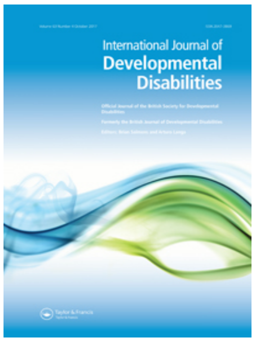

International Journal of Developmental Disabilities

ISSN: 2047-3869 (Print) 2047-3877 (Online) Journal homepage: http://www.tandfonline.com/loi/yjdd20

Speech generating technology to support request responses of persons with intellectual and multiple disabilities

Carlo Ricci, Orazio Miglino, Gloria Alberti, Viviana Perilli & Giulio E. Lancioni

To cite this article: Carlo Ricci, Orazio Miglino, Gloria Alberti, Viviana Perilli & Giulio E. Lancioni (2017) Speech generating technology to support request responses of persons with intellectual and multiple disabilities, International Journal of Developmental Disabilities, 63:4, 238-245, DOI: 10.1080/20473869.2017.1288888

To link to this article: http://dx.doi.org/10.1080/20473869.2017.1288888

Published online: 03 Oct 2017.

Submit your article to this journal

Article views: 50

View related articles

View Crossmark data

Full Terms & Conditions of access and use can be found at
http://www.tandfonline.com/action/journalInformation?journalCode=yjdd20

Download by: [University of Florida] **Date:** 31 October 2017, At: 23:07

Check for updates

Speech generating technology to support request responses of persons with intellectual and multiple disabilities

Carlo Ricci[1], **Orazio Miglino**[2], **Gloria Alberti**[3], **Viviana Perilli**[3], **Giulio E. Lancioni**[4]

[1]Walden Institute of Rome, Rome, Italy, [2]Department of Humanistic Studies, "Federico II" University of Naples, Naples, Italy, [3]Lega F. D'Oro Research Center, Osimo, Italy, [4]Department of Neuroscience and Sense Organs, University of Bari, Bari, Italy

Objective: This study assessed a new Speech Generating Device (SGD) for supporting request responses in five participants with intellectual and multiple disabilities.

Methods: The technology involved a smartphone, a series of mini objects or of cardboard chips with pictures, and special software. When the participants placed one of the mini objects or chips with pictures (that they carried at their waist) against the smartphone (that they had at their chest), the smartphone emitted a verbal request concerning the activity indicated by the mini object or chip. The study was carried out according to a non-concurrent multiple baseline design across participants using sessions of 20 min.

Results: During the baseline, the participants' mean frequencies of requests were zero or close to zero. Following the 11–15 intervention sessions, all participants were successful in making requests (i.e. their mean request frequencies were between about five and 12 per session). Three participants showed clear preferences (i.e. more requests) for some of the activities. The other two participants were rather varied in their requests within and across sessions.

Conclusions: The new SGD seems very useful for people with multiple disabilities who are blind or have poor control of their fine motor responses.

Keywords: Speech generating device (SGD), multiple disabilities, requests, staff interviews

Downloaded by [University of Florida] at 23:07 31 October 2017

Introduction

Persons with intellectual and multiple disabilities may fail to develop speech and to acquire functional use of non-verbal expressive communication means such as manual signs (Chung *et al*. 2012, Light and McNaughton 2012, Iacono *et al*. 2013, McNaughton and Light 2013, Cockerill *et al*. 2014). As a consequence, they tend to remain passive or to be inadequate or unsuccessful in their communication (e.g. they may fail to make requests even when they have an apparent interest in specific stimulation events) (Iacono *et al*. 2013, Snodgrass *et al*. 2013, Cockerill *et al*. 2014, Roche *et al*. 2014, Sigafoos *et al*. 2014, Sutherland *et al*. 2014).

Given the negative implications of such a situation, extensive research has been directed at helping these people acquire ways of communicating their needs and desires (i.e. of making requests successfully) (Ramdoss *et al*. 2011, Sigafoos *et al*. 2011, 2014, Couper *et al*. 2014, Lidström and Hemmingsson 2014). The means for making requests have typically involved: manual signs, a picture exchange communication system (PECS) and speech generating devices (SGDs) (Lancioni *et al*. 2007, van der Meer *et al*. 2012, Gevarter *et al*. 2013a, 2013b, Sigafoos *et al*. 2013, Bracken and Rohrer 2014, Lang *et al*. 2014). Communication via manual signs consists of the person making requests through specific hand movements. Communication via PECS consists of the person making requests by handing the therapist specific picture cards. Communication via SGDs consists of the person making requests by touching specific sensors or specific pictures causing a device to emit related verbal utterances/requests.

The use of SGDs can be considered more practical/functional than the use of other means due to the fact that (a) SGDs can be operated via simple responses and (b) the verbal messages emitted by SGDs can be immediately recognized/understood by any communication partner (Kagohara *et al*. 2010, 2013, Rispoli *et al*. 2010, Sigafoos *et al*. 2011, 2013, 2014). A number of studies has reported successful application of SGDs as communication means. For example, Schepis and Reid (1995) used a SGD with a 23-year-old woman, who was affected by profound intellectual disability as well as extensive motor impairment. The SGD was programmed for four verbal requests concerning preferred activities (e.g. looking at a magazine and using a keyboard). The woman could activate any of those

Correspondence to: Giulio E. Lancioni, Department of Neuroscience and Sense Organs, University of Bari, Corso Italia 23, 70121 Bari, Italy, Email: giulio.lancioni@uniba.it

© The British Society of Developmental Disabilities 2017
DOI 10.1080/20473869.2017.1288888

requests by pressing the matching picture on the device's front panel. Data showed that there was an increase in the woman's request frequency that was maintained over time.

Lancioni *et al*. (2011) reported the use of a SGD with a 33-year-old woman who presented with severe intellectual disability and respiratory problems. The woman used the SGD to request for five leisure activities (e.g. listening to music/songs and watching videos). Pictorial representations of those activities were visible on the SGD's front panel. The participant could activate the request message for any of the activities by touching the matching representation. Data showed that she made requests consistently during the sessions.

van der Meer *et al*. (2012) reported the use of SGD technology with four children who had a diagnosis of autism spectrum disorder and intellectual/developmental disabilities and were between 5 and 10 years of age. Their SGD (i.e. an Apple iPod Touch with Proloquo2Go software) showed three graphic representations concerning requests for snacks, play, and social interaction. The children were taught to target only one of the representations (i.e. snack or play) with the other two serving as distractors. All participants learned to use the SGD to make requests.

While the positive results reported in the literature suggest that SGDs are functional communication means for persons with intellectual and multiple disabilities, exceptions to their usability and effectiveness may exist. For example, largely common SGDs, such as iPads and iPods, may be unsuitable for persons whose disabilities include blindness or severe visual impairment (Lancioni *et al*. 2016) and, noticeably, also for persons with poor control of fine motor responses (e.g. screen touching/stroking) needed for operating those devices (Flores *et al*. 2012, van der Meer *et al*. 2012, 2015, King *et al*. 2014). To deal with the aforementioned problems, specifically those of persons with blindness or severe visual impairment, Lancioni *et al*. (2016) have developed an alternative SGD, which replaces the picture cues with three-dimensional cues (i.e. small objects or tabs with words in Braille) representing the activities the persons can request. These objects and tabs are attached to a box-like device placed on the persons' desk or wheelchair table. Each object/tab covers an optic sensor. By choosing and detaching an object/tab, the persons free an optic sensor and cause the device to emit a verbal request related to that object/tab and sensor.

The present study was in line with the aforementioned research work by Lancioni *et al*. (2016), and aimed to extend the assessment of SGD technology for persons with multiple disabilities who presented with blindness or had serious problems producing accurate screen touching/stroking responses (Kazdin 2011). Specifically, the study assessed a new SGD that allowed the use of mini objects or cardboard chips with pictures (as cues for preferred activities) and was more easily portable than the one developed by Lancioni *et al*. (2016). The five participants included in the study had a smartphone at their chest and a plastic pad (21 cm × 25 cm) with mini objects or chips with pictures (i.e. photos) attached to it, at their waist. The mini objects and chips were supplied with special frequency-code labels (see Boesch *et al*. 2013). Placing a mini object or a chip in contact with the smartphone caused this to utter a verbal request for the related activity that could be easily heard and promptly satisfied. The study also included interviews of staff personnel to determine their rating of the SGD.

Table 1 Participants' characteristics

Participants	Chronological Ages (years)	General Diagnosis
Paul	11	Intellectual disability and blindness
Sheila	19	Intellectual disability and blindness
Tim	60	Intellectual disability, blindness, and deafness
Nick	13	Intellectual disability and deafness
Carole	31	Intellectual disability and deafness

Method

Participants

The participants (with the assigned pseudonyms of Paul, Sheila, Tim, Nick, and Carole) were between 11 and 60 years of age and were affected by congenital encephalopathy with multiple disabilities. Table 1 reports the participants' chronological ages and general diagnosis. The first three participants were diagnosed with intellectual disability and blindness, which could be combined with spasticity or deafness. The last two participants were diagnosed with intellectual disability and deafness. The participants also presented with poor fine motor skills interfering with accurate touching/pointing or stroking responses. The levels of intellectual disability were considered to be within the moderate to severe range by the psychological services of the centers that the participants attended. Yet, no formal intelligence testing had been carried out and no IQ scores were available given the participants' complex condition. The participants' age equivalences on the Vineland scales (i.e. reported by the same psychological services) were (a) around 2 years (Paul and Tim) or below that level (the other participants) for expressive communication and (b) close to 4 years (Carole) or below 3 years (the other participants) for daily living skills (Sparrow *et al*. 2005).

The participants understood a variety of simple verbal instructions (Paul and Sheila) or gestures (Tim, Nick and Carole) concerning daily activities, but had no speech abilities except for Paul who could produce a number of difficult-to-interpret utterances. Tim and, to a lesser extent Sheila, could produce some level of gesturing that was more a signal of their intention to communicate than the formulation of specific messages/requests. The participants

Downloaded by [University of Florida] at 23:07 31 October 2017

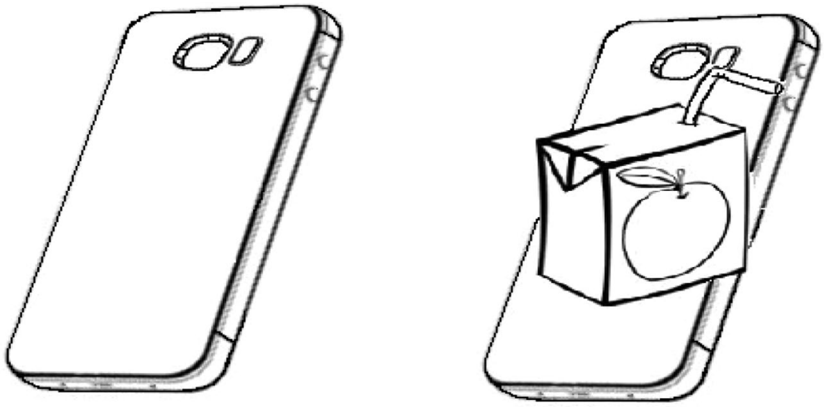

Figure 1 Representation of the smartphone's back with nothing on it (left) and with a mini object representing fruit juice placed on it (right).

were known to have preferences for a number of activities (i.e. based on staff reports and direct preference assessments that relied mainly on single- or paired-activity presentations; Virués-Ortega *et al*. 2014). For example, they enjoyed eating specific foods, drinking specific beverages, listening to songs or watching videos, playing with specific objects (e.g. a ball or a static bicycle), or walking with familiar persons. They matched corresponding objects of the same or different sizes, and Nick and Carole could also match pictures and pictures with objects (i.e. as verified via specific match-to-sample procedures; Nguyen *et al*. 2009).

Enabling the participants to make clear requests was a basic goal for staff and families. This ability would provide (a) the participants with the certainty of being understood in their requests and (b) the caregivers with the power of responding appropriately to the requests (Rispoli *et al*. 2010, Verdugo *et al*. 2012, Boesch *et al*. 2013, Sigafoos *et al*. 2014, Lancioni *et al*. 2016). The participants' condition did not allow them to provide formal consent for their involvement in the study. Their legal representatives gave such consent. The study complied with the 1964 Helsinki declaration and its later amendments and was approved by a relevant Ethics Committee.

Setting and technology

The study was carried out in activity and recreation areas of the centers that the participants attended. The technology involved (a) a smartphone (Samsung Galaxi A3, with Android 4.4.4), (b) a series of mini objects (with sizes not exceeding 7 cm) or of cardboard chips with pictures (of sizes matching those of the mini objects), all of which were provided with radio-frequency code labels, and (c) special software. The mini objects (i.e. nine for Tim and 10 for Paul and Sheila) and the chips with pictures (i.e. 10 for both Nick and Carole) were related to activities considered preferred for the participants (see Participants). For example, a mini bottle or a chip with the picture of a specific bottle served to represent 'drinking a particular beverage', and a mini doll or a chip with the photo of a person served to represent 'walking/playing with a familiar person'. The smartphone (a) read the code labels through a near-field communication module and (b) contained dedicated software which allowed the different code labels to activate different verbal emissions, which had been previously stored in its general memory (see Boesch *et al*. 2013). The verbal emissions consisted of one- to three-word request statements concerning activities related to the mini objects or chips with pictures used by the participants.

In practice, during the intervention and post-intervention sessions (see below), the participants had (a) the mini objects or chips with pictures (all supplied with frequency-code labels) attached to a pad that they wore at their waist and (b) the smartphone fixed at their chest with the display side facing their chest. To make a request, they were to detach an object or chip from the pad and put it onto the smartphone's back (see Figure 1). This caused the smartphone to emit a brief vibration and a verbal request audible in the room. The research assistant then helped the participant to access the activity requested (ensuring that the object or chip used was returned to the pad). The access time was of about 1–2 min except for Tim who had an access of 2–4 min based on his habits. The access time was shortened during the intervention phase to maximize the request practice.

Measures and data recording

The measures were the requests (frequencies and types) occurred per session as well as the mini objects or chips with pictures withdrawn per session. A request was recorded if the participant asked for one of the 9 or 10 activities programmed for him or her. Requests were to occur (a) through recognizable gestures, verbalization, or by handing a mini object or chip with picture to the research assistant during baseline (i.e. when the SGD was not available), and (b) via the SGD during the intervention and post-intervention phases. A mini object or chip with picture was recorded as withdrawn if the research assistant removed it from a participant's pad (i.e. after repeated selections of it; see below). Research assistants familiar with the participants and their contexts carried out the

Downloaded by [University of Florida] at 23:07 31 October 2017

sessions, which typically lasted 20 min, and recorded the measures. Inter-rater reliability was checked in over 25% of the sessions. Percentages of agreement (computed by dividing the number of sessions in which the two research assistants reported the same number and types of requests and of mini objects or chips withdrawn by the total number of sessions used for reliability and multiplying by 100%) exceeded 90 for all participants.

Experimental conditions

The study was carried out according to a non-concurrent multiple baseline design across participants (Barlow *et al*. 2009). Four to eight baseline sessions were pre-assigned to the different participants with the stipulation that a participant would receive extra sessions if his or her request frequency showed an increasing trend. (This condition never occurred.). The baseline sessions were followed by 11–15 intervention sessions, and 81–114 post-intervention sessions. Following the end of the post-intervention phase, 20 staff persons working in a center for people with multiple disabilities were interviewed about the SGD employed in this study (see below).

Baseline

The participants were accompanied to a desk containing the mini objects or chips with pictures to be used during the intervention and post-intervention phases. The participants could sit at the desk or move in the room (in which they could find furniture/objects unrelated to the aforementioned mini objects or chips). Requests would allow access to the activities requested. In case of no requests, the research assistant would simply allow the participants to access one activity during the last 5 min of the session.

Intervention

This phase was to enable the participants to use the technology and the mini objects or chips with pictures independently. The phase started with three mini objects or three chips with pictures on the participant's pad. A research assistant provided him or her with the least amount of verbal and/or physical guidance needed (and eventually/possibly no guidance) for using those objects or chips on the smartphone, thus making requests that allowed access to the corresponding activities. Five to nine non-consecutive requests were scheduled with each of the mini objects/chips. These requests were interspersed with totals of six to nine trials in which the participant was to make the request for an activity after he or she had obtained brief access to such an activity (e.g. after receiving a minimal dose of a preferred beverage, he or she was to select the corresponding object/chip and so obtain a further dose of that beverage). Guidance from the research assistant was used if needed. This strategy made the participant expand and modify the request practice (i.e. moving from the activity to the object/chip). A procedural sequence, such as the one described above, was repeated with a second group of three mini objects or chips. Then the two groups of mini objects or chips were presented in combination (ensuring that each object or chip was used two or more times). Eventually, the process was repeated with the last group of three or four mini objects or chips, which were in the end combined with all previous mini objects or chips.

Post-intervention

During the post-intervention phase, the participants had the SGD and the pad with all the mini objects or chips. Every request would allow access to the activity requested. No guidance from the research assistant was available. Yet, a particular mini object or chip would be removed from the participant's pad after three consecutive (or a total of four) requests involving it. This precaution was to foster attention to the various request options available and counter possible concentration on only the most preferred one(s).

Staff interview

Twenty staff persons (e.g. teachers and physiotherapists) working in a center for people with multiple disabilities were interviewed about the SGD used in the study. The staff persons were between 27 and 43 years of age and represented a convenience sample (Pedhazur and Schmelkin 1991). They were (a) shown the SGD and demonstrated its functioning by a research assistant familiar with its use and (b) asked to rate it in terms of its acceptability, practicality, and possible benefits in a daily context. The rating on each of the three questions was carried out via a special score form and could vary from 1 to 5, which represented the least and most positive values, respectively (see Lancioni *et al*. 2016).

Results

The five panels of Figure 2 summarize the baseline and post-intervention data for the five participants, respectively. The bars and diamonds indicate mean frequencies of requests made and of activities being requested (i.e. activities targeted by those requests) per session, respectively, over blocks of sessions. The number of sessions included in each block (i.e. bar-diamond combination) is indicated by the numeral above it.

During the baseline phase, the mean frequencies of requests per session were zero or close to zero with no positive trends. During the intervention phase, the participants practiced totals of 117 (Tim) to 168 (Sheila) requests. During the post-intervention phase, the participants' mean frequencies of requests performed per session varied between about five (Tim) and above 12 (Paul, Sheila, and Carole). Tim's lower request frequencies were largely due to the fact that he had longer access to the activities chosen. The mean frequencies of activities requested per session (i.e. targeted by the requests made during the session) varied between near four (Nick) and seven (Carole). In practice, participants seemed consistent in making requests

Downloaded by [University of Florida] at 23:07 31 October 2017

Downloaded by [University of Florida] at 23:07 31 October 2017

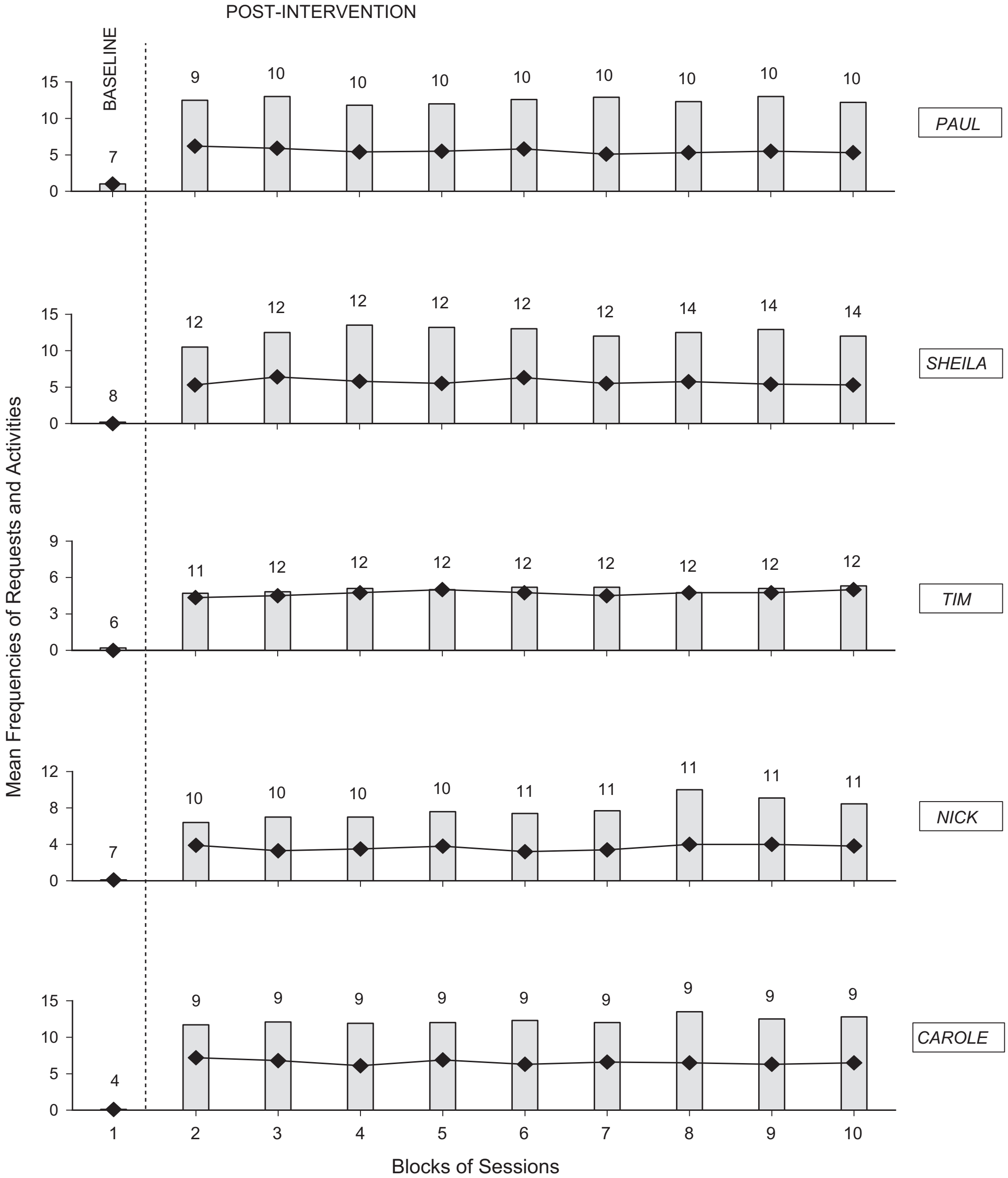

Figure 2 The five panels summarize the baseline and post-intervention data for the five participants, respectively. The bars and diamonds indicate mean frequencies of requests made and of activities being requested per session, respectively, over blocks of sessions. The number of sessions included in each block (i.e. bar-diamond combination) is indicated by the numeral above it. The frequency values on the panels' ordinates vary across participants.

(i.e. with generally limited frequency variations across sessions). They also seemed to have clear preferences for specific activities (e.g. getting specific foods or drinks, and playing with specific objects), which were requested more than once. All the other activities were also requested across sessions but with relatively low frequencies particularly in the case of Nick. The mean frequency of objects/chips withdrawn per session (i.e. after three consecutive or a total of four requests concerning it) was slightly above zero for Carole and Tim, about one for Sheila and Nick, and above two for Paul. The staff's rating of the SGD varied between 3 and 5 on each of the three questions with means of 4.4, 3.9, and 4.5, respectively (i.e. values suggesting a fairly positive view of the device).

Discussion

The results indicate that the five participants used the new SGD successfully. That is, they showed relatively high/consistent request frequencies across the entire post-intervention period. Their session requests spread across several activities while also showing clear preferences. These preferences did not become excessive request concentrations, given the precaution of removing the overly selected mini objects or chips. The encouraging evidence provided by the participants' data was corroborated by the staff opinion about the acceptability, practicality, and potential benefits of the technology in daily contexts. Taken together, these findings can be considered an important extension of the findings reported by Lancioni *et al*. (2016)

Downloaded by [University of Florida] at 23:07 31 October 2017

with a SGD developed for persons whose multiple disabilities included blindness or minimal residual vision. In light of the above, a number of considerations may be put forward.

First, the new SGD (a) seems suitable for supporting communication requests of participants with multiple disabilities who are blind or have poor control of their fine motor (i.e. touch/stroke) responses, (b) can be easily portable (i.e. the participants can carry the smartphone and the mini objects or chips), (c) can include fairly large numbers of mini objects or chips, and (d) allows different groups of mini objects or chips to be used across sessions. Given these positive features and the device's overall simplicity and affordability, one can argue that the new SGD compares favorably with the one developed by Lancioni *et al*. (2016). The new SGD represents a step forward in the efforts to promote request making in persons with multiple disabilities including blindness and/or poor fine motor skills (Meder and Wegner 2015).

Second, while the participants used a simple pad for carrying the mini objects and chips, it seems plausible that more socially agreeable (normalizing) and practical arrangements could be made with some, higher functioning participants (Cumming *et al*. 2014, Lang *et al*. 2014). For example, one could provide the participants with pocket-like bags (belt-bags) and ensure that each bag contains the mini objects or chips connected to a group of activities (e.g. eating and/or drinking activities). Obviously, these arrangements would need to be tested before any definite recommendation can be made about their use.

Third, the scores provided by staff during their interviews on the acceptability, practicality, and potential benefits of the SGD solution in daily contexts can be viewed as largely relevant. That is, they may be taken as a positive signal for a possible, future adoption of such solution within education and rehabilitation settings (i.e. settings that the staff essentially represent) (Lamontagne *et al*. 2013, Achmand *et al*. 2015). With regard to this point, it should be noted that the evidence on the effectiveness of the SGD technology in improving participants' performance might not be sufficient per se to guarantee its adoption within daily settings. Such an adoption, in fact, might also depend on the way staff personnel perceive the technology (Lenker *et al*. 2013).

Fourth, several limitations of the study may need to be mentioned here. The first limitation is the small number of participants. New studies should extend the assessment process with additional persons with intellectual and multiple disabilities to determine the robustness of the present findings (Barlow *et al*. 2009). A second limitation is the absence of any data on the participants' appraisal of the communication sessions with the technology. Given the opportunity to request their preferred activities, the assumption was that the participants enjoyed those sessions and favored them over other forms of engagement (Schepis and Reid 1995, Lancioni *et al*. 2013, Hagan and Thompson 2014, Sigafoos *et al*. 2014). Future studies should clarify this point (Lancioni *et al*. 2016). A third limitation concerns the staff interview. The number of staff involved in the interview was small and the number of questions posed to them was limited. Moreover, the staff were not shown videos of the participants during the request sessions, but rather were presented with the technology and a demonstration of its functioning. New studies would need to extend this research aspect and include carefully arranged forms of social validation assessment (Callahan *et al*. 2008, Luiselli *et al*. 2010). A fourth limitation concerns the fact that the length of the sessions and the length of access to the activities requested were based on brief, preliminary observations or general history of the participants. Both aspects should probably be reconsidered following a careful analysis of participants' performance and occupational conditions. A further limitation concerns the lack of reliability checks on the research assistants' performance. Although the extended experience of the research assistants employed in this study was thought to provide reasonable guarantee about their procedural fidelity, those checks remain critically important.

In conclusion, the study presents encouraging evidence on the usability and effectiveness of a new SGD for people with multiple disabilities who are blind or have poor control of their touch/stroke responses. New research needs to verify the reliability of these findings with additional participants and address the aforementioned limitations of the present study (Callahan *et al*. 2008, Barlow *et al*. 2009, Kazdin 2011, Lamontagne *et al*. 2013, Makel and Plucker 2014). Research would also need to investigate ways of upgrading the new SGD technology so as to improve its usability and overall acceptability (Foley and Ferri 2012, Lenker *et al*. 2013, Näslund and Gardelli 2013, Allen and Shane 2014, O'Rourke *et al*. 2014).

Conflict of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

References

Achmand, D., van der Meer, L., Augusta, J., Sigafoos, J., Lancioni, G., O'Reilly, M., Lang, R., Schlosser, R., Hodis, F., Green, V., Sutherland, D., McLay, L., and Marschik, P. 2015. Undergraduates perceptions of three augmentative and alternative communication modes. *Developmental Neurorehabilitation*, 18, 22–25.

Allen, A. A. and Shane, H. C. 2014. Autism spectrum disorders in the era of mobile technologies: Impact on caregivers. *Developmental Neurorehabilitation*, 17, 110–114.

Barlow, D. H., Nock, M., and Hersen, M. 2009. *Single-case experimental designs: Strategies for studying behavior change* 3rd ed.. New York: Allyn & Bacon.

Boesch, M. C., Wendt, O., Subramanian, A., and Hsu, N. 2013. Comparative efficacy of the Picture Exchange Communication System (PECS) versus a speech-generating device: Effects on requesting skills. *Research in Autism Spectrum Disorders*, 7, 480–493.

Bracken, M. and Rohrer, N. 2014. Using an adapted form of the Picture Exchange Communication System to increase independent requesting in deafblind adults with learning disabilities. *Research in Developmental Disabilities*, 35, 269–277.

Callahan, K., Henson, R., and Cowan, A. K. 2008. Social validation of evidence-based practices in autism by parents, teachers, and administrators. *Journal of Autism and Developmental Disorders*, 38, 678–692.

Chung, Y.-C., Carter, E. W., and Sisco, L. G. 2012. Social interactions of students with disabilities who use augmentative and alternative communication in inclusive classrooms. *American Journal on Intellectual and Developmental Disabilities*, 117, 349–367.

Cockerill, H., Elbourne, D., Allen, E., Scrutton, D., Will, E., McNee, A., Fairhurst, C., and Baird, G. 2014. Speech, communication and use of augmentative communication in young people with cerebral palsy: The SH&PE population study. *Child: Care, Health and Development*, 40, 149–157.

Couper, L., van der Meer, L., Schäfer, M. C. M., McKenzie, E., McLay, L., O'Reilly, M. F., Lancioni, G. E., Marschik, P. B., Sigafoos, J., and Sutherland, D. 2014. Comparing acquisition of and preference for manual signs, picture exchange, and speech-generating devices in nine children with autism spectrum disorder. *Developmental Neurorehabilitation*, 17, 99–109.

Cumming, T. M., Strnadová, I., Knox, M., and Parmenter, T. 2014. Mobile technology in inclusive research: Tools of empowerment. *Disability & Society*, 29, 999–1012.

Flores, M., Musgrove, K., Renner, S., Hinton, V., Strozier, S., Franklin, S., and Hil, D. 2012. A comparison of communication using the Apple iPad and a picture-based system. *Augmentative and Alternative Communication*, 28, 74–84.

Foley, A. and Ferri, B. A. 2012. Technology for people, not disabilities: ensuring access and inclusion. *Journal of Research in Special Educational Needs*, 12, 192–200.

Gevarter, C., O'Reilly, M. F., Rojeski, L., Sammarco, N., Lang, R., Lancioni, G. E., and Sigafoos, J. 2013a. Comparisons of intervention components within augmentative and alternative communication systems for individuals with developmental disabilities: A review of the literature. *Research in Developmental Disabilities*, 34, 4404–4414.

Gevarter, C., O'Reilly, M. F., Rojeski, L., Sammarco, N., Lang, R., Lancioni, G. E., and Sigafoos, J. 2013b. Comparing communication systems for individuals with developmental disabilities: A review of single-case research studies. *Research in Developmental Disabilities*, 34, 4415–4432.

Hagan, L. and Thompson, H. 2014. It's good to talk: Developing the communication skills of an adult with intellectual disability through augmentative and alternative communication. *British Journal of Learning Disabilities*, 42, 68–75.

Iacono, T., Lyon, K., Johnson, H., and West, D. 2013. Experiences of adults with complex communication needs receiving and using low tech AAC: An Australian context. *Disability and Rehabilitation: Assistive Technology*, 8, 392–401.

Kagohara, D. M., van der Meer, L., Achmadi, D., Green, V. A., O'Reilly, M. F., Mulloy, A., Lancioni, G. E., Lang, R., and Sigafoos, J. 2010. Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism. *Clinical Case Studies*, 9, 328–338.

Kagohara, D. M., van der Meer, L., Ramdoss, S., O'Reilly, M. F., Lancioni, G. E., Davis, T. N., Rispoli, M., Lang, R., Marschik, P. B., Sutherland, D., Green, V. A., and Sigafoos, J. 2013. Using iPods® and iPads® in teaching programs for individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities*, 34, 147–156.

Kazdin, A. E. 2011. *Single-case research designs: Methods for clinical and applied settings* 2nd ed.. New York: Oxford University Press.

King, M. L., Takeguchi, K., Barry, S. R., Rehfeldt, R. A., Boyer, V. E., and Mathews, T. L. 2014. Evaluation of the iPad in the acquisition of requesting skills for children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 8, 1107–1120.

Lamontagne, M.-E., Routhier, F., and Auger, C. 2013. Team consensus concerning important outcomes for augmentative and alternative communication assistive technologies: A pilot study. *Augmentative and Alternative Communication*, 29, 182–189.

Lancioni, G. E., O'Reilly, M. F., Cuvo, A. J., Singh, N. N., Sigafoos, J., and Didden, R. 2007. PECS and VOCAs to enable students with developmental disabilities to make requests: An overview of the literature. *Research in Developmental Disabilities*, 28, 468–488.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Green, V. A., Van der Meer, L., Alberti, G., Perilli, V., Boccasini, A., La Martire, M. L., and Lang, R. 2016. A speech generating device for persons with intellectual and sensory-motor disabilities. *Journal of Developmental and Physical Disabilities*, 28, 85–98.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., Ricci, I., Addante, L. M., and Trubia, G. 2011. A woman with multiple disabilities uses a VOCA system to request for and access caregiver-mediated stimulation events. *Life Span and Disability*, 14, 91–99.

Lancioni, G. E., Sigafoos, J., O'Reilly, M. F., and Singh, N. N. 2013. *Assistive technology: Interventions for individuals with severe/profound and multiple disabilities*. New York: Springer.

Lang, R., Ramdoss, S., Sigafoos, J., Green, V., van der Meer, L., Tostanoski, A., Lee, A., and O'Reilly, M. 2014. Assistive technology for postsecondary students with disabilities. In: G. E. Lancioni and N. N. Singh eds. *Assistive technology for people with diverse abilities*. New York: Springer, pp. 53–76.

Lang, R., Sigafoos, J., van der Meer, L., Carnett, A., Green, V. A., Lancioni, G. E., and O'Reilly, M. F. 2014. Teaching functional communication to adults with autism spectrum disorders. In: M. Tincani and A. Bondy eds. *Adults with autism spectrum disorders: Evidenced-based and promising practices*. New York: Guilford Press, pp. 118–139.

Lenker, J. A., Harris, F., Taugher, M., and Smith, R. O. 2013. Consumer perspectives on assistive technology outcomes. *Disability and Rehabilitation: Assistive Technology*, 8, 373–380.

Lidström, H. and Hemmingsson, H. 2014. Benefits of the use of ICT in school activities by students with motor, speech, visual, and hearing impairment: A literature review. *Scandinavian Journal of Occupational Therapy*, 21, 251–266.

Light, J. and McNaughton, D. 2012. The changing face of augmentative and alternative communication: Past, present, and future challenges. *Augmentative and Alternative Communication*, 28, 197–204.

Luiselli, J. K., Bass, J. D., and Whitcomb, S. A. 2010. Teaching applied behavior analysis knowledge competencies to direct-care service providers: Outcome assessment and social validation of a training program. *Behavior Modification*, 34, 403–414.

Makel, M. C. and Plucker, J. A. 2014. Facts are more important than novelty: replication in the education sciences. *Educational Researcher*, 43, 304–316.

McNaughton, D. and Light, J. 2013. The iPad and Mobile technology revolution: Benefits and challenges for individuals who require augmentative and alternative communication. *Augmentative and Alternative Communication*, 29, 107–116.

Meder, A. M. and Wegner, J. R. 2015. iPads, mobile technologies, and communication applications: A survey of family wants, needs, and preferences. *Augmentative and Alternative Communication*, 31, 27–36.

Näslund, R. and Gardelli, Å. 2013. 'I know, I can, I will try': Youths and adults with intellectual disabilities in Sweden using information and communication technology in their everyday life. *Disability and Society*, 28, 28–40.

Nguyen, D. M., Yu, C. T., Martin, T., Fregeau, P., Pogorzelec, C., and Martin, G. L. 2009. Teaching object-picture matching to improve concordance between object and picture preferences for individuals with developmental disabilities: Pilot study. *Journal on Developmental Disabilities*, 15, 53–64.

O'Rourke, P., Ekins, R., Timmins, B., Timmins, F., Long, S., and Coyle, E. 2014. Crucial design issues for special access technology; a Delphi study. *Disability and Rehabilitation: Assistive Technology*, 9, 48–59.

Pedhazur, E. and Schmelkin, L. 1991. *Measurement design and analysis: An integrated approach*. New York: Psychology Press.

Ramdoss, S., Lang, R., Mulloy, A., Franco, J., O'Reilly, M., Didden, R., and Lancioni, G. 2011. Use of computer-based interventions to teach communication skills to children with autism spectrum disorders: A systematic review. *Journal of Behavioral Education*, 20, 55–76.

Rispoli, M. J., Franco, J. H., van der Meer, L., Lang, R., and Camargo, S. P. H. 2010. The use of speech generating devices in communication interventions for individuals with developmental disabilities: A review of the literature. *Developmental Neurorehabilitation*, 13, 276–293.

Roche, L., Sigafoos, J., Lancioni, G. E., O'Reilly, M. F., Green, V. A., Sutherland, D., van der Meer, L., Schlosser, R. W., Marschik, P. B., and Edrisinha, C. D. (2014). Tangible symbols as an AAC option for individuals with developmental disabilities: A Systematic review of intervention studies. *Augmentative and Alternative Communication*, 30, 28–39.

Schepis, M. M. and Reid, D. H. 1995. Effects of a voice output communication aid on interactions between support personnel and an individual with multiple disabilities. *Journal of Applied Behavior Analysis*, 28, 73–77.

Sigafoos, J., Lancioni, G. E., O'Reilly, M. F., Achmadi, D., Stevens, M., Roche, L., Kagohara, D. M., van der Meer, L., Sutherland, D., Lang, R., Marschik, P. B., McLay, L., Hodis, F., and Green, V. A. 2013. Teaching two boys with autism spectrum disorders to request the continuation of toy play using an iPad®-based speech-generating device. *Research in Autism Spectrum Disorders*, 7, 923–930.

Downloaded by [University of Florida] at 23:07 31 October 2017

Sigafoos, J., Schlosser, R. W., Lancioni, G. E., O'Reilly, M. F., Green, V. A., and Singh, N. N. 2014. Assistive technology for people with communication disorders. In: G. E. Lancioni and N. N. Singh eds. *Assistive technologies for people with diverse abilities*. New York: Springer, pp. 77–112.

Sigafoos, J., Wermink, H., Didden, R., Green, V. A., Schlosser, R. W., O'Reilly, M. F., and Lancioni, G. E. 2011. Effects of varying lengths of synthetic speech output on augmented requesting and natural speech production in an adolescent with Klinefelter syndrome. *Augmentative and Alternative Communication*, 27, 163–171.

Snodgrass, M. R., Stoner, J. B., and Angell, M. E. 2013. Teaching conceptually referenced core vocabulary for initial augmentative and alternative communication. *Augmentative and Alternative Communication*, 29, 322–333.

Sparrow, S. S., Cicchetti, D. V., and Balla, D. A. 2005. *Vineland adaptive behavior scales* 2nd ed. (Vineland II). Minneapolis, MN: Pearson.

Sutherland, D., van der Meer, L., Sigafoos, J., Mirfin-Veitch, B., Milner, P., O'Reilly, M. F., Lancioni, G. F., and Marschik, P. B. 2014. Survey of AAC needs for adults with intellectual disability in New Zealand. *Journal of Developmental and Physical Disabilities*, 26, 115–122.

van der Meer, L., Achmadi, D., Cooijmans, M., Didden, R., Lancioni, G. E., O'Reilly, M. F., Roche, L., Stevens, M., Carnett, A., Hodis, F., Green, V. A., Sutherland, D., Lang, R., Rispoli, M., Marschik, P. B., and Sigafoos, J. 2015. An iPad-based intervention for teaching picture and word matching to a student with ASD and severe communication impairment. *Journal of Developmental and Physical Disabilities*, 27, 67–78.

van der Meer, L., Kagohara, D., Achmadi, D., O'Reilly, M. F., Lancioni, G. E., Sutherland, D., and Sigafoos, J. 2012. Speech-generating devices versus manual signing for children with developmental disabilities. *Research in Developmental Disabilities*, 33, 1658–1669.

van der Meer, L., Sutherland, D., O'Reilly, M. F., Lancioni, G. E., and Sigafoos, J. 2012. A further comparison of manual signing, picture exchange, and speech-generating devices as communication modes for children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 6, 1247–1257.

Verdugo, M. A., Navas, P., Gómez, L. E., and Schalock, R. L. 2012. The concept of quality of life and its role in enhancing human rights in the field of intellectual disability. *Journal of Intellectual Disability Research*, 56, 1036–1045.

Virués-Ortega, J., Pritchard, K., Grant, R. L., North, S., Hurtado-Parrado, C., Lee, M. S. H., Temple, B., Julio, F., and Yu, C. T. 2014. Clinical decision making and preference assessment for individuals with intellectual and developmental disabilities. *American Journal on Intellectual and Developmental Disabilities*, 119, 151–170.

Downloaded by [University of Florida] at 23:07 31 October 2017