting a video chat between a grandparent and a child, the parent must help manage behavioral disruptions that are especially common with young children. For instance, it is common for young children to run around the room [41] and/or to run away from the video chat [50]. Given the increased use of mobile devices among young children [2], our hypothesis is that while these devices are convenient, video chats are more likely to be disrupted when using a mobile device due to children's ability to run off with or away from the device and/or become distracted by other apps they frequently use. Data analysis of recorded video chats between grandparents and grandchildren will examine this question empirically.

Similar to the prediction of whether families had ever video chatted, younger grandparents and parents with higher levels of education video chatted more frequently. When designing supports for families using video chat to connect grandchildren with their grandparents, it may be more important to focus on older grandparents and parents with less education.

Taken together, these results suggest that the use of video chat to support grandchild-grandparent relationships fits within a larger family context and its use is differentially impacted by factors like distance, number of devices, and comfort with technology. Video chat may serve as but one tool that families use to remain connected. Contact via video chat may support strong familial ties, providing one form of quality time that allows for contingent interactions, which in turn heightens motivation to increase the frequency of interaction. In relation to social presence theory [28], this study highlights the affordances of one type of communication (video chat) in supporting family relationships at a distance. However, these results also stress how these on-screen connections are impacted by off-screen factors such as distance, device availability, and device comfort.

5.1. Insights from COVID-19 and Moving Forward. The COVID-19 pandemic changed the landscape of daily life [51]. While much attention was paid to its implications for work, education, and childcare, less attention was paid to what a global lockdown and forced isolation meant for grandparents and family systems. The COVID-19 pandemic also represented a unique risk to grandparents, with those individuals over 65 years of age at heightened risk of severe illness and death [52, 53]. The desire to protect elders resulted in many intergenerational families experiencing physical distancing, especially before vaccines were widely available. Seifert et al. [54] refer to the "double burden of exclusion" that was inflicted on older adults during the COVID-19 pandemic: not only did they face social isolation due to increased risk of severe illness due to COVID-19, but they also faced digital isolation, as not all older adults have the same access to devices and wireless networks, nor the experience with and knowledge of digital technologies to alleviate the social isolation they faced. While some headlines proclaimed that 2020-2021 was a lost year, other research suggested that many families turned to technology to prevent this loss [55]. Indeed, many families exhibited incredible flexibility as they navigated a global pandemic—separated in space, but together on screens. For example, the reported frequency of grandparents (83%) and parents (91.5%) ever having grandparent-grandchild video chats in this study is well above previous estimates, suggesting that families dynamically changed course when the pandemic began and in-person visits were eliminated, delayed, or limited. This quick transition to relying on a dynamic digital form of communication likely served as a potential source of resilience and connection. However, it is also important to consider differences in digital equity. Some families who did not have stable internet or modern devices could not benefit [56].

Families that video chatted more frequently actually had more technological barriers compared to those that video chatted less frequently. At first glance, this seems counterintuitive, as one might predict that more technological barriers would decrease the likelihood of engaging with more video chat. However, this finding instead suggests that more video chats involved more opportunities to experience barriers. The positive relationship between these variables speaks to the relative value families placed on video chat and the dynamic ability of families to deal with technological barriers as they arose. In other words, families persisted in using video chat despite encountering technological barriers in doing so.

Our previous research [24] suggested that family video chat has the potential to support grandparents' feelings of closeness to their grandchildren, but that both the frequency of video chat and the variety of behaviors in which families engaged (e.g., singing, waving, and reading stories) predicted feelings of closeness as well as both parents' and grandparents' enjoyment. This means that video chatting itself likely is not sufficient to establish closeness nor does it play an equal role across families. The finding that having met in person served as a positive predictor of ever having video chatted, but not as a predictor of video chat frequency, suggests that video chat likely supports, but does not replace, in-person meetings; instead, when video chat is possible, it can serve as a supplement to in-person meetings.

In a study of families during the pandemic, Gong et al. [57] investigated group family electronic communication (including text messaging, group chats, video calls, sending and receiving photos/videos, and video calling) in Hong Kong during a 6-day period in May of 2020, and its relation to wellbeing and personal happiness. They found that families that were more connected through virtual communication reported higher levels of wellbeing and personal happiness. But some important insights emerge from their data. First, respondents used video chat the least compared to the other forms of communication, but it was associated with the highest levels of family wellbeing. Thus, it is

important to consider the factors that predict both the use and frequency of video chat when considering how to support families during times of physical separation. Gong et al. found that individuals over 65 years of age used video chat more than the other age groups, in contrast to what we found here. Further, when studying use patterns during a pandemic, it is important to recognize that different time periods involved different risk levels, especially for older people, so findings should be reviewed in context.

5.2. Limitations. A number of limitations must be considered. First, we did not query the relationship between the parent and grandparent (child or in-law) which has been shown to impact grandparent-grandchild relationships [58]. Further, these data were collected during the COVID-pandemic, which likely impacted family use patterns of video chat [55]. For example, families experienced more social isolation during earlier stages of the pandemic before vaccines were widely available. The pandemic also affected income, employment status, and job location for many families, all of which likely impacted the time available to video chat. These factors may limit the generalizability of our results and warrant future investigation during more "normal" times. However, even outside of a pandemic, families are separated for other reasons (e.g., migration, incarceration, and geographical and/or travel constraints) and it will be important to better understand how video chat can support family members who are geographically separated from each other. Further, some limitations of our sample itself should be considered. Despite translating all materials and advertisements into Spanish during recruitment, we obtained a primarily White, English-speaking, and middle-classed sample. We advertised this study on the internet using services such as Prolific and ResearchMatch (in addition to convenience sampling via Facebook and other online advertising); thus, it was less likely that we reached families that were not already online.

5.3. Implications. This work and others suggest that there are a number of factors to consider when thinking about the implications of what is currently known about video chat and its ability (and limitations) in supporting family relationships and health and well-being.

First, access is not enough. While the digital divide is often construed as "with" or "without" access, van Deursen et al. [59, 60] stress that access is but one aspect of the digital divide, and that user attitude, device diversity, and the ongoing expenses to maintain hardware and software also factor into tech use [56].

Second, "grandparents" are not a monolith. Grandparents are more than a single group of individuals, all sharing the same access, attitude, and experiences. Viewing grandparents as a solitary group also prevents a more nuanced understanding of what interventions or supports could be helpful, with some qualitative work suggesting that there are potentially discrete profiles of older adults that impact their use of, comfort with, and ability to learn new technology [61]. Interventions designed to help older people learn new technologies related to digital communication have had mixed results, again suggesting one size does not fit all [62].

Third, much as in-person, face-to-face interactions vary across families (e.g., in language; [63]), virtual grandparent-grandchild interactions also vary. Strouse et al. [24] found that both frequency of video chat and the diversity of activities done during video chat were associated with how close grandparents felt to their grandchildren and how much both grandparents and parents reported enjoying video chat. McClure et al. [41] found that while grandmothers and families in general were remarkably flexible in engaging in joint visual attention with a young grandchild during video chat, there were individual differences: babies whose families were higher in frequency of joint visual attention behaviors showed increased attention. Individual differences in grandparent sensitivity also predicted infant valence [49, 64].

Finally, issues of timing must be considered. For example, while some studies have failed to find positive effects of video chat on older adults' feelings of isolation and loneliness [21], video chat was used rarely in that study. When external factors (such as a global pandemic) made a new technology a necessity due to lockdowns, this likely changed how people used video chats, even as the pandemic has waned. Now that the technology has become widespread for work, religious services, telehealth, and hanging out with friends, video chatting with family in 2022 likely is very different than it was in 2018—even different than it was in 2020. Understanding both short- and long-term shifts in technology use by families, and its impacts, are areas that are ripe for future investigation, and this trajectory of change must be considered when reviewing past literature.

5.4. Future Directions. There are a number of future directions for this work. Ongoing research will explore the quality and content of interactions using recordings of video chats between grandparents and their young grandchildren. Video chat interactions fit within a larger ecosystem of interactions within the family system, and the potential role and benefits of video chat likely vary based on these larger contexts. For example, the intermediate generation (parents) must support and scaffold grandparent-grandchild interactions, especially with young children. Examining patterns of triadic interaction during video chat is a question ripe for investigation. Although the present findings are promising, the correlational study was cross-sectional, and longitudinal research is needed to examine what predicts continued use over time.

The lessons learned here can be used to support families' use of video chat, but video chat is not the apex of digital technology. As virtual reality and the metaverse become more accessible to families, even more dynamic ways for grandparents to connect with grandchildren in virtual spaces will emerge. Imagine a child and grandparent separated by 1000 miles exploring a natural history museum together in a virtual space, or a child taking a grandparent into their virtual classroom for a "bring your grandparent to class" day. A focus on design is necessary to ensure that virtual spaces build connection rather than disrupt it [65] and ensure equitable access.

Data Availability

Data available on request from the authors.

Ethical Approval

The project was reviewed and approved with Georgetown University as the IRB of record.

Disclosure

This study was registered with OSF.io (kvd97). Study materials are available at https://osf.io/kvd97/.

Conflicts of Interest

The authors declare no conflict of interest.

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Supplementary Materials

An overview of the project and complete copies of the surveys can be accessed at https://osf.io/kvd97/. Annotated versions specific to the items reported in this paper are posted at https://osf.io/nrkxp/ and are provided as supplementary materials. *(Supplementary Materials)*

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