

# Enriching Virtual Visitation in Divorced Families

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Divorce is a traumatic disruption in the lives of families that puts both parents and children at risk for long-term emotional and social consequences. However, if the non-residential parent maintains a quality relationship with the child, many of these negative consequences are mitigated. Divorced families face substantial challenges in parenting while living apart, especially as geographic separation often makes in-person visitation more difficult. Many families are turning to *virtual visitation*—supplementing in-person visits with use of communication technologies such as videoconferencing. However, current communication technologies are often inadequate to support long-distance parenting. We discuss the needs of divorced families and how these may be addressed through design. We present a case study of a single intervention, called the ShareTable, aimed at enriching virtual visitation between parents and children who live apart. Finally, we discuss the challenges and opportunities of designing for divorced families.

## 1. Introduction & Motivation

It is becoming common for children to live apart from one of their parents. The 2008 U.S. Census found that 26% of children live with just their mother or just their father, with marital separation being the primary reason [7]. A synthesis of psychology and sociology literature on divorced families shows that both the parents and children in separated families tend to score lower on multiple measures of wellbeing and adjustment [2]. However, the findings also suggest that when the remote parent and child maintain meaningful contact many of the negative consequences of separation are mitigated [1]. Unfortunately, contact with the remote parent drops precipitously after the first year of separation, often due to geographic separation [21]. Considering how difficult meaningful parent-child communication may be even in a collocated setting (as described in the chapter on intra-family messaging with FamilyCircles), it is not surprising that currently available remote communication technologies are often not sufficient to achieve the quality and quantity of contact necessary for long-distance parenting [29]. The challenges of remote contact are additionally compounded in the younger age group (6-13) targeted by the investigations described in this chapter.

Increasingly, families are seeking out alternative forms of synchronous and asynchronous communication to provide contact between visits. Successful attempts at leveraging tools like videoconferencing and instant messaging for remote parenting have drawn attention from the news media. The *New York Times*

had several recent articles about videoconferencing with children [8,14]. A number of recent publications have featured articles on *virtual visitation*—using communication technologies to augment face-to-face time between parents and children in divorced families (e.g., [11]). There are efforts to incorporate virtual visitation into family law in almost every state, with five states already having added provisions for virtual visitation to custody case law [9]. Remote parenting is a relevant issue to families, lawmakers, and technology designers and is ripe for investigation from an HCI perspective.

In this chapter, we begin with a discussion of the specific challenges and unique aspects of designing for parenting after divorce. Next, we outline some opportunities for technological interventions in this space. We follow with a discussion of a case study of an intervention. We describe the ShareTable system, which aims to enrich virtual visitation in divorced families and summarize a formative evaluation of the system. Finally, we close with a discussion of the opportunities and challenges of doing work in this space.

## **2. Designing for Parenting after Divorce**

In this section, we highlight the unique aspects of designing for parent-child relationships in divorced families. First, we discuss how designing for this relationship is different from designing for other close ties. Next, we talk about the specific challenges faced by divorced families in maintaining parent-child contact. Finally, we highlight opportunities in leveraging technology to support these families.

### **2.1. Designing for Parent-Child Relationships**

Designing for parents and young children requires a different approach than doing so for friends or adult family members due to the (1) asymmetry in goals and needs between the parent and child, (2) the challenges posed by the cognitive and emotional limitations of young children, and (3) the focus on play and care rather than direct communication.

While strong-tie relationships (e.g., marriage) often involve symmetric goals and an equal involvement in relationship maintenance [26], the parent/child relationship is characterized by asymmetry. Dalsgaard et al. [10] found that the parent carried a greater responsibility over maintaining the relationship by creating a setting for trust and unity, providing care, and participating in play. Children rarely verbally expressed affection and they self-disclosed less than their parents desired. Modlitba & Schmandt [19] and Yarosh & Abowd [28] conducted interviews with work-separated families to find that parents and children have different emotional responses to separation; children are likely to experience anxiety before the parent leaves, whereas the parent is more likely to experience a sense of guilt during the absence. We conducted semi-structured interviews with parents and children in divorced families to understand the challenges that they faced in maintaining closeness [29]. Sharing on the part of children was oriented toward the current

moment; if they were unable to share something when it occurred, they were unlikely to remember to do so in the future. On the other hand, parents were more concerned about interrupting the routines of the other household and were unlikely to contact the child spontaneously. All of these points highlight that parents and children have different approaches to their mutual relationship. Technology for these relationships must balance the needs and motivations of disparate participants to succeed.

Designing for children holds another challenge: the child's cognitive and emotional limitations may make long-distance contact difficult. As the child develops, he or she can begin to separate mentally from the here and now to imagine past and future events, comprehend how others see the world, and understand representational images of the world. Modlitba & Schmandt [19] found in their interviews that it might be difficult for a young child to visualize where their parent is traveling and how long he or she will be away. Preschool children in interviewed families required the assistance of a collocated caregiver to initiate and make sense of their interaction with the remote parent. Even with school-age children, long-distance contact is challenging because many of them have not yet developed the communicational competencies to participate meaningfully in conversations without shared visual context [25]. Lastly, children have limited attention resources and motivation for remote contact, so families often find it difficult to keep a remote communication session engaging enough to hold the child's attention [4].

Lastly, one of the distinctive characteristics of the parent/child relationship is that closeness is built more through play and care together than through conversation. As Ballagas, Kaye, and Raffle discussed in the chapter on remote reading with children, shared activities are a key characteristic of parent-child contact. Perhaps this is unsurprising, since children have been shown to spend less than a one hour per week participating in "household conversation" but more than 20 hours per week participating in playing, reading, studying, and hobbies [15]. Dalsgaard et al. [10] found that parents and children build intimacy through care and play. Children and parents participate equally in mutual play, in collaborative activities (doing a puzzle, reading, or cooking together), in playing with shared artifacts (action figures or a board game), and in physical play behaviors. On the other hand, care is unidirectional from the parent to the child and includes activities such as setting rules, providing resources for learning, giving physical care, and assisting with everyday tasks and activities. Development literature emphasizes the importance of parental involvement in both care and play activities, to build secure relationships [17].

## **2.2. Divorced Family Dynamics**

In all parent-child relationships, continued quality and quantity of contact is key to building a connection but is rarely achieved in divorced families. We describe the challenges faced by these families.

Separation carries significant negative consequences for both the child and the parents [2]. However, these negative consequences can often be mitigated if the

distributed parent stays instrumentally involved in the child's life [1]. Smyth [24] emphasizes that the quality of contact may be as important to explore as the quantity. "Quality contact" may be difficult to unpack, but developmental psychologists have used the term "authoritative parenting" to describe the combination of monitoring and support that is likely to lead to positive behavioral and academic outcomes for children [24]. Gray & Steinberg [13] isolated and examined the behaviors that characterize this construct to find that the amount of communication and the act of showing interest in the child's life were the most influential constituent behaviors involved in authoritative parenting. Additionally, frequency and variety of contact are also important to maintaining relationship quality. Kelly & Lamb advise that parenting arrangements should provide "opportunities to interact with both parents every day or every other day in a variety of functional contexts" [17]. Unfortunately, these prerequisites for quality contact may be difficult to achieve for parents and children who live apart. Furstenberg & Nord [12] studied patterns of parenting after separation to show that the distributed parent was likely to be involved socially in the child's life, but rarely set rules or assisted with care activities such as helping with homework. Seltzer & Bianchi [21] showed that the quality and quantity of contact with the distributed parent decreased dramatically after the first year of separation.

We conducted an in-depth interview study with fifteen residential parents, non-residential parents, and children from divorced families to better understand the practical challenges they face in everyday life (for a more complete presentation of these results see [29]). The two major struggles experienced by these families center around maintaining a shared context while living apart and managing conflict. First, the remote parent often faces challenges in staying aware of the child's state and activities. Children are often not very good in providing such information and the residential parent may not be motivated to keep the non-residential parent up-to-date. Second, parents often have to weigh the desire to contact the child with the possibility of interrupting the daily routines of the other household. This often leads to most communication being scheduled ahead of time. Finally, parents often struggle with seeding conversation and keeping the child engaged. On the other hand, children struggle with managing the competition over their time and affection between the parents. In our study, we found that children were much more aware of this competition than their parents anticipated. This uncomfortable situation is often exacerbated by a lack of a private space to communicate with the remote parent. Lastly, the fact that most remote interaction is scheduled makes it difficult for children to communicate spontaneously when they think of something they want to share. Often, by the time the time there is an opportunity for scheduled interaction, the thought or feeling is long forgotten.

The themes we identified (which were confirmed in other work [20]) suggest that members of divorced families balance two major goals: reducing tensions between households and maintaining closeness. Children may try to reduce tensions by keeping the details of their involvement with the other parent as private as possible. Parents may seek to reduce conflict by maintaining only minimal contact

with each other, respecting each other's autonomy, and minimizing unscheduled interruptions of the other household. However, both of these goals may conflict with the parents' desire to remain aware of the child's everyday activities to provide support and drive conversation. The parent's need to minimize interruption may also clash with the child's goal of achieving spontaneous contact, as it leads to a regimented schedule of interaction with few opportunities for spur-of-the-moment conversation. Both parents and children expressed that they would prefer to stay in touch through something richer than phone conversations, but found that asymmetric rules and asymmetric access to infrastructure between households often lead to the lowest common technological denominator. While the non-residential parent may be driven to upgrade the infrastructure, there is often little motivation for the residential parent to do so. The residential parent may see the introduction of a new communication technology as a violation of their autonomy in raising the child. While all parties share the common goal of achieving positive outcomes for the child, they may disagree on what constitutes a "positive outcome" and how to get there. Designing for divorced families requires maintaining the balance between building closeness and reducing tension in such a way that the technology can be acceptable to all members of the family.

### 2.3. Current Use of Technology in Divorced Families

Though there are few studies investigating the effect of available communication technologies on maintaining contact between parents and children, the Pew report on the American "networked family" [18] showed that such technologies do have the potential to raise the quality of communication with friends and family. Fifty-three percent of respondents indicated that mobile phones and the Internet have increased their quality of communication with friends and distributed family (44% said that it remained the same). The report also indicated that increases in time spent using social media comes at the expense of time spent watching television, not at the expense of time spent socializing in-person. Most families already have the infrastructure to use communication technologies such as videoconferencing and many seem to be excited by the opportunities provided by these media.

Non-residential parents often turn to technology to supplement in-person communication. Some parents maintain websites and forums dedicated to sharing ideas about using technology to stay in touch, such as [distanceparent.org](http://distanceparent.org) and [internetvisitation.org](http://internetvisitation.org). Particularly, the combination of telephone, videoconferencing, and instant messaging to supplement in-person visits is known as *virtual visitation* [11]. As of 2009, five states have passed laws allowing virtual visitation to be incorporated into custody decisions. Several family law periodicals have featured virtual visitation, stating, "technology may be able to help maintain a relationship that would otherwise cease" [22]. Despite the fact that it is already becoming incorporated into state law, there has been relatively little academic or industry research into virtual visitation.

In our interview study [29], we found that technology use in divorced families is often characterized by asymmetric access to infrastructures between the two

households, which often leads to the lowest-common-denominator interaction. Unfortunately, this often means the telephone. Both the children and parents in our study found audio-only communication inherently difficult and unsatisfying (also confirmed in other investigations [4]). Most conversations amounted to quick calls good night or quick updates. While several families reported that videoconferencing was a much richer way of interacting, few used it regularly. Videoconferencing is difficult to set up [3], often requires more technical savvy and motivation than one or both parents in divorced families are willing to provide, and introduces concerns over privacy and safety that may prevent its adoption. Despite the widespread popularity of Skype, videoconferencing is still not used routinely for remote parent-child content. For example, in a study published in 2011, out of the 14 families where parents frequently travelled for work, only 9 had tried videoconferencing and of those only 5 used it regularly [28]. Despite widespread availability of free services like Skype, videoconferencing still presents very real challenges for the majority of families.

Overall, it seems that divorced families are open and willing to consider new technologies but there are few technologies designed explicitly for their needs.

### **3. Potential for Technological Intervention**

There are many opportunities for design interventions to support divorced families. In this section, we provide an overview of opportunities clustered from our work [29] and that of Odom et al. [20].

In the previous sections, we have shown that care activities and instrumental parenting on the part of both residential and non-residential parents are important to the child's wellbeing. Unfortunately, there are currently limited opportunities for the non-residential parent to provide such care. For older children, providing remote homework help may present one opportunity for instrumental contact. There is a great deal of CSCW and HCI literature on supporting work remotely that can be leveraged for homework help. Additionally, consistent instrumental care can only be possible if parents who share joint custody maintain consistent rules and cultures across households. Odom et al. [20] suggest that photo sharing, shared calendaring, and online networking can provide opportunities for creating a "joint culture" without direct communication between the parents.

Objects can hold a great meaning for children when their life is disrupted by divorce. An object brought between households (such as a teddy bear) can provide a necessary sense of stability. Other objects (such as a soccer ball or a favorite photo) can remind of shared time and reinforce closeness. Everyday physical objects could be augmented to support a sense of connection and closeness when direct contact between the parent and child is impossible. For example, the child's augmented soccer ball could vibrate slightly when her remote dad is playing soccer, encouraging her to participate in the same activity. Alternatively, virtual possessions could become a thread of stability by providing a context that is available to the child regardless of his or her physical location [20].

One of the biggest needs for divorced families is creating new opportunities for remote contact. One way to do this is by supporting asynchronous interaction. There are currently very few opportunities for remote communication with children, since they rarely own mobile phones. Creating dedicated messaging devices for children or incorporating such features into existing portable gaming devices would allow for quick spontaneous contact even when either party is unavailable for synchronous contact. The second way of creating new opportunities for remote contact lies in empowering the child to initiate the connection without help from the residential parent. The child is aware of the competition between the parents over his or her time and affection and may hesitate to approach one parent for help in setting up the connection to the other parent. Making it possible and safe for even young children to use technology like videoconferencing would increase opportunities for interaction. Lastly, we could focus on increasing the length of the synchronous communications between parents and children. In order to help parents and children have more meaningful interactions, it would be useful to provide the parent with information about the child's everyday life and activities to help seed the conversation. While in intact families, the remote parent can rely on a local adult to provide this information [28], divorced families may benefit from more indirect sources of information such as awareness systems. Finally, in order to make communication engaging and meaningful to both participants, it is helpful to provide a shared context for the interaction, especially when that context can include care or play activities.

While there are a number of possible interventions for divorced families, the remainder of this chapter focuses on a case study of one possible intervention. The ShareTable is a technology to support richer and more engaging remote synchronous interaction between parents and children.

#### **4. The Road to the ShareTable**

We focus on designing a technology to support richer synchronous interaction between parents and children in divorced families. In the next sections, we describe the specific design requirements that drove the creation of the ShareTable system, provide a brief overview of the system implementation, report on an initial evaluation, and discuss the process of adapting the system for a long-term field deployment. A more detailed discussion of this work can be found in [30].

##### **4.1. Design Requirements**

From our interviews with divorced families and the previous work in this domain, we determined four design requirements for a synchronous remote communication system for parents and children that face separation due to divorce.

###### **1. Add a Visual Channel for Communication**

The most common theme reported by both parents and children in our interview study was dissatisfaction with audio-only communication. During the

middle childhood, children are still developing the conversational competencies to interpret irony, humor, and fantasy [25]. Providing multiple channels and modalities for communication, particularly video, affords additional cues for the child and provides a shared context for communication.

## **2. Function without a Collocated Adult's Help**

The families we interviewed did not use videoconferencing regularly, because most videoconferencing systems are complex enough to require a collocated adult's involvement to arrange a chat session. Additionally, some parents saw it necessary to supervise videoconferencing, since the child could potentially contact or be contacted by a stranger. Our goal is designing a dedicated communication system with a minimal control interface that reduces the need for a collocated adult to assist the child with setting up and maintaining the connection.

## **3. Support a Wide Variety of Play Activities**

Keeping the child engaged and seeding conversation were two major challenges reported by parents. We seek to support engagement by leveraging activities that the parent and child are already used to doing together. We emphasize the system's ability to support a variety of activities, rather than incorporating interfaces for specific games or requiring specific accessories.

## **4. Provide Opportunities for Care Activities**

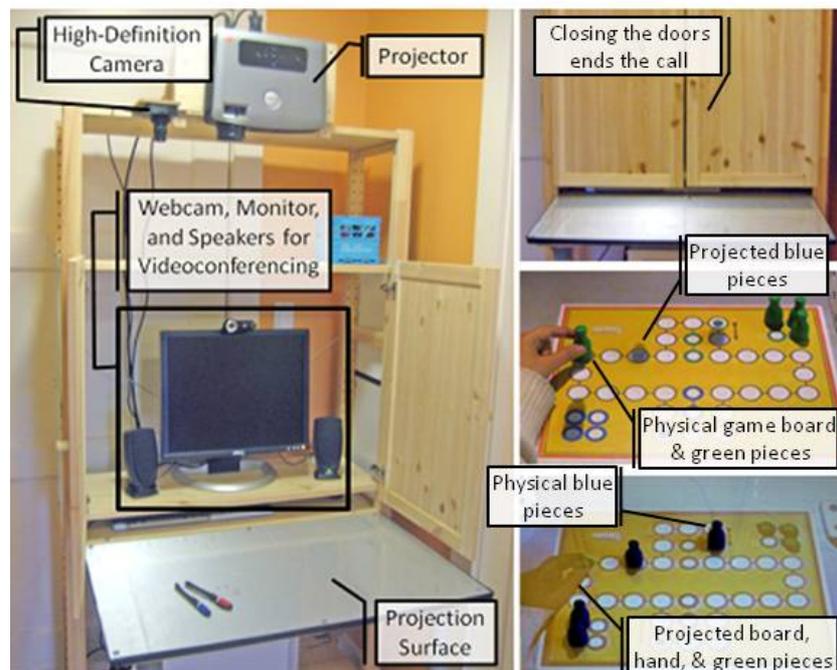
There is strong evidence that instrumental involvement of both parents in raising the child correlates with positive outcomes for children [17]. Many care activities require physical presence; however, there is a clear opportunity for remote instrumental care in providing homework assistance. The challenge to us as designers is to afford transitions between the physical artifacts of homework that the child possesses (e.g., textbook, worksheet) and digital versions of these artifacts, which the parent can view and annotate. We discuss how we addressed this challenge in the next section.

In the next section, we describe the ShareTable system, which is meant to address these four design requirements.

### **4.2. System Overview**

The ShareTable system consists of two identical table setups in the households of the child and the remote parent. Each shared workspace consists of an overhead camera that records any activity over the surface of the table and a projector that displays this video on the paired table in the other home (see Figure 1). The video from each camera is aligned precisely with the projection, so that artifacts placed on one table appear projected in the same location on the other table. The tabletop is coupled with a videoconferencing system (i.e., monitor, webcam, speakers, and

microphone) that let the users see and hear each other “face-to-face.” As in other videoconferencing systems, each user also sees a smaller video window showing how they appear to the other person. This setup allow the parent and child to talk to each other while *doing* something together, such as helping with homework, playing with plastic action figures, drawing, etc. We took the approach of sharing direct video rather than creating specific content to be shared (in contrast to the reading together chapter) in order to support play and collaboration with *any* toys, books, or artifacts that the parent and child may already have around the home.



**Figure 1** The ShareTable system consists of standard videoconferencing and a shared tabletop created through top-down projection, which allows joint activities with physical artifacts, such as board games and worksheets

The basic idea behind the ShareTable is simple, but multiple implementation questions had to be addressed in developing a functioning prototype. First, we needed an alternative to most existing tabletop systems because we wanted to support layering physical artifacts. To solve this, we chose to implement the system using top-down projection. For example, if the parent places a physical token on a projected game board, top-down projection allows the projected token to appear on top of the child’s physical board rather than projected unseen on the board’s bottom. Similarly, if a parent writes a comment on top of a projected worksheet, top-down projection allows this annotation to be displayed on top of the physical worksheet. Second, we needed to solve the problem of visual feedback or “echo,”

which is a major concern in camera-projector systems. Unmodified, the camera records an image of the projected artifact and sends it back to the originating surface. If the physical artifact is moved, an echo of its projection remains on the surface. If projected images are re-captured without any intervention, the resulting image keeps getting brighter and less clear. Without some way to filter projected artifacts from real ones, the ShareTable would be unusable due to this feedback effect. We wanted a lightweight way to eliminate visual feedback that still preserved color, so we used linear polarizing lenses to filter out the projected artifacts from the physical ones. Light that passes through the lens becomes polarized and cannot be seen through a lens with the opposite polarity. Thus, by attaching lenses with perpendicular polarization to the camera and projector, we prevent artifacts from being re-projected. In order to preserve the polarization of the light once it strikes the table surface, we use a non-depolarizing silver lenticular projection screen as the surface backdrop.

### **4.3. Initial Evaluation**

Our initial evaluation took place with an early prototype of the ShareTable that included both the face-to-face and the shared tabletop surface, but did not transmit data over the network (the tables were connected via video cables) and did not address how the connection would be initiated (we set up the connection for the participants). Though lab-based evaluations are inherently limited, the questions that motivated this initial investigation could reasonably be approached in a controlled setting. First, we wanted to observe ways in which interaction with the ShareTable is different from plain videoconferencing. Second, we wanted to establish that children would be able to understand and manage the interweaving of physical and projected spaces created by the ShareTable. Finally, we were interested in exposing participants to our system to gain insight to potential activities they may want the system to support. The lab evaluation methods and results are described in more detail in [30]

#### **4.3.1. Methods**

Seven parent-child pairs participated in the study. The set of parents, four males and three females, varied in age from 30 to 44 (average 37.3, median 38). Their occupations ranged from attorney to professor to student, but all had a high degree of education. The children, three females and four males, were between 7 and 10 years old (average 8.4, median 9). We recruited these participants through word-of-mouth and flyers posted around campus, which advertised that we were looking for individuals interested in technology for families who spend significant time apart.

We familiarized participants with the residential lab where the study took place and introduced the project. We gave them time to play and experiment with the ShareTable in an unstructured manner. They were encouraged to think about how

they would possibly use such a system while apart and to actively try out some of those activities. When the participants were ready to continue, we asked them to perform three separate tasks and fill out a brief questionnaire.

The first two tasks involved completing a worksheet together. The worksheet given to the child consisted of a political map of Africa without any labels, with instructions to color in all countries that began with a certain letter (“M” in the first task, “A” or “Z” in the second). The parent was given an answer sheet—a colored map of Africa that contained the names of the countries and their capitals—and instructed to assist the child in any manner they thought appropriate. For one of these tasks, the parent-child pair was asked to use videoconferencing, while the other task allowed them to use the ShareTable. Each parent-child pair completed both tasks, representing a within-participant design, counter-balanced for order effects. We were interested in comparing the strategies that parents and children used with the addition of the extra video channel.

In the third task, the parent and the child were asked to play a board game together using the ShareTable system. This represents a task that is currently impossible to carry out using a videoconference system alone, so there was no videoconferencing condition. We provided a simple game, based on the idea of “Ludo” or “Sorry!” (see Figure 1). Only the parent’s side had the physical game board, but each side had physical token pieces and a die. Thus, the child had to place his or her pieces on the projected surface of the board. We were interested in whether the child would be able to manage turn taking and access in this unusual space, which interweaves physical and projected artifacts. We chose the game of Ludo because it includes a rule that if your opponent stops her token in a space that’s currently occupied by one of your tokens, you must move your token back to the start position. In a physical game, this rule is easily enforced with physical constraints (only one piece can occupy a give space), but we were interested in seeing how the game would play out over the ShareTable where no such constraints were present.

We asked each parent-child pair to commit one hour to this study; however, they were also given the option of continuing to play with the system in whatever way they chose at the end of that time.

#### **4.3.2. Comparing ShareTable and Videoconferencing**

We began by observing how parents and children completed two worksheet tasks—one with the ShareTable system and the other with plain videoconferencing. After completing each task, we asked them to answer a few questions about their experience. A more detailed description of these findings can be found in [30]

We asked each parent and child how difficult it was to do the worksheet with each communication medium and how much he or she liked using each system on a 5-point Likert scale. We hypothesized that the ShareTable would be rated as both easier and better liked than plain videoconferencing and this was supported by the data. We turned to the observation data to better qualifying this difference.

In the videoconference condition, children and parents used the following strategy: the parent would verbally explain where the country is (e.g., “the little one to the left of the big one that looks like a heart”), the child would point to the country and hold up the worksheet to the webcam, the parent would confirm or reject the selection, and the child would color in the country if it was confirmed. The main breakdown in the process occurred as the child tried to identify and confirm the country. Two of the children seemed to assume that the parent could see where they were pointing without holding up the paper (even though it was explained that the parent could not). Five of the children had trouble understanding how the worksheet would look to the parent when held up to the camera—holding it too close, too far, or even upside down.

In the ShareTable condition, the child would keep the worksheet flat on the table. The parents described the correct country verbally, by pointing to it with their finger, or by circling it with a marker. Children would verbally confirm if they had the right country or would touch the country with the tip of the marker and look up at the video screen for confirmation. Interestingly, parents did not seem to be concerned with the efficiency of completing the worksheet. None of the parents simply put the sheet with the answers on the table. In one family, the mother explicitly acknowledged that if she showed the answers, she would feel like she was cheating and that her son would probably learn more if they worked through the worksheet together. Another common behavior was taking verbal tangents from the task to tie the worksheet to other experiences in the child’s life. For example, a father pointed to an African country to tell the daughter a story about her aunt who currently lives there. Additionally, every parent made a remark about the country Madagascar and the children’s animated movie by the same name.

It has previously been demonstrated that gestures over video streams can support quicker completion of remote tasks. When one user assists another for work, measures like time to completion make a lot of sense. However, when the users are parents and children, completing the task takes a back seat to engaging with each other. In the ShareTable condition, we noticed a greater level of engagement between the parent and the child. They spent more time looking at each other and less time looking at the task. They also spent more time laughing and talking about peripherally related information. Parents supported their child’s learning not by making sure that the worksheet was completed quickly, but rather by tying the activity to other aspects of the child’s life, such as familiar children’s media. By making the logistics of the task easier, we conjecture that the ShareTable freed the parent and child to focus on these other aspects of communication. In other words, the ShareTable enriched the activity of remote homework help.

#### **4.3.3. Using the ShareTable to Play a Physical Board Game**

To see how parents and children coordinated turn taking and interaction with physical artifacts while using the ShareTable, we asked them to participate in a simple board game task, similar to “Ludo.” Since the ShareTable just projects a video stream, each participant can only physically manipulate the artifacts on his

or her side of the table. We wanted to see how participants would manage the interaction of “bumping” each other’s pieces back to start. While all but one parent-child pair explicitly verbally acknowledged the possibility of refusing to move their piece when bumped, but quickly dismissed it, as it would “ruin the game” or make the game “no fun.” In fact, there was a great deal of physical behavior surrounding the bumping of a piece despite the fact that the participants could not physically replace the opponent’s piece back to the start. A common behavior was manipulating the game token in a “dancing” motion on top of the projection of the opponents’ piece after bumping an opponent.

Unlike an online board game, the ShareTable leaves the management of turns and rules up to the users. While the user was taking his or her turn, they would usually focus on the table surface; however, during their opponents turn, they focused on the face-to-face video. Looking up at the screen at the end of one’s turn seemed to signal to the other person that it was his or her move. One interesting facet we observed was that parents tried to bend the rules of the game to the advantage of the child—children won six out of the seven games played. Parents would do this by giving the child strategy advice and by letting them re-do moves or take extra turns. If we had built explicit games and rules into the infrastructure of the ShareTable, this interaction may have been lost.

In post-task interviews, two of the parents explicitly mentioned that, despite the lack of access to the opponent’s pieces, playing the board game using the ShareTable felt much more similar to playing a board game in-person than using any other computer-mediated channel. Another parent mentioned that after the first ten minutes of using the ShareTable, he felt that he could focus entirely on interacting with his daughter, rather than “using the system.” All of the children we interviewed said that they would like to try more board games with the ShareTable. Two of them explicitly requested the chance to play again at a later time. To summarize, parents and children were successful at managing access to artifacts and turn taking without specific system support—they mutually acknowledged the rules and possibilities of the interface and acted to manage them in a way similar to in-person interaction. Playing a board game using the ShareTable was more similar to the rich experience of playing together in-person than to the controlled experience of playing an online game.

#### **4.3.4. Observing Free Tasks and Considering Future Possibilities**

Finally, we observed the way users interacted with the ShareTable when given an opportunity for free play before and after the tasks. We sought to identify the features of the ShareTable that supported or hindered the activities that the parents and children chose. Several parent-child pairs participated in “collaborative drawing” in which the child or the parent would initiate a drawing while the other added elements to it (e.g., child draws butterfly and the parent adds patterns on the butterfly’s wings). One of the parents mentioned that this task was actually easier with the ShareTable than in-person because she and her son could occupy the central physical location at the table without getting in each other’s way. We observed

a variety of other playful activities. One parent-child pair participated in a “tracing” activity—the father put his hand on the table and the child carefully traced it. In one family, the child played a game of “tag” by trying to catch the projected version of her dad’s hand with her own. One family really wanted to try doing their own task—playing a game of chess with their own board and pieces. They were successful, but we noted that because the ShareTable places the two users on the same side of the table, the father was put in the awkward position of having to play his pieces from the opponent’s side of the board.

In post-study interviews, we asked the parents and children how they would use the system in their own home and if they had any suggestions for modifying the ShareTable. One parent said she wanted her son to be able to leave a short note on the table when he gets home from school. She wanted to be able to access a message left on the table from her mobile phone to quickly get feedback that her son safely arrived at home. One child suggested that her father could put printed pictures on his side of the table so that she could trace them. Another child mentioned that he would have liked to be able to share the drawings he and his mother created by giving them to his father to take to work or hanging them on the refrigerator. Both parents and children said that they would use the ShareTable for both play and homework if they had one in their home. Several parents mentioned wanting to be able to read with the child, but three expressed a concern that the resolution of the ShareTable surface would not be high enough to allow comfortably reading most books. The ShareTable only provides the medium for the interaction—creating content is left up to each family—so, it was encouraging to see that our participants could come up with a variety of compelling use cases for the system.

#### **4.4. From Functional Prototype to Robust System**

While the lab-based evaluation demonstrated that the ShareTable was compelling for parents and children, there were a number of changes necessary in order to make the system ready for long-term deployment in the home. We present these here to demonstrate that the transitioning from “functioning prototype” to “robust system” is frequently not trivial.

The first step was converting our quick Python solutions into something that could stand up to everyday use by a real family. For us, that meant changing large parts of the system to leverage existing APIs. After some experimentation, we decided to use the Skype API for the face-to-face video and audio, while the tabletop video used the Axis Camera API. While we do gain robustness by working with existing APIs, there were several points at which the APIs did not support specific functions we needed, requiring creative workarounds.

At this point, we had a number of tradeoffs to make in the design of the system. While the lab-based prototype of the ShareTable avoided network issues by physically connecting the two tables, we needed to consider how this system would function over a real network. Even leveraging the efficiencies of existing solutions, we are attempting to transfer considerably more data than a household connection is capable of supporting. We found that 1280x1024 overhead camera im-

age was the minimum to allow size 14 fonts to be readable over the table. When this is added to the already-heavy requirements of a Skype video call, most home networks come up short. In order for the system to work, we needed to consider potential trade offs to conserve bandwidth. Other videoconferencing systems do this by prioritizing frame rate over resolution. This makes sense for face-to-face videoconferencing where being able to perceive gesture and expression is paramount. Our face-to-face video adopts this strategy as well. However, for our tabletop surface we chose a different approach. In order to support reading and helping with homework, we decided to prioritize resolution over frame rate. With a home bandwidth connection, this unfortunately often means a frame rate as low as 2 fps.

Lastly, unlike the lab-based prototype, we needed to consider the way interaction would be initiated using the system. Most similar media spaces have been evaluated in the lab, therefore not needing to consider the way a connection would be initiated. Alternatively, many media spaces assume an always-on connection, again avoiding the question of initiating contact. An always-on connection would not be an acceptable solution to divorced families, so we needed to consider how to implement a solution for initiating a connection that would be simple enough for a child to use and where the state of the system would be immediately apparent to others in the house. We chose to implement a simple physical metaphor for initiating the connection. Opening the ShareTable cabinet activates the connection to the paired table (through a simple Reed switch circuit) and the receiving table rings as a telephone might. Closing the open doors ends the call.

While most telepresence studies are conducted in the lab, our process with the ShareTable emphasizes that there are a number of problems that are avoided in such deployments, but need to be considered in order to prepare a system for the field. The steps between “functioning prototype” and “robust system” are rarely made visible in publication, however we hope that by making these steps more transparent we can encourage others to try to take their system beyond the lab. We are now planning to conduct month-long deployments of the ShareTable system with three divorced families (6 households).

## **5. Discussion**

In this section, we discuss the challenges and opportunities of designing for divorced families highlighting both the difficulties and the importance of working in this domain.

### **5.1. Challenges**

The three most salient challenges of designing for divorced families are (1) creating technology before there is law to support its use, (2) designing in situations with conflicting stakeholders, and (3) taking technology from the lab into the home.

Though virtual visitation is in the process of becoming part of family law in most states, this is a slow process. While in the future a technology like the ShareTable may be installed at the request of the non-residential parent (for example, as a pre-condition for relocating the child), currently we can only deploy it in low-conflict families, where both parents are motivated to consent to this system. This doesn't allow us to fully explore the implications of the technology we have built. This may be the case for many novel technologies created for this audience, as the law will inevitably be slower than technological innovation.

Divorce is inherently a setting of conflict where different stakeholders may have radically different needs and motivations. Researchers in this domain acknowledge that divorce is an emotionally charged topic that is difficult to explore without "being identified as either a conservative or a liberal voice" [1]. Working closely with divorced families, there is implicit pressure from the participants to ally with a particular party. As an explicit design decision, we try to remain consistent with the shared goal of providing positive outcomes for the child. However, we must acknowledge that it is possible that introducing new technology in this domain may lead to unintended consequences and there are assumptions implicit in our intervention. We make the assumption that contact with both biological parents is beneficial to the child. While there is a large body of empirical evidence to support this hypothesis (e.g. [1,27]), this will not be true for every child and every parent. As with any divorce situation, it becomes the responsibility of policy makers, judges, and parents to tailor a solution appropriate to the specific situation. The most tentative assumption that we make is that improving communication between the child and the distributed parent will not negatively affect other family relationships in the child's life. There is evidence that quality contact with the biological parents does not negatively affect the child's relationship with their stepparents [12]. However, it is difficult to predict the way new technologies will affect the lives of users. We seek to include nonuser stakeholders in the evaluation of new communication technologies to help us understand when such conflicts do occur. We hope that by being explicit about our assumptions and the values that we bring to the table as researchers, we can avoid the trap of false objectivity.

Lastly, designing for divorced families shares a challenge with all design for the domestic space. Technologies are difficult to take from initial prototype to working system and nothing less than a robust solution would support a reasonable evaluation in the home. With divorced families, it is perhaps more important to deploy in the home than in other domestic situations. Interventions for divorced families must become familiar and routine enough in the home that the families stop acting like "good participants" [5] and begin acting within the patterns that truly reveal the nuances of the family's interactions. Unfortunately, it is hard to make such long deployments work within the timelines and budgets of academic research.

## 5.2. Opportunities

Despite all of the challenges highlighted above, there is a lot to gain in designing for divorced families.

Studying divorce foregrounds family issues that are usually difficult to get at in other families. This allows us to study situations that may be more infrequent in other families and thus harder to see and consider in the design. The first of these issues is the one of conflict. While conflict is assumed in divorced families, intact families are often considered to be harmonious units with common goals and motivations. This is often not the case, and making this assumption can lead to communication breakdowns [23,28]. The second issue relates to non-consensus and asymmetrical motivation. The motivations of the child to communicate with his or her remote parent are likely to be different from the expectations of both the residential and the non-residential parent. This highlights the importance of keeping in mind the obligation to communicate that new technologies may introduce and what may happen if these expectations are not met. The last issue concerns the privacy in families. While privacy may be a background issue in many intact families, we need to keep in mind that all families function within “numerous interrelated boundaries operating simultaneously” [6]. As recent deployments of media spaces in the home have shown, families do not function as a single-minded unit regarding how they manage their privacy with other family members and violations of individual privacy preferences can lead to the rejection of a technological intervention [16].

Just as the medical field tends to focus on the most extremely affected patients as a case study, so too can divorce serve as a “worst case scenario” of family interaction. It is likely that technologies designed for divorced families can extend to other situations such as grandparent-grandchild interaction, work-separated families, or even incarcerated parents. Conversely, it is less likely that technologies designed for situations with minimum conflict will be able to flourish in high-conflict households. At the same time, divorce is currently the most common cause of parent-child separation and one of the most permanent ones. Addressing the needs of divorced families provides an incredible opportunity to create an impact in the lives of over a million children who experience divorce every year in the United States alone [27].

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## References

1. Amato, P.R. The Consequences of Divorce for Adults and Children. *Journal of Marriage and the Family* 62, 4 (2000), 1269-1287.
2. Amato, P.R. Children of Divorce in the 1990s: An Update of the Amato and Keith (1991) Meta-Analysis. *Journal of Family Psychology* 15, 3 (2001), 355-370.
3. Ames, M.G., Go, J., Kaye, J., and Spasojevic, M. Making Love in the Network Closet: The Benefits and Work of Family Videochat. *Proc. of CSCW*, (2010), 145-154.
4. Ballagas, R., Kaye, J. "Jofish," Ames, M., Go, J., and Raffle, H. Family communication: phone conversations with children. *Proc. of IDC*, ACM (2009), 321-324.
5. Brown, B., Reeves, S., and Sherwood, S. Into the Wild : Challenges and Opportunities for Field Trial Methods. *Proc. of CHI*, (2011), 1657-1666.
6. Caughlin, J.P. and Petronio, S. Privacy in Families. In *Handbook of Family Communication*. Lawrence Erlbaum Associates, Mahwah, NJ, 2004, 379-412.
7. Census, U.S. *Household Relationship and Living Arrangements of Children Under 18 Years, by Age and Sex*. 2008.
8. Conlin, J. Living Apart for the Paycheck. *The New York Times*, 2009.
9. Cron, S.K. Virtual Visits: New Law Provides Alternative Visitation Options. *Law Office Computing*, (2006).
10. Dalsgaard, T., Skov, M.B., Stougaard, M., and Thomassen, B. Mediated intimacy in families: understanding the relation between children and parents. *Proc. of IDC*, ACM (2006), 145-152.
11. Flango, C.R. *Virtual Visitation — Is This A New Option for Divorcing Parents?* 2003.
12. Furstenberg, F.F. and Nord, W.C. Parenting Apart: Patterns of Childrearing after Marital Disruption. *Journal of Marriage and the Family* 47, 4 (1985), 893-904.
13. Gray, M.R. and Steinberg, L. Unpacking Authoritative Parenting: Reassessing a Multidimensional Construct. *Marriage and the Family* 61, 3 (1999), 574-587.
14. Harmon, A. Grandma's on the Computer Screen. *The New York Times*, 2008.
15. Hofferth, S.L. and Sandberg, J.F. How American Children Spend Their Time. *Marriage and Family* 63, 2 (121AD), 295-308.
16. Judge, T.K., Neustaedter, C., Harrison, S., and Blose, A. Family Portals : Connecting Families Through a Multifamily Media Space. *Proc. of CHI*, (2011), 1205-1214.

17. Kelly, J.B. and Lamb, M.E. Using Child Development Research to Make Appropriate Custody and Access Decisions for Young Children. *Family Court Review* 38, 3 (2000), 297-311.
18. Kennedy, T.L.M., Smith, A., Wells, A.T., and Wellman, B. "Networked Families." *Pew Internet & American Life Project Report*. Washington, D.C., 2008.
19. Modlitba, P.L. and Schmandt, C. Globetoddler: designing for remote interaction between preschoolers and their traveling parents. *Ext. Abst. of CHI*, ACM (2008), 3057-3062.
20. Odom, W., Zimmerman, J., and Forlizzi, J. Designing for dynamic family structures: divorced families and interactive systems. *Proc. of DIS*, (2010), 151-160.
21. Seltzer, J.A. and Bianchi, S.M. Children's Contact with Absent Parents. *Journal of Marriage and the Family* 50, 3 (1988), 663-677.
22. Shefts, K.R. Virtual Visitation: The Next Generation of Options for Parent-Child Communication. *Family Law Quarterly* 36, 2 (2002), 303-327.
23. Sillars, A., Canary, D.J., and Tafoya, M. Communication, Conflict, and the Quality of Family Relationships. In *Handbook of Family Communication*. Lawrence Erlbaum Associates, Mahwah, NJ, 2004, 413-446.
24. Smyth, B. Research into Parent-Child Contact after Parental Separation. *Family Matters*, 62 (2002), 33-37.
25. Stafford, M. Communication Competencies and Sociocultural Priorities of Middle Childhood. In *Handbook of Family Communication*. Lawrence Erlbaum Associates, Mahwah, NJ, 2004, 311-332.
26. Vetere, F., Gibbs, M.R., Kjeldskov, J., et al. Mediating intimacy: designing technologies to support strong-tie relationships. *Proc. of CHI*, ACM (2005), 471-480.
27. Wallerstein, J.S. and Kelly, J. *Surviving the Breakup: How Children and Parents Cope With Divorce*. Basic Books, 1996.
28. Yarosh, S. and Abowd, G.D. Mediated Parent-Child Contact in Work-Separated Families. *Proc. of CHI*, ACM (2011).
29. Yarosh, S., Chew, Y.C., and Abowd, G.D. Supporting Parent-Child Communication in Divorced Families. *Intl J of Human Computer Studies* 67, 2 (2009), 192-203.
30. Yarosh, S., Cuzzort, S., Müller, H., and Abowd, G.D. Developing a media space for remote synchronous parent-child interaction. *Proc. of IDC*, (2009), 97-105.