

# SketchUp™: A Technology Tool to Facilitate Intergenerational Family Relationships for Children with Autism Spectrum Disorders (ASD)

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*This study used a qualitative design to examine intergenerational relationships facilitated by an intervention employing Google SketchUp™, a freeware 3D design program. Seven high-functioning boys (ages 8–17) with autism spectrum disorders (ASD) participated in computer workshops. The investigators capitalized on the boys' strengths in visual-spatial skills. The interdisciplinary team structured the workshops to facilitate computer skill development as well as social interaction. Qualitative analysis involved thematic analysis of transcripts from focus groups with parents and grandparents. The two key themes that emerged were as follows: (i) reframing expectations (parental efficacy and creating a safe environment) and (ii) building intergenerational bridges among parents, children, siblings, and grandparents. These findings indicate that technology can build on the strengths of children with ASD and promote social engagement of the children with their families.*

**Keywords:** *autism; intergenerational relationships; social engagement; SketchUp™; technology*

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The prevalence of children with autism spectrum disorders (ASD) continues to increase with national estimates of one out of 110 children (Reed, Hyman, & Hirst, 2011; Sansosti, 2010). ASD is a neurodevelopmental condition with three core impairments: atypical social interactions, decreased verbal and nonverbal communication, and repetitive behaviors and/or restricted interests (Lombardo & Baron-Cohen, 2010). Parents of children with ASD express concerns about the future for their children, especially with respect to social interactions, independence, and employment (Harris Interactive, 2008). Research supports these concerns, as many adults with ASD live with parents and have lower rates of employment than neurotypical peers (Frith, 2004).

Many interventions for individuals with ASD address social and communication weaknesses (Ramdoss et al., 2011; Reed et al., 2011). Although social skill interventions result in skill gains, the generalization of social skills to natural contexts such as home, school, and the community is more difficult (Rao, Beidel, & Murray, 2008; Stock, Davies, Wehmeyer, & Lachapelle, 2011). Promoting generalization is critical for continued use of skills and for preparation for adult roles.

Many parents of children with ASD report that their children are highly engaged with videos, computer games, and other electronic media (Buggey, 2005; Charlop-Christy & Daneshvar, 2003). The use of computers with individuals with ASD may help focus their attention on relevant tasks (Farr, Yuill, & Raffle, 2010; Grynspan, Martin, & Nadel, 2008; Moore & Calvert, 2000). Furthermore, computer characteristics such as controllability and adaptability can be reassuring for children with ASD (Bosseler & Massaro, 2003). Individuals with ASD often excel at computer tasks and have excellent visual-spatial skills (Caron, Mottron, Rainville, & Chouinard, 2003; Mottron & Belleville, 1993). Researchers have begun to explore strengths in visual-spatial skills and interests in computers to develop programs for children with ASD using avatars and robots to promote social interactions (Moore, Cheng, McGrath, & Powell, 2005; Wainer & Ingersoll, 2011). Although study outcomes have focused on changes in social skills, generalization of the outcomes in natural contexts such as home and school were limited.

This study examined social engagement among families with a child with ASD following intervention workshops using SketchUp™, a 3D freeware design program used by professionals in architecture, construction, engineering, film, and video game production. Given visual-spatial strengths of individuals with ASD, computer programs like SketchUp™ may be especially appealing (Guerio, 2009). Google™ employees also received feedback from users of SketchUp™ that their children with ASD were drawn to this graphic design program. In response, Project Spectrum (<http://sketchup.google.com/spectrum>) was developed to encourage computer graphics skills that could lead to employment among individuals with ASD.

Similarly, the original intention of this study was to provide SketchUp™ workshops for children with ASD to develop skills for potential occupations. The focus and structure of the program evolved as the investigators became aware of the social aspects inherent within the workshop structure. The investigators began to examine more carefully how the workshops facilitated social engagement among the boys and their parents, siblings, and grandparents.

Social engagement involves interactions among individuals and sharing of common interests. Focusing on strengths, such as interests in computer technologies

and visual-spatial abilities, to facilitate social engagement for high-functioning children with ASD offers promise and promotes connecting the virtual world with interactions with family and peers (Bölte, Golan, Goodwin, & Zwaigenbaum, 2010; Kaliouby, Picard, & Baron-Cohen, 2006). For this study, the investigators used multiple familial contexts to promote social engagement including parents, siblings, and grandparents. Research supports the idea that grandparents may be key supporters in families who have children with disabilities including autism (Hillman, 2007; Lee & Gardner, 2010; Woodbridge, Buys, & Miller, 2011). Thus, inclusion of grandparents was an integral and innovative component in our program. Grandparent involvement is an overlooked, infrequent intervention strategy with children with ASD (Krumins, 2010; Margetts, LeCouteur, & Croom, 2006).

This study addresses a significant gap in the research with an intervention focused on school-age children that actively involved siblings, parents, and grandparents. Additionally, the investigators targeted the developmental phase when children with ASD become more aware of their differences in terms of social relationships (Winner, 2000). The unique focus of the study emphasizes the visual-spatial strengths often found with this disorder (Grandin, 1995; Mottron & Belleville, 1993), leveraging these strengths toward building social interactions and computer skill development. This study examined parents' and grandparents' perceptions of intergenerational family relationships following an intervention program for children with ASD using Google SketchUp™.

## METHOD

### Research Design

The investigators chose a participatory action research (PAR) approach, which the National Institute on Disability and Rehabilitation Research encourages for grantees (Fenton, Batavia, & Roody, 1993). PAR involves researchers and stakeholders collaborating in an attempt to minimize the gap between researchers and the intended beneficiaries of the research (McTaggart, 1991; Whyte, 1991). The PAR design of this study included family members of children with ASD as ongoing advisors (Turnbull, Friesen, & Ramirez, 1998), as recommended in the strategic plan by the Interagency Autism Coordinating Committee of the U.S. Department of Health and Human Services (Interagency Autism Coordinating Committee, U.S. Department of Health and Human Services, 2011). In this study, parents helped determine the structure of the workshops and the research questions addressed, as well as providing input on the data analysis and results.

### Intervention

The intervention involved an introductory community seminar for parents, grandparents, and teachers, a summer workshop for children on the spectrum, and a follow-up after-school program in the fall. The community seminar focused on Project Spectrum, which involves the Google SketchUp™ program, and was jointly sponsored by the university and Google™. The investigators chose the SketchUp™ design program as it was especially appealing to students

on the autism spectrum because of their visual-spatial skills. Feedback from the seminar indicated that parents wanted child-focused workshops on SketchUp™. As one parent noted, "We just want them to grow up to be taxpayers!"

In response, the investigators offered a five-session summer workshop for children with ASD. All children with high-functioning autism whose parents attended the community seminar were invited to participate in the summer workshops. However, only parents of boys enrolled their children in the summer workshops, perhaps because boys were more interested in technology, and more boys are on the high-functioning end of the autism spectrum. The summer and fall workshops involved hands-on computer time in which children on the spectrum were instructed on the use of different tools in SketchUp™ and presented their designs to their peers. The university-based sessions were two hours long and included a component in which the boys shared their design projects (see Wright, C, Diener, M. L., Dunn, L., & Wright, S., unpublished data).

Parents and other family members were encouraged to attend the sharing portion of the workshop. The sharing time provided an opportunity for children to ask and answer questions and provided peer support. Family members participated by asking questions and giving positive support. The investigators used a variety of strategies to involve the boys in teaching others about SketchUp™ and sharing their designs. On request of the participating families, the SketchUp™ workshops continued over the next 4 months, with six sessions provided after school and three Saturday workshops. Siblings were invited to the Saturday workshops as an opportunity for the boys to teach their siblings about SketchUp™.

At the completion of the workshops, the research team worked with the children's schools, enabling them to present to their classroom peers about SketchUp™ and share their design work. All the boys involved presented to their classes at school except the high school student, who was not granted an opportunity by his school to present his work. Additionally, two community events were planned in which the children presented their SketchUp™ design work to family, friends, and support people (teachers, tutors, and other caregivers).

### Participants

A purposive sampling technique was used to identify a group of families with children with ASD. Families were recruited from an e-mail list of parents who attended the original seminar on Project Spectrum. This purposive sample resulted in a self-selection of families who were interested in bringing their children to SketchUp™ workshops at the university. The workshops were promoted specifically for children on the autism spectrum. Seven male children participated in the workshops; the focus of this article is on these seven families.

The boys who participated in the workshops were between 8 and 17 years old (all were elementary school students except the high school student). In interviews, parents reported that six of the seven boys had a diagnosis of autism (most referred to their child as high functioning or Asperger's). The average age of diagnosis was 2 years old. Parents also reported other disability labels (including developmental delays, learning disabilities, attention deficit,

oppositional defiant, and disruptive disorder). One child was classified as having a variety of other disabilities, but did not have an autism diagnosis. According to parental reports, all of the children experienced difficulties in social interactions with peers. All but one of the boys participated in a variety of early behavior intervention programs. The families were primarily middle class; parents were mostly college educated. All families had two children except one family that had three children. One of the couples was separated, and in this family, both parents actively participated in the workshops. All the children except one were in inclusive regular educational settings; one child was in a learning disorder classroom. Siblings included four sisters and two brothers (ages 8–12) who participated on a regular basis. Four of the families had grandparents in the area who were active in their grandson's lives, and they participated in our program.

### Measures

Two focus groups were held separately with parents ( $n =$  six mothers and one father) and grandparents (two grandfathers and four grandmothers representing four of the seven families). The first focus groups occurred the week after the fall workshops and were about 2 hr long; follow-up focus groups took place 3 months later. We also held a combined focus group of parents and grandparents (that involved six mothers, three fathers, and three grandparents) 4 months after the end of the workshops. The discussions were initiated by a research team member ("Tell us about your child's/grandchild's experiences with the SketchUp™ workshops"), and then participants guided the direction of the discussions. The discussions focused on an evaluation of the workshops (what worked well, what could be improved, and next steps). The focus groups were videotaped with permission of participants and transcribed verbatim.

### Data Analysis

Focus group transcriptions were coded to identify themes that emerged from the data. The transcripts were read and reread by members of the research team. The research team included four faculty members, three graduate students, and one undergraduate student, all of whom participated in data coding. The investigators used triangulation across time and people to ensure trustworthiness of the interpretations. Research assistants and faculty coded the transcripts independently and then met as a group to identify general codes for each focus group. In the group, the researchers discussed categories and then grouped categories into themes. Independent theme development was followed by discussion of consensus on major themes. Information from observations and reflections after each group was used to assist with interpretation of the findings and the development of themes.

The investigators presented the themes and categories that had been identified to the families and asked for their feedback. The feedback from the parents was incorporated into the model. In addition, the special educator working on the project reviewed the themes and provided feedback. These procedures provide trustworthiness by comparing perspectives from multiple researchers using multiple methods (Krueger & Casey, 2000; Patton, 2002). See Figure 1.

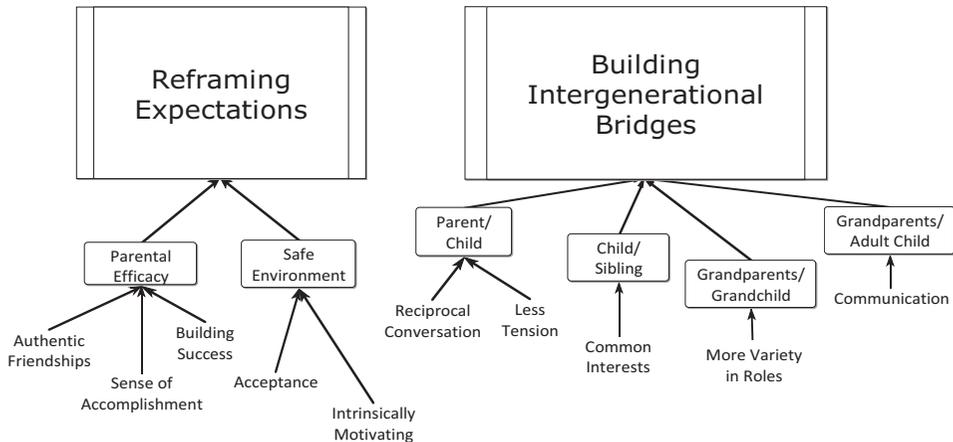


Figure 1: The data coding process.

## RESULTS

Results focused on parents' and grandparents' perceptions of how the technology workshops facilitated intergenerational social engagement. The two key themes that emerged were as follows: (i) reframing expectations (parental efficacy and creating a safe environment) and (ii) building intergenerational bridges (among parents, children, siblings, and grandparents). Selected quotes will be used to illustrate coding categories within each major theme.

### Key Theme: Reframing Expectations

*Theme 1: Parent efficacy* Perceived parental efficacy refers to the beliefs a parent holds of their capabilities to organize and execute a set of tasks related to parenting a child (Montigny & Lacharité, 2005). Based on previous experience, parents reported little efficacy in terms of choosing effective extracurricular activities. Parents (primarily the mothers) reported that they had tried every possible activity for their children with little success. Mothers were worn out from trying to find a niche for their sons. One mother expressed her strong feelings in relation to these previous activities, "Painful memories, Little Gym, T-ball, sporting things, karate, music classes—trepidation. We tried because our hearts were broken because that is what boys are supposed to do." Regarding these experiences, one of the mothers summarized:

Slowly, he will start to protest going... 'I don't want to go, I don't like it.' He doesn't make friends. It's always like defeat for us when he's recognized that he's a little different or spazy or quirky or even ostracized. He's giving up, or we're giving up because he doesn't fit in. It's not for him. We quit trying to get them into activities because they don't work.

Parents also expressed skepticism about the workshops based on these prior failures. One mother stated, "It was like 'here's another one'. He's not going to be smart enough on the computer... kids will be smarter...we will go home feeling defeated... I was wrong about this one."

These workshops seemed to be more aligned with the child's interests in technology, as one mother explained, "It was the first time I took him to something for him, that really turned out to be for him. Instead of me doing some checklist in my mom head—he's got to try basketball, ... social skills class, art class." Thus, by capitalizing on the boy's intrinsic interests, parents were able to feel effective in choosing a successful activity for their sons. This sense of efficacy enabled the parents to reframe their expectations about extracurricular activities for their child. The boys' friendships, sense of accomplishment, and success with the technology enabled the parents to have a greater sense of efficacy, leading them to reframe their expectations about their sons.

*Authentic friendships.* An important parenting goal was to provide activities for their child that might facilitate friendships. One mother explained her attempts to help her child make friends:

Always before when we would go to camps or go to things, he was always quiet in the car. Even with social skills classes. He would go and he participated but he wouldn't refer to them as friends. They're all smart. They understand when we're putting them in social skills classes. They know what we are up to.

The workshops provided an opportunity for the boys to expand their peer relationships, and parents recognized their child's tendency to gravitate to "like-minded people." Parents attributed this connection to comfort with similar peers, "It's like they have this sense when they meet another person on the spectrum." One mother noted, "with this program, instantly, every one of the boys became his friends. He knows them all by name." The workshops seemed to provide "authentic friends" who were peers with similar interests. Another mother commented, "I think they are really on each other's radar. They have started to connect at school. It is like we have the secret you know, it's like we are special."

On the very first day of the workshops, one mother recalled,

When I came back to watch, it was the noisiest place ever. The kids were moving and jumping, checking out what everyone was doing. It was just amazing... He really wants relationships with kids. He really wants that. He wants other kids to like him.

SketchUp™ became a tool to facilitate these peer interactions. The workshops reframed parents' expectations that their sons would be able to establish meaningful peer relationships instead of believing that they were incapable of developing friendships.

One mother explained her son would ask when someone was absent from the workshop, "Like an honest concern for someone if they weren't there—which I had never really seen before." Parents agreed that their children related to the other boys and support personnel in the workshops as "people," rather than characters in a movie or story:

This turned his conversation about people. He started to talk about things people did, instead of those fictitious characters he cares so much about. He talked about what other kids did and that he had fun.

A grandfather who noted having friends had always been "iffy" for his grandson stated this after attending his grandson's class presentation: "I'm seeing a different child. I went to his program yesterday, the bell rang, and they went out to recess, and he had a little friend with him. He was playing around. That's unusual."

Another important element of the program was the authentic friendships that the boys developed with the SketchUp™ instructor who taught the boys the more advanced components of the program. One of the mothers recalled that during her son's class presentation, he said, "This is my friend Steve, my buddy Steve over there." Parents noted the important mentor role the instructor played in the project for their child. Parents believed that by connecting with similar boys and adults who shared common interests in technology, their sons were able to develop friendships that had previously been difficult to establish.

*Sense of accomplishment.* Parents expressed feelings of pride in the accomplishments of their child in the program. One father noted, "I was amazed at the school presentation my son gave—he was confident, articulate, and funny." Another father also talked about his son's presentation to his class, "it was so interesting and fun to watch his own peers suddenly get a laser focus and see him in a much different light." Another parent commented on her son's performance, "I was also very, very, very proud of him being able to get up in front of people and present and act appropriately."

A mother explained, "He takes on that 'I'm kind of special' because I understand this more than anyone else." Another mother noted, "He'll show us what he can do with pride, and we encourage him and he builds confidence from that constantly."

Grandparents were also pleased that their grandchildren experienced increased confidence and resiliency when using a computer program that required higher level visual-spatial skills. One grandfather noted, "I've seen a great deal of confidence in him from the SketchUp™ workshops because he knew how to do this and this." One parent summarized the feelings of her child as, "I'm good at this, and this is cool that I am good at something! Wahoo! I am finally good at something! Am I like the coolest guy in the whole world?" Parents and grandparents perceived that this sense of accomplishment reframed both the child's and parents' expectations about future accomplishments. Parents saw their children as having special and unique skills through the designs they created in the SketchUp™ workshops.

*Building success.* Parents expressed relief in knowing that their child experienced success rather than failure. One parent explained how her son felt, "We go to this regularly, and this is a talent of mine."

Grandparents also perceived that their grandsons were successful with SketchUp™. "He has just blossomed with this program," expressed one grandfather after watching his grandson's school presentation. Another grandmother said, "His mother got him into this, and he's just loved it. Nothing succeeds like success!" Parents noted that this program celebrated their children for whom they were instead of whom they were not. Parents also perceived that the confidence from SketchUp™ was incorporated into other areas of life. "He always enjoyed coming—it has been a good thing for him. And also, I think hopefully it has branched out into other things."

One couple agreed, "Seeing what our son has been able to accomplish so far with social skills and the creative side of SketchUp™ has given us a renewed

hope that our future can and will be bright instead of dim." Another added, "Watching them do a good job puts us at ease for the future, what is coming up in their lives."

One mother explained that her child's teacher could not believe the great presentation he was able to give to his class. The teacher said, "I was shocked. I didn't think he would get up there and do as well as he did and just take control of the situation." The parent added, "We have preconceived ideas about how they will behave and because of those, they don't always get the chance to show what they can do."

Parents recognized that their children in fact possessed talents and skills that they would be able to build upon in the future: "Okay, so you're not going to fling hamburgers for the rest of your life or go from job to job. This is something that can help tunnel your focus in a positive way and give you a skill that we build on."

*Theme 2: Safe environment* The SketchUp™ program provided a safe environment for the boys to express their unique perspectives and talents. Parents described their children as bright, interesting, fascinating, creative, and funny. Workshops provided opportunities for others to see these character traits of their children that others usually do not see. One parent explained, "I saw it at the end of the first day, they could just be themselves. The charming, cute, funny people that we see, maybe in the privacy of our own homes." Another mother noted, "I'm just kind of speechless and in awe of how amazing he is by the way he sees things." One mother expressed this feeling:

We come to this [program] knowing it is a safe place...we're going to be happy and he's going to be happy. We walk away and take this feeling home with us. He has always enjoyed coming. This to us has been like so...like just a relief—to have a place where he continuously wants to come. That actually, honestly, changes our life. Every week. We can count on it, and its always a positive experience. Which is hard to come by for us.

*Intrinsically motivating.* Parents emphasized that their children enjoyed SketchUp™ and were self-motivated to come to the workshops, rather than having to be pushed. The mothers agreed that their children really enjoyed coming to the program, and it was something that their boys always wanted to do. Another mother described "there comes a point where you can't force them to be somewhere they know they are not comfortable, and it becomes really hard... he always wanted to come to the workshops."

*Acceptance.* The sense that the child was accepted in a safe environment without a focus on the child's deficits was raised repeatedly. One mother explained about her son, "He wants someone to recognize the things he's really good at." Another mother agreed, "He is in a place where he is welcomed and he's... and feeling like...he's got something to tell me he's proud of." Another mother explained the motivation as,

He's gotten a lot of negative strokes out in the world. He has failed...or hated soccer, basketball. He didn't understand the game, he didn't make friends. I think this project has been a place where he has gotten honest, positive strokes for something he's doing. No one is making him do it.

### Key Theme: Building Intergenerational Bridges

*Theme 1: Parent and child* Parent and child social engagement was enhanced by this shared experience. One mother explained, “the key really is confidence and since this is building their self-confidence, it makes them open up and share more with us instead of us drawing it out.” Parents and their sons were able to connect around the technology. A mother shared her interactions with her son regarding the workshops, “I don’t know SketchUp™ but you’re the expert, and you can tell me about it. That is the difference. That is why I think they love it so much—because it is their world.” Another parent explained, “This gave him something to be proud of and he loved to share it with his family. They are the experts, and they can tell others about it.”

*Reciprocal conversation.* SketchUp™ designs provided conversation starters. As one mother said:

On the way home in the car it would be like, ‘Did you see what G. did today?... Did you see what I did today?’ With success comes altruism because he no longer needed to be so concerned with self.

Another mother noted, “He would talk at length about what he created and what his creations were doing.”

*Less tension.* SketchUp™ workshops were a relaxing opportunity for parents because their children were happy to go and it was not a struggle. One mother explained, “This hasn’t been so adversarial between us at all for him to come here—which is great relief for me because so many things are with him.”

*Theme 2: Child and siblings* Parents perceived less tension at home with siblings because of their child’s participation in the program. One parent remarked, “He will be working on SketchUp™ and his brothers are like ‘wow, that’s really cool’. He’ll tell them ‘look, I can do this, and I can do this.” In one family with a particularly difficult sister–brother relationship the mother explained,

Oh, my gosh! They are sitting and not fighting. So for the family relationships, that’s been a real builder because he feels like—“I can do something that my sister doesn’t know....” “You know I (her son) can teach someone this.” His sister thinks it is so cool—that has been nice.

One of the mothers who observed a child’s class presentation that his sibling attended identified that the computer skills were a source of pride rather than embarrassment to the sibling: “There was a magical moment that happened where she was his absolute, biggest fan. And even now months later, she acknowledges him in the hallway instead of being repelled like this big magnet.” Another mother noted, “It seems the relationship between my kids, the sibling relationship seems to have improved. She [his sister] casts a big shadow. It was nice for him to have something that he knew separate from her.”

*Common interests.* In some families, the siblings used the program together at home, and one parent commented: “They are spending time together with this. He encourages her. He’s excited about the things she builds. She’s receptive to his comments where in other aspects of his life, she just doesn’t care what his

opinion is." One mother summarized the sibling dynamic as "He's a little cooler now instead of something to be embarrassed about."

*Theme 3: Grandparents and grandchild* The SketchUp™ program provided many opportunities for grandparents to actively participate in the project. These "active" grandparents had a particular investment in their grandsons with ASD. A grandmother expressed it this way, "I retired and so at that time I decided I would do what he [her grandson] wanted, and so I decided to make my goal his goal." These "active" grandparents provided their time and attention to their grandsons in the SketchUp™ program. In relation to this project, it was the unique opportunity of multiple generations to be involved in the workshops that helped to serve as the intergenerational "glue" for the family members of all ages.

*More variety in roles.* The grandparents of the families in the study played varied roles. Some grandparents were decidedly noninvolved in the workshops and chose not to attend and participate with their grandchildren. Some of these grandparents lived out of town; for other families, the grandparents were perceived as unsupportive of their grandchild's and the family's special needs. Six grandparents played a role in the workshop activities by being present at grandchildren's presentations either at their school or at community events. Others preferred to be less involved and observe the technological prowess of their grandchildren with ASD from a distance. Grandparents in the focus groups agreed with the statement by one grandparent that, "they do not want to take on the role of parent." The involved grandparents participated in an active manner by enrolling their grandsons in the technology workshops, providing transportation, and by attending the community events where the children presented their work, their grandson's school presentation, and family events associated with the project.

#### *Theme 4: Grandparents and adult children*

*Communication.* The workshops also provided a bridge to the grandparent and adult child. One mom explained that before this program her parents thought of her son's autism as "something shameful," whereas now they had something "they could be proud of." One mother described the difficulty with communication with her parents this way:

You don't have to be in a constant state of grief all the time and denial when you see him.... We can talk about it again without talking about it and feeling sick... It's hard for them.... your immediate family is one thing and your outer family is a whole different thing. It's like you can't really get through to them.

One mother noted, "My parents can come here and see that there's a place where he belongs and that it's okay." Grandparents also shared both their child's and their grandchild's frustrations in coping with autism. While the parent of a child with autism is immersed in his or her child's needs, the grandparent had the added concern for their adult child's well-being and that of their grandchild. They shared in the disappointments as one grandfather noted, "His mother tried to get him interested in playing soccer, tennis and so forth, except he just decided that that wasn't for him, so he'd stop doing it."

One mother explained that the program has given her parents a sense of renewed hope for his future, as well as a forum to share with the community their feelings and thoughts about kids with ASD. The mother noted, "His ASD was previously a bit of an unspoken dark cloud with his grandparents—now they have a renewed hope." The positive communication was an opportunity for grandparents and parents to focus on the strengths of their child or grandson.

## DISCUSSION

When developing the project, the investigators faced concerns that technology might further isolate the children from the real world. On the contrary, the research demonstrated that parents and grandparents perceived that technology could be used to facilitate intergenerational and peer relationships. The data from the study support SketchUp™ as a technological intervention for children with ASD to communicate their talents and creativity to others. It also provided a platform for conversations among family members, teachers, and peers.

Reframing expectations emerged as an important theme. Although the research occurred over a short period of 6 months, the participating families perceived that the program had a profound effect on them. The program provided opportunities for families to see their children as successful and confident boys who could share their technological expertise; this became a powerful reframing experience for the parents and grandparents. The sharing of the children's designs and knowledge of SketchUp™ occurred during weekly workshops, their class presentations, and two community events. One father explained after his son's presentations, "I am guilty of lowering the bar for my son... and this was one of those reminders of no, he just learns and picks up knowledge differently."

The results point to the importance of the family involvement in the project. The parents and grandparents involved in the study were active participants in guiding the direction of the project and the focus of the research. Family members were willing to share their thoughts because they were collaborators in the research process, as well as the design of the workshops. They may have felt empowered by the opportunity to help guide the structure of the workshops and provide feedback on their children's experiences (Turnbull et al., 1998). By doing so, they ensured that the workshops were relevant to their child, as was the research. The data clearly documented that parents and grandparents changed their expectations of the participating child. Through the success involved in this technology experience, the parents, siblings, and grandparents viewed the child as having a special technology skill rather than a focus on disability. As Robison (2007) noted:

Asperger's is not a disease. It is a way of being. There is no cure, nor is there a need for one. There is, however a need for knowledge and adaption on the part of the Aspergian kids and their families and friends (p. 25).

The strength-based approach capitalized on the unique dimensions of ASD, rather than focusing on remediating deficits. Technology builds on the interests

of many individuals with ASD. A more positive approach may reduce stress by emphasizing ways in which families are positively influenced by raising a child with ASD (Helf & Glidden, 1998; Kayfitz, Gragg, & Orr, 2010). This study is consistent with previous research showing that positive experiences may buffer families in stressful situations (Tugade & Fredrickson, 2004). Interventions that promote parenting self-efficacy may improve multiple dimensions of family functioning, as maternal efficacy appears to mediate psychosocial functioning and parenting behavior (Meirsschaut, Roeyers, & Warreyn, 2010; Teti, O'Connell, & Reiner, 1996).

Previous research has indicated that parents perceived that having a child with ASD may create isolation and strain with family members (Meirsschaut et al., 2010). The second primary finding of the study, building intergenerational Bridges, supports the idea of technology facilitating communication among family members. Parents and grandparents reported increased opportunities for conversations related to the child's new technology skills and creative designs. Having a positive outlet that builds on strengths may also promote family well-being and build family relationships (Myers, Mackintosh, & Goin-Kochel, 2009).

The research group continues to examine the successful elements of the program. This study is limited by the small sample size and the heterogeneous family population. Future research will involve replicating the program with larger samples of children, as well as incorporating additional types of technology and software programs.

Children with ASD often have difficulty with traditional teaching practices and settings (Kaweski, 2011). This data support the vital importance of the families in technology-based programs that promote social engagement and self-esteem for children with high-functioning autism. The investigators currently have a school-based version of the program underway (with 11 boys participating), but without the strong family component. The school-based students enjoy SketchUp™, but their parents have not had the same level of involvement. The use of technologies as interventions for children with ASD will likely be most successful by including multiple levels of the family as vital components of support and interaction. These findings support technology as a tool to facilitate family and social engagement in children with ASD. The SketchUp™ models that the children created provided avenues for parent-child discussion and facilitated grandparent and sibling interactions. Additionally, this strength-based approach focuses on children's abilities and creativity rather than their limitations. As one grandmother wrote about SketchUp™ program:

Like many grandparents with autistic kids, my heart belongs to him and I appreciate more than I can say, every bit of help that comes to help ease his way in life. This was truly a gift for this boy who is so badly in need of gifts.

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