The Parenting Actor-Network
of Latino Immigrants in the United States

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ABSTRACT

The field of Human-Computer Interaction (HCI) has shown a growing interest in how technology might support parenting. An area that remains underexplored is the design of technology to support parents from nondominant groups in positively impacting their children's education. Drawing on Actor-Network Theory (ANT), our paper takes a sociotechnical view of low-income Latino Spanish-speaking immigrants in the U.S.—a large nondominant group—attempting to form alliances with other actors such as teachers, the broader community, and technology to exchange information that might enrich their children's education. The use of ANT allowed us to advance work on parenting in HCI by providing a deeper understanding of the reasons—including attributes embedded in technology—impacting the quality of information channels in the parental engagement network of a nondominant group. Further, our ANT analysis illuminates a discussion of challenges and opportunities for technology to intervene in the network in ways that align with all actors' needs and harness their potentialities.

KEYWORDS

Parenting; Latino; Education; Actor-Network Theory

1 INTRODUCTION

People immigrating to high-income countries looking for a better future is a prevalent global phenomenon [54]. However, immigrant parents—especially those from a low-income background—usually struggle to ensure that their children harness educational opportunities for achieving such aspired future [9, 14, 16, 35]. Information and Communication Technologies (ICTs) could support these parents by facilitating access to learning-related information for enriching children's academic experience [5, 28, 66]. The field of Human-Computer Interaction (HCI) has a growing interest in how technology might support parents. Much of this work, however,

has focused on parents from dominant groups (e.g., middle-class natives) and their interaction with social media and mobile technologies for non-educational purposes (*e.g.,* finding support, protecting their children's privacy, and others) [1, 3, 7, 36, 46]. We extend this work by studying if and how technology might support low-income Spanish-speaking Latino [1] immigrant parents in the United States (U.S.)—a large nondominant [2] group in the country–towards positively impacting their children's education.

Despite Latinos' prevalent presence in the U.S. [11], they face a historically persistent low academic achievement rate [10, 71]. Latinos' appreciation towards mobile technologies as a catalyst for learning [27] suggests these parents could adopt ICTs for ensuring their children's academic success. Building upon Carreon et al.'s educational research on parental engagement as a relational phenomenon taking place both within and beyond schools [13], we present findings from a 1.5-year ethnographic study of Latino parents as actors in a sociotechnical network, interacting with a wide range of other actors—including technology—to form and maintain information channels for better supporting their children's education. Our goal is to illuminate ways for technology to diversify and strengthen these information channels, so that parents can access more and richer resources to shape their children's academic life.

To unpack the inner workings of the parental engagement network, we analyze our data using Actor-Network Theory, a framework that highlights how human and non-human actors negotiate their interests to form stable alliances—or fail in their attempts to do so [8, 12, 75]. Our use of ANT facilitates two important contributions to previous work on HCI and nondominant parents, an emergent area of interest for the field [23, 60, 79]. First, ANT illuminates the role that different actors (besides parents and including technology), have in enabling or hindering parents' access to information for diversifying their parental engagement strategies. Second, by unearthing each actor's interests—including technology's—and the reasons why these interests align (or not), our ANT analysis illuminates challenges and opportunities for designing technology that can strengthen parental engagement among immigrant groups in the U.S. and other contexts.

2 RELATED WORK

We now situate our research in HCI work on parenting and families from nondominant groups. We also define our view of parental engagement as a sociotechnical system and describe how Actor-Network Theory illuminates our analysis.

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[1]We use the term Latino rather than Hispanic or Latinx because that is the term our participants used to self-identify.

[2]Drawing from educational scholars such as [33], we use the term *nondominant* rather than terms such as marginalized or underserved to highlight the power relations between those who are in power and those who, despite their growing census numbers, are not.

2.1 Nondominant Families and Technology

Parents' efforts to enrich their children's learning experiences can make an important difference in children's ability to succeed at school and beyond [5, 6, 14]. Despite their efforts to support their children, parents from nondominant groups face significant barriers as they work towards that goal [22, 56, 74]. Heavily guided by practices from their original cultural contexts, Latino immigrants, for example, tend to put more effort on supporting their children's academic work at home (*e.g.,* sharing personal stories of sacrifice to motivate children to study, finding children a quiet workplace to study in an overcrowded home, and constantly using words of encouragement) rather than enriching their children's learning with a diversity of opportunities [13, 16, 35, 50, 57]. Further, intersecting factors (*e.g.*, language, culture, power structures, and ethnic stereotypes) still hinder the capacity of American schools to build communities where Latino immigrants can discuss learning opportunities with other parents and teachers [13, 39, 57]. As a result, there is a stark and persistent academic gap between Latino and their European American and African American peers [10, 71].

Careful design and application of ICTs could help by diversifying the learning resources that parents can access. Work in HCI has shown a growing interest in how technologies can support parenting, exploring how parents go online to seek social support [4, 46], construct a new parenting identity [3, 65], build capital [37, 80], and access parenting resources [2], among other purposes [1, 29, 64, 76]. Most of this work, however, has predominately studied middle- or higher-SES and non-immigrant families, thereby limiting its application for design endeavors only to those dominant groups.

As the binary divide between "haves"/"have nots" in terms of technology access keeps narrowing [15], research on nondominant communities and technology has moved to rather explore the inequities these communities experience when attempting to maintain [30] and harness online connectivity [20, 34, 51, 73]. With regards to nondominant families, this field has studied how parents and children adopt new technologies [31, 40, 49], emphasizing children's role in how families' use media [38, 39] and access online information [38, 59, 81, 81]. There is also emergent research on how technology could support these families' engagement in children's education [21, 23, 62, 72, 77]. Levinson and Barron, for example, observed how Latino parents and children used educational-related tablet apps and concluded there is much potential in these engagements for bridging the home-school disconnect [48, 49]. DiSalvo et al. stressed fear both towards technology and social interactions as a key factor preventing parents from nondominant groups to access online (and offline) learning resources [23]. Wong-Villacres et al. found that existing parent-school communication technologies tend to perpetuate such fears by reinforcing power structures [77]. We extend this body of work by providing a detailed account of parents' information-related struggles to engage in their children's education, at home, school, and beyond. From there, we identify considerations for technology to better respond to parents' complex, everyday realities.

2.2 Parental Engagement as an Actor-Network

Working with immigrant parents in American schools, educational researchers Carreon et al.'s proposed a shift in understanding how parents support their children's education [13]. Rather than studying whether parents are performing the involvement activities schools expect them to, they argued to understand parents' participation as the visible and invisible efforts that parents already make in and outside of schools, across an ecology of parental engagement. Drawing from their work, we study how parents dynamically interact with a network of individuals and resources to support their children. To analyze this sociotechnical system and identify the quality of the information exchanges that it supports, we use the ANT theoretical approach. ANT fundamentally rejects dwelling on the analysis of what is social and what is technical [12, 44]. Instead, it attempts a deep understanding of how *human* and *nonhuman* actors align their *interests* and goals to form and maintain networks of *alliances* or *associations* [8, 45, 67]. From an ANT perspective, thus, both human and nonhuman actors have agency to establish and affect alliances; they all have interests and motivations. Non-human actors such as mobile apps, for example, might lack intentionality, but embed *attributes* conveying a particular discourse which can shape other actors' interpretations, thereby helping to maintain or break up associations [63, 75]. ANT's focus on interests' alignment allows uncovering the actions actors are willing to perform to translate their interests as well as to persuade others [12]. In doing so, ANT has the potential to unpack the complex reasons that lead to a *stable* or *unstable* network, or to one that fails to establish itself.

In HCI, the ANT framework has proven to be productive for understanding the creation and maintenance of various, different sociotechnical systems (e.g., cyberstructures [61], the mobile media consumption culture in India [42], and others [26, 32]). Our use of ANT enables us to gather a systemic view of the information flow across all actors—including technology—of the parental engagement network. Further, it helps us unearth the interests actors mobilize to form stable/efficient information channels, as well as the misalignments that lead to unstable or inexistent channels. From this understanding, we propose new pathways for technology to align with actors' interests, leading to a more efficient flow of information that diversifies parents' opportunities to support their children's education.

3 METHODOLOGY

To gain a holistic understanding of the parental engagement network of Latino immigrants, we conducted a multi-sited ethnography across 12 locations in urban Atlanta, U.S. from 01/17 to 05/18. Our field locations included five schools and the ESOL—English as a Second Language—department of a school district we will call Lakeside, one NGO (non-governmental organization) we will call Solidaridad, one religious organization we will call Alianza Religiosa, and four after-school centers. Participants included 30 parents and 25 staff members at the different locations we studied (6 school liaisons, 2 members of a school district's staff, 8 school teachers, and 9 members of supporting organizations). Recruited parents belonged to low-income groups [3], half of them held 1-2 jobs, and all had lived in the U.S. for 6 months to 17 years. These parents' educational attainment was generally low, with only 5 reporting to have finished high-school. A summary of our parent participants' demographics can be found in Table 1. With regards

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[3]Family income is less than twice the federal poverty threshold [25].

to the organization staff members we studied, all had a bachelor degree, and the majority were female (22 of 25) of Latino background (14 of 25).

#Parents	Gender	Age Group	Children's Age Group	Country of Origin
30	Female (28) Male (2) [4]	22-45	4-17	Mexico (27) El Salvador (1) Honduras (1) Ecuador (1)

Table 1: Summary of parent participant's gender, age range, their children's age range, and their country of origin

We collected our data across three distinct periods of time through semi-structured interviews and (participant/non-participant) observations. First, we studied an elementary school in Lakeside district. (1/17-5/17). Finding that most Latino parents did not attend school functions frequently, we visited Solidaridad y Alianza Religiosa, two supporting organizations targeting Latino families (8/17-12/17). The data we collected there revealed the key role of school liaisons and after-school programs in influencing parents' access to information. To access these stakeholders, we visited the ESOL department of the Lakeside school district (which manages the liaison staff), four schools the department staff recommended for learning about school liaisons' relationship with parents, and four after-school centers targeting Latino children. The Lakeside school district and the schools we studied were likely confident they were investing wisely in supporting Spanish-speaking families. Thus, we recognize our data might highlight practices that are not prevalent in less invested schools. Details of our field locations, including type of location, methods, types and number of participants, and hours invested are found in Table 2.

Throughout our fieldwork, we also attended events held by different schools/organizations: two college fairs targeting Latino families, one parenting workshop for low-income Latino parents, a school district's liaisons' meeting, and the International School Night at an elementary school we studied. We also participated for 20 hours as volunteers at a computer literacy training program that one of the institutions we visited offered to Spanish-speaking Latino immigrants.

All interviews and conversations lasted 45-90 minutes and took place in participants' language of preference (Spanish or English). The data we collected was in the form of field notes and audio recordings, which we transcribed, translated, and analyzed through an inductive, interpretive process [53]. We coded our data thematically to identify emerging patterns relevant to information management practices related to supporting children's education. The identified patterns (*e.g.,* "class-based issues in the Latino community", "teachers' detachment from parents' realities", "children mediating their own education") highlighted the need for a framework to describe the many entities present in our participants' surroundings, and the complexity of these entities' information exchanges. This led us to choose ANT as a framework for further guiding our analysis. With ANT in mind, we conducted another iteration of coding, focusing on identifying the human and non-human entities in the network,

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[4]The low participation of fathers in our study is representative of gender roles in most Latino households, where women are primary caretakers of children [70].

their interests and motivations for forming associations, and the stability—or lack thereof—of such associations.

Time	Location	Methods	Participants	Hrs
1/17 - 5/17	*Lakeside school district:* - 1 elementary school	Interviews / Conversations	- 8 teachers - 1 liaison - 9 parents	50
		Observations	50 parents	
8/17 - 12/17	*Across Atlanta:* - Solidaridad (NGO) - Alianza Religiosa (religious org.)	Interviews / Conversations	- 21 parents - 4 NGO staff	120
		Observations	120 parents	
1/18 - 5/18	*Lakeside school district:* - ESOL deparment - 2 elementary schools - 1 middle school *Across Atlanta:* - 4 after-school centers	Interviews	- 2 ESOL staff - 5 liaisons - 4 centers' staff	20
		Observations	120 parents	

Table 2: Details of data collection periods, including types of locations studied, methods, type and number of participants, and hours invested per research period

4 THE PARENTING NETWORK

Four main categories of actors emerged to define the network that parents navigate for managing the informational resources they need to support their children's education. These included the familial unit, the schooling environment, the community at-large, and the technology. We articulate the different interests they hold—many of them shaped by culture, language, and class—and how their alignment or misalignment determine the quality of the information channels these actors establish with each other.

4.1 The Familial Unit

There are three members of the familial unit who are central actors in the parenting network—mothers, fathers, and children. Different circumstances determine how mothers behave in the network, and how children—and sometimes fathers—become key information carriers between mothers and schools.

4.1.1 Mothers. As described in other studies, we found mothers more frequently managing information related to children's education [70]. We saw a pattern of mothers' information practices that we identify as three roles in the network. These roles are by no means permanent for they may evolve and overlap as the network does. The first was that of the *resourceful mother*, who engages with a wide variety of actors within and outside the school to build strong information channels that allow her to gather resources for helping her children. The second was the *trusting mother*, who tends to trust the school system as well as the capacity of her children to be independent learners, and thus, prefers to allow her children to mediate her relationship with the school. Parents enacting this role, however, build information channels with close networks outside school to secure additional support for their children. The third role was that of the *insecure mother*—new to some aspect of the

educational system and thus eager to access new information channels with different actors around her, but also highly susceptible to mistrusting these actors and the information they provide.

Rita is 37 years-old with three school-going children and often enacts the role of a *resourceful mother*. She emigrated from Mexico 15 years ago with no knowledge of English and a few years of school education. Over time, however, she learned that the only effective way to help her children was by engaging in improving her own education. She explained, "I learned English on the go, because I realized that if I cannot communicate with others, I cannot understand what my children need from me". For Rita, learning opportunities are available, and accessing them is more a matter of monitoring and creating the right information channels. Her experience with learning English illuminates her approach:

> Initially my kids' homework where 'en chino' [5] [in a completely foreign language (e.g., in Greek)] to me, but using translators and dictionaries, I started using homework as a way to learn new words. I also realized that watching TV and YouTube videos with my children helped me learn new expressions. Then I took classes that the school advertised and even learned more about computing. Another thing that helped me was losing the fear to talk to Americans, because when you talk to them they usually do not make fun of you but correct you and teach you new things.

Other parents' realities, however, force them to have different interests, hindering their ability to open and manage as many information channels in the way Rita does. Elena, a 35 year-old mother of four children (ages 4 to 16), is more at ease being a *trusting mother*. Like Rita, Elena arrived to the US from Mexico more than 15 years ago, and with a limited schooling background. For her, mobilizing the resources for being at school as frequently as Rita is not possible. For starters, transportation is a hurdle; she does not own a car nor knows how to drive. It is also hard for her to find someone to babysit her children when she leaves the house, and she finds it problematic—and expensive—to take the bus or cabs with her children. Besides, she does not speak English and does not feel comfortable trying to talk to teachers. Given her current inability to be at school and develop a closer relationship with teachers, she chooses to trust them, trying to align her interests with theirs. This is even more the case now that teachers are using mobile technologies to push information to parents. As Elena said: "Teachers are always keeping me updated about what happens with the two little ones [ages 4 and 9], they keep sending me messages with information about what the kids have to do, about projects they need to work on, and even photos of what they are doing in the classroom."

Acknowledging her limitations with English, and education in general, Elena also chooses to trust her children's capacity to engage and navigate their education on their own as much as possible. She is particularly proud of her children becoming independent learners: "They pretty much do their homework on their own, and have done so ever since they started to go to school. I keep telling

them that it is their responsibility to understand what *la maestra* [the teacher] says, and ask questions to her when they need to". For Elena, engagement entails supporting this independence as much as possible by harnessing information channels with school and outside-school actors. Through teachers' remote messages, Elena monitors the status of her kids' to-dos, and is informed about possible modes of action when children need support (*e.g.,* buying a computer to support homework). Further, when her children need support, she accesses directly her close network (*e.g.,* her group of *vecinas* [female neighbors]) to organize meetings so that they can help each other's children with projects and homework.

When mothers encounter a new situation they do not know how to handle, we found many become extremely *insecure* about how to make sense of the information surrounding them. That was the case of 28 year-old Monica, for example. She recently immigrated to the United States from Mexico with her two boys (six and eleven years-old) and husband. Although she is more educated than Rita and Elena, the emotional and cultural burden of trying to help her children during these times of transition causes her to struggle with deciding what information channels to access and which to trust. Knowing that she needs information, she develops an interest for exploring every possible information channel she can (*e.g.,* teachers, school apps, school emails, other parents, neighbors). At the same time, cultural and linguistic clashes produces a misalignment between her and school information; thus, she ends up distrusting much of this information. This excerpt from a conversation between her and other parents reveals her insecurities in trying to decide how to act based on the information she has received:

> My 6 year-old is struggling with everything here. It has reached the point where he just does not want to come to the school anymore. Teachers say that he was very behind with school when he came in. I feel they are just being unfair to him because they keep saying he arrived knowing nothing, as if he had not attended school before, but that is not true. He went to school in Mexico for two years before we came. I have talked to everybody here, including Paula [the bilingual school liaison], to see how they can help me yet nothing changes. I think they do not care about helping Antonio [her son]. Did you all go through a similar experience?

Katz and Gonzalez found that immigrant parents' decision to adopt technologies are highly dependent on "localized structural and cultural forces" [40]. The cases of Rita, Elena, and Monica suggest that the motivation to choose certain information-seeking practices might be also dependent on their ever-changing immigrant circumstances (e.g., a trustful mother could become insecure when facing a new problem). Technology design, thus, might cater to these ever-changing needs. For example, technology could provide mothers like Elena with information channels that she currently cannot access (e.g., conversations with Americans). Further, parent-school technologies could minimize overloading mothers like Monica with information that could make her distrustful.

4.1.2 Fathers and Children. Our findings show that the collective media engagement that low-income immigrant families tend to practice [18, 62], often makes fathers and children responsible for mediating the relationship with schools. This mediation, however,

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[5]To recognize the decisions about cultural meanings that the translation process entails [69], we have kept certain terms—loaded with participants' assumptions, feelings, and values—in their original language.

can entail a misalignment of motivations that negatively impacts mothers' access to information. For example, Raul (30 years-old and a father of 3) is the only member of his household with an email account, which he set up to look for jobs. He is therefore in charge of letting his wife Gabriela know about any emails sent by the school. Since he is the only one with some knowledge of English between the two, he is also the one translating conversations between Gabriela and their children's teachers. Gabriela, however, often misses out on important information because Raul does not check his email often enough, or sometimes forgets to tell Gabriela about school news.

Given children's mastery of the English language and of technology, it is them, however, who are more often made responsible for mediating tasks [19]. As [38, 39] have shown, when helping their parents with everyday online tasks, children usually add value to the information they transfer. For example, 13 year-old Daniela taught Barbara, her mom, how to call her using WhatsApp so that they could talk without consuming voice plan's minutes; and 10 year-old Jose, explains to his mom the nuances of new words and expressions when she is helping with his homework. However, our findings show that, when having to translate school information to parents—such as grades and requirements to install new school apps—children tend to not enhance information in the same way. Oftentimes they are imprecise in explaining the meaning of information to their parents. In Daniela's case, for example, when Barbara asked her about an app teachers were asking Barbara to install, she vaguely replied "I think it has something to do with grades." Other times, children assume all control of school information without teaching their parents how to manage information on their own. By her mom's request, Angela, a 16 year-old girl, is in charge of the app for checking her younger sibling's grades. Angela's mom still does not know exactly what the app is for or how it works. Children's role as brokers entails many opportunities that might be harnessed for more effective information transfer [39]. At the same time, we found that, a misalignment of interests can make children behave like unreliable brokers where the end goal is to broker parent-school information/technologies.

4.2 The Schooling Environment

Key actors in the schooling environment who strongly impact parental engagement include teachers, bilingual school liaisons, and other parents. We describe them next.

4.2.1 Teachers. Teachers' connection to children, parents, and the educational world places them in a privileged position for accessing and conveying information that might support children at school and beyond. We saw two distinct roles that teachers enacted when managing information for children's well-being: the *information-publisher*, who provides parents with information that is typically disconnected from their child's familial context, and the *negotiator*, who provides information tailored to parents' constraints and abilities for supporting their children.

Dianne, a 27 year-old African-American fourth grade teacher in a school where 60% of students are Spanish-speaking, shows herself consistently interested in providing Latino children with the academic and emotional support they need to reject deficit-based views of their capacities. For example, when Pablo, 10 years old, struggled with math problems, Dianne advised:

I know you feel frustrated with Math sometimes, but that is because you have to struggle with two languages in your head, and that actually makes you smarter than many other kids in the classroom who cannot speak two languages and are still unable to solve the math problems you are able to solve.

Dianne, however, is not quite sure how to engage with Latino children's lives beyond school. Attempting to bridge cultural and linguistic gaps seems too daunting. Further, Latino parents are not as present at school as other parents. Her motivation to help leads her, thus, to support these parents by constantly *publishing information* for them through parent-school apps such as ClassDojo and parent portals. With the help of an interpreter, Dianne also lets these parents know details about their children's performance during parent-teacher conferences. Although her approach works for resourceful mothers like Rita—who are unafraid to voice their concerns—it can pose an obstacle for trusting and insecure parents who need information that fits their particular needs. Dianne, for example, was completely unaware that, after receiving the last report card, Pablo's mom had decided to quit her job and was now struggling to monitor Pablo's learning at home.

Like Dianne, Yaritza—a 31 year-old Latina fourth grade teacher at a school with 80% Latino students—deeply cares about at-risk Latino children. However, in contrast to Dianne, Yaritza is able to mobilize her cultural and linguistic capital to explore modes of support that better align with parents' realities. For example, she noticed how Carla, a recently immigrated 8 year-old Mexican girl, was deeply struggling with school. Rather than sending emails or messages through apps, Yaritza contacted Carla's mom on the phone to discuss and *negotiate* possible actions for Carla. Yaritza described this experience: "I asked her if Carla could attend after-school remediation classes and she refused. They don't have a car, and so she could not pick Carla up from school. I then offered to drop Carla at home myself and the mom accepted right away."

Both Dianne and Yaritza enact deep care towards Latino children and are willing to use resources (*e.g.,* an interpreter, technology, their native language) to support parental engagement. However, neither their care nor their ability to convey information to parents (even when it is in parents' native language) are enough to foster parental engagement. It is having information about parents' everyday contexts what can allow teachers to understand how to turn parents' limitations into opportunities.

4.2.2 Bilingual Parent Liaisons. The bilingual parent liaison's duty is to help teachers in their need for understanding parents' everyday context, and to help parents understand the school environment. In ANT's terminology, liaisons are expected to act as *mediators* who "transform, translate, distort and modify the meaning of the elements they are supposed to carry" [45]. However, the demand for highly-developed information management and social skills drives most liaisons to act as only as *partial*—rather than *full*—mediators, only transferring information between actors, without fully understanding their capacities and limitations.

Chabela has been working as a middle-school liaison for the last two years, and is still becoming familiar with the school. Her immigration experience was different from that of the parents she serves, and she struggles to understand the complexity of these

parents' realities. Interested in helping, but aware of her limitations, Chabela only feels capable of acting as a *partial mediator*, who transfers information, almost verbatim, from one source to the other. To do this, she relies on technology. For example, she uses Remind to send news about school events to all 500 Latino parents, translates newsletters and announcements that are later posted on the school's website, and makes phone calls to parents on teachers' requests to let parents know about their children's behavioral and/or academic issues. Although she does try to use her short interactions with parents to learn more about them, her still preliminary understanding of the school and parents impacts her ability to offer the support necessary. For example, she organizes events at school (such as ESOL workshops) that very few Latino parents (roughly 8 parents in a school with over 500 Latino students) take advantage of.

Veronica has been the bilingual liaison of a 95% Latino elementary school for 10 years. Her extensive experience with the community, mixed with her people skills and eagerness to expand her social network allows her to act as a *full mediator* between parents, schools, and the community outside the school. Like Chabela, Veronica relies on technology to push school-related news to all parents (*e.g.,* reminders about school events). However, to foster an information exchange that aligns with parents' realities, she prefers to ensure physical closeness through meetings and activities that cater to parents' different needs. For example, Veronica periodically meets with resourceful parents like Rita to discuss the information that the community as a whole could be interested in. For trusting parents like Elena who find it hard to be at school, Veronica manages outside-the-school community resources (*e.g.,* donations from restaurants, volunteers from churches) to facilitate attendance. She explains further: "I usually organize dinner or lunch meetings at parks close to where Latino parents live. I have also invited parents to movie nights with their kids where we first talk about school-related topics." Events such as these also address the interests and reality of insecure parents like Monica, who need to share their concerns with others.

The cases of Chabela and Veronica suggest that liaisons can play an essential role in the creation of the equitable parent-school communities that [77] proposes, but they need to ally with many other community actors to achieve so.

4.2.3 Other Parents. The third and final actor in the schooling environment that we discuss is the network of *other parents*. We identify actors in this network in terms of two groups of parents we saw coexisting in the schooling environment: *English-speaking*, and *Non-English-speaking Latino* parents. Katie, an American, and Alba, a bilingual Venezuelan immigrant, are an example of *English-speaking* actors. The two of them met during school events and children's birthday parties, and are now part of a group of parents who see each other regularly for play dates. Whenever they see each other, they have little trouble aligning their interests and exchanging information about summer camps/after-school options for their children. Given cultural, linguistic and often class-related clashing interests, parents like Katie and Alba rarely interact with *non-English-speaking* parents like Rita, Elena, and Monica. Since Rita and Monica—the resourceful and insecure mothers we described in the previous section—are able to be at school more often, Katie and Alba do recognize them and have even tasted Rita's

enchiladas during International School Night. However, not even Alba, who speaks Spanish natively, has conversed with these parents; given that she speaks English, she is not part of the meetings that the school liaison organizes for low-income Spanish-speaking parents. In the case of Elena—our trusting mother, her lack of presence at school decreases even more her chances of meeting these English-speaking parents. Resourceful parents like Rita often feel that *non-English-speaking parents* are not a cohesive group either. She further explains: "We are all in the WhatsApp group Paula [the liaison] created but most never come to school. Look now! Only 5 of us are here, where are the rest? They just don't see that the only way we can change things around here is by being here." Prior studies of nondominant parents have shown that sharing information among parents can increase their knowledge of learning opportunities and educational media for their children [23, 48, 77]. The accounts of these parents reveal, however, that the schooling environment offers little opportunities to Non-English-speaking Latino parents for establishing alliances with other parents that can foster such exchanges; these parents struggle to connect even with those of their same ethnicity, language and socioeconomic status.

4.3 The Larger Community

As we saw in the case of Rita and Elena—our resourceful and trusting mothers—many parents access information by forming alliances with members of the larger community outside their schools and homes. We see this larger community as comprised of three kinds of actors: those belonging to parents' *close relations*, *supporting organizations* providing a wide range of services (including educational), and *everyday people* who are—socially speaking—most distant from parents but can provide extremely diverse and novel information.

4.3.1 Close Relations. Extended family, neighbors, co-workers, and Latino businesses (*e.g.,* cellphone shops, cab companies), all form a network providing parents with information that aligns to their needs and context [52], even motivating them to use technology for novel purposes [49]. Our data highlights the potential of this network to also offer parents resources/information for impacting their children's education.

Like Elena—our trusting mother, many parents form stable alliances with this network for navigating their children's academic needs. As Barbara explained, technology can expand access to this network: "When *de plano se nos cerró el cerebro* [our brains cannot find a solution], I tell *la niña* to phone call her brother to see if he can help, and she sends him a picture of her homework". This network can also be convenient to keep parents updated on school life. For example, Barbara relies on spontaneous encounters with friends at work whose children attend the same school: "We always keep each other posted on school news, like asking 'Did they let you know [about a school event]?', 'Are you going?'" This information channel can also convey other kind of parental engagement information, such as free after-school and daycare options close to parents' homes.

However, our data shows that, given the interest of this network to help its members resolve everyday issues, it is better suited for providing information for *indirectly* broadening parents' access to education-related information. Sofía, for example, found out about Groupon through a co-worker, and used it to find a summer camp for her daughter. Julia's neighbor told her about a Latino cab

company that she now trusts to attend school with her children. Lucía was able to bargain for a new cellphone at a Latino phone shop where she could later install school-sanctioned apps. These nuances suggest that to harness close relations for supporting children's education—as [41] suggested—technology design could do more to diversify the information about learning that this network manages.

4.3.2 Supporting Organizations. The growth of the Latino immigrant community we studied has fostered the creation of supporting organizations specifically targeting their needs. These organizations' bi-cultural and bilingual nature, as well as their large social capital, makes them key mediators of information between families and the American population at large. We noticed three types of organizations based on their goals and capacity in terms of information dissemination. *Open organizations*, such as Solidaridad—the oldest, largest NGO working with Latino immigrants in the location we studied—offer a wide variety of services (*e.g.*, legal, health, economic, and education), and have no restrictions in their capacity to serve families. Solidaridad's large, open nature, makes it an obligatory site to visit, not only for immigrants but for other, smaller NGOs that use it as an information hub for advertising their services. This organization, thus, has the potential to form stable alliances with parents for they can convey a wide variety of rich information that fit their interests and needs. However, the quantity of information it manages hinders parents ability to find the right information about learning resources at the right time. For example, Elena—our trusting mother—visits Solidaridad once a year to get help in filling out health insurance application forms for her children. The last time she visited, a *señorita* gave her and other parents waiting a talk about Hermandad, an after-school program for Latino children. Elena, however, missed the information table with brochures from other NGOs, including the ones from Más Ciencia, explaining college financing options for Latino children. This information could have helped Elena broaden the opportunities she envisions for her 16 year-old daughter's academic future.

In contrast with Solidaridad, Hermandad and Más Ciencia are *specialized organizations* working towards improving the educational attainment and opportunities of Latino children. Both offer after-school programs, the first providing children with academic support, and the second expanding children's experience with Science, Technology and Mathematics. It is precisely their particular focus on children's education and their small size that enables them to offer services that align well with parents' information needs. For example, after the staff at Hermandad noticed some children falling asleep during class time, it offered a workshop for parents to learn more about appropriate sleeping hours. Hermandad has also offered workshops based on parents' expressed interests, like avoiding bullying and promoting self-esteem among children. Further, these organizations typically leverage cultural and linguistic capital to shape how they deliver information to parents. Dayanara, Más Ciencia's program coordinator, further explained: "When we have an event, we call them several times, many months in advance, first to know how they are doing and then to remind them about the event. To our people [referring to Latin Americans] such care shows we respect them and want them to be included." Despite these organizations' ability to form stable alliances with parents, their specialized nature limits the number of students and parents they can serve.

Finally, religious institutions like Alianza Religiosa are similar to organizations like Solidaridad, for they are large and open to the public. However, the power of these institutions relies on their ability to quickly align their interests to families' needs and concerns given the large, ready-to-act body of volunteers working with them. Alianza Religiosa's volunteers, for example, offer computer workshops and one-on-one literacy classes to parents who seek to learn. Having parents taking these classes could have an impact in their parental engagement practices. The news about these services, however, rely on word of mouth, which limits the number of parents they can reach.

Our data suggests that supporting organizations have enormous potential to foster a partnership across different community actors for supporting parental engagement: they are all highly-connected institutions that promote and leverage closeness to help parents broaden their ideas of what is possible and needed for their children's academic lives. However, these organizations need help in facing particular limitations (*e.g.*, overload of information, limited resources, etc.), hindering their ability to reach parents in need of this information.

4.3.3 Everyday People. Our last group of actors in this category are the everyday people, who are neither actors of parents' close networks nor of supporting organizations. The alliance between parents and this network tends to be unstable; parents have few opportunities for meeting people outside of their close relations and language and class-based gaps tend to make parents fearful of accessing larger, socially-distant networks [13]. Our resourceful mother, Rita, explained how she experienced class-based fear even among those who speak her same language: "those Latinos [Spanish-speaking] who are a bit better [economically], usually behave as if they were better than us, and end up being dismissive. I don't feel comfortable talking to them sometimes." Our data suggests, however, that this network offers richer opportunities to diversify parental engagement practices than close relations [49]. Mariana, for example, learned that she could access soccer classes for her son at the YMCA because the Latino doctor seeing him recommended it. From there, she was able to access other YMCA services such as parenting classes. Sofía, on the other hand, learned about Más Ciencia from a professor she cleans houses for. These examples suggest that more can be done to augment the possibility for parents and everyday people to form stable associations that promote meaningful exchanges of information.

4.4 The Technology

Technological actors play an integral role in mediating the information exchange taking place in the parental engagement network. In this category, we include not only devices that enable information transfer (*e.g.*, smartphones and desktop computers), but also apps, digital content (*e.g.*, videos), and infrastructure such as the internet. We describe these technologies as enacting two distinct roles based on their context of use: everyday and school-related technologies.

4.4.1 Everyday Technologies. In line with digital equity studies on Latinos' technology use, we found that smartphones are an everyday technology for Latino families [27, 47]. In most of our participant families, each member—including children—owned a smartphone with unlimited data access. Parents of these families had been using cellphones for over a decade. The ways in which

parents formed alliances with this non-human actor, however, was highly impacted both by the agency embedded in the design of the smartphone (and its apps) and its context of use. In the case of smartphones, their small size, personal nature, and ease of use make it an item individuals feel safe manipulating and harnessing in ways they want, like, and need [58]. Like other users from non-dominant groups in the U.S. and beyond, our parent actors aligned with these affordances to access diverse forms of entertainment and engage in one-on-one communication with close relations [17, 31, 49]. In addition, our data confirms previous findings on how Latino immigrants perceive certain mobile technologies as a connection with their new world [49, 55]. Adriana, for example, prefers to buy smartphones "because those let me practice English more, especially when I am at work, with the translator, you know?" Parents like Mariana and Niurka take this notion further and adventure to explore new apps and content for improving their English skills: following a co-worker's recommendation, Mariana is using Duolingo, and Niurka commonly searches for YouTube videos that teach Spanish speakers English. The agency embedded in mobile apps also shapes how willing parents are to form alliances with these ICTs. Our data suggests, for example, that parents' interpretation of ICTs' moral values can hinder their use of public social media platforms such as Facebook, which have much potential for supporting information transfer. Mariana, for example, explained how she perceived Facebook:

> Through Facebook I found Solidaridad's and the Mexican consulate page. Besides, it suggests pages I really like, with prayers and images of God. I just don't like that it often shows me people posting too many pictures of themselves or commenting in others' posts things that they should say to each other in person.

When the public aspect is minimized, however, our data suggests social media apps have a higher chance to foster community-building. Emilia, for example, belongs to a WhatsApp group initially created by a parenting program she attended that has now turned into a go-to group for sharing parenting concerns. For Niurka, the private Facebook group that Hermandad created for parents is also a safe place where she feels free to interact with the program coordinator and other parents. All these accounts suggest the relevance for designers to understand how certain ICTs can clash with parents' moral motivations, thereby hindering information transfer.

Another app that the larger community often considers an everyday technology is email. Email's attributes as a medium for quickly reaching a large number of individuals have turned into the 'de facto' medium for disseminating all kinds of information [43, 68]. Although we also saw that parents acknowledged the value of this non-human actor—driving them to have at least one email account in the family, our data reveals the alliance between educational institutions and email's attributes as highly misaligned with parents' understanding of communication paradigms. Schools, for example, propose email as the main medium to reach Latino families on an everyday basis. However, given the rare occasions parents receive information they consider vital through this medium they do not see the need to engage with this technology frequently. In Ximena's case, dismissing email's everyday relevance led her to miss a school notification abour her son's recent detention.

As the above cases show, everyday mobile technology enables opportunities to connect parents with the resources they need [27, 49]. However, attention is needed to select a communication medium that aligns with parents' everyday activities.

4.4.2 School-Related Technologies. Schools have allied with technology as a key actor not only in the classroom but also in how the school, teachers, and staff communicate with parents [77]. Our findings describe in detail the two different roles technology fulfills in the schooling environment and the state of the associations it forms with parents, teachers and liasions. First, there is technology that mediates parents and *classroom-related* content such as the topics children are learning, children's academic performance, and classroom behavior. Second, technologies act as media to carry *institution-related* information (e.g., changes in school calendar, school events) to parents.

Teachers usually form associations with different technologies to work towards sharing *classroom-related* content with parents so that they can have enough information to act when needed. Dianne—our information-publishing teacher—frequently recommends parents online educational technologies that children can use at home to practice classroom content (*e.g.,* Accelerated Reader, Dreambox, Raz Kids, and ABCYAs). For children in higher grades, she also shares information about free at-home internet and recommends places to buy desktop computers. Parents like Andrea follow her suggestion, but choose not to further engage with those technologies, thus missing opportunities to get involved in their children's progress: "I honestly only got it [the desktop computer] so that the kids could do their homework. The guy who set it up told me I could do a lot of things with it, but since I don't ever use it, I have no idea what is in there." Andrea's case confirms that parents do see the educational value in these technologies [48, 49]. However, when confronted with the possibility of using these technologies themselves, it becomes harder for parents to see how the attributes embedded in these technologies are aligned with their everyday needs and goals. For example, it is not clear to parents how sitting down at a computer to play these apps with their kids can inform them about children's academic progress.

Teachers have also formed alliances with parent-classroom communication technologies such as ClassDojo, Seesaw, Parent portals, and weekly newsletter emails, all of which keep parents updated on kids' activities in the classroom, including learning experiences, children's academic performance, and behavior. While most of our participant parents were not likely to engage with email-conveyed information, some of them did consider other teachers' recommended apps. However, our data highlights that these technologies' emphasis on reinforcing a one-sided communication paradigm—from teachers to parents—tends to hinder how parents interpret these technologies' attributes, and thus, form alliances with them. Carmen, the mother of a kindergartener, checks ClassDojo—an app for teachers to post pictures of the class and report on children's behavior—quite frequently. Given that nobody has explained to her what this app is for, she has concluded that it reflects her son's entire performance in the classroom. She explained how she was using this technology: "I noticed the teacher was taking points away from his *nota* [general score], so I punished him taking away toys and videogames". Later, the teacher explained to her that those points were taken from the entire class because they were being

too noisy, and that Carmen's son was actually doing really well at school. While resourceful parents like Rita would not be highly impacted by such misunderstandings, for trusting parents like Elena, misconstruing the purpose of an ICT could lead to an inability to act on time. For insecure parents like Monica, such incidents could augment levels of insecurity and mistrust towards teachers. Information fragmentation is an important factor hindering parental engagement [78]. Our findings indicate lack of clarity in technologies' purpose is another important limitation to overcome.

As the parents in [49], many of our parent participants found it easier to engage with their children's academic progress by forming alliances with everyday technologies. When Barbara's daughter needs help with homework, Barbara takes a picture of the homework with Google translator. Then, when she knows what the homework is about, she uses some phrases from the homework instruction to search information on the topic. In the meantime, her daughter also searches information—in English—on her own cellphone. Such active engagement with the content their children are learning allows parents to develop a clearer idea of what needs to be done. In Barbara's case, she now knows that her daughter needs help with Chemistry. However, our data also highlights that, regardless of the role they enact, Latino parents usually prefer their children to solve homework problems on their own, and act only when the child expressed a need for help.

The ability of online technologies to present information in centralized sites where individuals can quickly access and navigate it, has offered schools efficient media for disseminating institution-related information (*e.g.,* events, forms to be filled out, changes in school calendar) online through newsletter emails, websites, and Facebook pages. As Chabela, our partially-mediating school liaison, explained, schools put much effort into publishing all information online, both in English and Spanish. However, as she admitted, publishing information in Spanish is not enough: "It is is just too much information, often mixed with information in English as well, cause these sites are all bilingual. They [parents] don't read it. I've asked around and most parents do not even know we have a website." Eager to form more stable alliances with parents, most school liaisons have created other digital information channels that they moderate to, again, ensure a one-sided communication paradigm. Messaging apps like Remind or private social media like WhatsApp, where liaisons can send snippets of information— usually with images—in Spanish only, have had a more important impact on how parents process school information. The closeness and familiarity these apps afford align better with parents' everyday needs and goals. Given liaisons' moderation of these spaces, these channels' potential to act as community-building platforms has yet to be explored.

As our data show, parents—even trusting ones—realize the need to be informed. However, the technologies that schools and teachers align with to keep parents informed do not meet parents' everyday context. Our findings suggest a great potential for expanding the abilities of everyday technologies to address parent-school information exchange needs.

5 DISCUSSION

Using ANT allowed us to grapple with the complexities of the parental engagement network we studied. In particular, it shed

light on the interests of all actors in the network, the efforts these actors invest into aligning their interests, and the reasons why they succeed or fail at it. We now discuss how an ANT-motivated understanding of interests reveals pending challenges for technology to intervene as well as potential pathways for design to overcome such challenges.

5.1 Design Challenges: Clashing Interests

Our data analysis highlighted three groups of parents' interests that clash with other actors: parents' preference for everyday (vs. institutional) goals, for meaningful (vs. abundant) information, and for personal (vs. detached) interactions. We now discuss the role of non-human actors in these unstable alliances, thereby uncovering pending challenges for technology to effectively support information flow in the network.

5.1.1 Everyday vs. Institutional Goals. Our data shows that Latino immigrant parents tend to have an aloof response both to classroom management (*e.g.,* Parent Portals, ClassDojo) [40] and educational technologies (such as ABCYA and Raz Kids). Our ANT approach suggests this is due to these technologies' strong misalignment with parents' everyday goals. Teachers and schools choose these technologies because they align with their educational purposes (*e.g.,* teaching a math curriculum and informing parents about children's behavior), and with the schools' value system (*e.g.,* keeping information private). However, parents struggle to see value in such purposes and end up disengaging from these technologies; they forget/misinterpret these ICTs' purpose, disregard installing them, or make someone else responsible for them. A pending challenge for technology, thus, is to be able to respond to specific school-related purposes, values, and norms, while also eliciting in parents a desire to engage.

5.1.2 Abundant vs. Meaningful Information. Beyond the traditional home/school contexts where Latino immigrants have been studied [27, 47, 49, 55, 60], our data highlights the larger community (*e.g.,* supporting organizations, everyday people, and parents' close relations) as a key, but largely untapped source of learning resources for parents. This network's instability is due to a misalignment between the interest of members of the larger community to share information at scale and parents' need to consume information that resonates with their needs and aspirations. Further, the technologies some actors of this network (e.g. supporting organizations) use to send information out to parents (e.g., flyers, newsboards, and websites) reproduce this misalignment by not contextualizing how information can fit parents' present constraints (e.g. financial), or serve their aspirations (*e.g., "how can a robotics club help my child's future?"*). A pressing challenge for technology, thus, is to explore how to deliver abundant information while ensuring that this information is tailored to the needs and aspirations of parents from non-dominant groups, minimizing parents' sense of confusion or distrust.

5.1.3 Detached vs. Personal Interactions. Our data reveals that, in the context of immigrants, school-related technologies enforced as unidirectional communication channels (*e.g.,* Remind, WhatsApp groups, ClassDojo) perpetuate the already existing misalignment among school actors [77]. While on the surface it would seem as if these technologies at least allow information to flow, our ANT approach suggests the detached interactions they promote hinder

teachers' ability to understand how to route information that effectively attends to children's contexts (*e.g.,* deciding what information to deliver to a mother who quit her job to help her child). Further, the unidirectional communication paradigm also keeps immigrant parents disconnected from other parents. Technology designers could explore if and how technology might help establish methods for strengthening personal—rather than detached—interactions among actors in the parental engagement network so that all actors can engage in richer, more fruitful information exchanges.

5.2 Design Opportunities: Promising Alliances

In addition to highlighting tensions, our ANT analysis revealed promising alliances in the parenting actor-network of Latino immigrants. Below we discuss how instances where actors' interests do align can illuminate potential opportunities for technology design,

5.2.1 Designing to Engage, not Impose. To design parent-school technologies that parents find engaging—rather than imposing—we propose to learn from the stable alliance parents hold with everyday technologies. Our ANT analysis showed parents preferred these technologies because they align with their everyday activities (e.g., finding a place in Google Maps) as well as with their aspirations to learn about their host country (e.g., learning English in Duolingo and Google Translator). A way to increase parents' engagement with parent-school media, thus, could be to enhance everyday technologies so that they can provide support to parental engagement practices. For example, Google Translate could be augmented to help parents learn more about homework materials; it could keep track of the words being translated and, when determined that they are likely to be homework terms, suggest possible learning resources for parents to check out with their children. Another possible design pathway could be to redesign existing parent-school technologies to introduce interactions that align with parent's everyday goals and aspirations. For example, ClassDojo could be modified to fit parents' daily activities by forwarding messages and notifications to the private communication channels that parents already use (*e.g.,* text messages, WhatsApp). Further, Parent Portals could align with parents' aspirations by offering information about the cultural relevance of a particular homework/reading.

One issue to consider in the process of forming new alliances in the schooling environment would be the feasibility for major everyday technology companies such as Google and/or Facebook and schools to work together. It would also be important to explore the willingness of schools and teachers to provide content that is better aligned with parents' interest (e.g., content that helps parents draw cultural connections their kids' school activities [24]).

5.2.2 Generating Meaning at Scale. To enable the larger community to deliver learning-related information that parents find meaningful and actionable, we propose to learn from stable alliances that parents form with the larger community for the purpose of transferring various kinds of non-educational information (*e.g.,* coworkers recommending Groupons, or parents finding about health insurance through 'supporting organizations'). Our ANT approach highlights these alliances are successful due to *(1)* the trust that these community actors elicits in parents and *(2)* these actors' ability to quickly respond to parents' needs. Technology could replicate these traits when delivering learning-related information. For example, intelligent agents working on trusted communication channels (*e.g.,*

WhatsApp groups with schools) could curate information from the larger community and offer it to parents in the form of timely, digestible suggestions. These agents could also converse with parents to address doubts, provide contexts and anticipate needs.

Introducing intelligent agents to form associations with parents and the larger community, however, poses questions of privacy and trust that would require further exploration. These technologies would also require to further understand the motivation for the larger community to enter information in systems outside their responsibility. Finally, the deployment of these ICTs would need designers and other stakeholders to negotiate how the data is gathered, and who should be made responsible for gathering and curating that data.

5.2.3 Personalizing Detached Information. Our ANT analysis suggests that technology could support more personal interactions in the school environment by drawing from the effective alliances between parents and school staff. The connections taking place between *negotiating teachers* and *trusting parents*, for example, highlights the possibility for technology to create spaces that motivate parents and children to exchange rich, contextual information with teachers and liaisons. As our data suggests, this information would need to address limitations and opportunities that are part of their everyday lives (*e.g.,* current job situations, transportation limitations, or the supporting groups parents resort to for handling school projects). To help parents feel comfortable sharing family information and thus equalize the power dynamic, ICTs could give teachers the chance to also share personal information (*e.g.,* favorite books, interests, and hobbies). Further, these ICTs could also foster parent-to-parent meaningful exchanges, especially for connecting non-English speaking parents to bilingual ones. The stable alliance observed between *fully-mediating school liaisons* and parents suggests ICTs could also be designed to support school liaisons into becoming *fully-mediating school liaisons*. For example, ICTs could facilitate online communities for liaisons to share ideas for creating effective offline parent-school interaction spaces.

The design of these new technology actors should explore motivating teachers and parents to share personal information with each other, considering their time constraints and privacy concerns. Additionally, it would become key to explore how issues of classism—which our data highlights as prevalent in the Latino immigrant population—could affect online interactions in community-building platforms. Finally, technology designers would need to find technology platforms that respond to schools' regulations with regards to privacy and security.

6 CONCLUSION

· In response to the immense educational challenges faced by families increasingly immigrating to high-income countries, we investigated the role technology might play in supporting, extending, and leveraging the parental engagement of low-income Latino immigrants in the U.S. Latinos form the largest minority in the U.S., and also face historically low academic attainment rates [10, 71]. In this paper, we relied on the ANT framework to analyze findings from our multisited ethnography, outlining the role of different human *and non-human* actors in the network that Latino parents navigate to acquire and relay information for supporting their children's education. The use of ANT enabled us to provide a deeper

understanding of different actors' interests (*e.g.,* those of parents, teachers, school liaisons, and technology), how they align or not, and how these (mis)alignments shape the quality of information flows across the network. We additionally contribute a discussion of existing challenges and promising opportunities for technology to align with the interests of the network, thereby illuminating novel mechanisms for supporting the engagement of immigrant parents in the U.S. as well as other contexts.

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