



Technology-based communication among Hurricane Maria survivors in the United States: a trans-territorial lens

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Abstract

Purpose Rooted in a trans-territorial framework, the present study was designed to provide new evidence regarding the patterns of communication among Hurricane Maria survivors who migrated to the U.S. in the aftermath of the storm.

Methods A total of 319 Hurricane Maria survivor adults ages 18 and older were recruited into the Adelante Boricua study between August 2020 and October 2021. Most participants had relocated to the U.S. between 2017 and 2018. We used latent profile analysis and multinomial regression to examine the relationship of technology-based communication with depressive symptoms, well-being, cultural connection, and migration stress.

Results We identified a five-class solution, consisting of (1) moderate communication (32%), (2) disengaged (24%), (3) no social media (18%), (4) daily with family in Puerto Rico (6%), and (5) daily trans-territorial (13%) typologies. Participants in the disengaged class were more likely to report elevated depressive symptoms and limited English proficiency, lower prosocial behaviors, lower levels of religiosity, lower attendance at religious services in the U.S., and less engagement in social activities, compared to participants in the Moderate Communication class.

Conclusion Roughly one in four individuals in our sample reported very limited technology-based communication with friends/family in their sending and new-receiving communities. As technology and smartphones continue to become integrated into 21st-century life, it is vital that researchers explore how the tremendous potential for connectedness relates to trans-territorial crisis migrants' well-being and adaptation.

Keywords Hurricane Maria · Puerto Rican migrants · Communication · Depressive symptoms

Introduction

In September 2017, Hurricane Maria made landfall in Puerto Rico creating widespread damage in what was the third costliest hurricane in United States (U.S.) history [1]. In the storm's aftermath, several hundred thousand Puerto Ricans—many of whom were left without access to food,

water, electricity, or adequate housing for weeks or even months—fled to Central Florida and elsewhere on the U.S. mainland [2]. Maria survivors on the U.S. mainland only received temporary shelter through the Temporary Sheltering Program. Besides this program, no other federal supports were offered to aid survivors with the resettlement process [3]. Several years later, tens of thousands of “Maria survivors” remain in the U.S. [2]. Frontline journalism and broad surveillance efforts have provided important information about displaced Puerto Ricans; nevertheless, several questions remain as to the longer-term experiences of migration, adaptation, and health among this population.

One pressing question is the degree to which Maria survivors who migrated to the U.S. have integrated into their new-receiving communities while maintaining connections with friends and family in Puerto Rico. It has been observed that the construct of “trans-territorial” connect- edness is particularly salient for Puerto Ricans given their

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status as U.S. citizens, which allows for relatively easy back-and-forth movement between the island and the mainland [4, 5]. Critically, 21st-century technological developments have opened new possibilities for such connectedness as the omnipresence of sophisticated smartphones makes regular voice, text, and social media communication a possibility for many [6]. Whereas migration previously disrupted communication with important people in one's home country, today it is possible for migrants to be in daily contact with people back home.

Research on the Latin American migrant population has increasingly explored the construct of trans-nationalism (or trans-territorialism, to coin a phrase for Puerto Ricans) [7–10]. Trans-territorialism refers to myriad ways in which migrants maintain connection with individuals, traditions, and social activities both in their place of origin and their new-receiving context. Although the transnational/territorial migration literature is now quite robust and rapidly expanding, relatively little work has examined the ways in which technology-based communication facilitates such connections, particularly among Puerto Rican migrants [9, 10]. Furthermore, the few studies that have been conducted in this area suggest mixed findings [9]. A study investigating the impact of trans-nationalism/territorialism on immigrants' and migrants' wellbeing [9], found that maintaining some linkages with the place of origin was associated with higher levels of wellbeing. That study also found that having frequent transnational communication was associated with lower levels of wellbeing; however, this association was no longer significant after controlling for English fluency, gender, education and income, indicating the complexity of transnational/trans-territorial communication [9]. Other literature [8, 11] has found transnational/trans-territorial communication to be an essential part of building and maintaining ties with family members in the place of origin and of improving mental health and overall wellbeing. A study [8] found that transnational communication with family members can protect people from social isolation and enhance emotional support among (im) migrants, indicating the importance of maintaining strong ties with family in the place of origin. This literature suggests not only that it is necessary to understand whether people communicate with family members and friends in the place of origin, but also that it is imperative to assess the frequency of communication. Given the complexity of transnational/trans-territorial communication, there is a need to explore the ways in which migrants use phone/internet technology to facilitate trans-territorial connectivity and, in turn, to understand what the degree of connectedness may mean in terms of migrant adaptation and wellbeing.

Studying a population of Venezuelan adolescents, Salas-Wright, Vaughn, et al. [12] examined the dynamics of technology-based communication with friends in both

the U.S. and Venezuela. Using a person-centered approach, they identified subtypes of Venezuelan youth. These subtypes were characterized by substantial heterogeneity, with some youth reporting daily transnational communication, others reporting more frequent communication with friends in the U.S. than in Venezuela, and others who were relatively disconnected from friends in their new-receiving society and back home. Although that study shed new light on technology-based communication and its role in facilitating transnational dynamics, it was limited by several shortcomings, including its focus on young adolescents (who may have varying levels of access to phones/internet) and its singular focus on friends (which excluded critical family relationships).

Rooted in a trans-territorial framework and building upon recent work examining technology-based communication among Latin American migrants, the present study was designed to provide new and exploratory evidence as to the patterns of communication among Maria survivors in the U.S. Specifically, we use a person-centered approach to model the subtypes of trans-territorial communication with friends and family in both the U.S. and Puerto Rico among a population of recently arrived Puerto Rican migrants. Our study not only has the potential to shed new light on the experiences of displaced Puerto Ricans, but it was also designed to advance our understanding of the ways in which today's migrants build connections and stay connected back home.

Methods

Sample and procedures

A total of 319 Maria survivor adults ages 18 and older were recruited into the Adelante Boricua study between August 2020 and October 2021. To be part of the study, potential participants had to fulfill the following criteria: (1) be a Hurricane Maria survivor currently living in the U.S. mainland, (2) be at least 18 years old at the time of enrollment, and (3) have no plans of moving back to Puerto Rico for at least the next 6 months. This last criterion was included to be able to follow participants over a long period of time to better understand their resettlement experience; however, in practice, no interested individuals were excluded on the basis of this criterion.

We used a respondent-driven sampling approach to recruit participants, which consisted of community partner agencies referring initial—or “seed”—participants who, in turn, referred other participants [13]. Our primary community partner in Central Florida is a religious community that provides social services and supports to an array of recently arrived (im)migrant populations.

Community partners elsewhere included a local chamber of commerce, Puerto Rican community groups, and immigrant aid organizations. Recruitment took place via our partner organization's connections in Central Florida and via promotion on radio, television, and social media. We conducted community-engaged research where our community partners and community advisory boards provided input at every stage of the survey design, including the identification of relevant constructs and the evaluation of the linguistic and cultural appropriateness of items. The survey took approximately 60 min to complete, and it included topics related to demographics, migration-related cultural stress, acculturation, prosocial behavior, religiosity, and behavioral health outcomes. Participants who completed the survey received a \$100 incentive and were eligible for secondary incentives for referring eligible individuals who joined the study (\$30 per successful referral, up to five referrals). Bilingual study staff members were available to help participants access the online survey whenever participants requested support. Because of the COVID-19 pandemic, all data were collected online using Qualtrics survey software. English and Spanish versions of the survey were pretested and made available; however,

all Adelante Boricua participants (included in this manuscript) elected to complete the survey in Spanish.

Measures

All measures described below were translated and back translated by bilingual Spanish speakers familiar with the nuances of Puerto Rican Spanish and, subsequently, examined in cognitive interviews conducted with Puerto Rican individuals residing in the U.S. and in Puerto Rico. Any items that prompted confusion were carefully examined in conversation with our community partners and community advisory board comprised of leaders within the Puerto Rican migrant communities in Central and South Florida.

Trans-territorial communication

As shown in Table 1, we used 12 items to measure communication with family and friends in the U.S. and Puerto Rico. These items built upon the work of Salas–Wright, Vaughn, et al. [12] who previously adapted items from the Health Behavior of School-Age Children questionnaire [14, 15]. Three core questions were repeated with respect to four

Table 1 Self-reported trans-territorial communication

	Never or almost never [Casi nunca o nunca]	Less than weekly [Menos de una vez a la semana]	Weekly [Semanalmente]	Every day [Todos los días]
	%	%	%	%
United States				
How often do you communicate with friends in the United States via				
<i>[¿Qué tan frecuente usted contacta a sus amistades que viven en los Estados Unidos por?]</i>				
Phone/voice [Teléfono o video llamadas]	21.9	24.5	37.8	15.9
Text message/chat [Mensajes de text o chat]	13.8	22.2	36.9	27.2
Social media [Redes sociales]	33.2	18.8	29.2	18.8
How often do you communicate with family in the United States via				
<i>[¿Qué tan frecuente usted contacta a sus familiares que viven en los Estados Unidos por?]</i>				
Phone/voice	16.9	25.2	35.9	22.1
Text message/chat	14.9	22.2	37.5	25.4
Social media	35.3	17.1	29.7	17.8
Puerto Rico				
How often do you communicate with friends in Puerto Rico via				
<i>[¿Qué tan frecuente usted contacta a sus amistades que viven en Puerto Rico por?]</i>				
Phone/voice	17.3	26.6	35.9	20.2
Text message/chat	12.8	26.8	39.5	20.9
Social media	30.8	22.3	30.8	16.1
How often do you communicate with family in the Puerto Rico via				
<i>[¿Qué tan frecuente usted contacta a sus familiares que viven en Puerto Rico por?]</i>				
Phone/voice	9.4	17.1	40.0	33.6
Text message/chat	10.1	16.0	37.3	36.6
Social media	32.9	15.1	27.3	24.7

reference groups: friends in the U.S., family in the U.S., friends in Puerto Rico, and family in Puerto Rico. Specifically, participants were asked “How often do you communicate with [friends/family] in [the U.S./Puerto Rico] via” phone/voice (e.g., FaceTime or WhatsApp), text/chat (e.g., WhatsApp or Facebook Messenger), and social media (e.g., Instagram or Snapchat). Response options for each question included “almost never/never” (1), “less than weekly” (2), “weekly” (3) and “daily” (4).

Depressive symptoms

We used the Boston form of the Centers for Epidemiologic Studies Depression Scale [16]. This measure tapped into depressive symptoms, such as listlessness, anhedonia, and lack of interest in activities, during the week prior to assessment. Sample items included “I felt depressed” and “I felt like everything I did required a lot of effort” with response options including “rarely or never” (1), “sometimes” (2), “often” (3), and “almost always” (4).

We examined internal consistency with all 10 items and observed that the two positive items (“I was happy” and “I enjoyed life”) had item-rest correlations of 0.05 and -0.04 , and standardized loadings of 0.17 and -0.06 , whereas all other items had correlations in the range of 0.59–0.82. Based on these very low item-total correlation values, we removed these two items. Our finding with regard to these reverse-keyed items is similar to observations made by other researchers working with minority or international samples [17]. Notably, these two items were the only two positively phrased items in the Boston form of the CES-D. Prior validation work indicated that switching between positively and negatively phrased items can result in confusion and, ultimately, poor psychometric performance, especially in populations with lower overall levels of formal education [18]. Cross-cultural research using the CESD-10 has also found that the two positively phrased items perform differently than the remainder of the items, and have cautioned researchers to carefully consider their appropriateness [17]. Using the resulting 8-item version, Cronbach’s alpha was 0.89 in the present sample.

Wellness and strengths

Three measures were examined in the domain of wellness and strengths: prosocial behavior, intrinsic religiosity, and religious service attendance.

Prosocial behavior Prosocial behavior ($\alpha=0.90$) was measured using an adapted version of the Prosocial Tendencies Measure-Revised [19]. To reduce respondent burden, we used only the Dire (4 items) and Emotional (4 items) subscales from the Prosocial Tendencies Measure [20].

This measure included self-reported behaviors in various domains (e.g., public, anonymous, altruistic) and has been used widely with Latin American populations [21, 22]. Sample items include “I tend to help people who are in a real crisis or need” or “when people ask me to help them, I don’t hesitate” with response options ranging from “does not describe me at all” (1) to “describes me greatly” (5).

Intrinsic religiosity and religious service attendance Intrinsic religiosity ($\alpha=0.89$) was self-assessed using the Santa Clara Strength of Religious Faith Questionnaire: brief form, a multicultural assessment tool consisting of 5 items [23]. Sample items include “I pray daily,” and “I look to my faith as a source of inspiration” with response options including “strongly disagree” (1), “disagree” (2), “agree” (3), and “strongly agree” (4).

We also examined religious service attendance using the following prompt: “During the past 12 months, how many times did you attend religious services? Please do not include special occasions, such as weddings, funerals, or other special events in your answer.” Response options included “never” (1), “sometimes/two or three times per year” (2), “monthly” (3), “several times monthly” (4), and “weekly or more” (5). This item was adapted from a commonly used measure included in the National Survey on Drug Use and Health (see [24, 25]).

Cultural connection

Three measures were examined in the domains of cultural connection: involvement in U.S. activities, involvement in Puerto Rican/Latin American activities, and the degree to which individuals miss living in Puerto Rico.

U.S./Puerto Rican activities

An adapted version of the Bicultural Involvement Questionnaire (BIQ; [26]) was used to measure involvement in U.S./Puerto Rican Activities. The BIQ consists of two subscales: the U.S. subscale ($\alpha=0.92$) measured affinity for U.S. social behaviors (e.g., music, television, venues), and the Puerto Rican subscale ($\alpha=0.93$) measured affinity with Puerto Rican/Latino social behaviors—in the present study, we refer to the former as “U.S. activities” and the latter as “Puerto Rican activities.” For both subscales, response options ranged from “not at all” (1) to “very much” (5).

Miss living in Puerto Rico

A single item was used to measure the degree to which respondents missed life on the island: “How much do you miss living in Puerto Rico?” Response options included “I don’t miss it at all” (1), “I miss it sometimes” (2), “neutral”

(3), “I miss it” (4), and “I miss it a lot” (5). This straightforward item was developed based on feedback from our community partners and community advisory board.

Migration stress

Consistent with cultural stress theorizing (see [27, 28]), migration stress was measured via three constructs: negative context of reception, discrimination, and limited English proficiency.

Negative context of reception We measured negative context of reception ($\alpha=0.84$) using the 6-item Negative Context of Reception Scale [29]. Negative context of reception examines the degree to which migrants perceive that their group is unwelcome or mistreated on the basis of its cultural or national identity [29, 30]. Sample items include “People from Puerto Rico are not welcome here” and “People from this country regularly criticize Puerto Ricans.” Participants responded to each item using a 5-point scale ranging from “strongly disagree” (1) to “strongly agree” (5).

Discrimination We measured discrimination using Phinney, Madden, and Santos’s [31] seven-item self-reported discrimination instrument ($\alpha=0.95$). This measure assessed the frequency of being treated negatively by employers or not being accepted due to the person’s national origin or ethnicity. Sample items include: “How often do employers treat you unfairly or negatively because you are Puerto Rican?” and “How often do other people (such as police and shopkeepers) treat you unfairly or negatively?” Participants responded to each item using a 5-point scale ranging from “not at all” (1) to “almost every day” (5). Notably, negative context of reception and discrimination are distinct constructs as the former identifies general perceptions around one’s group whereas the latter captures direct experiences of identity-based mistreatment.

Limited English proficiency We assessed limited English proficiency using one question: “How well do you speak English?” Response options include “very little” (1), “little” (2), “well” (3), and “very well” (4). Response options were reverse coded to emphasize the language-related challenges experienced by many Maria survivors.

Demographic factors

Participant age (continuous), gender (male = 0, female = 1), and year of arrival in the U.S. (2017–2020) were included as indicator covariates in the latent modeling and control variables in the multinomial regression analysis.

Data analysis

Data were analyzed using a three-step approach. First, we identified a sequence of latent profile models ranging from one to seven classes using Latent GOLD[®] 5.1 software [32]. The twelve trans-territorial variables (i.e., how often do you communicate with (a) friends in the U.S. via phone/voice, text/chat, and/or social media; (b) family in the U.S. via phone/voice, text/chat, and/or social media; (c) friends in Puerto Rico via phone/voice, text/chat, and/or social media; and (d) family in Puerto Rico via phone/voice, text/chat, and/or social media) were specified as indicator variables with demographic variables specified as indicator covariates. Then, we used five statistical criteria to identify the best fitting model: the Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), Consistent Akaike Information Criterion (CAIC), log likelihood (LL), and entropy. All things being equal, lower BIC, AIC, and CAIC values and higher LL values reflect better model fit. Higher entropy values—approaching 1.00—indicate clear class delineation [33]. Latent Gold does not provide a likelihood ratio test, so this was not included as a factor in determining the number of classes for the final solution. When selecting the best fitting model, analysts should also consider parsimony (preferring solutions with fewer classes unless additional classes provide increased explanatory value) and the substantive interpretability of the solution. After modeling the latent classes, multinomial regression was conducted—with the nominal class solution specified as the dependent variable—using Stata 16 SE to examine key correlates of class membership while controlling for demographic factors.

Results

Participants in the present study were 319 adult Hurricane Maria survivors (71% women, $M=38.7$ years, $SD=12.1$ years, range 18–77, 80% under age 50) residing on the U.S. mainland. In terms of year of arrival, 59.3% of participants arrived on the U.S. mainland in 2017, 29.2% in 2018, 6.3% in 2019, and 3.8% in 2020. Most participants in this study (75.3%) were living in Central Florida at the time of data collection, with Orlando (41.9%) and Kissimmee (20.8%) being the areas where most Hurricane Maria survivors resided. Participants were also referred or recruited from Texas (6.3%), the New England states (3.8%), Illinois (3.2%), Delaware (1.9%), South Carolina (1.9%), and other U.S. locations (7.6%).

Latent classes

The latent class analysis indicated that a five-class solution was the best fitting model (see Table 2). A four-class solution

Table 2 Fit indices for latent classes

# Class solution	Log likelihood/LL	Bayesian information criterion/BIC	Akaike’s information criterion/AIC	Consistent Akaike’s information criterion/CAIC	Entropy R^2
1-Class	– 4785.87	9779.29	9643.75	9815.30	–
2-Class	– 4252.94	8799.90	8607.88	8850.90	0.90
3-Class	– 4058.75	8498.01	8249.51	8564.01	0.89
4-Class	– 3906.42	8279.82	7974.84	8360.82	0.92
5-Class	– 3836.86	8227.18	7865.72	8323.18	0.92
6-Class	– 3788.16	8216.26	7798.32	8327.26	0.91
7-Class	– 3727.66	8181.73	7707.31	8307.73	0.89

was a possibility in terms of statistical criteria; however, the four-class solution omitted a conceptually coherent and distinct class (see Class # 4 below), and the fit statistics for the five-class solution were acceptable. The conceptual fit of the latent profile models was examined by plotting the mean values for the twelve communication variables by each of the latent classes (see Fig. 1). Using the five-class solution, χ^2 tests for contingency tables with the five classes and each indicator variable (e.g., phone: friend, US) were significant at $p < 0.001$ for all of the indicator variables. We provided descriptive names for each of the classes based upon our interpretation of the “shape” of each class. A description and explanation of the five classes follows here:

Class # 1: moderate communication

This class comprised 32% of the sample and was characterized by engaging with friends and family in the U.S. and Puerto Rico slightly less than weekly via phone call, text message, and social media.

Class # 2: disengaged

This class comprised 24% of the sample. The Disengaged class was characterized by low levels of engagement with family and friends either in the U.S. or Puerto Rico via phone call, text message, or social media. Participants in

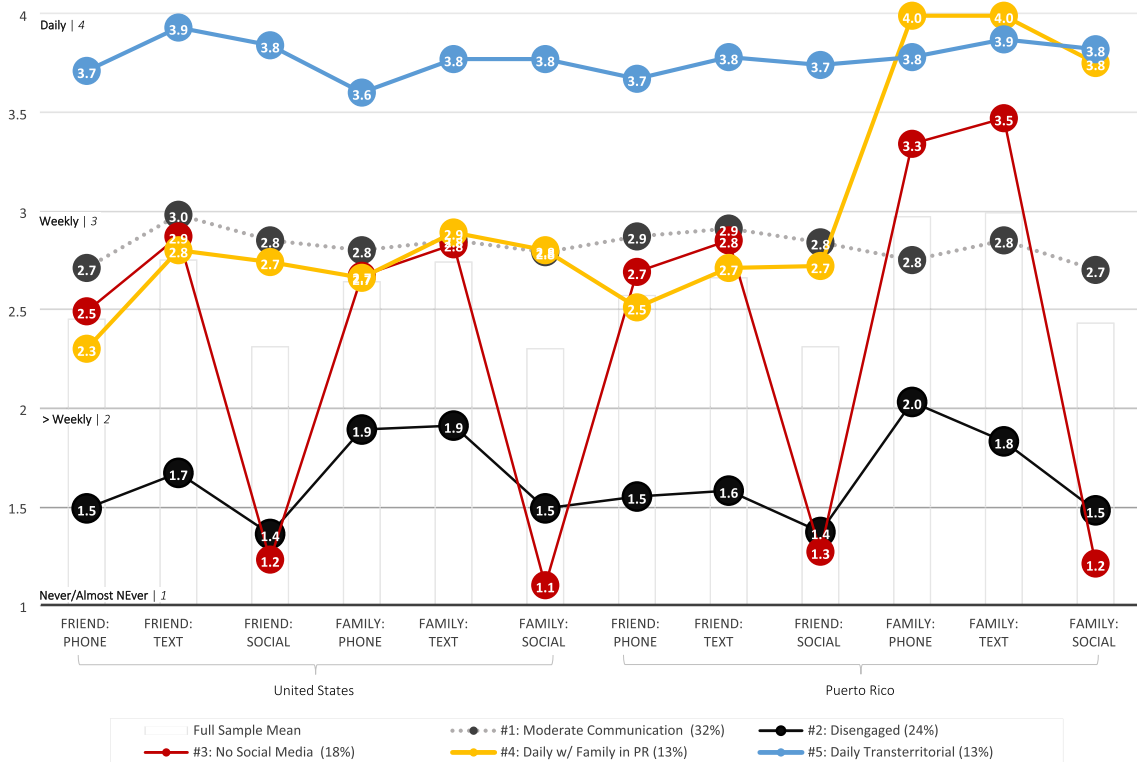


Fig. 1 Patterns of phone, text, and social media communication, by latent class

this class were slightly more likely to engage with family members in the U.S. and Puerto Rico, compared to engagement with friends.

Class #3: no social media

This class comprised 18% of the sample and it was characterized by slightly less than weekly levels of engagement with family and friends in the U.S. and with friends in Puerto Rico via phone and text. A particular feature of participants in this class is that they were entirely unengaged in social media.

Class # 4: daily with family in Puerto Rico

This class comprised 6% of the sample and it was characterized by having slightly less than weekly contact with family and friends in the U.S. and with friends in Puerto Rico via phone call, text message, and social media. What makes this class different than others is that this class also was characterized by having daily contact with family members in Puerto Rico through phone calls, text messages, and social media.

Class # 5: daily trans-territorial

This class was made up by 13% of the sample and was characterized by close to daily levels of engagement with family and friends in the U.S. and in Puerto Rico through phone calls, text messages, and social media.

Demographic characteristics of classes

Compared to participants in Class #1 (Moderate Communication), which was used as the reference class, members of the Disconnected class were more likely to be older ($M=41.5$, $SD=13.3$, $RR=1.04$ [95% CI 1.01–1.06]) and more likely to have moved to the U.S. shortly after Hurricane Maria ($RR=1.61$ [95% CI 1.01–2.58]). Members of Classes # 3 (No Social Media; 83.6%; $RR=2.94$ [95% CI 1.23–7.05]) and # 4 (Daily with Family in Puerto Rico; 86.7%; $RR=3.72$ [95% CI 1.41–9.77]) were significantly more likely to be female. Supplemental t tests revealed that—for the full sample—no differences were observed in terms of social media utilization between male and female respondents. No other demographic differences emerged between classes.

Psychosocial characteristics of the trans-territorial communication classes

Table 3 displays the intrapersonal and contextual characteristics of participants in Classes #2–5 as compared to

participants in Class # 1, which was used as the reference class. Participants in the Disconnected class were more likely to have reported higher levels of depressive symptoms ($RR=1.67$ [95% CI 1.06–2.64]), compared to participants who maintained moderate levels of communication with their families and friends in the U.S. and Puerto Rico. Participants in the Disconnected class also were less likely to engage in prosocial behaviors ($RR=0.55$; [95% CI 0.37–0.83]), to report lower levels of religiosity ($RR=0.50$; [95% CI 0.32–0.77]), and less likely to attend religious services in the U.S. ($RR=0.73$; [95% CI 0.58–0.93]), compared to participants in the Moderate Communication class. We also found that participants in the Disconnected class were less likely to enjoy American ($RR=0.55$; [95% CI 0.39–0.77]) and Puerto Rican ($RR=0.67$; [95% CI 0.46–0.97]) activities, and less likely to report missing living in Puerto Rico ($RR=0.79$; [95% CI 0.63–0.99]), compared to participants in the Moderate Communication class. Finally, participants in the Disconnected class were more likely to report limited English proficiency ($RR=1.71$; [95% CI 1.25–2.35]) compared to participants in the Moderate Communication class.

Participants in the No Social Media class were less likely to enjoy Puerto Rican activities ($RR=0.65$; [95% CI 0.43–0.98]) or to miss living in Puerto Rico ($RR=0.77$; [95% CI 0.60–0.99]), compared to participants in the Moderate Communication class. Participants with daily communication with family in Puerto Rico were less likely to enjoy American activities ($RR=0.63$; [95% CI 0.43–0.93]), compared to participants in the Moderate Communication class. Finally, participants in the Daily Trans-Territorial class were less likely to perceive discrimination ($RR=0.50$; [95% CI 0.31–0.79]).

Discussion

The present study provides new evidence as to how Puerto Rican Hurricane Maria survivors develop and maintain—to various degrees and in various configurations—technology-based connections with friends and family in their new-receiving context and in Puerto Rico. Critically, findings also shed new light on how such communication intersects with wellness, cultural connectedness, migration stress, and mental health. The first key finding is the identification of five distinct subtypes of Puerto Rican migrants on the basis of trans-territorial communication. Simply, we did not see an ordinal layering of trans-territorial communication variables (e.g., low, medium, high), but rather the person-centered analysis suggests that substantively distinct configurations of communication exist. For instance, we found that roughly one-third (32%) of our sample maintains “Moderate Communication” (slightly less than weekly, on average) with

Table 3 Intrapersonal and contextual characteristics of latent classes

	#1: Moderate communication (<i>n</i> = 103; 32%)			#2: Disconnected (<i>n</i> = 76; 24%)			#3: Moderate, no social media (<i>n</i> = 55; 18%)			#4: Daily w/family in Puerto Rico (<i>n</i> = 45; 6%)			#5: Daily transterritorial (<i>n</i> = 40; 13%)			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>RR</i>	95% <i>CI</i>	<i>M</i> (<i>SD</i>)	<i>RR</i>	95% <i>CI</i>	<i>M</i> (<i>SD</i>)	<i>RR</i>	95% <i>CI</i>	<i>M</i> (<i>SD</i>)	<i>RR</i>	95% <i>CI</i>	<i>M</i> (<i>SD</i>)	<i>RR</i>	95% <i>CI</i>
Depression																
CESD mean	1.68 (0.6)	1.91 (0.7)	1.67	1.06–2.64	1.82 (0.7)	1.39	0.83–2.33	1.74 (0.5)	1.14	0.65–2.00	1.54 (0.6)	0.68	0.36–1.29			
Wellness/strengths																
Prosocial	4.06 (4.1)	3.71 (0.8)	0.55	0.37–0.83	4.12 (0.6)	1.03	0.63–1.66	4.18 (0.7)	1.10	0.64–1.88	4.27 (0.7)	1.60	0.91–2.82			
Religiosity	3.23 (0.7)	2.97 (0.8)	0.50	0.32–0.77	3.19 (0.8)	0.72	0.43–1.18	3.13 (0.7)	0.69	0.40–1.17	3.28 (0.8)	1.09	0.63–1.89			
Religious services	2.56 (1.38)	2.11 (1.33)	0.73	0.58–0.93	2.53 (1.56)	0.91	0.71–1.15	2.44 (1.44)	0.90	0.69–1.17	2.73 (1.4)	1.10	0.85–1.43			
Cultural connection																
US Activities	3.53 (1.0)	2.95 (0.9)	0.55	0.39–0.77	3.20 (0.8)	0.74	0.52–1.05	3.09 (1.1)	0.63	0.43–0.93	3.81 (1.1)	1.34	0.91–1.97			
PR activities	4.36 (0.7)	4.12 (0.9)	0.67	0.46–0.97	4.16 (0.9)	0.65	0.43–0.98	4.34 (0.9)	0.83	0.52–1.33	4.59 (0.6)	1.64	0.92–2.92			
Miss living in PR	3.97 (1.3)	3.60 (1.3)	0.79	0.63–0.99	3.51 (1.3)	0.77	0.60–0.99	3.95 (1.4)	1.02	0.77–1.35	4.3 (1.1)	1.24	0.89–1.72			
Migration stress																
Negative context	2.51 (0.7)	2.62 (0.8)	1.12	0.76–1.65	2.31 (0.7)	0.69	0.45–1.05	2.40 (0.8)	0.82	0.52–1.29	2.24 (0.9)	0.64	0.40–1.02			
Discrimination	2.27 (0.9)	2.34 (1.0)	1.04	0.75–1.43	2.07 (0.9)	0.75	0.52–1.09	1.98 (0.8)	0.69	0.46–1.04	1.76 (0.8)	0.50	0.31–0.79			
Limited english	2.54 (1.0)	3.14 (0.9)	1.71	1.25–2.35	2.76 (1.0)	1.12	0.81–1.56	2.69 (1.0)	1.11	0.78–1.57	2.65 (1.1)	1.08	0.76–1.55			

Class # 1 is reference class

M mean value for latent class, *SD* standard deviation, % proportion of latent class, *RR* risk ratio, *CI* confidence interval

friends and family in the U.S. and in Puerto Rico via phone, text, and social media. We also identified subgroups defined by no engagement on social media (18%), daily contact with family in Puerto Rico (6%), and daily trans-territorial contact with friends and family in the U.S. and in Puerto Rico (13%).

Beyond the modeling of heterogeneity in general, the second key finding is that nearly one-quarter (24%) of our sample was classified as “Disconnected.” Members of this class reported infrequent communication with friends/family in the U.S. and, to a slightly lesser degree, with loved ones in Puerto Rico. In simple terms, these individuals—who we found to be somewhat older (25% were age 50+) and migrated almost exclusively in 2017 or 2018 (97%)—are quite isolated in terms of technology-based communication. Close inspection revealed that this “Disconnected” group is distinct from the rest of our sample in several important ways. They are less likely to report prosocial behavior, less likely to be religious or attend religious services, and are less likely to enjoy activities (music, entertainment, social events) that are rooted in Puerto Rican or U.S. culture. We also found that members of this “Disconnected” group were more likely to report limited English language ability yet—somewhat paradoxically—less likely to miss living in Puerto Rico. This relatively large group seemed to be disconnected not only from technology-based communication, but also from other key social and cultural aspects of life. It is perhaps unsurprising that rates of depressive symptoms were especially elevated among this profoundly isolated subgroup. Although we are unable to draw further conclusions based on our data, one possibility for the level of disengagement of this class may be a function of their relatively elevated median age as well the fact that members of this class migrated shortly after the hurricane, which may suggest that a health condition and the need for stateside medical care may have been an important driver. Future studies should try to better understand the social support, employment status, and service access among Hurricane Maria survivors (as well as survivors of other natural disasters) to better understand the characteristics of this disconnected group.

Other noteworthy findings relate to characteristics of the other latent subtypes. For instance, we found that members of the “Daily Trans-Territorial” class were substantially less likely to report having experienced discrimination. Although our data do not allow us to determine why this is the case, several possibilities exist. For one, it is possible that members of this class are outside of the workforce and therefore less exposed to discrimination. Alternatively, it may be that members of this class are especially open to frequently engage with friends and family in the U.S. because they have experienced less discrimination. Another noteworthy finding—which is arguably more straightforward to interpret—is that members of the “Daily with Family in Puerto

Rico” class are less likely to enjoy engagement in U.S.-style social activities. This finding seems consistent with a class defined by close/daily connection with family back home in Puerto Rico. In other words, it may be that members of this class remain especially connected with key people and practices that reflect the rich cultural heritage of the island. A final important finding is that there were no differences on depression, wellness, or migration stress between the moderate communication and no social media classes, suggesting that perhaps the level of communication that people have with their families and friends is what is important, regardless of the method of communication.

Implications for practice and research

Findings have several implications for practice. One is that mental health clinicians and other helping professionals tasked with supporting migrant populations would do well to be mindful to assess technology-based trans-territorial communication [11]. This objective is perhaps most important in terms of identifying individuals who are disconnected from the post-migration context and may be at risk of experiencing mental health problems. Among individuals who appear to be disconnected, it may make sense to explore options for developing connections with others in their new-receiving context or finding ways that such individuals can benefit from the positive elements of social engagement. For instance, given that members who appear to be disconnected also reported limited English language ability, promoting English learning courses could help to decrease their isolation levels. State and local governments can also promote the engagement and resettlement process of Hurricane Maria survivors by providing job development trainings, as well as increased access to health and mental health care. Moreover, it is important to identify ways that disconnected participants can be reached, particularly by health, mental health providers, and community organizations.

In terms of implications for research, this last point also speaks to the need for future research to understand the dynamics involved in trans-territorial communication. Among individuals who are most disconnected, there is a need to understand what is driving this disconnection. Are disconnected individuals temperamentally predisposed to isolation? Do they struggle with technology or lack the resources (e.g., a smartphone or tablet) that can facilitate such communication? Do they have strained relationships with friends and family in Puerto Rico? Do they have different traumatic experiences from the hurricane that are making it more difficult to socialize? Do they have more physical health issues that may make it more difficult to socialize? Although we are not able to explore these questions in the present study, qualitative research has the potential to provide the richness and texture necessary to address

such questions. Mixed methods research with individuals in other classes—such as the Daily Trans-Territorial and Daily with Family in Puerto Rico classes—would also help us to understand not only the frequency of communication, but the quality and nature of how people interact via phone, text, and social media.

Study limitations

Findings from the present study should be interpreted in light of several limitations. First, our sample is limited to Puerto Ricans who migrated to the U.S. mainland after Hurricane Maria; therefore, their experiences are not representative of the larger Puerto Rican population. Second, the use of a cross-sectional design indicates that causal relationships cannot be established—for example, limited communication could lead to higher depressive symptoms, or depressed individuals may communicate less with their social networks. Third, we measured structural aspects of communication (i.e., frequency), but we did not assess the content of this communication and do not have information on the nature or quality of the communication. The associations between trans-territorial communication and psychosocial outcomes may depend on the content of what is being communicated as well as on the frequency of contact. Fourth, lack of data on employment status, social support, and physical health pre- and post-migration limits our ability to draw conclusions about what may be impacting or driving levels of communication with family and friends in the U.S. and in Puerto Rico. Finally, the present study was conducted during the context of the COVID-19 pandemic, and public health guidelines and social distancing may have impacted people's communication habits and their psychosocial functioning.

Conclusion

Several years after Hurricane Maria upended the lives of countless Puerto Ricans, our findings provide new insight into the experiences and adaptation of Maria survivors who relocated to the U.S. In particular, person-centered analysis revealed substantial variation in terms of how members of this displaced population communicate with friends and family, both in their new-receiving context and back home in Puerto Rico. Of particular relevance, we found that roughly one in four individuals in our sample reported very limited technology-based communication with friends/family in their sending and new-receiving communities. Members of this class were at elevated risk of experiencing depressive symptoms and tended to experience isolation across the domains of wellness/strengths and cultural connection. As technology and smartphones continue to become integrated into 21st-century life, it is vital that researchers explore how

the tremendous potential for connectedness relates to the well-being and adaptation of migrants.

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Data availability The data that support the findings of this study are available upon reasonable request from the corresponding [MPL], second [CPSW], or senior authors [SJS].

Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval All study procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments and were approved by the Institutional Review Board at the University of Miami (Ethics approval number: IRB0053570).

Consent to participate Before initiating the survey, all participants consented to be part of the study.

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