Social Positioning: Increasing the Nonsymbolic and Symbolic Communication of Students with Complex Communication Needs

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Abstract

The purpose of this single case A-B-A-B study was to determine if the dependent variables of eye gaze, vocalization, and reaching would increase among students and peers with severe and multiple disabilities and complex communication needs when the independent variable of positioning for communication and socialization (peers facing each other and no more than two feet apart) was manipulated. Speech-generating devices were also provided as part of the intervention package. Three middle school students attending a therapeutic day school participated in the study during their out-of-wheelchair time. A functional relation was demonstrated between eye gaze and social positioning across all students. However, they did not maintain these levels of communication one and two weeks after completion of the study. Future research and implications were discussed.

Keywords*: social positioning, non-symbolic communication, symbolic communication, developmental disabilities, complex communication needs, speech-generating devices*

Introduction

Communication is *"both a fundamental human right and a behavior that occurs naturally across settings in the school and community*" (Bailey & Murray-Branch, 1993, p. 29). Yet, individuals with severe and multiple disabilities and complex communication needs (SMD-CCN) can struggle to convey their most basic needs, experience limitations in developing and maintaining relationships, and have fewer opportunities to participate in daily life (Bailey &

Murray-Branch). Consequently, their daily life and quality of life may be compromised without appropriate supports.

Oftentimes, individuals with SMD have intellectual and physical impairments, due to a developmental disability (e.g., cerebral palsy, autism spectrum disorder, and intellectual disability), in conjunction with CCN (Buekelman & Mirenda, 2005). Students with CCN may have difficulty communicating through conventional, symbolic means which can interfere with daily activities and communication (Clendon, Sturm, & Cali, 2013; Douglas, Light, & McNaughton, 2013). Symbolic communication includes but is not limited to speech, speech-generating devices (SGDs), written language, sign language, or picture communication systems. Non-symbolic communication is a means of communicating and can include but is not limited to using vocalizations, eye gaze or eye contact, reaching, body movement, or methods that are unique to the individual (Beck, Stoner, & Dennis, 2009; Bunning, Smith, Kennedy, & Greenham, 2013; Dennis, 2002; Houghton, Bronicki, & Guess, 1987; Snell, 2002).

Theoretical Framework

The theoretical framework for this study was based on a combination of Albert Bandura's work in human thought and behavior as described in *Social Learning Theory* (1977) as well as Jerome Bruner's ideas of education theory as conveyed in *The Process of Education: A Landmark in Educational Theory* (1977). Social Learning Theory suggests that individuals can learn by observing the actions of others and Bruner's educational theory is grounded in the ideas that individuals must have structure, be ready to learn, and have a desire to learn. In this study, the participants were positioned in proximity to one another for socialization with their peers. In this position, they could observe each other and interact together in an environment that promoted success.

Social Positioning

The positioning of individuals with SMD-CCN can influence the development of basic social-communication skills (McEwen, 1992). Communication attempts, whether symbolic or non-symbolic, must begin with the opportunity to communicate and physically positioned to have the best chance for interaction. Numerous researchers have emphasized positioning individuals with SMD-CCN for functional purposes, such as for therapeutic benefit or SGD use (Costigan & Light, 2011; Hulme, Gallacher, Walsh, Niesen, & Waldron, 1987; McEwen & Karlan, 1989; McEwen & Lloyd, 1990; Nwaobi & Smith, 1986). However, with the exception of McEwen and Karlan, these authors focused their studies mainly on seating in wheelchairs. These studies emphasized that positioning can facilitate peer interaction (Causton-Theoharis & Malmgren, 2005a; Causton-Theoharis & Malmgren, 2005b), improve breath support for vocalization (Nwoabi & Smith), enhance functional activities (McEwen, 1992), and increase access to SGDs and communication aids (McEwen & Karlan). Social positioning (i.e., a term the authors used for positioning individuals with SMD-CCN in order for them to communicate socially with peers as opposed to communicating wants and needs) can be accomplished by placing individuals in proximity (no more than two feet) and having individuals face each other. Providing access to SGDs with appropriate messages for communicating and socializing with peers is also important for maximizing their symbolic communication.

Social positioning is important for individuals with SMD-CCN as they are frequently out of their wheelchairs during the day. Adaptive equipment "such as wedges, sidelyers, standers, adapted chairs, and different types of wheelchairs" (McEwen & Lloyd, p. 21) are oftentimes required for comfortable repositioning. Repositioning is usually necessary throughout the day to perform various functional tasks, increase participation, relieve pressure, manage muscle tone/contractures/abnormal reflexes, improve breathing, and to relax (Costigan & Light, 2011; McEwen, 1992; McEwen & Karlan, 1989; McEwen & Lloyd, 1990; Nwaobi & Smith, 1986). Furthermore, specific positioning of individuals with SMD-CCN can increase their functional communication and communicative abilities (McEwen & Lloyd).

Eye gaze. Eye gaze or eye contact is one means to express preferences and interact non-symbolically (Houghton et al., 1987). Socially, eye gaze can be used to supply information, regulate social interactions and social control, convey intimacy, and enrich communication and cooperation (Kaartinen et al., 2012). Increasing opportunities for eye gaze through social positioning in proximity with peers can facilitate the interaction of individuals with SMD-CCN.

Vocalization. Vocalization is another non-symbolic form of communication for individuals with SMD-CCN (Houghton et al., 1987). Positioning for communication can increase respiratory function and improve vocalizations (Nwaobi & Smith, 1986). Many individuals with SMD-CCN are nonspeaking and may only be able to vocalize or make subtle movements (Bunning et al., 2013), thus attention to their positioning is critical so that they can communicate in the most effective and efficient way.

Reaching. Body movement, such as attempting to reach, is a form of non-symbolic communication, especially for individuals with physical limitations (Houghton et al., 1987). Positioning of individuals with SMD-CCN can increase hand function (McEwen & Karlan, 1989) and overall upper extremity function (Nwaobi & Smith, 1986), which can improve the ability to reach toward their peers and increase socialization attempts. Proper positioning can also increase the ability to activate a speech-generating device (SGD).

SGDs. Individuals with SMD-CCN can benefit from the use of SGDs (Stoner, Angell, & Bailey, 2010). In order for a student to use SGDs, it is crucial for him or her to be positioned so that it is possible to reach and activate the SGD. For example, if a student has access to a SGD but is not positioned for communication, he or she is unable to effectively communicate with a partner. McEwen and Karlan (1989) studied students in different positions and found that many positioning options were available, but that the success of SGD and other communication aid use in each position was dependent on the individual.

Communication Partners

Carter, Sisco, Chung, and Stanton-Chapman (2010) emphasized "the relationships students have with their peers can make important contributions to social and emotional development, promote success in school, and enhance overall quality of life" (p. 63). Much of the literature that addresses the communication of students with SMD-CCN focuses on interactions with the staff members who care for them (Bunning et al., 2013; Houghton et al., 1987; McEwen, 1992) or communication opportunities with typically developing peers (Arthur,

Bochner, & Butterfield, 1999; Sigafoos, 1999). However, even in this era of inclusion, many students with SMD-CCN are in segregated classrooms and in closer proximity to students with similar needs and abilities. According to the U.S. Department of Education's National Center for Educational Statistics (2012, Table 46), students with disabilities are actually spending more than half of their time in a segregated setting or in some cases all of their time in a segregated setting. Given this, it becomes important for students with disabilities to be able to communicate with each other. Because communication can occur at any time during the day, the time spent out of the wheelchair may be ideal for social communication with peers. Yet, unless the individuals are properly positioned for communication, this time is lost.

Purpose of the Study

The purpose of this study was to determine if the positioning of students with SMD-CCN would increase their non-symbolic communication. The specific research questions that guided this study were: (a) Will social positioning increase the non-symbolic communication of eye gaze, reaching, and vocalizations for students with SMD-CCN? and (b) Will students maintain their communication after the final intervention condition of the study?

Methods

Participants

Two male students (pseudonyms were Terry and Julian) and one female student (pseudonym was Gianna) from different school districts attending a private, therapeutic day school in a middle school classroom participated in the study. All three students had SMD-CCN, gastrostomies for nutrition and hydration, and wheelchairs for mobility. The inclusion criteria consisted of (a) middle school age students with SMD-CCN, (b) students who required repositioning out of their wheelchairs at least once per school day, (c) students with communication goals focused on SGD activation, (d) students who had some active movement of their upper extremities in order to indicate reaching, (e) students with the ability to access a SGD in some way, and (f) guardian consent.

Julian. Julian was an 11-year-old, Caucasian male with a diagnosis of 1Q chromosome deletion syndrome, dysgenesis of the corpus collosum, seizure disorder, and hypospadias with severe developmental delay. He had a tracheostomy with a speaking valve and limited upper extremity mobility due to uncontrolled movements. His IEP stated that he had severe to profound cognitive and physical impairments. He communicated with vocalizations, facial expressions, body movement, eye gaze, pictures, and a variety of SGDs when available (BIGmack[1]™, LITTLEmack[2TM], LITTLE Step-by-Step[3]™, Twin Talk[4]™, TalkableIII[5TM]). He communicated his preferences, yes and no, and physical feelings regularly with at least 75% accuracy overall according to his most recent speech-language pathology annual evaluation. He was often alert and responsive to communication partners. During a typical day, he participated in the classroom curriculum, one or more group therapies (e.g., speech therapy, occupational therapy, recreational therapy, music therapy, physical therapy), and relaxation time out of his wheelchair repositioned in a Tumbleforms2[6]™ chair. Julian sat in the Tumbleforms2 chair in all conditions of the study.

Gianna. Gianna was a 10-year-old, Hispanic female with a diagnosis of metachromatic leukodystrophy. Her IEP stated that she had profound cognitive and physical impairments. She communicated non-symbolically through eye gaze and facial expressions to express physical feelings and to make choices. Prior to this study, as reported by her father to the classroom teacher, Gianna had never used a SGD or pictures for communication and she had never been enrolled in school until the year of the study. She used a SGD for the first time during this study after a speech-language evaluation. She activated the LITTLEmack by facial movements registered by a Twitch Switch[7]™ secured near the corner of her mouth with medical tape. She acquired this switch and SGD during the fourth intervention session and continued using them through the remaining observations during both intervention conditions. Gianna was alert about 50% of the day and responded intermittently to communication partners as stated on her most recent speech-language pathology annual evaluation. She participated in similar activities and therapies as Julian. During time out of her wheelchair throughout the study, she was positioned side lying on the same wedge.

Terry. Terry was a 13-year-old, Caucasian male with a diagnosis of cerebral palsy. His IEP stated that he had severe to profound cognitive and physical impairments. Terry's motor movements were uncontrolled and he had limited upper extremity mobility. Terry communicated non-symbolically with vocalizations, facial expressions, body movements, eye gaze, and used pictures with eye pointing for communication on occasion. He used a variety of SGDs (Twin Talk, LITTLEmack, and LITTLE Step-by-Step) as well as an ECO[8]™ with ECO point[9]™ communication device mounted to his wheelchair. He used his ECO by selecting messages using eye gaze (e.g., color choices, biographical information, activity preferences). He was moderately accurate when activating it though appeared to lack motivation to use it. This opinion was corroborated by his most recent speech-language pathology annual evaluation. He did not use the ECO during this study as he had difficulty accessing it when appropriately positioned out of his wheelchair. He communicated choices, yes and no, physical feelings, basic concepts, and preferences in these ways regularly with about 80% accuracy overall. He was often alert, aware of his peers, and appeared to respond to communication partners. During school, he participated in the classroom curriculum, group therapies, and relaxation time out of his wheelchair positioned prone over a wedge. He was positioned prone over a wedge in all conditions.

Setting and Materials

The students attended a private, state-certified, therapeutic day school dedicated to serving students aged 3 to 21 with SMD-CCN in a Midwestern state. All 25 students in the school received services from a nurse, speech-language pathologist, physical therapist, occupational therapist, occupational therapy assistants, recreational therapist, and music therapist throughout the week. The study took place in a middle school classroom staffed with a certified special educator, three paraprofessionals, and seven students. The classroom was roughly 400 sq. ft (121.9 sq. m), with one side dedicated to academics (table, instructional materials, books) and the opposite side reserved for repositioning (mats, wedges, standers, Tumbleforms2 chairs). The study took place when the students were out of their wheelchairs for repositioning on weekdays between approximately 11:00 a.m. and 1:00 p.m. Staff members were present during the study.

The first author videotaped the students when they were out of their wheelchairs during all study conditions. Each student was videotaped for 10 min using either a Canon Powershot

G12 10.0 MP Digital Camera[10]™ or a Sony Cyber-shot DSC-T5[11]™ Digital Camera. The first author viewed the videos daily to collect data on the number of eye gazes, vocalizations, reaches toward a peer, and SGD activations.

The SGD offered by staff members for the students to use during intervention and maintenance sessions included but were not limited to: BIGmack, LITTLE Step-by-Step, Twin Talk, and Talkable III. SGDs were programmed to provide simple messages, such as, "*Hi, How are you?*" "*How was your weekend?,*" "*I like that music. Play some more!*" or recorded with music as if the student was singing.

Response Definitions and Recording Procedures

The communication behaviors observed throughout the study included eye gaze, vocalization, and reaching. SGD activations were tallied only during the intervention conditions. Eye gaze was recorded any time the student looked in the direction of a peer with whom he or she was paired. Vocalization was recorded as any vocalization that occurred when the student looked at a peer or in response to interaction with the peer with whom he or she was paired (within 20 s of the dyad partner using his or her SGD, vocalizing, reaching for, touching, or looking at the student). Reaching was recorded any time a student reached toward or touched a peer. SGD activation was recorded any time the student activated his or her SGD or a switch connected to the SGD.

The first author developed a direct observational recording system for the study. In particular, she used event recording to tally each instance of eye gaze, vocalization, reaching, and SGD activation. She watched video recordings of each student for 10 min per day during each condition of the study (baseline, intervention, and maintenance) to collect the data.

Research Design

This study used a single case withdrawal design (Gast, 2010) with five conditions presented in the following order: baseline (A_1), intervention (B_1), baseline (A_2), intervention (B_2), and maintenance. The withdrawal design allowed us to determine if there was a functional relation between the intervention of the social positioning intervention package (students facing each other, no more than two feet apart, with access to a SGD) and the students' non-symbolic communicative behaviors (i.e., eye gaze between students, reaching for another student, and vocalizations) through the repeated introduction and withdrawal of the intervention package. The mean and range per condition were calculated and a visual analysis of the change in level and trend of the data across conditions for each behavior took place. Specifically, the relative and absolute level change and percentage of non-overlapping data (PND) across adjacent conditions illustrated the magnitude of effect for a population of students where small changes are significant. These are described below.

Between conditions relative level change. To determine the between conditions relative level change, we (a) found the median of the last half of the first condition and the median of the first half of the second condition, (b) subtracted the smaller from the larger, and (c) determined if the level of the data were increasing or decreasing (Gast, 2010).

Between conditions absolute level change. To ascertain the between conditions absolute level change, we (a) compared the last data point in the first condition to the first data point in the second, (b) subtracted the smaller number from the larger, and (c) concluded the level change had increased or decreased (Gast, 2010).

PND. To find the PND, we (a) found the data range in the first condition, (b) noted how many data points from the second condition were outside of the range found in the first condition, (c) divided the number of data points outside the range of the first condition by the total data points in the second condition, and (d) multiplied by 100 (Gast, 2010).

Procedures

Baseline. During A_1 and A_2, the students were positioned out of their wheelchairs by the staff and SLP (first author) in a typical arrangement (on positioning wedges or in Tumbleforms2 chairs up against a wall around the periphery of the classroom) that was observed before the study began. Students were positioned in the same manner daily. See Figure 1 for a graphic representation of the classroom during baseline. Students did not have access to a SGD when out of their wheelchair. Each session was videotaped in order to collect data. The first author arranged the video cameras in a position that would capture the communications of the students. She placed each camera as close to the student(s) being recorded as possible at an angle that allowed her to see each student's eye gaze to their partner. She taped the students for 10 min (generally in the beginning of their out of wheelchair time, but occasionally in the middle or at the end of their out of wheelchair time due to changes in staff schedules) sometime between 11:00 a.m. and 1:00 p.m. on weekdays a total of seven times during A_1 and five times during A_2. The first author collected data on the three non-symbolic target behaviors by viewing the videos after the students were dismissed from school.

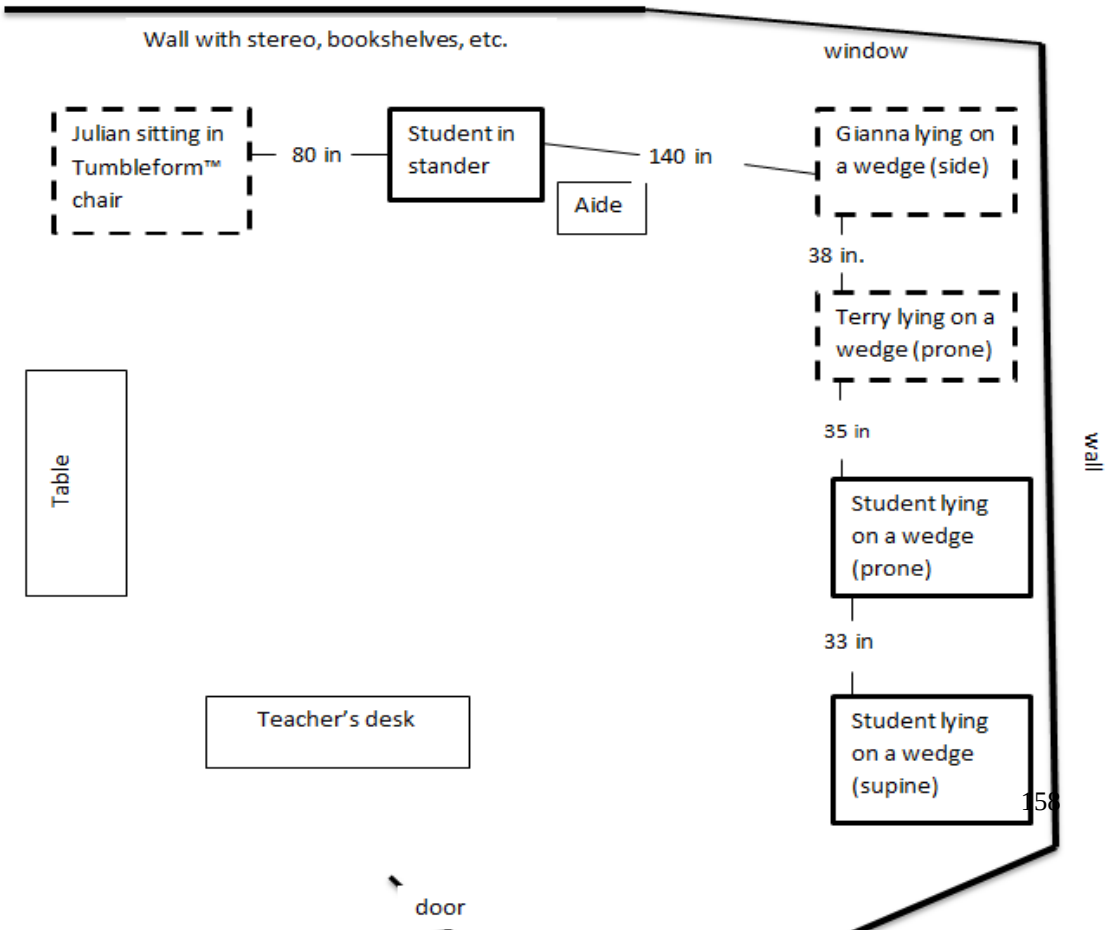

Figure 1. **Typical classroom arrangement during baseline observations**. The middle to right side of the classroom is shown. Students participating are denoted by dashed boxes. Other students in the classroom are denoted by boxes with solid lines. The distance between students was measured from head to head and noted between the solid lines between each student.

Staff preparation. After the first baseline condition (A_1), the first author explained social positioning to the four staff members in the classroom in a 15-min session in the classroom. She (a) presented the staff with the rationale of the study, (b) described how to position the students to promote peer interactions, (c) provided a demonstration of proper positioning, (d) discussed placement SGDs, and (e) answered questions. This informational session prepared the staff to assist the first author with social positioning during intervention and then maintain the positioning after the study was completed.

Intervention. At the beginning of each intervention session (B_1 and B_2), the first author recorded the students in attendance for that particular day, made a diagram of how to position each student, and shared the diagram with the staff members in order to utilize their assistance in positioning the students. Communicative partners were chosen based on convenience with study participants and nonparticipants.

The staff members, with assistance from the first author and using the diagram, positioned the students during their out-of-wheelchair time. Students were no more than two feet (.60 m) from each other (as the first author measured using a standard measuring tape), facing each other. SGDs with pre-recorded greetings, comments, questions, or music were placed next to the student's dominant hand. The students were able to reach the SGDs or had access to the SGD via a switch connected to the SGD. See Figure 2 for an example of positioning during the intervention condition. Sessions were videotaped in the same manner as during baseline. Data were collected on the three non-symbolic communicative behaviors in addition to SGD activation.

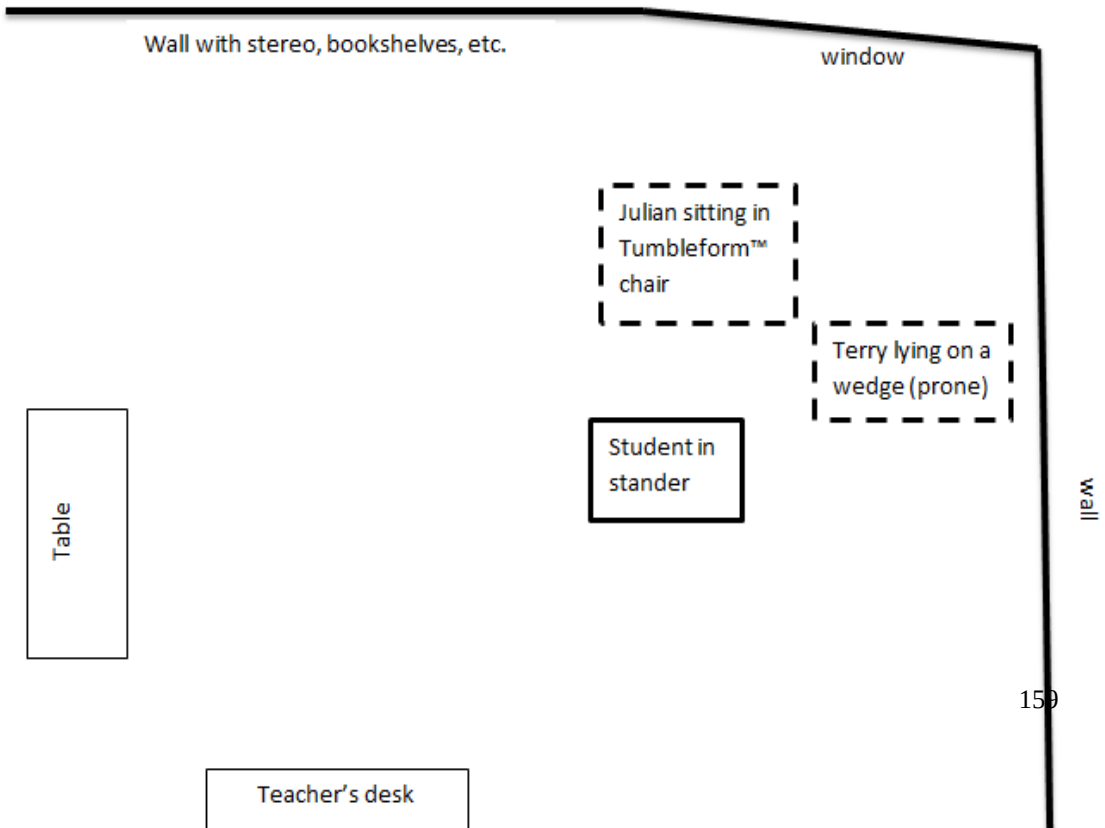

Figure 2. **Example of positioning during the intervention condition.** The middle to right side of the classroom is shown. The left side of the classroom included a changing table, closet, and storage space for wheelchairs. Students not participating in the study are denoted by boxes with solid black lines. The distance between students was measured from head to head to be 2 feet (24 inches) or fewer.

Maintenance. Maintenance sessions were conducted at one and two weeks following the final session in the second intervention condition (B_2). Staff independently positioned the students without any help or cues from the first author. The video cameras were set up in the same manner and at the same time of day as the other conditions. Students were videotaped for 10 min each to determine if there was carryover of peer socialization. Data were collected on the three target behaviors and SGD activation.

Reliability

Procedural Reliability. At the start of each session, the first author completed the steps on the following procedural checklist: (a) take attendance, (b) make a diagram of the desired student positions and sharing the diagram with the staff members, (c) assist the staff to position the students, (d) set up the video camera, and (e) write down the type of SGD each student was given. The second author was provided with diagrams and videos to score the procedural reliability for at least 20% of the sessions in each condition. Procedural reliability was calculated by dividing the number of observed behaviors by the number of opportunities to observe the behavior and multiplying by 100 (Billingsley, White, & Munson, 1980).

Interobserver Agreement. The second author also viewed at least 20% of the videos in each condition to determine interobserver agreement (IOA) on each dependent variable. The first author trained the second author on reliably observing the target behaviors (counting how many instances of eye gaze to a partner, vocalizations to a partner, reaches toward a partner, or SGD activations were completed per 1-minute intervals). Training occurred prior to the start of the start with nonparticipants and until the second author met the criteria of at least 95% correct for two consecutive sessions. Each 10-minute session was divided into 1-minute intervals. IOA was calculated by dividing the number of agreements per 1-minute interval by the number of agreements plus disagreements and multiplying by 100 (Gast, 2010). IOA was calculated and reported for each target behavior in each condition.

Results

The data from this study were analyzed visually to determine the effectiveness of social positioning on the target behaviors (see Figure 3 for data on each target behavior for each student). In addition, Tables 1, 2, and 3 present the mean and range occurrences, between condition level changes, and PND for each target behavior across conditions for Julian, Gianna, and Terry, respectively. SGD data were also presented in these tables.

All three students increased their communication during both intervention conditions. Julian communicated through eye gaze and vocalizations (though his vocalizations did not return to baseline levels in A_2), while Gianna and Terry increased their eye gaze toward a peer. Julian and Gianna did not reach toward a peer at any time and Terry only reached occasionally. Maintenance data were variable across students. A functional relation was demonstrated for eye gaze for each student. All students activated their SGD when it was presented during intervention.

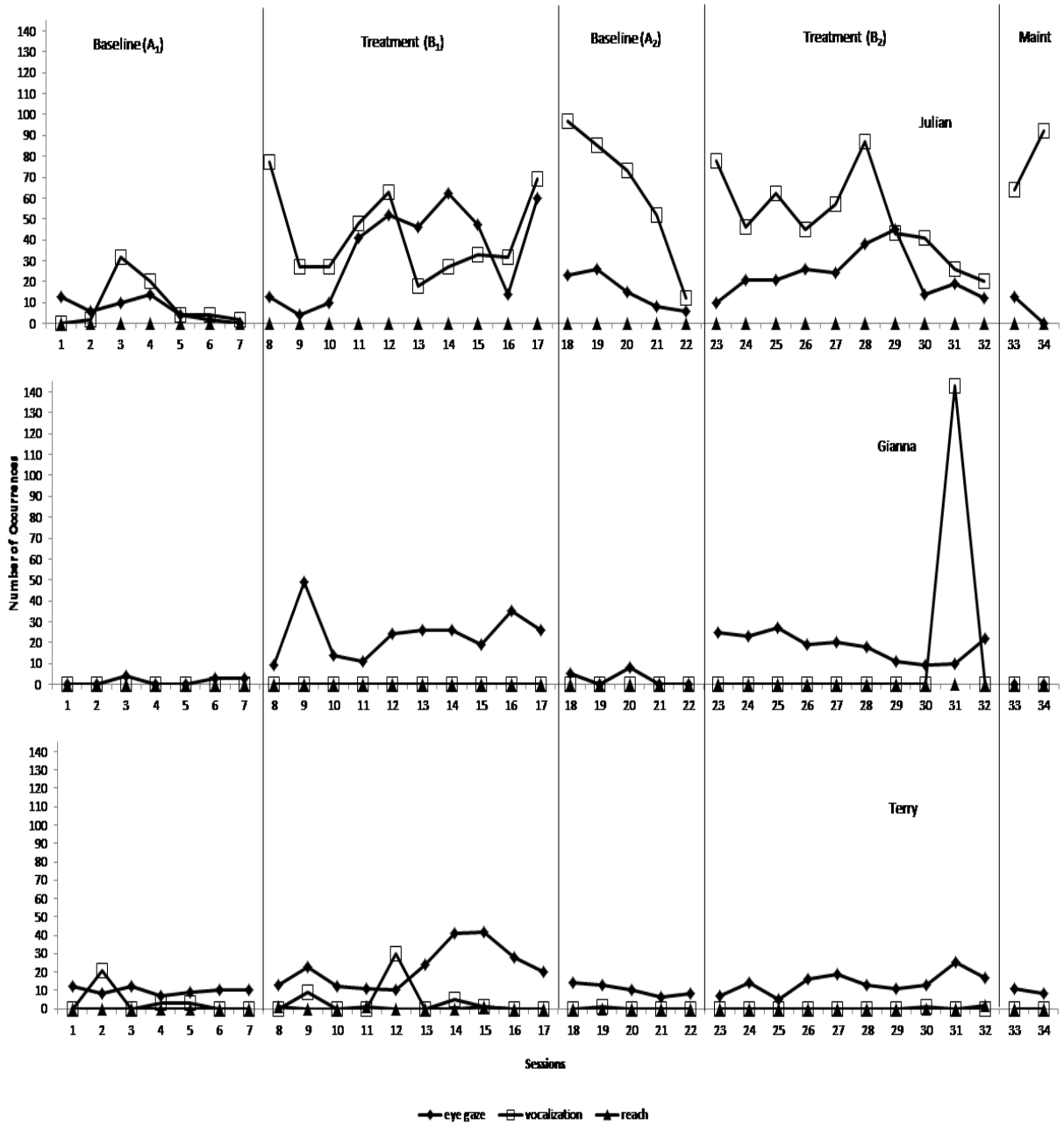

***Figure 3*. Participant communicative behaviors observed in each condition**. Eye gaze is noted with a closed diamond, vocalization with an open square, and reaching with a closed triangle

Julian

During both baseline conditions, Julian demonstrated low and stable data for all of the target behaviors except for vocalizations. During A_1, vocalizations started and ended low (0-4 occurrences) but had a spike during sessions three and four with 32 and 20 occurrences respectively. During A_2, vocalizations had a decelerating trend which overlapped with intervention data in B_1 and B_2. During B_1, Julian had an increase in level for all behaviors except for reaching, which remained at zero throughout. Data followed similar data patterns during the second intervention condition (B_2).

The similarities between the number of occurrences of each behavior in similar conditions and the differences in the number of occurrences between adjacent conditions are clearly portrayed in Table 1. The higher the relative and absolute level change, the stronger the demonstration of effect or impact of the intervention. The relative level changes were high for eye gaze but lower for vocalizations and zero for reaching. The absolute level changes were also high for all behaviors across all condition comparisons except for vocalization during B_1 and A_2. Additionally, it is preferable to have high PND, which strengthens the demonstration of effect. Julian's PND was high for eye gaze and vocalizations between A_1 and B_1. A functional relation was demonstrated for eye gaze through the change in level, immediacy of effect, and PND. During maintenance, staff positioned Julian for social positioning. Julian's vocalization data were accelerating, but eye gaze data were decelerating and reaching data had zero celeration. Julian consistently activated his SGD when it was presented.

Table 1. Julian's Data

	Mean (range) occurrences				
Target behavior	A_1	B_1	A_2	B_2	Maintenance
Eye gaze	7(0-14)	39(10-62)	16(6-26)	23(10-45)	7(0-13)
Vocalization	9(0-32)	42(18-77)	64(12-97)	51(20-87)	78(64-92)
Reaching	0(0-0)	0(0-0)	0(0-0)	0(0-0)	0(0-0)
SGD activation		266(60-461)		230(33-477)	0(0-0)
	Between conditions relative level change				
Target behavior	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	38	22.5	14	-11.5	
Vocalization	44	-58	25	-37	
Reaching	0	0	0	0	
	Between conditions absolute level change				
Target behavior	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	13	37	4	1	
Vocalization	74	-28	66	44	

Reaching	0	0	0	0
Target behavior	PND			
	A_1 & B_1		A_2 & B_2	
Eye gaze	70%		20%	
Vocalization	50%		0%	
Reaching	0%		0%	

Note. The data displayed includes the mean number of times and range in number of times Julian completed a target behavior, relative and absolute level changes, and percent of non-overlapping data (PND).

Gianna

Gianna demonstrated zero or near zero levels for all behaviors across each baseline condition prior to the introduction of the intervention conditions. Conversely, the level increased for eye gaze during both intervention conditions. For vocalization, she demonstrated zero celeration until B_2 where one data point drastically increased to 148 occurrences but did not maintain. She had not been observed vocalizing before this session. Gianna's data remained at zero for reaching. There were similarities between the number of occurrences of each behavior in similar conditions as well as level changes between adjacent conditions for eye gaze as demonstrated in Table 2. PND was high for eye gaze between A_1 and B_1 as well as A_2 and B_2. A functional relation was established for eye gaze. During the maintenance condition, staff positioned Gianna for social positioning. Gianna's data demonstrated zero celeration for eye gaze, vocalization, and reaching. Gianna activated her SGD intermittently when it was offered throughout the study.

Table 2. Gianna's Data

Target behavior	Mean (range) occurrences				
		B_1	A_2	B_2	Maintenance
Eye gaze	1(0-4)	24(9-49)	3(0-8)	18(9-27)	0(0-0)
Vocalization	0(0-0)	0(0-0)	0(0-0)	15(0-148)	0(0-0)
Reaching	0(0-0)	0(0-0)	0(0-0)	0(0-0)	0(0-0)
SGD activation		1(0-3)		6(1-19)	1(0-2)
Target behavior	Between conditions relative level change				
	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	8	23.5	23	-11	
Vocalization	0	0	0	0	
Reaching	0	0	0	0	
Target behavior	Between conditions absolute level change				
	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	6	21	25	-22	
Vocalization	0	0	0	0	
Reaching	0	0	0	0	
Target behavior	PND				
	A_1 & B_1		A_2 & B_2		
Eye gaze	100%		100%		

Vocalization	0%	10%
Reaching	0%	0%

Note. The data displayed includes the mean number of times and range in number of times Gianna completed a target behavior, relative and absolute level changes, and percent of non-overlapping data (PND).

Terry

Terry demonstrated low baseline data with some variability prior to the onset of intervention conditions. After the introduction of the positioning intervention, eye gaze data increased more toward the end of the intervention conditions while vocalization and reaching data remained similar to baseline data. Table 3 provides Terry's within and between conditions data. Changes in level were small for eye gaze and vocalizations and nonexistent for reaching. Terry had high PND for eye gaze between A_1 and B_1. Eye gaze data illustrated a function relation. During the maintenance condition, staff positioned Terry for social positioning. Terry's eye gaze data slightly decelerated and had a similar level as the baseline data while his vocalization and reaching data were at zero. Terry activated his SGD frequently when it was offered.

Table 3. Terry's Data

	Mean (range) occurrences				
Target behavior	A_1	B_1	A_2	B_2	Maintenance
Eye gaze	10(7-12)	22(10-42)	10(6-14)	14(5-25)	10(8-11)
Vocalization	4(0-21)	5(0-30)	0(0-1)	0(0-1)	0(0-0)
Reaching	0(0-0)	0(0-1)	0(0-0)	0(0-2)	0(0-0)
SGD activation		10(4-18)		11(0-25)	0(0-0)
	Between conditions relative level change				
Target behavior	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	2	14.5	7	-3.5	
Vocalization	0	-0.5	0	0	
Reaching	0	0	0	0	
	Between conditions absolute level change				
Target behavior	A_1 & B_1	B_1 & A_2	A_2 & B_2	B_2 & Maintenance	
Eye gaze	3	6	-1	-6	
Vocalization	0	0	0	0	
Reaching	1	0	0	-2	
	PND				
Target behavior	A_1 & B_1		A_2 & B_2		
Eye gaze	70%		40%		
Vocalization	10%		0%		
Reaching	30%		10%		

Note. The data displayed includes the mean number of times and range in number of times Terry completed a target behavior, relative and absolute level changes, and percent of non-overlapping data (PND).

Reliability

Procedural reliability. At least 20% (range: 20-29%) of all sessions in each condition had procedural reliability data collected across each student. The mean procedural reliability across all students and conditions was 100%.

Interobserver agreement. During a minimum of 20% (range: 20-29%) of all sessions in each condition, IOA was calculated for each target behavior. The mean IOA for eye gaze across conditions was 81% (range: 70%-100%) for Julian, 95% (range: 80%-100%) for Gianna, and 81% (range: 65%-100%) for Terry. Percentages of IOA data for eye gaze were lower as eye gaze was difficult to measure at times given the video recording. The mean IOA for vocalizations was 90% (range: 75-100%) for Julian, 100% for Gianna, and 98% (range: 90%-100%) for Terry. The mean IOA for reaching was 100% for Julian, 100% for Gianna, and 99% (range: 95%-100%) for Terry. The mean IOA for SGD was 94% (range: 75%-100%) for Julian, 99% (range: 90%-100%) for Gianna, and 97% (range: 90%-100%) for Terry.

Discussion

Existing research with this population found that positioning in adaptive seating devices increased reaching and socialization (Hulme, Gallacher, Walsh, Niesen, & Waldron, 1987), increased lung capacity which had implications for speech (Nwaobi & Smith, 1986), increased student peer interactions after paraprofessional training (Causton-Theoharis & Malmgren, 2005a), and increased interactions when students needing high intensity of supports were out of their wheelchairs (McEwen, 1992). Despite differences in the aforementioned research with this population and positioning in general, the previous studies showed either increased socialization with proper positioning when participants were in or out of their wheelchairs, or increased interaction with peers given staff training.

To further this line of research, the results of this withdrawal design study indicated that when students were taken out of their wheelchairs for repositioning, they demonstrated increased communication for socialization when positioned facing each other, two feet or less from one another, and given SGDs. While a clear functional relation was only demonstrated for eye gaze, there was an increase in vocalizations too. Students also used their SGD when they were provided; however, specific SGD training is warranted to further increase usage and ensure intentionality.

Specifically, this study extends the literature on the communication of individuals with SMD-CCN by showing that communication can be promoted and can occur when individuals are appropriately repositioned out of their wheelchairs near their peers. In fact, it shows that repositioning time is a good time for individuals with SMD-CCN to socialize with their peers and should not be looked at as an unproductive time. Though the improvements were small in this study, simply giving individuals with SMD-CCN an opportunity to communicate can make a difference in their world. Social relationships have the chance to be formed, friends can be made, and social learning may occur when individuals interact with each other.

Julian. During social positioning, Julian increased his eye gaze and vocalizations. Reaching remained at zero throughout all conditions however. Julian's SGD activations, like the other students, were tallied any time he activated a SGD and he often activated it repeatedly. He appeared to enjoy a variety of SGDs (e.g., single, dual plate, or multiple message SGD) with

specific messages (e.g., "*Hi, Mike*" and "*Play me some music!*") or with music recorded on them as evidenced by increased smiling and vocalizations. Although it is likely that many of his communications were intentional, it appeared as though he also liked the act of activating a SGD as his activations were continuous at times. Furthermore, Julian pressed a SGD recorded with music several times (which we interpreted as a form of singing) and it is possible that his peers' responses may have been increasingly motivating for him. It is also possible that he enjoyed playing music for himself.

Gianna. During baseline conditions, Gianna often fell asleep, but during intervention conditions she was able to stay awake. In fact, if she began to close her eyes and a peer would activate his or her SGD to communicate with her, she would open her eyes and eye gaze in his direction. Gianna's Twitch Switch was always connected to a SGD with multiple message capability. In general, her SGD was programmed with messages such as "*Hi, Terry*," or "*How's it going?*" etc. During the ninth intervention session of B_2, Gianna greatly increased her number of vocalizations, which was rare for her. It is unclear why she vocalized so much at this particular time. Except for this one instance, vocalizations and reaching remained at zero throughout the study. She showed the greatest increase in eye gaze during the social positioning intervention.

Terry. Terry demonstrated one instance of more than typical vocalization during A_1, but it was determined that this vocalization was directed at a staff member (whom he also followed with his gaze) as he apparently required a diaper change and did not prefer to be wet/soiled. His vocalizations decreased after he was changed. During both intervention conditions, Terry demonstrated an increase in eye gaze. His vocalizations decreased when he had the opportunity to use his SGD (most often a dual plate SGD or a multiple message SGD on occasion) with specific messages on it (e.g., "*Hi, Gianna!*" and "*How was your weekend?*"). Terry demonstrated variable and often erratic vocalizations throughout the study. It is possible that it was more difficult for him to vocalize in the prone position that he maintained in during out of wheelchair times for respiratory purposes. He did, however, have much more consistent increases in eye gaze during B_1 and B_2. In his wheelchair he used an eye gaze communication device, but in a prone position, he exhibited improved upper extremity movement and he was able to use SGDs that he could activate with his hands.

Limitations

First, this study had a small sample size and non-random sampling techniques given the population of students; however, this is common and appropriate in single case research. Second, SGDs were not provided in baseline conditions because they were a part of the social positioning intervention package, so a functional relation could not be determined between social positioning and SGD use. The number of SGD activations may have been due to availability. Future studies should assess SGD use across all conditions to ensure that positioning alone causes the increase in SGD use. Third, intentionality of communication was not a measure of this study and needs to be in the future. For example, creating a response definition for meaningful vs. accidental communicative behaviors would be important for determining the true communication intentions between baseline and intervention conditions. Fourth, the intervention was researcher directed and not teacher or staff directed. The researcher assisted with positioning through the

intervention conditions, which may have contributed to the decreased carryover into the maintenance condition. Future studies should collect fidelity data on the staff training and implementation procedures in addition to having the researcher present for support through staff coaching and cueing during B_1 and B_2 if necessary. Fifth, the responses of the communication partners were not measured. This could have provided information on the responsiveness or lack thereof to communication partners which would possibly warrant response training or prompting. Additionally, maintenance data should have been extended for additional weeks and more training should occur if positioning is not maintained by the staff. Also, no participant training was given regarding how to socialize when positioned in proximity to one another and should be included in future studies. This study was designed to record initial communicative behaviors after social positioning without specific communication instruction. Finally, SGDs, SGD messages, and partners were not always consistent throughout the study. Novelty could have played a role in increased or decreased behaviors at any point. This created confounding variables and should be controlled in future studies.

Future Research

Further research into positioning for social interaction among students with SMD-CCN is needed to confirm these findings and extend its external validity as future research seems promising and necessary given the results of this study. In addition to the suggestions made above, further research on positioning for social interaction should occur (a) at different times of the day, (b) with small groups, (c) with adults with SMD-CCN, (d) with individuals in their wheelchairs, or (e) in different settings (e.g., schools, day programs, and group homes). A study of how people with disabilities socialize with peers without disabilities following opportunities to socialize with peers with disabilities could be very interesting too.

Practical Implications

The data presented provide preliminary evidence that the combination of social positioning (with the availability of SGDs) can increase the amount of interaction (eye gaze) between children with severe communication impairment. The best practice evaluated for this study was based on the literature available for positioning students with SMD in the classroom (see Table 4 for best practices for positioning students for peer communication). Given this preliminary evidence and the limited research on this topic, teachers and staff should be trained to assist students with SMD-CCN to communicate with each other.

Table 4. Best Practices for Positioning Students with Severe and Multiple Disabilities for Peer Communication

• Teach communication in settings where it would occur naturally and be meaningful through functional activities (Bailey & Murray-Branch, 1993). This may involve arranging the environment to maximize peer interaction by changing the space available, toys offered, or the children in the group (Arthur, et al., 1999).
• Teachers, parents, paraprofessionals, assistants, etc. should teach communication collaboratively (Bailey

& Murray-Branch, 1993) at different points throughout the day (Snell, 1988) using methods such as "modeling, prompting, and reinforcement" (Arthur, et al., 1999, p. 376) or "incidental teaching, mand models, and time delays" and "interrupted sequence training" (Snell, 1988, p. 307) as these have been proven methods for teaching students with disabilities.
• Provide "structure and routine" when teaching verbal and nonverbal behaviors as "populations with severe multiple disabilities benefit" from these things. With structures and routines, students will start to understand that communication requires cooperation; they will be able to anticipate activities, initiate communication, and protest changes to the routine (Bailey & Murray-Branch, 1993, p. 40).
• Make adaptations for skills to keep students from remaining dependent (Snell, 1988). For example, use AAC instead of requiring students to answer yes/no questions in physical ways.
• Use positive feedback to teach and maintain social skills (Miller, Lane, & Wehby, 2005).
• Nurses can guide staff members on positioning (Madden & Parkes, 2010) especially during feeding times where other therapists (i.e. speech pathologists and physical therapists) may be able to guide positioning during other activities (Costigan & Light, 2011; McEwen & Lloyd, 1990).
• Staff members should keep students close to each other especially during work time (Causton-Theoharis & Malmgren 2005a), take care not to become a physical barrier to communication between peers with disabilities (Causton-Theoharis & Malmgren, 2005b), and should try to fade the assistance they are giving (Causton-Theoharis, 2009).
• Communication partners should face one another and give extra time for responses (Douglas et al., 2012).
• Stay in proximity to each other during communication (Arthur-Kelly et al., 2007; Chung et al., 2012) or times when communication is possible.
• Keep individuals within reach of their AAC devices (Chung et al., 2012).
• Communication partners should face one another and give extra time for responses (Douglas et al., 2012).

Note. A list of best practices to be used when positioning individuals with severe and multiple disabilities during out-of-wheelchair time for maximum communication.

According to Causton-Theoharis and Malmgren (2005a), training was the most effective way to teach staff to encourage communication and socialization. Training is essential for teachers and staff of students with SMD-CCN as the peer partners are often fully dependent on the staff for social positioning. Teachers and staff who are trained to properly position and provide SGDs can begin to facilitate interactions among peers with disabilities. This study is an important addition to the literature because it specifically details how educators can increase peer communication and socialization for students with SMD-CCN to promote friendships and quality of life. It further extends the literature on how students with SMD-CCN can and will communicate with their peers with disabilities when provided with the opportunity. While there were limitations of this study, the positioning of students as described above created opportunities for communication with peers that were previously unavailable. This positioning further changes the perception of whom communication partners can be as staff members were no longer the only possible communication partners at times when individuals were out of their wheelchairs.

Compliance with Ethical Standards

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants' guardians included in the study and assent was obtained from all individual participants included in the study.
Conflicts of interest: The authors declare that they have no conflicts of interest.

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End Notes

[1] BIGmack is a product of AbleNet, Inc. of Roseville, MN.

[2]LITTLEmack is a product of AbleNet, Inc. of Roseville, MN.

[3] LITTLE Step-by-Step is a product of AbleNet, Inc. of Roseville, MN.

[4] Twin Talk is a product of Enabling Devices of Hawthorne, NY.

[5] Talkable III a product of Enabling Devices of Hawthorne, NY.

[6] Tumbleforms2 is a product of Patterson Medical of Warrenville, IL.

[7]Twitch Switch is a product of Enabling Devices of Hawthorne, NY.

[8]ECO is a product of Prentke Romich of Wooster, OH.

[9] ECO point is a product of Prentke Romich of Wooster, OH.

[10] Canon Powershot G12 10.0 MP Digital Camera is a product of Canon, Inc. of Tokyo, Japan.

[11] Sony Cyber-shot DSC-T5 Digital Camera is a product of Sony Corporation of NY, NY.

Authors' Note

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