EXPLORING COMMUNICATION TECHNOLOGY BEHAVIOUR OF ADOLESCENTS WITH CEREBRAL PALSY IN SINGAPORE

Nadia natasha binte mohamed rasid
Nanyang Technological University

Karen P. Nonis
Curtin University

Communication among adolescents with cerebral palsy can be restricted with traditional Augmentative and Alternative Communication (AAC) device coupled with environmental and social barriers. The advance of communication technology offer solutions to reduce such barriers. Given that there is limited research in communication behaviours of adolescents with cerebral palsy using communication technology devices in Singapore, this study investigated the change in behaviour of adolescents with cerebral palsy as a result of using communication technology devices. A total of nine adolescents with cerebral palsy (N = 9, Males = 7 and Females = 2, Age = 14 – 18 years) were recruited from a special school in Singapore. A modified interview questionnaire (Lund & Light, 2007) was administered to determine if communication technology devices changed communication behaviours among adolescents with cerebral palsy. Using a qualitative approach, data were analysed by open and axial coding software, HyperRESEARCH (Hesse-Biber, Kinder & Dupuis, 1990). Four core categories emerged from this study which included (1) Desire and ability to communicate, (2) Navigation of devices (3) online self-disclosure and (4) Devices and applications. Overall, adolescents with cerebral palsy use social media and mobile chat to stay in touch with peers and family for school-related purposes and personal reasons. Based on the findings of this study, the authors suggest that the use of communication devices can expand the social network of adolescents with cerebral palsy.

Introduction

Communication Technology Devices and Platforms for Communication and Friendships

Communication is defined as the process of sharing information and ideas. Communication can be successfully achieved through communicative functions such as seeking social interactions, making requests and negations of an object or social interactions (Hallahan, Kaufman & Pullen, 2012, p. 267).

Communication technology devices are a category of Augmentative and Alternative Communication (AAC) and one which individuals with disabilities use to communicate. There are several types of AAC devices ranging from low-technological options such as gestures, visuals, and sign language to high-technological devices such as Speech Generating Devices (SGD) and Voice Output Communication Aids (VOCA).

In the last decade, there has been a rise of generic communication technology devices. Bryen (2006) defined generic communication technology devices as the use of land-line telephones, email, Internet (eg. Group chat, instant messaging, interactive gaming), cell phones, fax machines and specialized AAC devices. More recently, Smartphone and computer tablets have gained a large market share for mobile technology. This increase has given consumers numerous options to share ideas and chat in real time regardless of where they are in the world at a touch of the button. Social media sites have revolutionized communication allowing people to communicate instantly across time-zones in real time. The low cost of using these sites has also been another reason for its popularity. Most of these sites have a free sign up that allows users to link to other social networking sites. Users can access these sites with a communication technology device that allows

them to access the Internet. The sites provide the individuals a means to communicate in private and without the demands of instant reciprocity when using their natural voice.

Use of Communication Technology among Individuals with Physical Disabilities

Successful communication using AAC devices largely depends on the function of the technology, the severity of the individuals' disabilities with regards to their physical, sensory and cognitive functions. The ability of their carers or aides to intervene for individuals with physical disabilities whenever there was a communication lapse between the AAC user and another person is a determining factor on a successful two-way communication using AAC devices (Higginbotham, Shane, Russell, & Caves 2007).

Factors that promote the communication for individuals with physical disabilities are willingness of non-disabled persons to interact with individuals with disabilities, addressing similarities between the two groups generated better outcomes of acceptance with individuals with disabilities. By contrast, factors which reduced interaction opportunities between the disabled and non-disabled population included the type of AAC devices used by the individuals with physical disabilities (Lilienfeld & Alant, 2005; Lund, 2006; McCarthy & Light, 2007). Non-disabled adults preferred to interact with individuals with disabilities who possess AAC devices with voice output as compared to low-tech systems such as message boards attributed to the lower number of opportunities of interactions for individuals with physical disabilities (Lund & Light, 2006). Attitudes of the society and the comfort level of the AAC user are influential to communication. McCarthy and Light (2005) discussed the impact of attitudes on the opportunities and societal participation for the physically disabled. The authors reported that positive attitudes provide support to these individuals while negative barriers restrict do not promote an inclusive society.

Ease of Access to Communication Technology Devices

The ability to successfully navigate in a social media site is dependent on the user's confidence to access the social media site. Adolescents with cerebral palsy may possess the desire to want to communicate on social media sites but may not have the knowledge of what is the etiquette of beginning communication on social media sites. Raghavendra, Newman, Grace and Wood (2013) reported that the participants in their study did not know how to initiate or respond to communication on Facebook. The poor response was due to the lack of exposure to the platform, low expectations of the participants to use social media sites and parents preventing their children from exploring social media sites. The authors emphasized on the importance of technical knowledge when operating communication technology devices (Raghavendra et al., 2013).

Literacy Competence Using AAC and Communication Technology Devices

The level of literacy to communicate with others to establish online relationships may hinder the use of AAC and or communication technology devices (McNaughton, Rackensperger, Benedek-Wood, Krezman, Williams & Light, 2008; Raghavendra et al., 2013). Selecting the appropriate vocabulary and sentence structure can be difficult for some users (McNaughton et al., 2008; Raghavendra et al., 2013). The user's current age, exposure to language, vocabulary expectancy for his chronological age would be factors which affect the literacy levels of the user. McNaughton et al., (2008) reported that a child with a physical disability required time to learn where the words were stored in his AAC device. The participant had to figure out the sequence of the word order to form sentences to communicate. Stoner, Angell and Bailey's (2010) single case study of a 16-year-old male adolescent with athetoid cerebral palsy reported that the participant was successful in using his AAC device because he had above average cognitive skills with reading and math skills at grade level.

Challenges Faced by Individuals with Cerebral Palsy when Using Traditional AAC Devices

Understanding the purpose, benefits and limitations of traditional AAC devices such as SGD and VOCA can help to further reiterate the benefits of using communication technology devices for socializing. Lund and Light's (2007) longitudinal study of young adults with cerebral palsy and complex communication needs (Age range = 19 - 23) reported that social support such as an inclusive community and strong parental advocacy could promote greater opportunities for interaction. In addition, the expectations of success and family involvement in intervention can contribute positive outcomes towards the experience of the AAC user (Lund & Light, 2007). Similarly, Dattilo, Estrella, Estrella, Light, McNaughton and Seabury's (2008) study in an online forum for individuals with cerebral palsy aged between 27 to 44 years old (N = 8; Females; n = 4, Males; n = 4) reported that their AAC devices provided support as well as restrictions when they wanted to engage in leisure activities. Two of the participants attributed part of their independence to the AAC devices that they had which promoted independence and a life more fulfilled with the use of their communication devices. However, certain features of the AAC devices limited the participants' ability to fully participate in outdoor activities. Communication technology devices such as Smartphones, computer tablets and computers

can reduce the language barriers as there are many different pre-set language inputs in the devices. These devices are readily available in Singapore from mobile service providers and computer retail outlets. Communication technology devices are used by the disabled and non-disabled population.

Few studies have reported favourable feedback from AAC users with physical disabilities on the use of communication technology devices online (McNaugton & Bryen, 2007; Rackensperger, Krezman, McNaughton, Williams & D'silva, 2005; Raghavendra, et al., 2013). The feedback included increased opportunities to learn and socialize within the family, community and globally as a result of having the environmental and social barriers significantly reduced when communicating online (McNaugton & Bryen, 2007; Rackensperger et al., 2005; Raghavendra, et al., 2013).

Traditionally, AAC are used mainly for face-to-face communication and several studies have reported mixed results on the success of high technical equipment on the communication used by users with physical disabilities with communication needs (Beck et al., 2010; Lilienfeld & Alant, 2005; Lund, 2006; Trembath, et al., 2010). However, there are a few studies which have reported success among users with physical disabilities on their experience when using the computer to log on to the Internet to email friends and families (Dattilo et al., 2008; McNaughton & Bryen, 2007; Sundqvist & Rönnberg, 2010).

Communication technology devices can provide meaningful social participation among individuals with cerebral palsy. Obst and Stafurik (2010) reported that websites catering to individuals with physical disabilities have increased the levels of social support among the users. These websites targeted to individuals with physical disabilities provide avenues to share, guide and foster new friendships through online forums and newsgroups. Sundqvist and Rönnberg (2010) noted the significant contribution that the Internet has provided for communication. The authors wrote that it paved the way for individuals with disabilities to stay in touch with what is happening around them and maintaining and establishing old and new networks (Sundqvist & Rönnberg, 2010).

Wilson, Washington, Engel, Ciol, and Jensen, (2006) assessed the level of motor functioning through the use of a modified version of Gross Motor Functioning Classification Scale (GMFCS; Palisano, Rosenbaum, Walter, Rassell, Wood and Galuppi, 1997). When conducting interviews with the participants parents or guardians. There were five levels in this scale in which Level I was the ability to walk without restrictions but would have difficulties in higher gross motor skills. Level V was severely limited mobility with the use of assistive technology for example, power wheelchair. Levels II to IV have increasing limitations in functioning. The authors reported that adolescents with milder types of physical disabilities, who were participants at Level I in the GMFCS, were more mobile and therefore had more opportunities to engage in social activities such as extracurricular activities, outings with peers and received encouragement from their social circle (Wilson et al., 2006).

In summary, there is limited information about the perceptions of adolescents with cerebral palsy using communication technology devices. Studies show favourable feedback experienced from the participants when traditional AAC devices were not able to fulfil their communication needs (Lidström, Ahlsten & Hemmingsson, 2010; Mavrou, 2011; Raghavendra, et al., 2013). Communication technology devices allow for real-time communication that does not require its users to be face-to-face. Instead, users can be at their current location to communicate immediately with their communication partners.

This study explored the communication behaviours of adolescents with cerebral palsy in Singapore when using communication technology devices. Specifically this study asked how do communication behaviours of adolescents with cerebral palsy change when using communication technology devices.

Method

The Participants

Nine adolescents (Age Range = 14 to 18 year olds) were recruited using convenience sampling from local special schools (see Table 1). Letters of consent was obtained prior to commencement of the research. This research was approved by the Institutional Review Board (IRB, Early Childhood and Special Needs, The National Institute of Education, Nanyang Technological University, 2012).

Table 1
Description of the Participants

Participants	Age	Gender	Disability	Devices Used
P1	17	Male	[a]Cerebral Palsy	Computer, laptop, iPhone
P2	18	Female	[b]Cerebral Palsy	iPhone 4
P3	17	Male	[c]Mild Cerebral Palsy	Galaxy Note, iPad, laptop, PS3
P4	18	Male	[c]Diplegia with left Hemiplegia	Laptop, 2G handphone (no Smartphone functions and Data bundle)
P5	16	Male	[c]Spastic Diplegia	IBM laptop, Samsung Galaxy Ace connected through WIFI
P6	15	Male	[c]Spastic Diplegia	iPhone, Samsung Galaxy Ace 2, laptop, computer

Note. a Obtained medical diagnosis from Green Cross Medical Centre, Singapore

b No referral letter found - last reference to diagnosis on file from doctor conducting in the school Orthoclinic

c Obtained medical diagnosis from Kandang Kerbau Women's and Children's Hospital (KKH), Singapore

d Obtained medical diagnosis from Lifeline Loyang Point Medical Clinic, Singapore

Table 1 (continued)
Description of the Participants

Participants	Age	Gender	Disability	Devices Used
P7	15	Male	[c]Spastic Diplegia	Samsung Smartphone, iPad, laptop
P8	14	Male	[c]Left Hemiplegic Cerebral Palsy	Computer, 2G handphone (no Smartphone functions and data bundle)
P9	18	Female	[d]Spastic Cerebral Palsy	Smartphone, laptop, computer

Note. a Obtained medical diagnosis from Green Cross Medical Centre, Singapore

e No referral letter found - last reference to diagnosis on file from doctor conducting in the school Orthoclinic

f Obtained medical diagnosis from Kandang Kerbau Women's and Children's Hospital (KKH), Singapore

g Obtained medical diagnosis from Lifeline Loyang Point Medical Clinic, Singapore

Procedures

The face-to-face interview. All individual face-to-face interviews were conducted at the school premises. With the exception of one participant who used an iPad 2 to communicate text-to-speech, eight participants communicated with the researcher. The face-to-face interview took 90 minutes to complete and was conducted in a quite therapy room equipped with a computer with internet access.

(i)The interview process. The participants' responses in the questionnaire were recorded on the interview questionnaire. After the participants answered each question, confirmation to ascertain the authenticity was carried out to ensure that the information recorded was accurate

Assessment Instrument - Modified Interview Survey Questionnaire

(i) The interview questionnaire. Based on a pilot study, the questions in Lund and Light (2007) were modified to include contingent questions and further refinement to facilitate the participants to expand on their initial response. The questions were rephrased clearly and specifically relating to communication technology devices. The modified questionnaire considered the level of English of the participants. Irrelevant questions in relation to this study were removed. Based on the pilot study, questions on online self-disclosure to ascertain the communication behaviours and level of safety taken by the participants online was added to the modified questionnaire. In addition, a senior Speech and Language Therapist (SLT) from the special school reviewed the modified questionnaire prior to the final use of the questionnaire in this study.

The Reduction and Analysis of Data

(i) Face-to-face interviews. All the data from the face-to-face interviews were transcribed individually. The responses were analysed through the use of the qualitative approach of data analysis by coding the data (Lund & Light, 2007). The types of questions in the questionnaire generated categories used in open coding. The

categories were generated from the interview transcripts.

(ii) ***Core categories and emergent themes.*** The transcribed data were reviewed and analysed further to include emergent themes. The four core categories that emerged from the coding corresponded with the five questions and sub-questions. A total of four core categories corresponded with four different questions and these included: Question one was Devices and Applications, Question two was Navigation of device, Questions three and four were Desire and ability to communicate and Question five was Self-disclosure. The method of open coding was used to categorize concepts which were recurrent in the participants' responses (Creswell, 2008, p. 434-437). The questions were formulated to have a general focal point. For example, question one discusses the types of communication technology devices and the applications used. Question two discusses the usability of the communication devices. Question three and four dealt with the emotions and skills when using communication devices to interact with others. Question five discusses the online safety measures when communicating online. The responses received were in tandem with the categories formulated from the questions. At the end of the open coding process, outlines of the categories were generated as the main headings which were directly related to the questions.

(iii) Sub-themes. The second level of coding was axial coding. This coding was done to justify the emergent categories based on the responses given. Responses from the sub-questions of the core categories were further analysed to derive emergent sub-themes. These emergent sub-themes which were similar were clustered together. This process of coding, categorizing and developing of themes were done for all transcripts individually after which all the core categories and themes were merged together. For example, for the first core category of Desire and ability to communicate, seven sub-themes emerged from the participants' responses: disclosure of disability- impact of communication, face- to- face communication - face-to-face communication vs online communication, feelings- establishing social support, frequency of communication, online communication- face-to-face communication vs online communication and people participants communicate with – expansion of social network. The frequency derived from the core categories and sub-themes were calculated from the number of times the participants mentioned the salient points within the core categories and emergent themes after coding and categorizing the data.

Data were analysed using HyperRESEARCH, a Computer-Aided Qualitative Data Analysis Software (CAQDAS), (Hesse-Biber, Kinder & Dupuis, 1990). This software enabled coding, retrieving and building on emergent themes. The responses were categorized based on the emergent themes and further analysed to the sub-themes within the software.

Results

Four Core Categories

Four core categories emerged from this study. These included (1) Desire and ability to communicate (2) Navigation of devices, (3) Online self-disclosure and (4) Devices and applications. The four core categories were from the most to the least influential when asked questions pertaining to the participants' communication behaviours when using communication technology devices (see Table 2).

Desire and ability to communicate. All the participants (N = 9, 100%) responded that the majority of the people they communicated with online were peers and volunteers from their school (see Table 3). Four of the participants (44%) responded that they formed friendships online with other adolescents whom they have never met or met only after some time of communicating online. The results showed that the participants communicated with people with and without physical disabilities. Five of the participants (56%) revealed their disabilities to individuals they never met online. Four of the participants' (44%) disclosed of their disability to their online communication partners which had an impact on the participants' communication outcomes (see Table 3).

Table 2. Summary of Sub-Themes Contribution to Participants' Socialization (N = 9).

Core Category	Sub-Theme	Percentage Mentioned % (*n*)	Sub-total of Frequency Mentioned
Desire and ability to	Disclosure of disability -	89 (8)	45

communicate	Impact of communication		
	Face-to-face Communication - Face-to-face vs online communication	56 (5)	
	Feelings - Establishing social support	100 (9)	
	Frequency of communication	100 (9)	
	Online communication - Face-to-face vs online communication	33 (3)	
	People participants communicate with - Expansion of social network	100 (9)	
	Phone communication	11 (1)	
Navigation of devices	Accessing applications - Convenience	100 (9)	45
	Challenges	100 (9)	
	Convenience	100 (9)	
	Duration	100 (9)	
	Ease on devices - Using devices with ease	100 (9)	

Table 2 (continued)

*Summary of Sub-Themes Contribution to Participants' Socialization (*N = 9).

Core Category	Sub-Theme	Percentage Mentioned % (*n*)	Sub-total of Frequency Mentioned
Online Self-disclosure	Strangers	100 (9)	36

	Familiar people	100 (9)	
	General self-disclosure	100 (9)	
	Socializing with online friends	100 (9)	
Devices and applications	Communication devices	100 (9)	27
	Mobile applications	100 (9)	
	Social media sites	100 (9)	

Note: Total frequency score =153

The frequency that the participants spent online had a direct influence with their expansive social network. A longer time spent online meant that they had current information about their online friend's activities. It also enabled them to communicate more quickly and easily when they were connected online. Six of the participants (67%) responded that social media sites were used to gain updates of their online friends via news feed, chat and play online games (see Table 3).

In terms of establishing emotional support, five of the participants (56%) responded that social media sites enabled them to seek emotional support and to share their feelings. For example, Participant nine (P9) attributed her preference for online communication to her shy disposition due to her occasional unclear speech. On the other hand, Participant five (P5) reported that face-to-face communication were essential to build relationships and it allowed the participant to see the facial reactions of the communication partners (see Table 3). The results showed that the participants had various reasons to communicate using social media sites as well as mobile chat applications. These reasons included, establishing friendships, expanding social networks and a platform for emotional support (see Table 3).

Navigation of devices.

The results showed that the participants had several platforms to communicate using communication technology devices which included mobile chat applications and social media sites. All the participants (N = 9, 100%) responded that they could communicate with ease using communication technology devices (see Table 4). For example, Participant two (P2) reported that it was easy to navigate her Smartphone to access social media sites and mobile chat applications. Eight of the participants (89%) reported that they were able to navigate the social media sites and mobile chat applications with ease. Easy access enabled participant one (P1) to navigate multiple social media sites and mobile chat applications from his laptop and Smartphone. Seven of the participants (78%) reported that social media and mobile chat applications enabled them to overcome their social barriers such as instant reciprocity during face-to-face communication or environmental barriers such as navigating around places that have no barrier-free access or travelling in public transport that are not wheelchair-friendly (see Table 4). The results showed that eight of the participants (89%) have utilised a communication device for at least one year (see Table 4).

Table 3. Summary Sub-themes in Core Category of Desire and Ability to Communicate

People participants communicated with	Face-to-face vs online communication	Expansion of social network	Establishing social support	Impact of Communication
Friends from school, Volunteers from JC, YMCA camps, church friends. People never met, just know online, from other apps other countries. Talk about interest. Who start not important. (P1)	More confident online. Because if I talk to a person face-to-face I don't know how will the person react. I am afraid they will run or change topic based on my condition. It doesn't matter whether I'm in a chair or wheelchair behind the computer I am just P2. (P2)	I usually Whatsapp and Facebook. Sometimes everyday. Usually 2-3 times a week. (P3)	Yes. Don't need to think I am lonely anymore both on Facebook and Whatsapp. (P2)	For people I have never met, I will tell them about my condition, ask them if they don't mind. If I don't tell them now later, they will know. Depends on them. So if they don't want to be friends, they don't answer. (P1)
Friends from school, some from outside. Friends from outside are Facebook friends. They just add me. Some from other schools, rest not sure. For those on Facebook I don't know, I think from Singapore. (P2)	Online. It's just a feeling. You can't see them and they can't see you, just see avatar. If see each other face-to-face, they tend to ask more of they questions. (P6)	Sister, need basis, relatives from overseas, - not so frequent school friends. Not really unless school holidays (everyday). Volunteers introduction from other people to new people to Facebook. When have something happiness updates on my blog etc. (P5)	Sometimes, when I happy I just SMS or during emergency (P4)	Tell some people I have never met on Facebook I have a physical disability, type on chat. Some can continue to be friends some run away. They think I'm just like any other girl. (P2)

Table 3 (continued)

People participants communicated with	Face-to-face vs online communication	Expansion of social network	Establishing social support	Impact of Communication
School friends, outside friends (mother's friend son) so many. Neighbourhood friends. (P3)	Online. Shy, more understood online as verbally [people] may not understand. (P9)	Normally on facebook to check news feed to see if I have messages or friend requests. Daily-2 hours interval or all day if there's something. Play games on Facebook such as Candy Crush. (P6)	Yes, eg. How are you today? 30 minutes rant [when have] Something to share. (P5)	They are accepting, most of them. There are some who say I look funny, walk weird, why you walk like this? Just delete them off Facebook. (P6)
My friends from school only. (P4) Sometimes they are busy online. Face-to-face outside [to meet]. (P3)	Face- to- face. Very easy to talk and understand. (P3)	Friends (all the time, no homework or what…just communicate with them). Use Facebook everyday at least twice, at least 2 hours each. To chat and read news. (P7)	Ya feel very happy. Because they also sometimes give me advise, motivation and support when I give up or I am sad. (P7)	They do know I have a disability. They just say don't mind be friends. I feel ok. (P9)
Sister, relatives from overseas, school friends, volunteers to keep in touch. (P5)	Face-to-face, more things to talk about it. (P4)	Facebook more than 5 times in a week. SMS when need to. (P8)	Okay because still keep in touch. (P8)	

Summary Sub-themes in Core Category of Desire and Ability to Communicate

People participants communicated with	Face-to-face vs online communication	Expansion of social network	Establishing social support	Impact of Communication
Friends (school mates, person that I meet outside with similar interests don't reveal too much information). Family (uncle on Facebook stays far away, uncle initiates chat) (P6)	Face-to-face, can see reaction. Real-life relationships can do things together. Family relationship important. (P5)	When I get a text, personal message, but will still go on Facebook to read news feeds. (P9)		
Friends (outside friends, classmates), family, cousins (P7)	Face –to-face. Facebook because I know all these person so I feel comfortable. (P7)			
My mum, my friends sometimes I need to know where they go and when they come back. (P8)	Face-to-face because they are friends and I like them. (P8)			
Friends from outside (Facebook), school friends and teachers. (P9)				

Note: Impact of communication is categorized within Disclosure of Disability sub-theme; Face-to-face vs online communication is categorized within Face-to-face Communication and Online Communication; Establishing social support is categorized within Feelings sub-theme; Expansion of social network is categorized within People participants communicate with sub-theme.

Table 4. Summary Sub-themes in Core Category of Navigation of Devices

Convenience	Duration	Using devices with ease	Challenges
In front of computer more comfortable talking. I'm a bit shy.	Facebook more than 3 years. Instagram about 1-2 years, YouTube	Whatsapp on phone is convenient. Computer easy to play games to	Sometimes, iPhone keyboard hard to type. I want to type one

(P2)	about 1 year, Twitter about 3 years. (P2)	see. Facebook ok, whatsapp convenient to talk and share photos. (P1)	word but keep pressing the wrong key. (P2)
Just have to type. Very easy. (P3)	Galaxy Note about 7 mths, iPad 2 about 1 year, laptop about 4 years, PS 3 very long use to connect to Internet. (P3)	Very easy and very fast. (P3)	No difficulty, sometimes tired typing and texting. (P4)
A bit easy helps to chat with other people. (P4)	Laptop about 2 years , phone about 3-4 years (P4)	Very easy to explore around. No difficulty sending text and whatsapp. So log on to Facebook, Instagram, YouTube, Twitter via iPhone. Convenient because it is all from one device. (P2)	When I start getting a phone, I need 1 day if difficult programming, 1 week. No difficulty typing. (P6)
Social media is a good thing. Can connect with friends because of the mobility issue. Check Facebook every day. (P5)	Laptop about 2 years, Samsung Galaxy ACE less than 1 year (P5)	Started email at 7 years , send journals to aunt. School into Facebook about 12-13 years old. SPD intro Twitter about 2 years not so active because not so many followers. YouTube to listen to music. (P5)	Auto correct on SMS, can be frustrating because it types something not intended. (P5)
Like when I meet a person, I ask him for Facebook or other contacts and if we are close friends use to plan outings (time and place to meet) call or message. (P6)	Samsung Galaxy Ace 2 about 1 month. Laptop about 3 months (P6)	When you use Facebook on computer and mobile you use your hands, no problem navigating between both. (P6)	

Table 4 (continued)

Summary Sub-themes in Core Category of Navigation of Devices

Convenience	Duration	Using devices with ease	Challenges
Easier no need to move around. (P7)	Samsung Smartphone about 2 years, iPad about 1 year, laptop more than 5 years (P7)3	I'm so… Used to it using all these. (P7)	

Talk verbally sometimes they don't understand. About 1 hour a day on social media. Facebook can chat. Instagram can upload photos of family and friends. (P9).	Handphone since 12 years old, computer since 9 years old, laptop since 16 years old. (P9)	Easy to operate. Usually evenings. Talk about anything. Movies, music, boys, English Station for music, MTV (Jersey Shore) and music. (P9)

Note: Accessing applications sub-theme has been merged with Convenience sub-theme and renamed Convenience.

Online self-disclosure. All the participants (100%) responded that they understood the importance of withholding personal information from strangers online because of safety reasons and identity theft (see Table 5). All the participants (N = 9, 100%) reported that they would give their mobile numbers to people they knew very well such as their school friends or family members (see Table 5). Eight of the participants (89%) reported that they would advise teenagers not to disclose their personal information of themselves to individuals who were unfamiliar. The participants attributed this to the dangers of online hackers, scammers, sexual predators and also overall sense of danger when disclosing personal information to individuals unknown to them (see Table 5).

Participants choice of devices and applications. Overall, participants used a range of communication technology devices which included Smartphones, laptops, tablet computers and computers. The results showed that all of the participants (N = 9, 100%) have used communication technology devices to communicate prior to the face-to-face interviews. The participants responded that they chatted, texted or made comments on mobile chat applications and social media sites such as Facebook and Twitter or photo sharing sites like Instagram. All of the applications were synced to the various communication technology devices and accessed through their usernames and passwords. The results showed that all the participants (100%) used short message sent (SMS) texting to communicate. Six of the participants (67%) used mobile chat applications and SMS to chat. The mobile chat application that these participants used was Whatsapp. Whatsapp operates by using the phone data bundle and this mobile chat application can be downloaded from App Store for iPhone users and Google Play Store for Android users (see Table 6). For example, participant six (P6) communicated with communication partners using other mobile chat applications. These mobile chat applications use the Internet data and may have free downloads. Texting using mobile chat application do not cost mobile carrier charges and payment is not required to be made to the service provider if the user exceeded the data bundle limit. Email was not a popular mode of communication among the participants. The results showed that all the participants had access and used social media sites to socialize. All the participants (100%) have Facebook accounts. Five of the participants (56%) have Instagram and Twitter accounts respectively (see Table 6).

Finger and hand control. Five of the participants (56%) reported that finger dexterity which affects the typing speed and spelling errors which were important to ensure successful communication.

Knowledge and ease of access. Five of the participants (56%) reported that confidence in accessing the social media sites and mobile chat applications and being comfortable in the process were important factors to ensure successful communication. Participant two (P2) reported that she was confident when logging onto the Internet to access the social media sites. Participant three (P3) and nine (P9) reported that it was important to feel happy and comfortable when communicating online (see Table 7).

Competence in Literacy. Two of the participants (22%) attributed having good vocabulary as an important factor to communication as it helped them to be understood when communicating online. Participant seven (P7) reported that good vocabulary, spelling, sentence structure and typing fast were important to successfully communicate online (see Table 7).

Strangers	Familiar people	General self-disclosure	Socializing with online friends
No. Not say really know about me so not safe. Safety first. (P1)	Yes. If I know them very well then I give. If I not know them very well I won't give.	No. Some are hackers. Safety come first. Cannot suka-suka just give. A lot of people	Depends if you really know. Got to know for 1 year. Cannot just say want to go…go.

	Not for acquaintance. (P1)	are hackers. So for safety I won't give. (P1)	Safety is important. Friends I know I will go. Decide first things. Eg. Lunch, bowling etc. (P1)
People I just get to know just email for Facebook but handphone no… not really. Because it is dangerous I don't know that person. (P2)	Some maybe. Because some are not so close I don't know the person really well. About safety and danger. (P2)	No. Dangerous (P2)	There was one time, I met this girl at Junction 8. She knows about me. Chat and ate. Girl has no disability. Chat online for about 1 year then met up. Still in touch. Girl knows I'm on wheelchair. For school friends who have whatsapp, make plans to go out. If possible 1-2 times every few months. Go for movies. Chat 1 by 1. Go out with one other friend. Mostly, go out 2 persons, a girl last time from AWWA. (P2)

Table 5. Summary Sub-themes in Core Category of Online Self-Disclosure

Table 5 (continued)

Summary Sub-themes in Core Category of Online Self-Disclosure

Strangers	Familiar people	General self-disclosure	Socializing with online friends
I give only to girls because I see the picture. Give handphone number when chatting online. For guys see picture like gangster I ignore but sometimes I give handphone if look like good boy I will give handphone. If a	Yes because they are my best friends. (P3)	Up to them, I don't care. If they want to give I don't care. None of my business. (P3)	Yes vivo city, Jurong Point, IMM JCube [to meet] online friend. Best friends and other friends, Vivo City. Happy go lucky. (P3)

girl ask to meet, I will meet outside like Vivo City. I always watch movies. I see how for guys. (P3)			
No, because once you give them they will pass to other people and they will come to my house if I don't know that person. It's dangerous. Handphone also no, very dangerous later become scam. (P4)	Handphone and address can…school friends yes. YMCA friends, I don't dare handphone number can but not home address. (P4)	No, it's very dangerous. (P4)	Don't go out with friends from school. (P4)
No, harassment, parents will ask why/what I am doing. (P5)	To my friends, school friends, yes email and handphone for Whatsapp only no address. Acquaintances no, Facebook chat. Other details no, because they may harass. Really close volunteers meet at least once and have same interests. (P5)	No cannot. Can get blackmail when get too close romantically and then get scam from $500- $50,000 from crime watch that I saw. Cannot give address because friends may give address to loan sharks who will harass you. (P5)	Unless it's a close friend or accompanied by family members. Have someone to look out for me after cousin said to make more friends. Seldom meet face-to-face like once or twice so wanna take train to see what they are up to. Older cousins, meet one at a time, Whatsapp then ask parents can meet (in the future when independent). (P5)

Table 5 (continued)

Summary Sub-themes in Core Category of Online Self-Disclosure

Strangers	Familiar people	General self-disclosure	Socializing with online friends
Full name if they want to know me. But first I will look at how they talk to see if suitable. Phone numbers – no. 4 emails active, if they don't ask I will not give. If they ask, I will ask them to chat	Yes. Because family members won't prank you. Can contact family when parents are not around or they can contact you. School friends, teachers I can give phone number for school info such as	Basically to ask the other party for their contact details instead of revealing mine. I will not recommend to give out address to acquaintances. If do give bear consequence of own actions if information	It depends if it's a girl or a boy. If people fake their gender? I don't usually go out with them. Unless teachers or school friends who have good reputation, I will go out maybe I will hang out with him or

on Facebook. But if they insist, I give the one I don't particularly log in. (P6)	outings. If school friends call too often, I will set a block. (P6)	is revealed. No handphone coz number maybe passed around. Email also no unless you have many accounts so it's up to you. (P6)	her. If they are gangsters or have bad reputation, I will make excuse like I'm busy or have to do my work. School friends will go to Time Zone, temple, church, doesn't matter what religion… card shop (P6)
First name, rest of the info, no. Because I think it's safer. For starting to know the person, just give a little bit of info, don't give a lot. (P7)	For my friends, I will give them (HP no, email). For my twin brother's friends because meet only when there's projects and not meet so often so I will think about it. (P7)	I think it's not… because you may not know people. Now it is so high-tech, people can hack into your account anytime and use personal details. (P7)	No don't go out. (P7)
Handphone number, address and email – no. Because they are strangers and we don't know them. (P8)	Yes. Because they are my friends, I love them, I give them. Strangers no, I do not know so I don't give them. (P8)	No it is still strangers. Not nice to talk to strangers when we don't know them. (P8)	No, go out with family. School friends only during outings. (P8)

Table 5 (continued)

Summary Sub-themes in Core Category of Online Self-Disclosure

Strangers	Familiar people	General self-disclosure	Socializing with online friends
No. Scared if they want to do something. If they say I want to go to your house when your parents are not at home. Handphone will give, sometimes lazy turn on Facebook so go to whatsapp. Not active on email. (P9)	Yes. Because they are family members and I know them. Friends form school, if they have anything important they can call me. (P9)	No because you just don't know them and you don't know their background. They might ask to go out with them, if you say don't want they may come to your house, parents not around, force to open your door. They may ask you to do	Only go out with friends from school not Facebook friends much I don't know them. Go bowling at Downtown East or go and eat. (P9)

something. (P9)

Table 6. Summary Sub-themes in Core Category of Devices and Applications

Mobile applications	Social media sites
Whatsapp, SMS, not really email (P1)	Four Square sometimes use, Instagrams depends on what I want to put. Group pictures of CCA friends from SDSC. Facebook alert then will check of read news feed. More than 4 times. Twitter not often. All connected to Facebook though iPhone. (P1)
Whatsapp, SMS, don't really use email (P2)	Facebook, Instagram, YouTube, Twitter (P2)
Whatsapp, SMS, email not really (P3)	Facebook, Instagram, Twitter (P3)
SMS. Laptop (email) (P4)	Facebook via laptop (P4)
Email, Whatsapp SMS (P5)	Facebook, Twitter, Blogger, YouTube (P5)
SMS, Email not often Whatsapp, Line, Viber, WeChat, Internet (P6)	Facebook (P6)
Usually SMS, Email not often unless for school work (P7)	Facebook, Instagram, Twitter (P7)
SMS, Email (P8)	Facebook 3 years (P8)
SMS, Whatsapp, Email (P9)	Facebook , Twitter, Instagram (P9)

Table 7. Participant Competencies to Communicate Successfully

Identified skills to possess for successful communication
Step-by-step. First, gradually… cannot first time use well. Under medication, if don't take hard to control hand function. (P1)
Confidence, knowing how to log into the sites. (P2)
Happy and comfortable. A bit difficulty typing using right hand but left hand ok because break my right hand. (P3)

Sometimes difficulty in spelling like a long sentence are difficult. Type a bit fast. (P4)

Good vocabulary, good social skills, sometimes feels awkward around. Siblings because they go to mainstream, school and the topics are not familiar. (P5)

Be sure what you want to ask, ask specific questions, don't be random.

Sometimes people get annoyed when asked 'crappy' or random questions. Then I say sorry. (P6)

Vocabulary and typing, spell properly. Make sure sentence are not broken. Type fast. (P7)

Type fast. Talk about school outings and hydro. Very good teachers and sometimes can get fierce. (P8)

More comfortable. (P9)

Discussion

Increased Socialization with Communication Technology

This study revealed that communication technology promotes socialization because it allowed the participants to communicate with multiple online friends simultaneously, a finding supported by other studies (McNaughton & Bryen, 2007). Social media sites and online chat applications enabled instant communication which did not require the participants to meet face-to-face. This modality was useful for a participant who was shy (see Table 3). While participants in this study were keen to communicate using communication technology devices, they showed preference towards face-to-face communication (see Table 3). These findings suggested that a combination of both communication technology devices and face-to-face social interactions appeal to adolescents with cerebral palsy.

The indicators of success were communication in the category of Desire and ability to communicate and Navigation of devices (see Table 2) which is supported by other research (Beck, Thompson, Kosuwan, & Prochnow, 2010; Cooper, Balandin, & Trembath, 2009; McNaughton & Bryen, 2007). For example, similar to McNaughton and Bryen (2007), this study revealed that all the participants (N = 9, 100%) established communication online using Smartphones, computer tablets, laptops and computers connected to the Internet to social media sites and mobile chat applications.

Reduced Social and Environmental Barriers

Communication technology devices reduced the environmental barriers to communication for the participants in this study (N = 9, 100%). Environmental barriers included the lack of space to manoeuvre with a wheelchair, places without ramps or lifts and public buses that are not wheelchair accessible (Wilson et al., 2006). In this study, participants three and six were able to move around independently. Hence, they could go out and meet people without having a family member to accompany them. Participant nine could move around independently on short distances and would meet her friends for leisure unaccompanied by family members. Participants five used a Kaye walker and would meet his close friends on his own. Participant eight could go out on school outings independently. However, as his family preferred that they go out together, he

would not go out with his friends outside school hours although he did not require assistive devices to walk (see Table 5).

The participants in this study who were independent walkers and or used Kaye walkers reported that they could make plans to socialize using their communication technology devices and then meet up in person to watch movies, have a meal or go bowling. However, four of the participants (44%) except participant three (P3) reported that the people they made plans with online were peers they were familiar with and had relationships prior to their online relationships, these included classmates, campmates, volunteers in their special school and extended family members (see Table 5). Communication technology devices serve as an extension of the socialization of participants who may have difficulty getting around due to their physical mobility. Hence, socialising online meant that the participants' disability did not become an essential part of the friendship when environmental and social barriers are removed. Consequently, the removal of these barriers promotes greater opportunities to share common ideas and mutual topics of interest (Lidström et al., 2010; Martinez, 2011; Mavrou, 2011).

This study found that it was important to provide opportunities to communicate using communication technology (see Table 3), a finding supported by other studies (Dattilo et al., 2008; McNaughton & Bryen, 2007; Raghavendra et al., 2013). Given this finding, it is recommended that adolescents with cerebral palsy could be educated in the use of Information Communication Technology (ICT) by the age of 13 years. Education in ICT usage would help them in their learning and socialization. At age 13 years, adolescents graduate to secondary schools where they have to manage increased peer pressure and social acceptance as compared to primary school. ICT for learning, social and environmental barriers can be removed hence increasing the opportunities for communication for adolescents with cerebral palsy, an idea supported in other studies (Lidström et al., 2010; Ratliffe, Rao, Skouge & Peter, 2012; Raghavendra et al., 2013).

Access to Social Media Sites and Instant Messaging

All the participants (N = 9, 100%) in this study had access to social media and accounts for texting using mobile phones. The duration the participants spent on these platforms were based on need (ie, a chat initiated by friend or relative) to daily two-hour blocks (see Table 3). All participants in this study had different groups of friends who included school friends, volunteers during school camps, friends of friends (acquaintances) and people they have not met but added to the friends list. Social media platforms create and connect communities of individuals with similar interests as well as struggles and allow empowerment between the users (Hew & Cheung, 2012; Raghavendra et al., 2013). Apart from sending messages and posting on the webpages, social media sites allows interactive game playing between the users. This provides a medium for them to interact based on their interests. All the participants (N = 9, 100%) in the current study, sent texts to their communication partners. Texting via short message sent (SMS) on the other hand, was mostly used to convey and receive instant information such as informing parents of where they were and school information such as outings and what was required for school the next day. Texting served as a convenient way to communicate with people whom the participants were familiar with and saw more frequently. For seven participants (78%) who have data bundle tied to their mobile phones, they sent texts through Whatsapp. This feature is one of many applications that allowed accessibility from the mobile phones which could be used for conversations and plan outings and discuss and share information.

In summary, communicating online provides an alternative platform for the participants to interact with others. It allowed them to share interests and speak to their friends and families within the comfort of their location.

The instant reciprocity of chatting online increased the number of relationships formed as well as extended present ones such as allowing classmates to continue communicating after school hours. This study showed that online social media platforms can serve as virtual communities. Individuals with lifelong disabilities tend to have smaller friendship groups which comprises usually of family members or their attendants (Cooper et al., 2009; Wilson et al., 2013). Therefore, having online communities will increase the socialization for this population. The convenience which communication technology devices provide in terms of speed when broadcasting messages can be explored in education.

Conclusion

The aim of this study was to ascertain if communication technology devices change the communication behaviours of adolescents with cerebral palsy. Three conclusions can be drawn from this study:

(i)The desire and the ability to communicate were ranked one of the highest determining factors which posited successful communication using communication technology devices.

(ii)Information Communication Technology (ICT) Education could be introduced at least by the age of 13 years. The use of ICT helped the participants in their learning and socialization. Navigating through the various social media sites and mobile applications establishes a high ability to communicate online.
This coupled with the desire to communicate ensures that the participant can independently communicate with others.

(iii) Participants did not understand that their personal information could be obtained through the IP address. Education on safe ways of communicating online needs be addressed prior to using such communication and social platforms.

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